The Credit Ratings Game

by

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Abstract: The spectacular failure of top-rated structured finance products has brought renewed attention to the conflicts of interest of Credit Rating Agencies (CRAs). We model both the CRA conflict of understating credit risk to attract more business, and the issuer conflict of purchasing only the most favorable ratings (issuer shopping), and examine the effectiveness of a number of proposed regulatory solutions of CRAs. We find that CRAs are more prone to inflate ratings when there is a larger fraction of naive investors in the market who take ratings at face value, or when CRA expected reputation costs are lower. To the extent that in booms the fraction of naive investors is higher, and the reputation risk for CRAs of getting caught understating credit risk is lower, our model predicts that CRAs are more likely to understate credit risk in booms than in recessions. We also show that, due to issuer shopping, competition among CRAs in a duopoly is less efficient than no competition under a monopoly CRA, in terms of both total ex-ante surplus and investor surplus. Allowing tranching decreases total surplus further. We argue that regulatory intervention requiring upfront payments for rating services (before CRAs propose a rating to the issuer) combined with mandatory disclosure of any rating produced by CRAs can substantially mitigate the conflicts of interest of both CRAs and issuers.

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1 Introduction

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

- Analyst at one of the main credit rating agencies in an email referring to structured finance products, April 5, 2007[1]

The analyst in the above statement refers to the key problem for credit rating agencies: how should the agencies act when their principal revenue stream comes from the firms whose products are getting rated? This question has been brought to the public's [and regulators'] attention many times, such as during the East Asian Financial Crisis (1997) and the failures of Enron (2001) and Worldcom (2002), but it has never been so salient as in the current subprime crisis. The dollar value of originations of subprime mortgages rose from $65 billion in 1995[2] to approximately $600 billion in 2006[3], and Moody's profits tripled between 2002 and 2006[4]. In this paper, we examine the conflicts of interests that credit ratings agencies (CRAs) face and the pros and cons of several proposals to regulate the industry.

The key elements of our model include:

- *Issuers' payments may influence ratings*: While CRAs have, in principle, list price schedules, they may renegotiate fees with regular customers (White (2002)).[5],[6] The SEC found that senior analytical managers and supervisors participated in fee discussions with issuers[7] and the analytical staff also discussed ratings decisions and methodology in the context of fees and market share. For instance, a senior analytical manager

[1] United States Securities and Exchange Commission (2008), p.12.

[2] Chomsisengphet and Pennington-Cross (2006), p. 37.

[3] Ashcraft and Schuermann (2008).

[4] "Triple-A-Failure," by Roger Lowenstein, *New York Times Magazine*, April 27, 2008. Moody's profits are the easiest of the CRAs to measure since they are a public stand-alone company. "Moody's operating margins exceeded 50 percent for the past six years, three to four times those of Exxon Mobil Corp., the world's biggest oil company.""Bringing Down Wall Street as Ratings Let Loose Subprime Scourge," by Elliot Blair Smith, www.bloomberg.com, Sept 24, 2008.

[5] The SEC found that in a sample of subprime RMBS deals, 12 arrangers represented 80% of the business in both number and dollar volume, while for CDOs of subprime deals, 11 arrangers accounted for 92% of the deals and 80% of the dollar volume. (SEC (2008) p.32).

[6] The CFA institute, which represents 96,000 investors, brokers, analysts, and other finance professionals found in a survey of its members "that 11% of the 1,940 respondents globally said they had 'witnessed' a ratings firm 'change a rating as a consequence of pressure andor influence' from an outside party such as a bond underwriter." "Finance Group Questions Bond-Rating Proposals" by Aaron Lucchetti, Wall Street Journal, July 7, 2008.

[7] SEC (2008) p.24.

wrote, “the CDO team didn't agree with you because they believed it would negatively impact business”.[8] In addition, CRAs offer related consulting services, such as pre-rating assessments (of what a rating might be).

- *Issuers shop for ratings*: “Typically the rating agency is paid only if the credit rating is issued”[9]. If an issuer is unhappy with a rating, it may solicit another one. “Brian Clarkson, then the president and chief operating officer of Moody's Investor's Service acknowledged that, ‘There is a lot of rating shopping that goes on...What the market doesn't know is who's seen certain transactions but wasn't hired to rate those deals.”[10]

- *CRAs' models may vary in precision*: Deven Sharma, president of S&P, said, “Events have demonstrated that the historical data we used and the assumptions we made significantly underestimated the severity of what has actually occurred”.[11] Other errors in the models CRAs use have been detected as well.[12] Moreover, there is no requirement that CRAs verify or perform due diligence with respect to the underlying loans for RMBS. A rating agency “conducted an internal review of 45 loan files and reported that it found the appearance of fraud or misrepresentations in almost every file”.[13]

- *There are large barriers to entry in the credit rating industry*: The SEC created the Nationally Recognized Statistical Rating Organization (NRSRO) category in 1975, to designate credit ratings agencies whose ratings were recognized as being valuable for investment decisions. Although 7 firms initially had this designation, mergers brought this down to 3 (Standard & Poor, Moody's, and Fitch) while the SEC refused to admit

[8] SEC (2008), p.26.

[9] SEC (2008), p.9.

[10] "Bond-Rating Shifts Loom in Settlement; N.Y.'s Cuomo Plans Overhaul of How Firms Get Paid", Aaron Lucchetti, Wall Street Journal, June 4, 2008. The article also states that "last month, Mr Clarkson, who once ran the Moody's group overseeing mortgages and other structured finance products, stepped down, effectively in July."

[11] "Testimony before the Committee on Oversight and Government Reform, United States House of Representatives", Deven Sharma, October 22, 2008.

[12] "...an internal investigation by law firm Sullivan & Cromwell LLP...focused on an error in Moody's models that affected 11 debt products known as constant-proportion debt obligation, or CPDOs. After the error was detected, Moody's found through model testing that correcting the error would have lowered triple-A ratings given to the 11 CPDOs to double-A territory....Moody's around that time was also changing its methodology for how to rate CPDOs. The company said it didn't make changes to the methodology ‘to mask any model error’. But the law firm's review found that Moody's analysts ‘considered factors inappropriate to the ratings process when reviewing CPDO ratings’". WSJ "Moody's Loses a Key Player..." July 2, 2008. In another (in)famous situation, a ratings agency "issued ratings...on a model that contained an error...nonetheless, the committee agreed to continue to maintain the ratings for several months, until the securities were downgraded for other reasons." SEC (2008), p.26.

[13] SEC (2008) p. 17.

new firms.[14] Since Congress, local governments, and regulatory agencies adopted this designation, this created an "absolute barrier to entry".[15] High profit margins (as noted above) are also emblematic of a highly concentrated industry.

- *Reputation plays a role in decisionmaking*: Short term gains from inflating an investment's quality can be smaller than long term losses from jaded investors. A report by Standard & Poor's to the SEC in 2002 states that "the 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". [16]

In this paper, we incorporate the above elements in a simple model of the ratings process. We look at different market structures (monopoly and duopoly) in the credit ratings market where CRAs obtain noisy information about the quality of the investment and can provide reports communicating that information. Issuers can purchase a report and have it issued or shop around by having certain reports not disclosed to investors. Investors may be either naive, in which case they take reports at face value, or sophisticated, in which case they understand the structure of the game and can figure out the CRAs' incentives. The information reported is nonverifiable, but CRAs may suffer reputations costs (such as loss of future business) for misselling.

We find that CRAs may inflate the quality of the issuer's investment when there are more naive investors or CRA expected reputation costs are lower. This suggests that in boom times when more investors are naive (or when more investors have lower incentive to perform due diligence) ratings inflation is more likely to occur. More precise information increases current payoffs to inflating, but also increases the probability of getting caught. In an intriguing result, we find that, due to issuer shopping, duopoly is less efficient than monopoly in terms of both total ex-ante surplus and investor surplus. A duopoly may provide more information, but it also gives the issuer more opportunities to take advantage of naive investors through shopping. Allowing issuers to restructure their products can decrease surplus further.

We analyze three potential reforms to the industry in the context of our model. The

[14] Until 2006, when the SEC gave 7 new NRSROs designations. "The Ratings Racket", The Wall Street Journal, June 25, 2008.

[15] White (2002)

[16] Standard & Poor's Ratings Service, U.S. Securities and Exchange Commission Public Hearing - November 15, 2002 Role and Function of Credit Rating Agencies in the U.S. Securities Markets http://www.sec.gov/news/extra/credrate/standardpoors.htm

Cuomo plan, which is an agreement between New York State Attorney General Andrew Cuomo and the three main CRAs, requires that the issuers pay CRAs upfront for their rating, not contingent on the report. In our model, this plan implements truthtelling and increases surplus, but doesn't implement the optimal market structure for some parameters. We suggest a revised Cuomo plan, which adds a no-shopping clause to the Cuomo plan. This implements truthtelling and prevents issuers from profiting from naive investors, therefore achieving the optimal market structure. Lastly, we show that an investors-pay plan can do as well as the revised Cuomo plan, but may be more costly in terms of government supervision. All three plans, however, suffer from a potentially severe moral hazard problem, as they may undermine CRA incentives to invest in information and due diligence.

The subprime market has unique potential for exacerbating conflicts of interest. Figure 1 depicts the number of ratings subprime deals received. While many are rated by all three agencies (S&P, Moody's and Fitch), an important fraction are rated by only two raters. This fraction increased substantially for subprime deals after 2005. And while two ratings in the corporate bond market would always come from S&P and Moody's, in the subprime market they could come from any of the three. So while the figure alone is not conclusive evidence of shopping behavior, it indicates that it was a possibility. At the same time, the ability to restructure deals meant that repackaging and renaming deals might be an issue whether the issuer stays with the same credit rating agency or shops. Lastly, consulting over how to structure deals and what their ratings will be has meant more income and closer ties to issuers for CRAs.[17]

There is by now a substantial literature on information intermediaries in both microeconomics and finance. In the microeconomics literature information intermediaries have been studied in their role as certifiers of quality, as for example in Biglaiser (1993) and Lizzeri (1999). Typical assumptions in this literature are that information intermediaries commit to information disclosure rules and that their incentives to certify quality come from the possible reputation costs they incur when they provide inaccurate information. This problem of quality certification is akin to the role financial analysts play when they recommend stocks, as analyzed by Benabou and Laroque (1992) and by Morgan and Stocken (2003). The model of Morgan and Stocken (2003) also addresses the issue of unverifiable information provision, when the certifier can lie but thereby incurs a lying cost (this problem is examined further

[17] This CRA consulting activity is problematic for another reason. It is akin to a teacher providing exam questions ahead of the exam and explaining how to answer them to get a good grade. This is obviously not a good way of testing students' ability and level of learning.

in Kartik, 2008, Kartik, Ottaviani, and Squintani, 2007, and Ottaviani and Sorensen, 2006).

Although our signaling game is simpler in some respects, we extend the analysis relative to this literature by examine how strategic contracting between the informed party (the CRA) and an interested party (the issuer in our case) can affect information revelation. Our problem is also related in this respect to the economics literature on strategic contracting when the information revealed affects a third party, which covers a wide number of microeconomic issues (see Inderst and Ottaviani, 2008, Durbin and Iyer, 2008, and Mariano, 2008). In Bolton, Freixas, and Shapiro (2007) we analyze a situation of strategic contracting where the informed parties (banks) are setting prices for their products at the same time as providing recommendations about them to uninformed investors. In Pagano and Volpin (2008) CRAs have no conflicts of interest, but can choose to be more or less opaque depending on what the issuer asks for. They show that opaqueness can enhance liquidity in the primary market but may cause a market freeze in the secondary market.

Several recent papers study the implications of shopping for good ratings. First, Faure-Grimaud, Peyrache and Quesada (2006) look at corporate governance ratings in a market with truthful CRAs and rational investors. They show that issuers may prefer to suppress their ratings if they are too noisy. They also find that competition between rating agencies can result in less information disclosure. Second, Farhi, Lerner, and Tirole (2008) assume that information intermediaries (such as ratings agencies) provide different types of verifiable information and study how market structure affects shopping behavior by agents (issuers) who are being rated. Third, Skreta and Veldkamp (2008) also assume that CRAs truthfully relay their information and demonstrate how noisier information creates more opportunity for shopping by issuers to take advantage of a naive clientele.

The finance approach to the role of credit rating agencies has mainly focused on the effect of announcements on the pricing of both bonds and stocks. The main finding is the asymmetry between downgrades and upgrades: downgrades have a significant negative impact on price, but there is virtually no price change following an upgrade. The effect of ratings changes on price is complex as the impact of ratings changes is different for firms with low ratings than for firms with high ratings. Overall, there is a clear consensus that information provided by CRAs have an effect on price (see Hand, Holthausen and Leftwich, 1992, Hite and Warga, 1997, Berger, Davies and Flannery, 2000, Dichev and Piotroski, 2001, and Jorion and Zhang, 2007) These findings suggest a role for CRAs in the allocation of capital process. Yet, these results do not rule out the possibility of self-serving ratings inflation, as a CRA can decrease the probability with which it truthfully reveals some information, and this information may still have a price impact when it is revealed. An alternative view is that CRAs inflate ratings in good times and truthfully rate in bad times so that, on average, the information is still relevant for the market. The paper closest to ours is Mathis, McAndrews and Rochet (2008), who examine the incentives of a CRA to inflate ratings in a model of endogenous reputation.[18] They find that reputation cycles may exist where a CRA builds up its reputation by relaying information accurately only to take advantage of this reputation to later inflate ratings.

A recent empirical study of CRA ratings by Becker and Milbourn (2008) provides empirical support for our findings. They find that increased competition from Fitch's increased market share in the corporate bond market led to more issuer-friendly ratings and also less informative ratings, which matches the predictions of our model. In a related study, Ashcraft, Goldsmith-Pinkham, and Vickery (2009) examine subprime and Alt-A mortgage backed securities during the period leading up to the subprime crisis and find evidence that several proxies for incentive problems are correlated with CRA ratings, but that there is no overall systematic decline in rating standards.

The paper is organized as follows: In Section 2, we write down the model and solve the case for a single CRA. In Section 3, we analyze the case of competition between two CRAs. Section 4 compares welfare in the two market structures in terms of total ex-ante surplus and investor surplus. Section 5 investigates different plans to regulate the credit rating industry and Section 6 concludes.

2 The Model

In the simplest version of the model, we consider three types of agents: an issuer, a monopoly credit ratings agency (CRA), and a mass 1 of investors. There are multiple periods in which funds are sought for an independent investment each period, although we will primarily analyze the first period.

An investment is characterized by its probability of default. A bad investment defaults with probability $p > 0$, and a good investment defaults with probability zero. They both yield the same return R when not in default, and the recovery amount r conditional on

[18] Strausz (2005) also models endogenous reputation for information intermediaries. He provides interesting insights in line with our findings, as he argues that honest certification has some of the characteristics of a natural monopoly.

default. The investment has constant returns to scale, so that each unit issued has the same return profile.

All agents believe ex-ante that the investment is good with probability $\frac{1}{2}$. This creates a role for the CRA, which can use its technology to find out whether the investment is good or bad. A signal $\theta \in \{g, b\}$ is the private information of the CRA and has the following informational content about the true state of the world ω:

$$\Pr(\theta = g \mid \omega = g) = \Pr(\theta = b \mid \omega = b) = e$$

$$\Pr(\theta = g \mid \omega = b) = \Pr(\theta = b \mid \omega = g) = 1 - e$$

The term e measures the quality of the signal received, which we will refer to as the *precision* of the signal.[19] At $e = \frac{1}{2}$ the signal has revealed no information and agents retain their ex-ante beliefs. For $e > \frac{1}{2}$, the signal becomes informative. We assume that the level of precision is known and in the interval $(\frac{1}{2}, 1)$.

Given a level of precision, the CRA posts two fees before the signal is retrieved. The initial fee ϕ^I must be paid by an issuer before the CRA does the work of retrieving the signal, and the ratings fee ϕ^R is paid for the rating to be issued. The initial fee may be thought of as a fee for hiring the CRA to perform the analysis, or alternatively for doing a pre-assessment of the investment. The ratings fee may be thought of as the fee to have the rating publicly reported, and could also include revenues from consulting business with the issuer. The rating will be a message or report of $m = G$ ("Good") or $m = B$ ("Bad") that will be observable to investors.

The CRA then retrieves the signal and makes a report. After observing the report, the issuer can pay ϕ^R to have it distributed, or refuse to purchase it. Thus we allow the issuer to "shop" for ratings. This is meant to capture the back and forth negotiations that often go on when CRAs make their ratings reports.[20] If the issuer shops and refuses to buy the CRA's report, that in itself may be a signal. We assume that in this case, naive investors retain their ex-ante beliefs but sophisticated investors update their beliefs in a way consistent with the Perfect Bayesian Equilibrium.

[19] No confusion with the statistical use of the term is possible in this context.

[20] We don't allow for unsolicited ratings. We do, however, analyze the process of altering a structured financial product in section 6.

Once the rating is announced, or if it is not announced due to the issuer's refusal to purchase it, the issuer sets a uniform price T for an investment. Since the cost of production of the investment is normalized to zero, we can interpret the price T as a spread. The investors observe the report and decide how much of the investment to purchase.

There are two types of investors, *sophisticated* and *naive.* A fraction $1 - \alpha$ of investors are sophisticated. These investors observe the payoffs of the game for both the CRA and the issuer, and therefore understand the CRA's potential conflict of interest. They do not know, however, whether the investment is good or bad or observe the signal of the CRA. Naive investors simply don't understand the incentives of the CRA and take its ratings at face value. The coexistence of naive and sophisticated investors may be thought of as the result of different types of incentives to perform due diligence. Naive investors may be managing third party investment and their revenue only depends marginally upon the ex-post return of the assets they manage[21]; sophisticated investors' incentive packages may be, instead, more related to the ex-post behavior of the investments they select.

If investors find out that the CRA lied, they will punish the CRA in future periods by ignoring its reports. Investors, however, cannot determine at the time the rating is issued whether it is truthful or not. More formally, they cannot determine whether the rating $m \in \{B, G\}$ is equal to the signal received by the CRA $\theta \in \{b, g\}$. But they are able to find out ex-post whether the CRA lied in the event of a default. In practice it is difficult to determine whether a CRA misled investors even ex-post. Still, it is generally easier to make that determination ex-post rather than ex-ante. To simplify the analysis we make the somewhat extreme assumption that investors can perfectly identify whether the CRA lied in the event of a default.[22]

Hence, if the CRA receives a signal $\theta = g$ and reports $m = G$, then should the investment fail the CRA will not be punished, as investors can see that it acted in *good faith.* However, a CRA who receives a signal $\theta = b$ and reports $m = G$ will be punished if the project fails. Reputation costs create the incentive to tell the truth, since investors can eventually learn and punish the CRA.[23] We define the discounted sum of future profits as ρ, which in essence

[21] Regulation that forces managers to only purchase investments with good ratings could also provide these incentives.

[22] Formally we can motivate this assumption by assuming that the recovery value in default is a random variable and even though the expected value is always r, the realizations differ depending on the signal θ observed by the CRA ex-ante. The economic idea here is that the issuer also gets a noisy signal θ ex-ante and takes greater precautions to salvage some recovery value when $\theta = b$ than when $\theta = g$.

[23] Interestingly enough, CRAs are "immune from misstatements under Section 11 of the Securities Act of 1933" and have won most cases against them based on the arguments that credit ratings are free speech and

is the gain from not lying. Reputation costs are exogenous in the model, as in Morgan and Stocken (2003), Ottaviani and Sorensen (2008), and Bolton, Freixas, and Shapiro (2007). This allows us to focus on policy implications in a tractable manner.

We assume that the reputation at stake is slightly noisy:

Assumption A0: There is a tiny amount of uncertainty on the part of the CRA about the actual value of ρ, i.e. $\rho \in [\tilde{\rho} - \varepsilon, \tilde{\rho} + \varepsilon]$ such that $\varepsilon \to 0$. This uncertainty is resolved when the CRA receives its signal.

This assumption restricts the CRA's strategy space since for any small amount of uncertainty, however small, it will be unable to set fees exactly at levels to make itself indifferent between reports. Thus, this small uncertainty limits the CRA to pure strategies.

Both types of investors are risk neutral. They can either purchase 1 unit or 2 units of the investment. We assume that they have a reservation utility that is increasing in the size of their investment, specifically they need a return of u on the first unit of their investment and a return of U on the second unit, where $U > u$.[24] One may think of this in several ways: it could be an investor holding her money in cash and needing a larger return to invest all of it, a need for a higher return in order to commit to only one investment vehicle and not diversify, or a form of risk aversion.

We define the probability of default cutoff p^* such that an investor is indifferent between purchasing two units or just one unit of the investment:

$$(1 - p^*)R + p^*r = U. \tag{1}$$

We also make the following assumptions on the returns on investment:

$$(1 - p)R + pr > u \tag{A1}$$

$$(1 - e)p < p^* \tag{A2}$$

$$\frac{p}{2} > p^* \tag{A3}$$

are "extensively disclaimed" (Partnoy (2002)). Hence, the punishment we refer to is investors withdrawing their business.

[24]The specific form the reservation utility takes could be modeled in multiple ways and give the same results, this form is chosen for simplicity.

Assumption A1 says that an investor who knows the investment is bad would be willing to purchase 1 unit. Assumption A2 says that an investor with reliable information that the investment is good purchases 2 units. The information problem is explicit in assumption A3: not knowing whether an investment is good or bad (and evaluating the investment with the ex-ante beliefs), an investor would only purchase 1 unit. This implies that if the CRA did not exist, the issuer would not be able to sell 2 units to any investor since the probability that the issue is bad is too large. The CRA can therefore potentially increase welfare by providing information.

Timing of moves

The timing of the game is as follows:

1. The CRA posts its initial fee ϕ^I and ratings fee ϕ^R.
2. The issuer asks for the signal to be retrieved or not.
3. Given a request by the issuer, the CRA receives the signal and then makes a report of $m = G$ or $m = B$.
4. The issuer observes the report and decides whether to buy and distribute it or not. The issuer then sets a price T for a unit of the investment.
5. Investors observe the price T and the CRA rating if there is any and decide how much of the investment to purchase.
6. The return is realized.

To simplify notation, we make the following definitions:

$$V^G = (1-(1-e)p)R + (1-e)pr$$

$$V^B = (1-ep)R + epr$$

$$V^0 = (1-\frac{p}{2})R + \frac{p}{2}r$$

The first expression V^G represents the maximum value either type of investor can have for an investment given precision e. The second expression V^B is the minimum value, and the final expression V^0 is the investors' ex-ante valuation of the investment. Notice that

$$V^G > V^0 > V^B$$

and that

$$\frac{1}{2}V^G + \frac{1}{2}V^B = V^0.$$

2.1 The Ratings Game with a single CRA

The CRA receives a signal and must decide what to report. The issuer must decide whether to purchase the report, and subsequently how much to charge investors. Sophisticated investors must infer how good the investment is and formulate their willingness to pay.

There are situations where the action '*Don't buy*' is off the equilibrium path. As we employ the concept of Perfect Bayesian Equilibrium, there is no restriction on off-the-equilibrium-path beliefs. However, we shall restrict attention to equilibria where off the equilibrium path beliefs are equal to ex-ante beliefs (that is, the investment is expected to be *good* with probability $\frac{1}{2}$). This is not really restrictive, since the issuer can refuse to deal with the CRA before the CRA receives a signal, in which case the issuer would always have the option of dealing directly with investors with ex-ante beliefs.[25]

For the analysis, we focus on the situation where the issuer purchases at least one type of report, which will be confirmed as equilibrium behavior. We solve the game backwards, beginning with the decision of what report to issue after observing the signal.

Lemma 1 *Given the fee ϕ^R, the CRA's reporting strategy is:*

1. *For $\phi^R > ep\rho$, the CRA always reports "G"*

2. *For $0 < \phi^R < ep\rho$, the CRA reports the truth, relaying its signal perfectly.*

Proof. Given that the issuer may not purchase after a given report, we will label the fee ϕ^R as two different fees, the fee collected after a "G" report, ϕ^R_G (which could be ϕ^R or zero) and the fee collected after a "B" report, ϕ^R_B (which could be ϕ^R or zero).

Conditional on receiving a good signal, the CRA may report "G", in which case it earns

$$\pi(G \mid g) = \phi^R_G + \rho.$$

[25] Hence, we implicitly consider the case where beliefs off the equilibrium path are also worse than the ex-ante beliefs.

It receives a fee ϕ_G^R for its report $m = G$ and subsequently earns its full future rent. If the CRA were to report $m = B$ conditional on receiving a good signal, it would earn

$$\pi(B \mid g) = \phi_B^R + \rho,$$

as there is no punishment for having said the investment was bad. Similarly, conditional on receiving a bad signal, the payoff of rating $m = B$ is

$$\pi(B \mid b) = \phi_B^R + \rho.$$

Reporting $m = G$ conditional on a bad signal $\theta = b$, however, yields:

$$\pi(G \mid b) = \phi_G^R + (1 - ep)\rho,$$

since now with probability ep the investment defaults and the CRA is punished, while with the complementary probability there is no default and the CRA earns ρ.

Conditional on receiving the good signal, the incentive to report $m = G$ depends on the difference in payoffs:

$$\pi(G \mid g) - \pi(B \mid g) = \phi_G^R - \phi_B^R.$$

Conditional on receiving the bad signal, the report to say $m = B$ is:

$$\pi(B \mid b) - \pi(G \mid b) = \phi_B^R - \phi_G^R + ep\rho.$$

This yields three possible information regimes: if $\phi_G^R - \phi_B^R > ep\rho$, the CRA always reports G, if $0 < \phi_G^R - \phi_B^R < ep\rho$, the CRA reports truthfully, and if $\phi_G^R - \phi_B^R < 0$, the CRA always reports B.

There is no informational regime where a report of B increases the valuations of sophisticated investors above their ex-ante valuation of V^0. Moreover, by assumption, a report of B decreases the valuations of naive investors below V^0. Therefore, there is no reason for an issuer to purchase a B report, making the CRA's return on a B report equal to $\phi_B^R = 0$. The lemma follows from the non-negativity of fees. ■

There are thus two possible reporting regimes, one where the CRA inflates the investment quality and one where the CRA truthfully reveals the investment quality. The lemma establishes that a B report will never be purchased. Therefore the issuer provides incentives by using only the reporting fee and its right to shop.

We proceed by analyzing the fees the CRA would set in each informational regime.

Proposition 1 *The equilibrium of the fee setting game is:*

1. *If* $\alpha 2V^G - V^0 > ep\rho$*, the CRA always reports* $m = G$*, sets* $\phi^R \in (ep\rho, \alpha 2V^G - V^0]$ *and* $\phi^I = \alpha 2V^G - V^0 - \phi^R$*, and has profits*

$$\alpha 2V^G - V^0 + (1 - \frac{ep}{2})\rho,$$

2. *If* $\alpha 2V^G - V^0 < ep\rho$*, the CRA reports truthfully, sets* $\phi^R \in [0, \min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho]]$*,* $\phi^I = \frac{1}{2}(\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] - \phi^R)$*, and has profits*

$$\frac{1}{2}\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] + \rho.$$

Proof. If the CRA always reports $m = G$, the issuer is willing to purchase this rating as long as the sum of the fees are not above

$$\alpha 2V^G - V^0$$

the incremental profit obtained from naive investors. There are many beliefs off the equilibrium path for sophisticated investors such that no deviation will occur. Always reporting $m = G$ is feasible when

$$\alpha 2V^G - V^0 > ep\rho$$

(from Lemma 1) and CRA profits are then

$$\alpha 2V^G - V^0 + (1 - \frac{ep}{2})\rho.$$

If the CRA reveals its signal truthfully, the $m = G$ report induces the highest valuations from both naive and sophisticated investors buying two units, while the $m = B$ report induces the lowest valuations for sophisticated investors and the ex-ante valuation for naive investors (because it is not disclosed). So that the maximum ratings fee is given by:

$$\phi^R = 2V^G - \max[\alpha V^0, V^B].$$

If $\phi^I = 0$, ϕ^R must also satisfy the issuer ex-ante participation constraint is:

$$\frac{1}{2}((2V^G - \phi^R) + \max[\alpha V^0, V^B]) \geq V^0$$

It is clear that $\phi^R = 2V^G - \max[\alpha V^0, V^B]$ violates this. The maximum fee is then given by this participation constraint binding:

$$\phi^R = 2V^G + \max[\alpha V^0, V^B] - 2V^0$$

Reporting truthfully and setting $\phi^R = 2V^G + \max[\alpha V^0, V^B] - 2V^0$ is not feasible whenever always reporting $m = G$ is feasible since

$$\alpha 2V^G - V^0 > ep\rho \quad \Rightarrow \quad 2V^G + \max[\alpha V^0, V^B] - 2V^0 > ep\rho.$$

This implies that the ratings fee set for reporting truthfully must be no more than

$$\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho].$$

Profits from reporting truthfully therefore are given by

$$\frac{1}{2}\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] + \rho.$$

Lastly, if both always reporting $m = G$ and truthtelling are feasible ($\alpha 2V^G - V^0 > ep\rho$), the CRA prefers to always report $m = G$ since:

$$\alpha 2V^G - V^0 + (1 - \frac{ep}{2})\rho > (1 + \frac{ep}{2})\rho \geq \frac{1}{2}\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] + \rho$$

■

The optimal choice for the CRA is unique and always exists since

$$\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] > 0$$

for all parameters. The proposition establishes that the CRA can maximize its present discounted value of profits by choosing either of the two informational regimes depending on the parameters. Overstating the quality of the investment is an equilibrium outcome, despite the presence of reputation costs. This is also a point that Mathis, McAndrews, and Rochet (2008) make.

The cutoff $\alpha 2V^G - V^0 - ep\rho$ determines whether the CRA inflates the quality of the investment. For low reputation costs and a large naive audience, the CRA takes advantage of the naive investors by always reporting $m = G$. For high reputation costs and a large sophisticated audience, the CRA is willing to tell the truth and create information for all investors. This suggests that ratings inflation will be greater in times when there is more naivete among investors. This may occur in boom times, when investors have less incentive to hunt for bargains or perform due diligence. An increase in the precision of the signal has competing effects. It raises the expected valuation of naive investors, giving higher short term returns to the CRA. On the other hand, it also makes the probability that the CRA gets caught for misleading investors larger, decreasing future returns.

The payoff to truthtelling is bounded above by the expected reputation cost $ep\rho$. This constraint on information revelation is also present in Bolton, Freixas, and Shapiro (2007).

3 Competition among Ratings Agencies

We now examine the game where two ratings agencies compete in selling ratings to issuers. The CRAs can be thought of as having differentiated products since they are receiving imperfect ($e < 1$) signals about the quality of the investment. In addition, more than one CRA's rating may be purchased to provide maximum information.

The timing of the game with competition is similar to the game with one CRA:

1. The CRAs post fees ϕ_k^I and ϕ_k^R, where $k = 1, 2$ represents the firm.
2. The issuer asks each CRA for their signal to be retrieved or not.
3. The CRAs receive their signals and produce reports of $m = G$ or $m = B$,
4. The issuer observes the reports and decides whether to purchase and distribute one, both, or neither report. It then sets a price T per unit of the investment,
5. Investors observe the report(s) purchased by the issuer and decide how much of the investment to purchase,
6. The return is realized.

Again to simplify notation, we adopt the following definitions:

$$
\begin{aligned}
V^{GG} &= \left(1 - \frac{(1-e)^2}{(1-e)^2 + e^2} p\right) R + \frac{(1-e)^2}{(1-e)^2 + e^2} pr \\
V^{BB} &= \left(1 - \frac{e^2}{(1-e)^2 + e^2} p\right) R + \frac{e^2}{(1-e)^2 + e^2} pr \\
\pi^{two}(\alpha) &= \frac{1}{2}(e^2 + (1-e)^2)(2V^{GG} + \max[\alpha V^0, V^{BB}]) + 2e(1-e)\alpha 2V^G \\
\pi^{one}(\alpha) &= V^G + \frac{1}{2}\max[\alpha V^0, V^B]
\end{aligned}
$$

The terms V^{GG} and V^{BB} represent the value to sophisticated investors when both CRAs report respectively $m = G$ and $m = B$ truthfully. They also represent the value to naive investors when both CRAs report $m = G$ and $m = B$ whether truthfully or not. The value to naive investors when one CRA reports $m = G$ and the other reports $m = B$ is V^0, the ex-ante value before any information is obtained about the investment. Note that, as one would expect,

$$V^{GG} > V^{G} > V^{0} > V^{B} > V^{BB}.$$

The term $\pi^{two}(\alpha)$ defines the ex-ante (expected) revenues that the issuer has from contracting two truthful CRAs. Similarly, the term $\pi^{one}(\alpha)$ defines the ex-ante (expected) revenues that the issuer has from contracting one truthful CRA. Note that these are revenues, i.e. the fees are not included.

We make the following assumption about the value added of an extra report:[26]

$$\alpha 2V^{G} - V^{0} > 2(V^{GG} - V^{G}) \tag{A4}$$

The inequality says that the value of the first G report for naive investors is larger than the value of a second G report for all investors. We also make the following assumption to guarantee existence of the truthtelling equilibrium:

$$\alpha 2V^{G} - V^{0} - 2(\pi^{two}(\alpha) - \pi^{one}(\alpha)) < ep\rho^{D} \tag{A5}$$

This condition prevents a CRA from unilaterally deviating to sell only to naive customers.

Lastly, we assume that

$$\frac{\frac{3}{2}V^{0}}{2V^{G}} < \frac{V^{BB}}{V^{0}} \tag{A6}$$

This is not critical to the results, but aids in presentation. It does two things. First, it will be used to define a range of α such that approaching 2 truthtelling CRAs has less value than approaching 1 truthtelling CRA.[27] Second, it implies that $\frac{V^{0}}{2V^{G}} < \frac{V^{BB}}{V^{0}}$, which fixes cutoffs for which shopping will occur. For example, when there are two B reports the issuer must decide between charging V^{0} to naive investors or V^{BB} to everyone. There is then a cutoff $\frac{V^{BB}}{V^{0}}$ for α such that it is best to target naive investors for α higher than this cutoff (when there are two B reports), i.e. $\max[\alpha V^{0}, V^{BB}] = \alpha V^{0}$. This will be relevant in the proposition below and in the welfare section.

[26] Without A4, there can still be equilibria where both CRAs tell the truth and equilibria where both CRAs always report G (and there would be no equilibria where one CRA tells the truth and one always reports G). However, there would be multiple equilibria for each informational regime, there would need to be another restriction on parameters to guarantee existence, and both types of equilibria could co-exist. Assumption A4 also places a lower bound on α, which means some shopping will always occur. This plays a role in our welfare analysis.

[27] This range also exists if the opposite is true, but we would need an alternative condition to denote the cutoff.

The discounted sum of future profits for each CRA if it is not caught lying is ρ^D. This is an exogenous amount as in the case of monopoly. It is a strong assumption, since with two CRAs there are many possible ways to model reputation. First, it might be that should one CRA be caught lying, the other CRA gets larger continuation profits than if neither were caught lying. Second, it might be that a CRA only gets caught if it is lying and the other CRA is telling the truth (i.e. the CRA's falsification stands out and is not attributable to industrywide factors). Third, it might be that both CRAs (the whole industry) gets punished when any CRA is caught. Our assumption is the simplest, though we remain interested in exploring the other options.

As before, we solve the game backwards, beginning with the decision of what report to issue after observing the signal.

Lemma 2 *For a given set of fees for both CRAs, CRA k's reporting strategy is:*

1. *If $\phi_k^R > ep\rho^D$, the CRA always reports G.*
2. *If $\phi_k^R < ep\rho^D$, the CRA reports the truth, relaying its signal perfectly.*

The proof is the same as that of Lemma 1. We now solve for the Nash Equilibrium of the fee setting game.

Proposition 2 *The Nash equilibrium of the fee setting subgame (assuming A4-A6 hold) is:*

1. *If $\alpha 2(V^{GG} - V^G) > ep\rho^D$, both CRAs always report G, $\phi_k^R \in (ep\rho^D, \alpha 2(V^{GG} - V^G)]$, and $\phi_k^I = \alpha 2(V^{GG} - V^G) - \phi_k^R$ for $k = 1, 2$ with CRA profits given by*

$$\alpha 2(V^{GG} - V^G) + (1 - \frac{ep}{2})\rho^D.$$

2. *If $\alpha 2(V^{GG} - V^G) < ep\rho^D$, both CRAs report truthfully, $\phi_k^R \leq ep\rho^D$, and*
   (a) *If $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, 1]$*
      i. *and $\pi^{two}(\alpha) - V^0 - 2(\pi^{two}(\alpha) - \pi^{one}(\alpha)) \geq 0$, $\frac{1}{2}\phi_k^R + \phi_k^I = \pi^{two}(\alpha) - \pi^{one}(\alpha)$, $k = 1, 2$*
      ii. *and $\pi^{two}(\alpha) - V^0 - 2(\pi^{two}(\alpha) - \pi^{one}(\alpha)) < 0$, any fees that satisfy $(\frac{1}{2}\phi_1^R + \phi_2^I) + (\frac{1}{2}\phi_2^R + \phi_2^I) = \pi^{two}(\alpha) - V^0$ and $\frac{1}{2}\phi_k^R + \phi_k^I \leq \pi^{two}(\alpha) - \pi^{one}(\alpha)$, $k = 1, 2$ are an equilibrium.*

(b) *If* $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$, *the issuer only hires one CRA and* $\phi_k^R = \phi_k^I = 0$, $k = 1, 2$

The proof is in the appendix.

There are thus two possible equilibria: one where both CRAs always inflate the quality of the investment, and one where both CRAs reveal truthfully their information about the investment. The cutoff determining which equilibrium prevails is whether $\alpha 2(V^{GG} - V^G) - ep\rho^D$ is larger than zero or not.

In the truthtelling equilibrium, when there are few naive investors so that α is small, a duopoly is not sustainable. The reason is that the information rent for the issuer of an additional rating is small, given that it won't be able to take advantage of a large number of naive investors. When the issuer hires only one CRA, then the CRAs compete a la Bertrand and set fees $\phi_k = \phi_{-k} = 0$.

With a larger fraction of sophisticated investors and a larger reputation cost there will be more truthtelling. An increase in the precision of the signal, however, creates a tradeoff. The probability of getting caught is rising in the precision, making truthtelling more likely. But, the current payoff from manipulating $(\alpha 2(V^{GG} - V^G))$ is increasing for low precision levels, meaning that truthtelling is less likely. However, in contrast to the case of monopoly, for high precision levels the current payoff is decreasing in the precision, meaning that current and future incentives are aligned in making truthtelling more likely.

Notice that although both CRAs are making positive expected profits, it is possible for the investors to observe two reports, one report, or zero reports. One report or zero reports imply that we are in the situation where the CRAs are telling the truth. The converse, of course, is that more (two) reports implies a greater likelihood that the CRAs are inflating the quality of the investment.

Comparing Monopoly and Duopoly in terms of Information Revelation

Comparing the outcome under competition to the case of a monopoly CRA–where the cutoff for truthtelling is whether $\alpha 2V^G - V^0 - ep\rho$ is larger than zero or not–we find again a tradeoff. First, we see that by assumption A4, the payoff to inflating ratings is larger in a monopoly. In other words, competition reduces the rents from always reporting G. Still, it is likely that $\rho > \rho^D$, since the expected loss of business should be larger in monopoly. This may mitigate the increase in fees available to the monopolist.

Understanding the difference between plain vanilla corporate bond ratings and structured finance products is important for understanding the subprime crisis. One possible explanation could be that the complexity of assets increased, decreasing the precision of the CRAs' analysis. We find that shopping increases in duopoly when precision decreases if we define shopping as taking place when there are less than two G signals (Pr(Shopping) = 1- Pr(of two G signals)).[28][29] However, at the same time, we have shown that a decrease in precision lowers the benefit of inflating and its costs, making it unclear whether truthtelling will decrease in either market structure. Furthermore, a decrease in precision also makes the benefits of inflating in monopoly decrease faster than the benefits of inflating in duopoly. This makes it unclear whether a decrease in precision diminishes truthtelling more in monopoly or in duopoly.

A stronger explanation in our model lies in increasing the size of the naive population, which unambiguously gives larger incentives to inflate the quality of the investment. At the same time, an increase in naivete makes inflating more likely in monopoly than duopoly, so market power could have played a role. Moreover, if naive investors overestimated the precision of the CRAs' reports, the incentive to inflate would be very strong irrespective of market structure (current payoffs increase, future costs don't change). Ashcraft and Schuermann (2008) support the idea of overestimation, "Credit ratings were assigned to subprime MBS with significant error. Even though the rating agencies publicly disclosed their rating criteria for subprime, investors lacked the ability to evaluate the efficacy of these models."

4 Welfare

We now turn to the evaluation of the efficiency of the equilibrium outcomes. Note that in our model it is not completely obvious what the relevant efficiency benchmark is, as we have a fraction of investors who are naive. We consider two welfare criteria: total ex-ante surplus and investor surplus, and we evaluate expected surplus for all agents from the point of view of a sophisticated agent, thus adopting a paternalistic point of view. In other words we take the view that one role of financial regulation is to protect small and naive investors from

[28] Skreta and Veldkamp (2008) also point out that less precise signals imply more ratings shopping by issuers.

[29] As Calomiris (2008) has argued: "Subprime was a relatively new product, [...] Given the recent origins of the subprime maket which postdates tle last housing cycle downturn in the U.S. (1989-1991), how were the rating agencies able to ascertain what the LGD would be on a subrpimer mortgage pool?" Thus the lower precision of CRA's information about subprime credit risk may have been a source of ratings inflation through greater shopping pressure by issuers. Charles Calomiris, (2008), *The subprime turmoil: What's old, what's new, and what's next.* Vox: http://www.voxeu.org/index.php?q=node/1561

themselves. The main motivation for this view is that naive investors would support such regulations with the benefit of hindsight once their naivete is exposed.

4.1 Total Ex-ante Surplus

We begin by establishing two benchmarks for total surplus, the first best and the market solution when there are no CRAs. The first best is given by:

$$\begin{aligned} W_{FB} &= \frac{1}{2}(2R - u - U) + \frac{1}{2}((1-p)R + pr - u) \\ &= ((1 - \frac{p}{2})R + \frac{p}{2}r - u) + \frac{1}{2}(R - U) \\ &= V^0 - u + \frac{1}{2}(R - U) \end{aligned}$$

The top expression is given by the probability that the investment is good multiplied by the surplus created when investors purchase two units plus the probability the investment is bad multiplied by the surplus when only one unit is purchased.

The market solution when there are no CRAs is just given by $V^0 - u$ since both naive and sophisticated investors would then only purchase one unit. Therefore the maximum surplus that can be gained through the provision of credit ratings is given by $\frac{1}{2}(R - U)$, the extra unit purchased when the investment is good.

We now analyze the total surplus created in each equilibrium. In the total surplus calculations, we add the surplus of investors, credit rating agencies and issuers. The fees of credit rating agencies and the prices charged by issuers net out. Note that since our reputation parameters ρ and ρ^D are exogenous and only represent returns to the CRA from continued interaction, and not investors or issuers, we exclude future surplus from our calculations and thus look only at welfare in the short run. We also point out that assumption A4 implies that $\alpha 2V^G - V^0 > 0$, or $\alpha > \frac{V^0}{2V^G}$. We will therefore examine total surplus (and investor surplus) for the interval $\alpha \in [\frac{V^0}{2V^G}, 1]$.

1. Monopoly CRA, $\alpha 2V^G - V^0 > ep\rho$ (The CRA always reports G):

   Total surplus is:

$$W_M^G = \frac{1}{2}\alpha(2R - u - U) + \frac{1}{2}\alpha(2((1-p)R + pr) - u - U)$$

(where the subscript M refers to the monopoly and superscript G refers to the fact that the CRA always reports G).

Only naive investors purchase at the high prices as the rating reveals no positive information to sophisticated investors. Since naive investors believe the investment is good, they invest 2 units. We can rewrite this expression as:

$$W_M^G = \alpha[2((1-\frac{p}{2})R + \frac{p}{2}r) - u - U] = \alpha[(V^0 - u) + (V^0 - U)]. \qquad (2)$$

This expression is positive, although it may be quite small. Clearly, the fewer naive investors there are, the less surplus there is, although there is a lower bound on the size of the naive investor group given by the condition that this is indeed an equilibrium. Also, the first term in the expression in square brackets is our market solution when there are no CRAs and is positive, while the second term is negative by A3. Hence, as intuition suggests, the presence of a credit rating agency actually reduces surplus in this scenario.

2. Monopoly CRA, $\alpha 2V^G - V^0 < ep\rho$ (The CRA reports its signal truthfully):

   There are two subcases here, depending on how the issuer prices the investment when there is no report (interpreted correctly by sophisticated B investors as a B report that was not purchased). We first assume that $\alpha V^0 < V^B$, which implies that both investors buy one unit. Total surplus equals:

$$\begin{aligned} W_M^{truth1} &= \frac{1}{2}[e(2R-u-U)+(1-e)(R-u)] + \frac{1}{2}[e((1-p)R+pr-u)+ \qquad (3)\\ &\quad (1-e)(2((1-p)R+pr)-u-U)] \\ &= (1-\frac{p}{2})R + \frac{p}{2}r - u + \frac{1}{2}[(1-(1-e)p)R + (1-e)pr - U] \\ &= V^0 - u + \frac{1}{2}[V^G - U] \end{aligned}$$

Thus, the surplus here depends on the precision of the signal. Still, as expected, the surplus is higher than when there is no CRA as $V^G > U$ by assumption A2. As the precision approaches $e = 1$, the surplus approaches the first best.

When $\alpha V^0 > V^B$, there is an additional distortion, because the issuer sets its price high when there is no report to capture naive investors, but excludes sophisticated investors. In this subcase, the total surplus is smaller:

$$W_M^{truth2} = V^0 - u + \frac{1}{2}[V^G - U] - \frac{1-\alpha}{2}[V^B - u] \tag{4}$$

3. Duopoly, $\alpha 2(V^{GG} - V^G) > ep\rho^D$ (Both CRAs always report G):

   The total surplus here is exactly the same as when there is a monopoly CRA who always reports G.

   Naive investors purchase 2 units and sophisticated investors purchase nothing. The split of rents between CRAs and the issuer, however, is different here, as the issuer can earn more than V^0 per investor due to competition. If there is a fixed operating cost for CRAs, this would be less efficient than the case of a monopoly CRA. Both an inflating monopoly and an inflating duopoly are less efficient than a market without CRAs.

4. Duopoly, $\alpha 2(V^{GG} - V^G) < ep\rho^D$ (Both CRAs report their signals truthfully):

   If $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$, only one of the CRAs is hired, and the total surplus is the same as in the truthtelling monopoly case where $\alpha V^0 < V^B$.

   When $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, \frac{V^{BB}}{V^0}]$, both CRAs are hired and both types of investor purchase one unit when there is no report. Total surplus then equals:

$$\begin{aligned} W_D^{truth1} &= \{\frac{1}{2}[(e^2 + 2e(1-e)\alpha)(2R - u - U) + (1-e)^2(R-u)] \\ &+ \frac{1}{2}[e^2((1-p)R + pr - u) + (2e(1-e)\alpha + (1-e)^2)(2((1-p)R + pr) - u - U)]\} \end{aligned}$$

   We can rewrite this as:

$$\begin{aligned} W_D^{truth1} &= (e^2 + 2e(1-e)\alpha + (1-e)^2)(V^0 - u) \\ &+ \frac{1}{2}(e^2 - (1-e)^2)(R - U) + (2e(1-e)\alpha + (1-e)^2)(V^0 - U) \end{aligned} \tag{5}$$

In contrast, when the fraction of naive investors is large, so that $\alpha \in [\frac{V^{BB}}{V^0}, 1]$, both CRAs are hired and only naive investors purchase when there are no G reports. The naive investors are also the only ones to purchase after one G report. Thus the total surplus is the same as in equation (5), minus the surplus lost from the fact that sophisticated investors no longer purchase one unit of the investment:

$$
\begin{aligned}
W_D^{truth2} &= (e^2 + 2e(1-e)\alpha + (1-e)^2)(V^0 - u) \\
&+ \frac{1}{2}(e^2 - (1-e)^2)(R - U) + (2e(1-e)\alpha + (1-e)^2)(V^0 - U) \\
&- \frac{1-\alpha}{2}[(1-e)^2(R-u) + e^2((1-p)R + pr - u)]
\end{aligned} \tag{6}
$$

Comparing the expressions for total surplus, we find a surprising result: truthtelling in duopoly yields a lower surplus than truthtelling in monopoly. We prove this in the following proposition:

Proposition 3 *Given Assumptions A0-A6, a truthtelling duopoly (where both CRAs are hired) is less efficient than a truthtelling monopoly.*

The proof is in the appendix.

A duopoly is less efficient because there are more opportunities for the issuer to take advantage of naive investors. This can occur when one CRA reports G and one reports B, or when both report B. In contrast, in monopoly there is only the opportunity to shop when the monopoly CRA reports B. As a result, issuers set high prices that exclude sophisticated investors from the market when, from an efficiency perspective, they should be participating. Also, the additional information of the second report is washed away. This is predicated on the fact that assumption A4 places a lower bound on the number of naive investors, since clearly shopping doesn't occur when all investors are sophisticated.

When this result is coupled with the fact that a duopoly is equally as efficient as a monopoly when both are inflating the quality of the investment (and less efficient if we consider operating costs), this suggests that competition may be detrimental with information intermediaries when shopping is allowed. More formally, conditional on being in the same informational regime, monopoly increases total surplus. Therefore, policy proposal encouraging entry may not be the best methods to increase welfare. This is in line with the evidence presented in Becker and Milbourn (2008), who document less accurate ratings in the corporate bond market due to more competition from Fitch. We discuss other policy proposals in section 5.

The caveat with regards to the welfare loss from an additional firm, of course, is that this depends on being in the same informational regime. In section 3, we discussed whether more truthtelling would occur in monopoly or duopoly. The following result, while not surprising, makes this caveat important:

Lemma 3 *Total surplus when there are two CRAs who report truthfully is larger than when there are one or two CRAs who always reports G.*

The proof is in the appendix.

Not surprisingly, surplus is higher when there is truthtelling in duopoly than a monopoly or duopoly where G is always reported. Furthermore, in combination with the previous proposition, this implies that a truthtelling monopoly is more efficient than a monopoly who always reports G.

This lemma also demonstrates that when comparing monopoly and duopoly it is important to know which informational regime the parameters place us in.

4.2 Investor Surplus

Investor surplus is the valuation of investors in excess of the price paid. The maximum amount of investor surplus available is: $V^0 + \frac{1}{2}R$. In the absence of CRAs, investor surplus is equal to zero since all investors value the investment at V^0 and the issuer sets a price of V^0. Equilibrium values of investor surplus in each of our four cases are respectively:

1. Monopoly CRA, $\alpha 2V^G - V^0 > ep\rho$ (The CRA always reports G):

   Investor surplus is equal to:

   $$\alpha(2V^0 - 2V^G) < 0$$

   From sophisticated investors' perspective, naive investors are getting duped and pay more than the true value of the investment. Therefore naive investors get a negative surplus in this case.

2. Monopoly CRA, $\alpha 2V^G - V^0 < ep\rho$ (The CRA reports its signal truthfully):

   As before there are two subcases here. When the fraction of naive investors is small, so that $\alpha V^0 < V^B$, both types of investors buy one unit. Investor surplus then equals:

$$\begin{aligned} & \frac{1}{2}[e(2R - V^G) + (1-e)(R - V^B)] + \frac{1}{2}[e((1-p)R + pr - V^B) \\ & +(1-e)(2((1-p)R + pr) - V^G)] \\ = & \; V^0 - \frac{1}{2}V^G - \frac{1}{2}V^B \\ = & \; 0 \end{aligned}$$

Here, the investors have their full surplus extracted, but are clearly doing better than when the monopoly CRA always reports G.

When the fraction of naive investors is large, so that $\alpha V^0 > V^B$, total surplus is again negative and equal to $\frac{\alpha}{2}(V^B - V^0)$. Here, the issuer takes advantage of naive investors and doesn't sell to sophisticated investors when there is a B report. Nevertheless, this investor surplus is greater than when the CRA always reports G.

3. Duopoly, $\alpha 2(V^{GG} - V^G) > ep\rho^D$ (Both CRAs always report G):

   Investor surplus equals:

$$\alpha(2V^0 - 2V^{GG}) < 0$$

   Here, naive investors are getting fooled once again, and paying more than in the case of a monopoly.

4. Duopoly, $\alpha 2(V^{GG} - V^G) < ep\rho^D$ (Both CRAs report their signals truthfully):

   If $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$, only one of the CRAs is hired, and investor surplus is zero, the same as in the truthtelling monopoly case where $\alpha V^0 < V^B$.

   When $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, \frac{V^{BB}}{V^0}]$, both CRAs are hired. Investor surplus then equals:

$$\begin{aligned} & \frac{1}{2}[e^2(2R - 2V^{GG}) + 2e(1-e)\alpha(2R - 2V^G) + (1-e)^2(R - V^{BB})] \\ & + \frac{1}{2}[e^2((1-p)R + pr - V^{BB}) + 2e(1-e)\alpha(2((1-p)R + pr) - 2V^G) \\ & +(1-e)^2(2((1-p)R + pr) - 2V^{GG})] \\ = & \; \frac{1}{2}e^2(R - V^{GG}) + 2e(1-e)\alpha(2V^0 - 2V^G) + (1-e)^2\frac{1}{2}(((1-p)R + pr) - V^{GG}) \\ = & \; 2e(1-e)\alpha(2V^0 - 2V^G) \qquad (7) \end{aligned}$$

This surplus is negative, as naive investors who observe one G report are being taken advantage of by the issuer.

When the fraction of naive investors is large, so that $\alpha \in [\frac{V^{BB}}{V^0}, 1]$, only naive investors buy the assets when there are no G reports. Therefore, investor surplus is the same as in equation 7 minus the surplus lost from the naive investors being fooled:

$$2e(1-e)\alpha(2V^0 - 2V^G) - \frac{\alpha}{2}(e^2 + (1-e)^2)(V^0 - V^{BB}) \tag{8}$$

We show in the next proposition that a duopoly with truthful reporting provides a lower investor surplus than a monopoly with truthful reporting.

Proposition 4 *Given A0-A6, Investor surplus for a truthtelling duopoly (when both CRAs are hired) is strictly smaller than that of a truthtelling monopoly.*

The proof is in the appendix.

Given that capital markets are competitive, issuers extract most of the surplus that is created by the CRAs. This surplus may be real or perceived. When only real surplus is taken away, there is no difference between a monopoly and a duopoly. However, there is more scope for perceived added surplus by the naive investors in the case of a duopoly, since the states of the world where G and B are reported and where B and B are reported present opportunities to the issuer to dissemble to naive investors through its shopping behavior. As a result of this issuer shopping behavior, a truthful CRA duopoly is worse for investors than a truthful CRA monopoly. Therefore, conditional on being in the truthful information regime, more firms can make investors worse off.

We now demonstrate that investors are better off when CRA(s) reveal their information truthfully.

Proposition 5 *Investor surplus for a truthtelling duopoly is larger than that of monopoly or duopoly who always reports G.*

The proof is in the appendix.

This result is not all that surprising, since naive investors are not duped as often or by as much when CRA(s) are telling the truth. Furthermore, it is obvious from the text that investor surplus is larger for a truthtelling monopoly than a monopoly who always reports G. This once again adds a caveat to the comparison between monopoly and duopoly. Conditional on being in the same information regime, duopoly is worse here. However, a truthful duopoly is more desirable than a monopoly that always reports G.

5 Regulating the Credit Ratings Industry

The subprime crisis has brought to light the poor performance of CRAs in rating structured financial products and reminded investors of CRAs' past poor performance in predicting the East Asian crisis, the excesses of the dotcom bubble, and the collapse of Enron. There have thus been renewed calls in recent months to regulate CRAs.

New York State Attorney General Andrew Cuomo already reached an agreement with credit ratings firms to change some features of the rating process. Also, the SEC was given authority by the United States Congress in 2007 to regulate the credit ratings industry and has begun to propose rules in the summer of 2008. The European Union is also pursuing regulations to resolve conflicts of interest in the credit ratings industry.

In this section we discuss the most prominent proposals in the context of our model. In our view, the key issues which the proposals seek to address are:

1. eliminating the CRA conflicts by preventing issuers from paying for specific ratings,
2. preventing issuers from shopping for ratings and disclosing only ratings they prefer, and
3. monitoring the quality of the ratings methodology.

5.1 The Cuomo Plan

The agreement between Andrew Cuomo and Standard & Poor's, Moody's, and Fitch essentially addresses the first point, preventing issuers from paying for specific ratings and forcing issuers to pay the CRA upfront before it does its initial analysis.[30] This restriction can eliminate CRA conflicts-of-interest and their incentives to inflate the quality of the investment in our model, but importantly it does not eliminate shopping by the issuer.

In our model, issuer shopping can create distortions even with unbiased CRA ratings due to the naivete of some investors. With only an upfront fee for a rating, the issuer no longer has a means to provide incentives for good ratings.[31] As the CRA gets the same fee irrespective of what it announces, it now has incentives to report B when it receives a b signal thus avoiding the reputation cost ρ. When the CRA receives a g signal it is indifferent

[30] There is a fine point here which is that the deal specifies upfront payments for initial analysis but does not prevent subsequent payments. This is obviously an issue, but outside the scope of our model.

[31] It is of course possible through repeated interactions between an issuer and a CRA to dynamically create these incentives. This is out of the scope of our analysis, but certainly a caveat.

between reports: we assume that it reports G, which could be justified by an epsilon cost of lying.[32]

The solution to the game is then straightforward. The presence of upfront fees selects the truthtelling equilibrium as the equilibrium for any parameter values. Indeed, this is the same truthtelling equilibrium as in Proposition 1 (for monopoly) and Proposition 2 (for duopoly) where (i) there are no restrictions on parameter values for which this is the solution and (ii) $\phi^R = 0$. Therefore issuer profits, CRA profits, total surplus, and investor surplus are then exactly the same as in the truthtelling equilibrium.

While the Cuomo agreement ensures that CRA truthtelling is the unique equilibrium outcome, shopping still occurs. This ensures that a duopoly can exist even though it is inefficient from the social welfare point of view.

5.2 Eliminating Shopping from the Cuomo Plan

Given that under the Cuomo agreement naive investors can still be exploited by issuers who shop for the best ratings, we examine the merits of a stronger regulation of CRAs: forcing credit ratings agencies to disclose ratings on any investment for which they have received an upfront fee. In terms of the model, this means removing the stage where the issuer decides whether to publish the rating(s) from the timing of the game under the Cuomo agreement.

Under a monopoly CRA, given that both good and bad ratings get disclosed, the issuer is now forced to set $T = V^B$ when a B rating is reported. Issuer profits are therefore equal to

$$V^G + \frac{1}{2}V^B - \phi,$$

so that the CRA can set a fee of

$$\phi = V^G + \frac{1}{2}V^B - V^0 = \frac{1}{2}V^G.$$

The CRA's profit, total surplus, and investor surplus are then exactly the same as in our model in section 2 and under the Cuomo agreement if $\alpha V^0 < V^B$. However, if $\alpha V^0 > V^B$, CRA profits are lower[33] here than in the model in section 2 and under the Cuomo agreement, while total surplus and investor surplus is larger. Hence, when there are many naive investors to take advantage of, eliminating shopping has clear welfare gains.

[32] Note, however, that in situations when it is difficult to verify whether a CRA lied even ex-post, this model may give rise to excess CRA conservatism or cautiousness, thus eliminating the informational value of ratings.

[33] It is easy to show that $\frac{1}{2}V^G + \rho \leq \frac{1}{2}\min[2V^G + \max[\alpha V^0, V^B] - 2V^0, ep\rho] + \rho$ reduces to $V^B \leq \max[\alpha V^0, V^B]$.

In the case of a CRA duopoly, the issuer now must sets $T = V^{BB}$ if there are two B ratings and V^0 if there are conflicting ratings. Issuer profit from soliciting two reports is then:

$$\frac{1}{2}(e^2 + (1-e)^2)(2V^{GG} + V^{BB}) + 2e(1-e)V^0 - \phi_k - \phi_{-k}.$$

And, issuer profits when hiring only one CRA is:

$$V^G + \frac{1}{2}V^B - \min[\phi_k, \phi_{-k}],$$

so that the difference in profits of hiring two versus one CRA is (after simplifying):

$$-e(1-e)V^0,$$

which is always negative. Therefore, the issuer purchases only one rating. This induces Bertrand competition with the CRAs setting their fees $\phi_k = \phi_{-k} = 0$. Total surplus and investor surplus must then be the same as when there is a monopoly CRA and $\alpha < \frac{V^B}{V^0}$.

The unintended consequence of eliminating shopping is to reduce the number of ratings. This occurs because the rents to an extra rating decrease. By Proposition 3, total surplus is higher under a truthtelling monopoly CRA without shopping than under a truthtelling duopoly with shopping for the interval $\alpha \in [\frac{V^0}{2V^G}, 1]$.

In sum, the no-shopping plan is equivalent to the Cuomo plan in terms of total surplus and investor surplus when $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$, and better for $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, 1)$. Thus, eliminating issuer shopping is an unambiguous improvement over the Cuomo agreement. Shopping may be difficult to eliminate however, because informal discussions between issuers and CRAs may still take place. Disclosure requirements, such as those advocated by the SEC, may reduce the latitude to have such discussions. In the section on structured finance products, we point out that there may also be unintended negative consequences from promoting disclosure.

5.3 An Investors-Pay Solution

The credit rating industry in the U.S. underwent a transformation in the early 1970s from investors paying for ratings to issuers paying for them. The main reason for the shift was the reduction in profits for credit rating firms due to *free riding* by investors (White, 2002 observes that this shift coincides with the spread of the photocopier).

As the issuer-pays model has inherent conflicts-of-interests, a natural policy proposal is to return to an investors-pay model. To get around the free-riding problem, a transactions tax on investors could be used to pay for the ratings of bonds and structured finance products.

Besides enforcing such a tax, the government also faces the following problems: computing the optimal tax so as to reward CRAs sufficiently, monitoring CRA performance and providing credible punishments so that there are indeed reputation effects for inflating the quality of an issue, and choosing how many CRAs should be active.

In principle, an investors-pay model supplemented with a transactions tax could do as well as the Cuomo plan without shopping, by guaranteeing upfront payments to CRA(s) and by imposing the full disclosure of ratings. If the government were then able to determine the likely fraction of naive investors, it could implement the optimal market structure (either using a total surplus or investor surplus criteria). Given the likely costs of such government intervention, though, this proposal may still be dominated by the simpler Cuomo agreement without issuer shopping.

5.4 Moral Hazard Issues

The Cuomo plan with or without shopping, and the investors-pay plan can strictly increase total surplus when there is a monopoly. Still, there is a risk for welfare loss from this plan due to moral hazard. Suppose the precision of the signal e were a choice variable of the CRA and larger precision is more costly. If the CRA can choose this precision after being paid upfront[34] and it is non-contractible then the CRAs would choose the minimum precision of $\frac{1}{2}$ and knowing this, the issuer would not hire the CRA in the first place. Therefore there would be breakdown in the market for certification.

This breakdown can occur under the Cuomo plan with or without shopping or in the investors-pay plan due to the fixed upfront payments for the ratings. In our main model with no regulation, adding the observable choice of precision in monopoly will lead to positive investment by the CRA since the issuer pays contingent fees. Still, our total surplus calculations show that breakdown of the CRA market could still be a better outcome than a CRA who inflates quality, but worse than an a CRA who tells the truth.

If the plans were accompanied by oversight of minimum analytical standards for the CRAs (and these standards were set appropriately and could be enforced), they could regain the beneficial aspects summarized above.

[34]If precision were not effort in performing the analysis on the investment, but quality of the analytic models used, then the CRAs would choose larger precision, since it would in essence be chosen *before* the fees were paid.

6 Rating Structured Finance Products

Our analysis so far has considerably simplified the back and forth negotiations between issuers and CRAs and has only allowed for a limited form of issuer shopping. For structured finance products, however, issuers can make changes in the characteristics of the asset pool and the tranching of the issue to obtain a higher rating for the senior tranches (see Gorton, 2008, Ashcraft, Goldsmith-Pinkham, and Vickery, 2009, and Benmelech and Dlugosz, 2008). In this section we extend the model to analyze the effect of such negotiations between issuers and CRAs. Specifically, we extend our model to allow the issuer to change the probability of default of the investment. To focus on the effects of this change we restrict attention to the case of a monopoly CRA. We also assume that all investors are naive and precision is equal to one, just to make the calculations simple. Nevertheless, setting the precision equal to one and not permitting the issuer to have any private information makes this a situation where ratings inflation is less likely to occur than otherwise, so our findings bear extra weight.

The main changes to our model are as follows. First, we let the ex-ante belief about the probability of default p be uniformly distributed over the continuous interval $[0, 1]$.[35] The ex-ante expectation of p is then $\frac{1}{2}$. We also modify assumption A3 such that $p^* < \frac{1}{2}$, where p^* is as before the cut-off at which an investor is indifferent between one or two units of the investment (see equation 1). Second, the CRA now receives a signal about whether the investment will default with probability lower than p^* (the good signal g) or probability higher than p^* (the bad signal b). The CRA can make a subsequent report of G or B.

Redefining our notation, a good rating now gives expected value

$$V^G = R - \frac{p^*}{2}(R - r),$$

a bad rating gives expected value

$$V^B = R - \frac{1 + p^*}{2}(R - r),$$

and the ex-ante valuation of the investment is the same as before,

$$V^0 = R - \frac{1}{2}(R - r).$$

Following a bad report, the issuer can then restructure an investment as follows. He can propose the creation of a senior tranche and a junior tranche, where the probability that the

[35] We need p to be continuous to define how an investment can be restructured.

senior tranche defaults is decreased by an amount Δ. The issuer keeps the junior tranche, which involves a loss of $\Delta(R-r)$, the expected value of the senior tranche minus the expected value of the original investment. The probability that the senior tranche will then be rated as good, or below p^*, is then $\frac{\Delta}{1-p^*}$.[36]

This credit enhancement is only relevant if the CRA intends to truthfully rate the issuer. The CRA prefers truthtelling to overstating the quality of the issue if the following condition holds:

$$2V^G - V^0 < \frac{1+p^*-\Delta}{2}\rho.$$

We maintain this assumption throughout this section.

Then, following a proposed bad rating, the issuer chooses Δ to maximize its expected profits:

$$\max_{\Delta}\{\frac{\Delta}{1-p^*}(2V^G - \Delta(R-r) - \phi^R) + (1-\frac{\Delta}{1-p^*})V^0\}$$

We assume that the issuer only gets one chance to restructure the investment. If the investment fails to get a G rating the issuer doesn't purchase a rating and sells the original investment without any tranching.

The solution to the issuer's credit enhancement problem is:

$$\hat{\Delta} = \frac{2V^G - V^0 - \phi^R}{2(R-r)}$$

and his expected profits under optimal enhancement are:

$$\frac{(2V^G - V^0 - \phi^R)^2}{4(R-r)(1-p^*)} + V^0 \tag{9}$$

Clearly, as long as $\left(2V^G - V^0 - \phi^R\right)$ is positive, the issuer has an incentive to restructure the investment.

In the initial stage where the issuer submits the original investment for a rating, the CRA earns ϕ^R for a G rating and $\frac{\hat{\Delta}}{1-p^*}\phi^R$ for a B rating. Since we have that $2V^G - V^0 < \frac{1+p^*-\Delta}{2}\rho$, it must be the case a fortiori that $2V^G - V^0 < \frac{1+p^*}{2}\rho$, which implies that the CRA will also tell the truth in the initial stage.

The CRA's profits in the initial stage are then:

$$\max_{\phi^R,\phi^I}(1-p^*)\frac{\hat{\Delta}}{1-p^*}\phi^R + p^*\phi^R + \phi^I$$

[36] We assume an interior solution where $\frac{\Delta}{1-p^*} < 1$.

substituting in for $\hat{\Delta}$ and solving yields:

$$\phi^R = \frac{2V^G - V^0 + 2p^*(R-r)}{2}.$$

This means that the equilibrium probability reduction of default is:

$$\hat{\Delta} = \frac{2V^G - V^0 - 2p^*(R-r)}{4(R-r)}.$$

To ensure existence of a solution we must therefore assume that:

$$2V^G - V^0 > 2p^*(R-r) \tag{A7}$$

This assumption implies that $\hat{\Delta} > 0$ and also that $\phi^R < 2V^G - V^0$, which guarantees that the CRA indeed prefers truthtelling. Lastly, the CRA sets ϕ^I such that the issuer's ex-ante surplus is equal to the outside option V^0.

In sum, the solution to our credit ratings game is such that: 1) the issuer applies for a first proposed rating; 2) if the rating is good the issuer purchases the rating at price ϕ^R; 3) if the rating is bad, the issuer restructures the issue by creating two tranches at a cost of $\hat{\Delta}(R-r)$, which lowers the probability of default of the issue by $\hat{\Delta}$; 4) the CRA responds by changing its rating from bad to good with probability $\frac{\hat{\Delta}}{1-p^*}$. Thus, the effect of restructuring is to increase both the number of highly rated issues and the average probability of default of highly rated issues.

Given that credit enhancement helps reduce the probability of default it is not clear a priori whether this restructuring activity is welfare reducing or whether it reduces investor surplus. Consider first how total ex-ante surplus is affected. Our benchmark is the surplus in the game without restructuring. From section 2 we know that the equilibrium fee in the game without restructuring is $\phi^R = 2V^G - V^0$. Since $2V^G - V^0 < \frac{1+p^*}{2}\rho$, the CRA is in the truthtelling information regime and total ex-ante surplus under no restructuring is given by:

$$\begin{aligned} TS &= p^* \int_0^{p^*} (2(R - p(R-r)) - u - U)\frac{1}{p^*}dp + \\ &\quad (1-p^*)\int_{p^*}^{1} (R - p(R-r) - u)\frac{1}{1-p^*}dp \\ &= V^0 - u + p^*(V^G - U) \end{aligned}$$

In contrast, under restructuring total ex-ante surplus is:

$$
\begin{aligned}
\widehat{TS} &= p^*\int_0^{p^*}(2(R-p(R-r))-u-U)\frac{1}{p^*}dp \\
&+\hat{\Delta}\int_{p^*}^{p^*+\hat{\Delta}}(2(R-(p-\hat{\Delta})(R-r))-u-U-2\hat{\Delta}(R-r))\frac{1}{p^*}dp \\
&+(1-p^*-\hat{\Delta})\int_{p^*+\hat{\Delta}}^{1}(R-p(R-r)-u)\frac{1}{1-p^*-\hat{\Delta}}dp \\
&= p^*(2(R-\frac{p^*}{2}(R-r))-u-U)+\hat{\Delta}(2(R-(p^*+\frac{\hat{\Delta}}{2})(R-r))-u-U) \\
&+(1-p^*-\hat{\Delta})(R-\frac{1+p^*+\hat{\Delta}}{2}(R-r)-u) \\
&= V^0-u+p^*(V^G-U)+\hat{\Delta}(R-(p^*+\frac{\hat{\Delta}}{2})(R-r)-U)
\end{aligned}
$$

The first part is equal to the benchmark total surplus under no restructuring. The last term is due to the restructuring, and is negative given equation 1. There is no extra value added from restructuring since the cost of credit enhancement nets out with the decrease in the probability of default. However, restructuring convinces investors to purchase an extra unit, which from a welfare point of view is inefficient.

The issuer is clearly benefiting in an ex-post sense (after ϕ^I is sunk) from the ability to restructure the investment as its ex-post profits are strictly greater than what it earns in the benchmark case, V^0. This can be seen in equation 9. The credit rating agency is also benefiting. This can be seen using a revealed preference argument: the CRA can induce no restructuring, but chooses not to. The CRA must set a lower fee in order to induce more restructuring, but makes more profits since it now gets paid sometimes after an initial B rating. Therefore the welfare loss is coming directly from the loss in investor surplus. Investors are being made to pay excessively (and purchase excessively). The issuer and the CRA are capitalizing on the investors' naivete despite the fact that the issuer is telling the truth. In sum, restructuring and credit enhancement is a wasteful activity that only serves the purpose of deceiving naive investors.

Lastly, this suggests that some types of transparency and disclosure are inefficient. If the CRA made the rating process transparent to the issuer, then the issuer would provide exactly the minimum amount of credit enhancement that permits the signal to be G. As a consequence, the distribution of p for a portfolio that has reached the G rating becomes p^*, worsening the distortion. This would be similar to giving an copy of the exam to students before the exam date and hoping to measure their ability from the results.

7 Conclusion

Our paper contains an analysis of Credit Rating Agencies (CRAs) and their conflicts of interest. The model includes the critical elements of the industry: issuer's payments may influence ratings, issuers may shop for ratings, CRA models may vary in precision, barriers to entry create market power for CRAs, and reputation considerations affect decisionmaking.

We find that the presence of more naive investors or lower reputation costs give CRAs incentives to inflate the quality of investments, while the precision of the CRAs analysis has dual effects: more precision raises current payoffs but also increases the probability of paying a reputation cost. Our welfare analysis makes it clear that a monopoly is more efficient than a duopoly, both in terms of total ex-ante surplus and investor surplus. This is because a duopoly provides more opportunities for the issuer to shop and mislead naive investors. Finally, we demonstrate that allowing issuers to restructure their investments can further harm investors and reduce surplus.

We consider three regulatory proposals. The Cuomo plan, which proposes upfront payments to CRAs, eliminates conflicts of interest for CRAs but still permits shopping by issuers. We suggest a revised Cuomo plan, prohibiting shopping by enforcing disclosure of all ratings, which benefits naive investors. An investors-pay solution is equivalent to the revised Cuomo plan, but with the important caveat that it will be difficult to implement. Unfortunately, all three proposals provide little incentive to CRAs to gather information and perform their job well, forcing additional oversight.

It would be interesting to extend this line of research in a dynamic direction in order to quantify the potential reputation costs that CRAs may incur. In the pursuit of simplicity, we have made CRAs ex-ante homogeneous. Considering heterogeneity along the lines of different analytical capabilities (and precision of signals) would add realism and potentially other interesting results. Finally, we have only considered two signals, but real CRAs have a much finer gradation.

8 Appendix

8.1 Proof of Proposition 2

First, consider the case where issuers have paid ϕ_1^I and ϕ_2^I and both CRAs always report G. If the issuer buys no reports, its profit is V^0. If the issuer buys one report its profit is

$$\alpha 2V^G - \min[\phi_1^R, \phi_2^R].$$

If the issuer buys two reports, it gets

$$\alpha 2V^{GG} - (\phi_1^R + \phi_2^R).$$

The issuer thus prefers two G reports to one when

$$\alpha 2(V^{GG} - V^G) \geq \phi_k^R, k = 1, 2.$$

If each CRA sets its fee ϕ_k^R equal to $\alpha 2(V^{GG} - V^G)$, the issuer is willing to buy both reports as long as this is preferable to purchasing no reports, which is true if

$$\alpha 2V^{GG} - \alpha 4(V^{GG} - V^G) > V^0$$

which can be rewritten as

$$\alpha 2V^G - V^0 > \alpha 2(V^{GG} - V^G).$$

This condition is satisfied by assumption A4. Any fees $\phi_k^R \in (ep\rho^D, \alpha 2(V^{GG} - V^G)]$ then satisfy A4. These ratings fees, along with initial fees $\phi_k^I = \alpha 2(V^{GG} - V^G) - \phi_k^R$ yield profits

$$\alpha 2(V^{GG} - V^G) + (1 - \frac{ep}{2})\rho^D$$

for each CRA.

Note that there can't be an equilibrium where both CRAs set higher fees of $\alpha 2V^G - V^0$ such that the issuer would only want to purchase a single G report. Indeed, since the reports are homogeneous goods, each CRA would profit by deviating and lowering its price as in Bertrand competition, eliminating this possible equilibrium. Also, note that a total fee of $\phi_k^R + \phi_k^I = \alpha 2V^G - V^0$ isn't a profitable deviation from the equilibrium by assumption A4, which guarantees that this deviation total fee is larger than $\alpha 2(V^{GG} - V^G)$, so that the issuer simply wouldn't pay the high fee.

Now assume that both CRAs rate the investment truthfully. If the CRAs set their fees to sell their reports when two G reports are issued, the maximum ratings fee for each CRA is

$$\phi_k^R \leq \min[2(V^{GG} - V^G), ep\rho^D]$$

since $2(V^{GG} - V^G)$ is the maximum fee that makes the issuer prefer two reports rather than one, and since $ep\rho^D$ is the upper bound of the truthtelling constraint. Assumption A4 implies that the issuer prefers two reports to none. From assumption A4 we also know that the issuer purchases a G report when the other CRA reports B.

We also need to check the issuer's incentives from an ex-ante perspective, i.e. before paying the initial fees, does the issuer want to deal with both, either, or neither CRA? We now use the definitions $\pi^{two}(\alpha)$ and $\pi^{one}(\alpha)$ to explore this.

It is easy to show that $\pi^{two}(\alpha)$ is strictly larger than V^0 given that α satisfies A4. The condition for the issuer preferring two CRAs to zero is then:

$$\pi^{two}(\alpha) - V^0 \geq (\frac{1}{2}\phi_1^R + \phi_1^I) + (\frac{1}{2}\phi_2^R + \phi_2^I) \tag{10}$$

The condition for the issuer preferring two CRAs to one is:

$$\pi^{two}(\alpha) - \pi^{one}(\alpha) \geq \min[\frac{1}{2}\phi_1^R + \phi_1^I, \frac{1}{2}\phi_2^R + \phi_2^I] \tag{11}$$

The left hand side of this condition is equal to:

$$\begin{aligned}\pi^{two}(\alpha) - \pi^{one}(\alpha) &= 2e(1-e)(\alpha 2V^G - \frac{1}{2}\max[\alpha V^0, V^B]) \\ &\quad + \frac{1}{2}(e^2 + (1-e)^2)(\max[\alpha V^0, V^{BB}] - \max[\alpha V^0, V^B])\end{aligned}$$

When $\frac{V^0}{2V^G} < \alpha < \frac{V^{BB}}{V^0}$ and one out of two reports is a G, the issuer sets only purchases the G report and sets V^G as the price, duping naive investors. The difference in profits between two versus one CRA is:

$$\pi^{two}(\alpha) - \pi^{one}(\alpha) = 2e(1-e)(\alpha 2V^G - \frac{3}{2}V^0)$$

which is negative for $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$ and positive for $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, \frac{V^{BB}}{V^0})$ given A6.
Next, in the interval $\frac{V^{BB}}{V^0} < \alpha < \frac{V^B}{V^0}$, the difference in profits is now:

$$\pi^{two}(\alpha) - \pi^{one}(\alpha) = 2e(1-e)(\alpha 2V^G - \frac{3}{2}V^0) + \frac{1}{2}(e^2 + (1-e)^2)(\alpha V^0 - V^{BB}),$$

which is positive given A6. Finally, when $\alpha > \frac{V^B}{V^0}$:

$$\pi^{two}(\alpha) - \pi^{one}(\alpha) = 2e(1-e)(\alpha 2V^G - \frac{2+\alpha}{2}V^0),$$

which is also positive given A6.

This implies that for $\alpha \in [\frac{V^0}{2V^G}, \frac{\frac{3}{2}V^0}{2V^G})$, the issuer has no incentive to hire 2 CRAs for any set of fees. It will then hire one CRA. Since the CRAs are ex-ante homogeneous, this will provoke Bertrand competition and all fees will be set equal to zero.

For $\alpha \in [\frac{\frac{3}{2}V^0}{2V^G}, 1]$, the issuer will hire 2 CRAs. There are two possible solutions in this range. Each CRA can set its fees equal to the maximum amount to make the issuer indifferent between 2 CRAs and 1 CRA:

$$\frac{1}{2}\phi_k^R + \phi_k^I = \pi^{two}(\alpha) - \pi^{one}(\alpha),\ k = 1, 2$$

This is possible if it doesn't violate the condition that the issuer prefers two CRAs to zero, i.e.:

$$\pi^{two}(\alpha) - V^0 - 2(\pi^{two}(\alpha) - \pi^{one}(\alpha)) \geq 0$$

Should this condition not hold, the CRAs will set any fees such that equation 10 holds with equality and equation 11 is not violated.

When both CRAs are hired, a CRA may want to deviate by setting high fees $\frac{1}{2}\phi_k^R + \phi_k^I = \alpha 2V^G - V^0$ and always report G to earn rents when the other CRA truthfully issues a B report. This deviation is ruled out by assumption A5.

Finally, if $\alpha 2(V^{GG} - V^G) > ep\rho^D$ then deviating to a fees of $\alpha 2(V^{GG} - V^G)$ and always reporting G is profitable for a CRA. This sets a boundary on the parameters for which truthtelling can be an equilibrium.

There can't be an equilibrium where CRA k reveals truthfully and CRA $-k$ always reports G. If this was an equilibrium, we would need $\phi_k^R < ep\rho^D$ and $\phi_{-k}^R > ep\rho^D$. However, CRA k has a profitable deviation to set $\phi_k^R = \phi_{-k}^R - \varepsilon$ and always report G. For the same reason, there can't be an equilibrium where the issuer only purchases one report since any fee that CRA $-k$ would set would be undercut by a deviating CRA k.

8.2 Proof of Proposition 3

Total Surplus with a truthtelling duopoly (where both CRAs are hired) depends on how large the fraction of naive investors is; that is, what interval α is in: $[\frac{\frac{3}{2}V^0}{2V^G}, \frac{V^{BB}}{V^0}]$ or $[\frac{V^{BB}}{V^0}, 1]$.

In the first interval, total surplus W_D^{truth1} given by equation 5 is increasing in α

$$\frac{d}{d\alpha}W_D^{truth1} = e(1-e)(2R - 2U + 2((1-p)R + pr) - 2u).$$

And in the second interval, total surplus W_D^{truth2} given by equation 6 has a larger positive slope than in the first interval.

Total surplus in the first interval is larger than in the second for all α except at the top when $\alpha = 1$. Total surplus in the two intervals is equal to

$$V^0 - u + \frac{1}{2}(e^2 + (1-e)^2)(V^{GG} - U) + 2e(1-e)(V^0 - U),$$

at their maximum point of $\alpha = 1$.

In sum, the composite total surplus curve increases in the first interval and jumps down and increases in the second interval.

Total Surplus with a truthtelling monopoly also depends on what interval α is in: $[\frac{V^0}{2V^G}, \frac{V^B}{V^0}]$, or $[\frac{V^B}{V^0}, 1]$.

Over the first interval total surplus is independent of α (see equation 3), while over the second interval it jumps down and is increasing (see equation 4).

We compare first W_M^{truth1} and W_D^{truth1}.

When $\alpha = 0$, the difference in total surpluses is:

$$\begin{aligned}
W_M^{truth1}(\alpha &= 0) - W_D^{truth1}(\alpha = 0) \\
&= [V^0 - u + \frac{1}{2}[(e - (1-e))(R - U) + (1-e)2(V^0 - U)]] \\
&\quad -[(e^2 + (1-e)^2)(V^0 - u) + \frac{1}{2}(e^2 - (1-e)^2)(R - U) + (1-e)^2(V^0 - U) \\
&= 2e(1-e)(V^0 - u) + e(1-e)(V^0 - U) \\
&= e(1-e)(3V^0 - 2u - U).
\end{aligned}$$

This expression is positive since $2V^0 - u - U > 0$.

When $\alpha = 1$, the difference in total surpluses is:

$$\begin{aligned}
W_M^{truth1}(\alpha &= 1) - W_D^{truth1}(\alpha = 1) \\
&= \frac{1}{2}[V^G - U] - [\frac{1}{2}(e^2 - (1-e)^2)(R-U) \\
&\quad +(2e(1-e) + (1-e)^2)(V^0 - U)] \\
&= \frac{1}{2}[(e-(1-e))(R-U) + (1-e)2(V^0 - U)] \\
&\quad -[\frac{1}{2}(e-(1-e))(R-U) + (1-e)(1+e)(V^0 - U)] \\
&= -e(1-e)(V^0 - U)
\end{aligned}$$

This expression is again positive as $V^0 < U$.

As we have already shown,

$$W_D^{truth1}(\alpha = 1) = W_D^{truth2}(\alpha = 1),$$

and

$$W_D^{truth1}(\alpha = 0) > W_D^{truth2}(\alpha = 0).$$

And since both are linearly increasing in α, the argument above implies that $W_M^{truth1} > W_D^{truth2}$.

Lastly, we must examine whether W_D^{truth2} and W_M^{truth2} can cross. We know that

$$W_D^{truth2}(\alpha = 1) < W_M^{truth2}(\alpha = 1)$$

(since

$$W_D^{truth1}(\alpha = 1) = W_D^{truth2}(\alpha = 1)$$

and also

$$W_M^{truth1}(\alpha = 1) = W_M^{truth2}(\alpha = 1)).$$

Furthermore, we can establish that $W_D^{truth2}(\alpha = 0) < W_M^{truth2}(\alpha = 0)$:

$$\begin{aligned}
W_M^{truth2}(\alpha &= 0) - W_D^{truth2}(\alpha = 0) \\
&= \frac{1}{2}[e(2R - u - U) + (1-e)(2((1-p)R + pr) - u - U)] \\
&\quad -\frac{1}{2}[e^2(2R - u - U) + (1-e)^2(2((1-p)R + pr) - u - U)] \\
&= e(1-e)(2V^0 - u - U) > 0.
\end{aligned}$$

Given that both W_D^{truth2} and W_M^{truth2} increase linearly in α, they cannot cross. This establishes the proof.

8.3 Proof of Lemma 3

The total surplus when two CRAs report truthfully (and both are hired) is smallest when $\alpha V^0 > V^{BB}$. This is given in equation 6. We compare this expression to the total surplus when one or two CRAs always report G, which are given by equation 2.

First, total surplus when the two CRAs report truthfully and $\alpha = 0$ can be written as:

$$W_D^{truth2}(\alpha = 0) = \frac{1}{2}[e^2(2R - 2U) + (1-e)^2(2((1-p)R + pr) - 2u) + (e^2 - (1-e)^2)(U - u)] > 0$$

while total surplus when both CRAs always report G and $\alpha = 0$ is equal to zero.

Both total surpluses are increasing linearly in α since

$$\begin{aligned} \frac{d}{d\alpha}W_D^{truth2} &= e(1-e)(2R - 2U + 2((1-p)R + pr) - 2u) \\ &+ \frac{1}{2}[(1-e)^2(R-u) + e^2((1-p)R + pr - u)], \end{aligned}$$

and

$$\frac{d}{d\alpha}W_M^G = (R - U) + (((1-p)R + pr) - u),$$

are both positive.

Finally, when $\alpha = 1$, the difference between the total surpluses is:

$$\begin{aligned} W_D^{truth2}(\alpha &= 1) - W_M^G(\alpha = 1) \\ &= [\frac{1}{2}(e^2 - (1-e)^2)(R - U) + (2e(1-e) + (1-e)^2)((1 - \frac{p}{2})R + \frac{p}{2}r - U)] \\ & -[((1 - \frac{p}{2})R + \frac{p}{2}r) - U] \\ \\ &= \frac{1}{2}(e^2 - (1-e)^2)(R - U) - e^2((1 - \frac{p}{2})R + \frac{p}{2}r - U) \end{aligned}$$

which is larger than zero by A3 and $e \geq \frac{1}{2}$. This completes the proof.

8.4 Proof of Proposition 4

For the interval $\alpha \in [\frac{V^0}{2V^G}, \frac{V^B}{V^0}]$, the proposition is obvious. Therefore, take $\alpha \in [\frac{V^B}{V^0}, 1]$, so that the difference in investor surplus between a truthtelling monopoly and a truthtelling duopoly is:

$$
\begin{aligned}
& \frac{\alpha}{2}(V^B - V^0) - 2e(1-e)\alpha(2V^0 - 2V^G) + \frac{\alpha}{2}(e^2 + (1-e)^2)(V^0 - V^{BB}) \\
= \; & \frac{\alpha}{2}p(R-r)(\frac{1}{2} - e - 4e(1-e)(1-2e) + \frac{1}{2}(e^2 - (1-e)^2) \\
= \; & \frac{\alpha}{2}p(R-r)4e(1-e)(2e-1)
\end{aligned}
$$

which is strictly positive for $e > \frac{1}{2}$.

8.5 Proof of Proposition 5

First, notice that investor surplus for a monopoly who always reports G, is larger than investor surplus for a duopoly that always reports G. Therefore a comparison with the former is sufficient to establish the result. Second, given that $2e(1-e) < 1$, investor surplus in a truthtelling duopoly is strictly larger over the interval $\alpha \in [\frac{V^0}{2V^G}, \frac{V^{BB}}{V^0}]$.

Over the interval $\alpha \in [\frac{V^{BB}}{V^0}, 1]$ the difference in investor surplus between the truthtelling duopoly and the inflating monopoly is:

$$
\begin{aligned}
& 2e(1-e)\alpha(2V^0 - 2V^G) - \frac{\alpha}{2}(e^2 + (1-e)^2)(V^0 - V^{BB}) - \alpha(2V^0 - 2V^G) \\
= \; & 2\alpha(e^2 + (1-e)^2)(V^G - V^0 - \frac{1}{4}(V^0 - V^{BB})) \\
= \; & \frac{1}{2}\alpha(e^2 + (1-e)^2)p(R-r)(4e - \frac{5}{2} + \frac{(1-e)^2}{(1-e)^2 + e^2})
\end{aligned}
$$

All but the last term in parentheses are unambiguously positive.

The last term is equal to 0 at $e = \frac{1}{2}$. The first derivative is

$$
4 - \frac{2e(1-e)}{((1-e)^2 + e^2)^2},
$$

which is equal to 2 at $e = \frac{1}{2}$, while the second derivative

$$
\frac{(4e-2)[((1-e)^2 + e^2)^2 + 4((1-e)^2 + e^2)e(1-e)]}{((1-e)^2 + e^2)^4},
$$

is non-negative, so that the first derivative is increasing.

Therefore the first derivative is always positive and the last term is positive, which completes the proof.

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