The Trust Alternative*

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Abstract

We propose an alternative market design to the current credit ratings industrial organization. An issuer delegates a pass-through non-monitoring trust to acquire ratings from credit ratings agencies (CRAs). The trust pays outcome contingent fees, such that truth-telling is incentive compatible for CRAs, eliminating ratings inflation. Moreover, because the trust acts as an intermediary, it eliminates the ability of issuers to shop for better ratings. Surplus generated through improved ratings efficiency ensures voluntary participation in this mechanism from both issuers and CRAs. Finally, outcome contingent payments through the trust can induce CRAs to compete over accuracy of ratings, which is welfare-enhancing.

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"The Subcommittee's investigation uncovered a host of factors responsible for the inaccurate credit ratings issued by Moody's and S&P [during the financial crisis]. One significant cause was the inherent conflict of interest arising from the system used to pay for credit ratings. Credit rating agencies were paid by the Wall Street firms that sought their ratings and profited from the financial products being rated ... Rating standards weakened as each credit rating agency competed to provide the most favorable rating to win business and greater market share. The result was a race to the bottom."

Wall Street and the Financial Crisis - Anatomy of a Financial Collapse
Senate Permanent Subcommittee on Investigations, April 2011

The recent financial crisis and the debacle of asset-backed securities have brought to the public attention the possibility that the credit worthiness of a large fraction of highly rated securities that were issued between 2000 and 2008 might have been largely overstated. Since credit rating agencies (CRA) are responsible and compensated for determining such credit worthiness, they have been under the scrutiny of regulators, industry experts and academicians ever since the height of the crisis. In particular, the current set up, where issuers/underwriters pay a handful of CRAs for the publication of credit ratings has been questioned as one of the possible culprits for the severity of the financial crisis.

Bolton, Freixas, and Shapiro (2012), among others, identify the main issues that arise from the current rating industry organizational structure: CRAs have an incentive to inflate ratings to attract more business, "rating inflation", and issuers have an incentive to only buy good ratings, "rating shopping". Other factors have been filling the narrative, among which the lack of due diligence by CRAs, a limited competitive environment in the industry, and the excess reliance upon ratings for capital requirements purposes. In response, a high degree of intervention by several governing regulatory authorities has been solicited.[1]

[1] In June 2008, New York State Attorney General Cuomo announced reform agreements with the nation's three principal CRAs. International Organization of Securities Commissions (IOSCO), a body of regulators

We propose an alternative market design that not only solves the primary concerns related to the interactions of rating agencies, issuers of securities and investors, but also does not require any regulatory intervention. We show that contracts can be structured so that CRAs will exert effort to increase the accuracy of ratings, especially so when competing with other CRAs.

Specifically, we propose the introduction of an intermediary, a trust, to which the issuer may voluntarily delegate the task of obtaining a rating. The trust interacts with the CRAs by devising a payment scheme that is contingent upon outcomes.[2] Delegation removes the ability of issuers to shop, and the incentives of CRAs to inflate ratings, thus disciplining the behavior of both. Outcome contingent fees facilitate truth telling from the CRAs and are advantageous inasmuch as they can be properly designed to increase a CRA's effort to produce more precise signals, by paying more for a successful prediction of failure (i.e., the less likely outcome) than for a correct prediction of success. When the trust retains more than one CRA, competition for the production of the most accurate rating can be fostered by including additional outcome contingent payments that flow from an escrow account funded by the CRAs.

From a modeling perspective we rely heavily on the elegant set up proposed by Bolton, Freixas, and Shapiro (2012). In their, and hence our model, three risk neutral type of players (issuer, CRAs, investors) participate in the credit rating evaluation and issuance of a security which proceeds are used to finance a real investment. The investment has zero cost, and it is evaluated by investors on the basis of the credit report compiled by the rating

has revised the code of conduct for CRAs, asking them to scrutinize their own models and to improve transparency by, for example, ensuring that ratings of structured products are differently labeled from those of less volatile bonds. In July 2010, U.S. Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank Act"), which, among other things, amended Section 15E of the Securities Exchange Act of 1934 to enhance the regulation, accountability and transparency of CRAs. As mandated by the Dodd-Frank Act, the Office of Credit Ratings was created in support of the Commission's mission to protect investors, facilitate capital formation, and maintain fair, orderly, and efficient markets.

[2]Because in the real world the trust would serve a pool of issuers, it could effectively construct a fee-structure that is based upon the ex post performance of the entire pool of securities, which is at least statistically measurable (i.e., by calculating default frequencies and/or rating transition probabilities).

agency, if such report becomes public. Investors can also choose how much of the project to finance: a larger investment will be made only if the quality of the project is reported to be good. An important feature of the model is that there are two type of investors: a trusting (non-strategic) type and a sophisticated type who understands the strategic behavior of the issuer and the CRA.

In the original framework of Bolton, Freixas, and Shapiro (2012), the issuer approaches the CRA and solicits a rating report about the quality of the investment. The CRA draws a costless signal and communicates a report. The issuer can choose whether to purchase the report or to issue the security without a credit validation. On one hand, the issuer will always prefer not to purchase a bad report as it triggers the lowest valuation from investors. On the other hand, the CRA is concerned with its long-term reputation (i.e., the stream of future cash flows originating from the rating business) and will always produce a report in accordance with the signal when the short term profits (i.e., the fee that can be extracted from rating the current project) are lower than the expected value of the future revenues. When the CRA can charge a large fee for rating the current project, it will always release a good report, hence the rating inflation, because the issuer will never buy a bad report. This leads to a socially sub-optimal equilibrium, as the sophisticated investors can infer the strategy of the CRA (i.e., they know whether the CRA might be inflating ratings) and therefore never participate in the financing of the project unless the issuer sells the security at a lower price than what the trusting investors are willing to pay. Therefore the fraction of sophisticated investors in the economy determines the equilibrium of the game. The presence of two (or more) CRAs alters the equilibrium of the game in two ways: first, it lowers the fees as the CRA compete way some of the monopoly rent; second, it allows the issuer to shop for the best rating possible, threatening one CRA to divert business to the other.

Relative to Bolton, Freixas, and Shapiro (2012), we expand the model by allowing the issuer to delegate to an intermediary, a trust, the task of acquiring a credit rating for the security. The trust is designed as a pass-through structure that on average collects enough funds from the issuers to pay the rating fees that it independently negotiates with the CRAs. By approaching the trust, the issuers forgo the option not to purchase any bad report. However, they gain the possibility that the trust will set up fees that incentivize truth telling from the CRAs and therefore will convince the sophisticated investors to participate in the project. We show that as long as there are enough sophisticated investors, there exists a set of outcome contingent fees that induce truth telling and voluntary participation of the CRAs and the issuers.

Notably, the two features that characterize the trust alternative, outcome–contingent fees and issuer ex-ante commitment (through delegation) to buy a report, are not *independently* sufficient to induce truth telling by the CRA. Both features are necessary. It is also worth noting that one of the main feature of the trust is that it allows ex-post commitment from the issuers. A situation in which the issuer approaches the CRA and ex-ante commit to purchasing any rating is in fact not renegotiation proof. Other applications of delegation as a commitment device have been studied, for example, by Melumad and Mookherjee (1989), Bolton and Scharfstein (1990), and Katz (1991).[3]

Relatively surprising theoretical results and empirical evidence suggest that competition among CRA does not lead to better outcomes for investors (see for example, Skreta and Veldkamp (2009), Becker and Milbourn (2011) and Bolton, Freixas, and Shapiro (2012)). Competition among CRAs is considered problematic because it eventually leads CRAs to exert lower efforts. We consider competition and endogenous effort by the CRAs in the context of our model.

[3]The literature on delegation is vast and also includes but is not limited to Schelling (1960), Holmstrom (1984), Caillaud, Jullien, and Picard (1995), Alonso and Matouschek (2008), Bond and Gresik (2011) and Gerratana and Kockesen (2012).

We show that the trust, if directed to maximize the size of the issuance while at the same time minimizing the expected fees, can induce CRAs to exert effort to increase the quality of the signal. We note that, because the precision of the signal affects the investor's valuation, it also affects the issuance size. Therefore, the trust will prefer the CRA to exert more effort, a behavior that can be induced by paying more for correct bad reports than for correct good reports. When more than one CRA is present, even greater effort can be incentivized by including an additional outcome-contingent payment. Upon agreeing to the trust contract, CRAs deposit a amount into an escrow account which is used to make side payments between CRAs in case one of them correctly predicts an outcome while the other does not. If both CRAs issue the same rating, the escrow account is liquidated and the funds returned to the CRAs. In expectation, no side payment is actually paid, but the threat of it is sufficient to force both CRAs to exert more effort. Moreover, we show that the size of a CRA's deposit into the escrow fund is decreasing in the number of CRAs that participate in the game.

The establishment of a trust is therefore a Pareto-optimal alternative to the current industrial organization of credit quality validation as it aligns the incentives of all the economic agents in play, and fosters an environment in which competition between CRAs can lead to more accurate ratings. A higher social welfare can therefore be accomplished, by mean of the trust, without the necessity of more regulations.

The paper is directly related to a vast strand of literature that formalizes the conflicts of interest present in the current rating system and that lead to rating inflation and rating shopping: Mathis, McAndrews, and Rochet (2009) study whether reputation concerns are sufficient to induce CRAs to truthfully report their signals. Bolton, Freixas, and Shapiro (2012) consider how ratings issued by a CRA also with reputation concern are affected by the presence in the economy of investors who are not strategic and believe any rating report that is published. In a similar framework, Bar-Isaac and Shapiro (2013) endogenize reputation as a function of macro-economic condition and derive conditions for rating inflation that are related to the business cycle. A number of papers consider how CRAs can be manipulated by issuers. Skreta and Veldkamp (2009) and Sangiorgi, Sokobin, and Spatt (2013) focus on the issuer ability to shop for ratings, and the impact that that has on different types of assets. Pagano and Volpin (2012) focus on conditions that would lead issuers to choose inefficiently low levels of transparency of the information that is released through ratings by the CRA.

Researchers have also examined the role of new and old regulations. Bongaerts, Cremers, and Goetzmann (2012) and Cole and Cooley (2014) argue that most of the distortions in the rating process are created by excessive regulatory reliance on credit ratings, rather than by mis-aligned incentives of CRAs. Opp, Opp, and Harris (2013) show that if, due to some regulation, investors have a large incentive to hold highly rated securities, CRAs will not exhort any effort in trying to produce a signal about the quality of the project, but instead will rate every issuer as of the highest quality. Becker and Opp (2014) study a new system wherein the regulator pays for credit assessments, in place of ratings, for asset backed securities held by insurance companies. Bongaerts (2014) shows that regardless of the pay structures (issuer, investor, or co-investment) a high degree of regulatory intervention would be necessary to eliminate distortions in the rating process. Kashyap and Kovrijnykh (2014) show that ratings bias is larger in the issuer–pay than in the investor–pay model.

Because in our model the trust does not pay up-front fees and the CRAs can voluntarily decide to produce a rating to participate in the game, our paper is also related to the literature on unsolicited ratings, including but not limited to Poon, Lee, and Gup (2009) and Fulghieri, Strobl, and Xia (2014). Moreover, because we analyze the efficiency differences produced by oligopolistic CRAs relative to a monopoly, our work is related to papers that analyze the impact of the industrial organization of financial certification on the quality of ratings, such as for example Faure-Grimaud, Peyrache, and Quesada (2009) and Becker and Milbourn

(2011). Since by approaching the trust, issuers abandon the option to not disclose certain ratings, our analysis is also linked to papers that study the disclosure incentives of issuers, such as for example Faure-Grimaud, Peyrache, and Quesada (2009), Sangiorgi and Spatt (2012) and Cohn, Rajan, and Strobl (2013).

1. The model

1.1. Setup

Our initial setup follows from Bolton, Freixas, and Shapiro (2012). Their work provides a simple framework that illustrates how ratings inflation and ratings shopping emerge from the issuer pays model, which is currently in use in much of the world.

1.1.1. Agents and investment opportunities

There are three types of risk neutral agents in the economy: issuers who have no capital, CRAs, and investors who provide capital to issuers. The agents interact in a one period game. Investment opportunities are of type $\omega \in \{g, b\}$, where good g or bad b have an unconditional probability of $\frac{1}{2}$. Good investments do not fail, and bad investments fail with a probability $p > 0$. If successful, investments return R for each unit of capital invested. In case of failure, all capital is lost.

The investors have unit measure, and are sub-divided into two types, a fraction α is composed by trusting and the remaining $1-\alpha$ are sophisticated investors. Trusting investors take CRAs at face value, while sophisticated investors recognize the possibility that CRAs might have incentives not to report the signals they observe. Investors can purchase either one or two units of investment.

1.1.2. Information, CRAs and reputation

Investors and issuers cannot discern the quality of investments beyond the unconditional probability of types being equal. CRAs have a costless technology that allows them to obtain a private signal, $\theta \in \{g, b\}$, regarding the type of investment at time $t = 0$.[4] The signals are not perfect, and are characterized by a precision level, e, defined as the conditional probability of identifying the true type:

$$Pr(\theta = g|\omega = g) = Pr(\theta = b|\omega = b) = e.$$

If $e = \frac{1}{2}$, the signal is uninformative beyond what the investors and issuers already know from unconditional probabilities. If $e = 1$, the signal is perfectly informative, and there is no uncertainty. Hence, we assume that $\frac{1}{2} < e < 1$. CRAs publish purchased reports as a message $M = \{G, B\}$ to all investors.

CRAs have a reputation ρ at time $t = 0$, which can be thought of as an expected discounted sum of future profits.[5] At $t = 1$, the project succeeds or fails. If the project fails, the issue will be audited and the true signal will be revealed. In this case, the CRA can be in one of two predicaments. Either the signal is discovered to be the same as the message and the CRA is not punished, or the signal is found to not match the report and the CRA suffers a permanent loss of reputation.

For value to be created, some additional surplus must be generated by the presence of rating reports. This is achieved by requiring the reservation utility of the payoff in the presence of a good signal to be higher than the expected return in the absence of any information. We make one essential change to the Bolton, Freixas, and Shapiro (2012) set up, in order to make the model numerically more tractable. In particular, in the original

[4] In Section 3, we relax the assumption that precision e of signal θ is exogenous, to allow CRAs to improve the precision of the signal they obtain by exerting costly effort.

[5] To restrict the set of strategies of the CRA to pure strategies, we need a technical assumption that the CRA knows ρ up to a certain precision $\epsilon > 0$, where $\epsilon \to 0$.

model there are only two reservation utilities U and u, which the investors requires for investing two and one unit of the project, respectively. We add to this a third reservation utility, $v < u$, that the investor requires to fund one half unit of the project when the report from the CRA indicates that the project is bad. The set of basic assumptions of the model, therefore becomes: $(1-p)R > v$, $(1-(1-e)p)R > U$, $(1-p/2)R > u > (1-ep)R$, $U > u > v$.

The marginal valuation of the security (i.e., the marginal surplus), when the investor believes the rating, also depends on the rating report:

$$\begin{aligned} V^G &= (1-(1-e)p)R - U \\ V^0 &= (1-\frac{p}{2})R - u \\ V^B &= (1-ep)R - v \end{aligned}$$

where V^0 corresponds to the case where no report is published.

1.1.3. Timeline

CRAs post their fees $\phi \in \{\phi_G, \phi_B\}$ conditional on the ratings they give $M = \{G, B\}$ before they receive the signal θ about an upcoming issue. The CRA then produces (to the issuer) a credit report. The issuer may purchase the report and pay fees ϕ or choose not to purchase the report and issue the security without credit validation.

If the issuer purchases the report, then the CRA publishes the rating as a message $M = \{G, B\}$. The issuer then sets a price for the issue, and investors decide whether and how much of the security to purchase.

A representation of the sequence of actions is shown in Figure 1 for the case with only one CRA.

1.2. One credit rating agency

Because the issuer can observe the report before buying it, and because the bad report will always trigger the lowest valuation from the investor, a bad report will never be purchased. Thus, the relevant strategies of the CRA are limited to two: "truth-telling", in which case the CRA gets paid only when it receives a good signal, or "rating inflation", in which case the CRA report a G message regardless of the signal. Obviously if the CRA inflates the rating, it will get paid whether it receives the good or the bad signal. However, issuing a good report when the signal is bad exposes the CRA to the possibility that the issue fails and the CRA is discovered to have lied. As highlighted by Mathis, McAndrews, and Rochet (2009) and Bolton, Freixas, and Shapiro (2012), the relevant tradeoff is between the fee that the CRA can extract from the issuer, ϕ_G, and the expected reputation cost, $ep\rho$. If the fee is large enough, the CRA will choose to inflate ratings, otherwise truth-telling will prevail.[6]

Because in the base case without effort, there cannot be any improvement over truth-telling, we will focus our analysis on the inflation equilibrium. Given a good rating report, $m = G$, the issuer invites investors to buy the security at price V^G. The sophisticated investors, who know all the parameters of the game, understands that the CRA is inflating the ratings and therefore refuses to buy the security at any price higher than V^0 (at that price they will buy only one unit). On the other hand, the trusting investors will participate by acquiring two units of the security. The total amount issued is therefore equal to $\max(2\alpha V^G, V^0)$, where α is the fraction of trusting investors.

Therefore, the CRA chooses to maximize its profits by extracting all the surplus created from the credit report and therefore set the fee, ϕ, equal to the the total marginal surplus of $\left[\max(2\alpha V^G, V^0) - V^0\right]$.

[6]The condition that separates truth-telling from inflation can be obtained by solving the following inequality that describes the CRAs profits as a function of the rating report and the observed signal:

$$\pi(M = G|\theta = g) - \pi(M = G|\theta = b) > 0,$$

where $\pi(M = G|\theta = g) = \phi_G + \rho$, and $\pi(M = G|\theta = b) = \phi_G + (1 - ep)\rho$.

1.3. Two credit rating agencies

In the case of two CRAs, (Bolton, Freixas, and Shapiro 2012) use the following notation to capture the marginal value of investment based on two identical reports:

$$\begin{aligned} V^{GG} &= \left(1 - \frac{(1-e)^2}{(1-e)^2 + e^2} p\right) R - U, \\ V^{BB} &= \left(1 - \frac{e^2}{(1-e)^2 + e^2} p\right) R - v. \end{aligned}$$

If the CRAs issue contrasting reports, then the marginal value to all investors is V^0, which is the ex-ante marginal value. The reputation of each CRA is given by ρ^D, where $\rho^D < \rho$ since the discounted sum of future profits is lower in oligopoly than it is in monopoly.

As in the monopoly case, if the fees, denoted in this case by $\phi_k; k = 1, 2$, are greater than the expected reputation loss, then the CRAs choose to inflate ratings. The sophisticated investors do not purchase any security for a price higher than V^0, since they realize that the economy is in an inflation equilibrium. The amount of fees charged by each CRA is lower in a duopoly as CRAs are able to extract only the marginal surplus of the second (additional) rating, $\phi_k = 2\alpha(V^{GG} - V^G)$.

Competition does not mitigate the incentives to inflate ratings: in fact it only facilitates ratings shopping. The fact that competition lead to worse rating is not a unique result of Bolton, Freixas, and Shapiro (2012). For example, Skreta and Veldkamp (2009) reach the same conclusion with a model that relies on very different assumptions. It appears instead to be a result of the fact that the models are quite accurate in describing the existing trade-offs faced by CRAs and issuers. The theoretical prediction is in fact confirmed by the existing empirical findings, reported by Becker and Milbourn (2011), that document how the entrance of Fitch in the rating business lead to more biased ratings from Moody's and Standard and Poor's.

In the next section, we propose a new market design and show that it is possible to align the incentives of all the market participants, thus leading to more efficient outcomes.

2. The trust

We propose a new market design, that relies on the introduction of a delegated intermediary between the issuer and the CRA, as a possible solution to the ratings inflation and rating shopping problem. In this set up, instead of paying the CRA directly, the issuer delegates a trust to acquire a rating report, as described in Figure 2. The trust is designed in our model as a pass-through organization. It does not monitor the issuer and simply collects, from the issuer, enough funds to be able to pay the CRAs.

The trust has however two important features: first, due to delegation, it serves as an ex-ante commitment device for the issuer (as, for example, in Melumad and Mookherjee (1989)) to buy any (good or bad) rating report. This eliminates one of the main incentives for the CRAs to inflate ratings, and for the issuer to shop. Second, the trust negotiates a set of fees that are paid contingent upon outcome: a good (bad) rating produced by a CRA will be rewarded with a cash payment only if the project succeeds (fails).

This section provides conditions under which the trust ensures (i) truth telling by CRAs, and (ii) voluntary participation by CRAs and issuers in the market design involving the trust. The parameter space is that which generates the inflation equilibrium in the setup of Bolton, Freixas, and Shapiro (2012), as described in Section 1.

2.1. One credit rating agency

We start by describing the fees and the relative profits of the CRA. As suggested above the trust will pay outcome contingent fee upon the realization of the project. Therefore, if the CRA report was good ($M = G$) and the project succeeds (S), the fee will be ψ_S. On the other hand, if the report was bad ($M = B$) and the project fails (F) then the fee will be ψ_F.

The CRA profits corresponding to a certain report and conditional on a signal being observed are as follows:

$$\begin{aligned}
\pi(M = G|\theta = g) &= (1 - p + ep)\psi_S + \rho \\
\pi(M = B|\theta = b) &= ep\psi_F + \rho \\
\pi(M = G|\theta = b) &= (1 - ep)\psi_S + (1 - ep)\rho \\
\pi(M = B|\theta = g) &= (p - ep)\psi_F + (1 - p + ep)\rho
\end{aligned}$$

where the respective equations reflect the fact that fees are paid only when the outcome matches the message, and the reputation takes a hit when the CRA is caught lying, which happens only in failure when the issue is audited.

The truth telling conditions

$$\pi(M = G|\theta = g) - \pi(M = B|\theta = b) > 0$$

$$\pi(M = B|\theta = b) - \pi(M = G|\theta = g) > 0$$

imply that the expected fees generated by truthfully reporting the signal are higher than misreporting the signal. Proposition 1 provides the relationship between fees such that the truth telling conditions are satisfied.

Proposition 1. *(CRA Truth Telling Condition) For the CRA to choose to truthfully report the signal (θ), a trust must ensure that fees $\{\psi_S, \psi_F\}$ satisfy the following inequalities respectively:*

$$\psi_F \geq \left(\frac{1}{ep} - 1\right)\psi_S - \rho \tag{1}$$

$$\psi_F \leq \left(\frac{1}{p(1-e)} - 1\right)\psi_S + \rho. \tag{2}$$

The sequence of actions allows for the issuer to choose between approaching the CRA directly or relying on the trust. The issuer will choose the latter if any surplus is generated by the presence of the trust, where the surplus is defined as the additional issuance amount that can be raised from the sophisticated investors, who, without the trust, do not participate when the economy is in the inflation equilibrium. The presence of the trust and CRA truth telling conditions, in fact, assure that the sophisticated investors will accept the ratings as informative and hence always fund the investments.

At the same time, the presence of the trust also improves the situation for the CRA that could now be paid when the signal is good or bad. Because the design of the fees is in the hand of the trust, a question arises as to whether the CRA would participate or pre-commit not to deal with the trust. To avoid having to analyze such a possible situation, we also impose a condition for voluntary participation of the CRA under which the expected fees paid if the CRA truthfully reveal its signal is larger than the fee that the CRA can extract without a trust.

Proposition 2. *(Participation Constraint) The following conditions must hold respectively for the issuers and the CRA to participate in the trust:*

$$\psi_F \leq \frac{1}{ep}\left(2V^G + \frac{1}{2}V^B - 2V^0\right) - \psi_S\left(1 + \frac{1-p}{ep}\right) \tag{3}$$

$$\psi_F \geq \frac{1}{ep}\left(4\alpha V^G - 2V^0 - 2ep\rho\right) - \psi_S\left(1 + \frac{1-p}{ep}\right) \tag{4}$$

Proof is in the appendix.

Note that the set of inequalities (1)-(4) forms a space with possible interior solutions for the fees only if the intercept of equation (3) is larger than the intercept of equation (4).

The fraction of trusting investors α is an important parameter in the model. On one hand, in Bolton, Freixas, and Shapiro (2012), a large fraction of trusting investors reduces the incentives of CRAs to truthfully report the rating. In fact, if $2\alpha V^G - V^0 \geq ep\rho$ the CRA will always inflate the rating. Therefore, truth telling occurs only if

$$\alpha \geq \frac{V^0 + ep\rho}{2V^G} \tag{5}$$

On the other hand, the issuer will participate in the trust mechanism only if the proceedings of the security issuance net of the transfer to the trust are higher than what can be raised by not obtaining a rating at all. The trust requires from the issuer a payment that is high enough to cover the expected outcome-contingent fees and set such fees so that, again in expectation, they are at least higher than what the CRA can charge without the trust. Thus we obtain that:

$$V^G + \frac{1}{4}V^B - (2\alpha V^G - V^0) \geq V^0 \tag{6}$$

The above conditions provide the range in which the trust ensures truth telling:

$$\frac{V^0 + ep\rho}{2V^G} \leq \alpha \leq \frac{1}{2} + \frac{V^B}{8V^G} \tag{7}$$

If $\alpha \in [0, \frac{V^0+ep\rho}{2V^G}]$ then truth telling is the only equilibrium as in Bolton, Freixas, and Shapiro (2012). If $\alpha \in [\frac{V^0+ep\rho}{2V^G}, \frac{1}{2} + \frac{V^B}{8V^G}]$, a region in which there would be inflated ratings in Bolton, Freixas, and Shapiro (2012), then the trust guarantees truth-telling. If $\alpha \in [\frac{1}{2} + \frac{V^B}{8V^G}, 1]$, then issuers will choose to forego the trust and directly interact with CRAs.[7] Therefore, the presence of trust allows us to ensure truth telling equilibrium over a larger range of values of $\alpha \in [0, \frac{1}{2} + \frac{V^B}{8V^G}]$ than in Bolton, Freixas, and Shapiro (2012).

[7]Strictly speaking, the CRA participation constraint would not be formally necessary, as the CRA would be unable to pre-commit not to play in a one shot game. Consequently, his commitment would be broken by backwards induction, and he would accept any strictly positive fees. However, we recognize that real world CRAs exhibit a certain amount of market power in the industry, and this participation constraint represents the strictest possible use of this market power.

2.2. Two credit rating agencies

In presence of another CRA in Bolton, Freixas, and Shapiro (2012), fees are competed down so that both CRAs receive only the marginal revenue from the additional rating, $\phi^D = 2\alpha(V^{GG} - V^G)$. As was the case in the previous section, we start with the assumption that we are in the inflation equilibrium, where CRAs will choose to inflate in the absence of the trust (i.e., $\phi^D > ep\rho^D$).

The truth telling conditions of CRAs are similar to inequalities (1) and (2), replacing ρ with ρ^D. The participation constraints on each CRA and issuer change as a function of the fact that the payoff to the issuer is different because there are now two CRAs who can split the message, even if they are reporting truthfully. This causes the investors to revert the valuation to the case where no information is given, V^0, and to only finance one unit of the project. The CRA participation constraint changes, relative to (3), as the payoff in duopoly is different than the one in monopoly, under the scenario where no trust is present.

Proposition 3. *(Participation Constraint in CRA Duopoly) The following conditions must hold respectively for the issuers and the CRAs to choose to participate in the trust:*

$$\psi_F \leq -\psi_S\left(1+\frac{1-p}{ep}\right)+\frac{1}{ep}\left((\frac{1}{2}-e+e^2)(2V^{GG}+\frac{1}{2}V^{BB})+2(e-e^2)V^0-\alpha(4V^G-2V^{GG})\right) \quad (8)$$

$$\psi_F \geq -\psi_S\left(\frac{1-p+ep}{ep}\right) + \frac{1}{ep}\left(4\alpha(V^{GG} - V^G) - ep\rho^D\right) \quad (9)$$

Proof is in the appendix.

As for the monopoly case, a set of fees that insures participation of the CRAs and the issuer will exist if the intercept of (8) is larger than the intercept of (9). Moreover, as previously discussed in Section 2.1, the presence of a trust induces truth telling for a range of the fraction of trusting investors larger than in the original Bolton, Freixas, and Shapiro (2012): $\alpha \in [0, \frac{(\frac{1}{2}-e+e^2)(2V^{GG}+V^B/2)+2(e-e^2)V^0+ep\rho^D}{2V^{GG}}]$.

3. Endogenous effort choice

In this section we extend the setup described in the previous portion of the paper by allowing CRAs to exert some effort to improve the precision of the signals they receive. In general, the extension enables us to address questions about the optimal level of diligence chosen by the CRAs, and provides several key insights into the optimal payment scheme of the trust.

Moreover, the addition of the effort choice allows us to analyze more accurately the ramifications of competition among CRAs. In the previous section, we have demonstrated that, when CRAs can only compete on the dimension of price (i.e., the fees required to issue a rating), the trust mechanism can remove the ill effects of the existence of more than one CRA by eliminating the ability of issuers to shop for ratings. Here, we show that the trust can create positive externalities that affect the welfare of investors, by forcing CRAs to compete along the dimension of effort and rating accuracy.

3.1. Effort and signal precision

Following the setup of Bolton, Freixas, and Shapiro (2012), we have assumed so far that CRAs are unable to improve upon the accuracy of the signal they receive. However, it is possible, and maybe more realistic, that CRAs exert some costly effort to generate better quality signals, and when facing other CRAs, engage in competition over the precision of the signals.

In this section, we endogenize the CRA effort's choice. We define $\underline{e}$ as the precision that corresponds to zero effort and with e the precision level that can be chosen in the domain $[\underline{e},\ 1]$ by exerting some effort equal to $\frac{c}{2}(e-\underline{e})^2$, where c is scale parameter. We assume that the effort exerted by the CRA is not observable, however the trust and the sophisticated investors can infer from the outcomes what the precision of the signal e is. In effect, we assume that the sophisticated investors and the trust understand the mapping of effort to outcome in terms of accuracy of ratings, and that the mapping of effort to outcome is the same for every issuance rated by a CRA. Even if an individual issue's outcome may provide a noisy estimate of the effort of the CRA, in practice, sophisticated investors and the trust will observe the outcomes of a large number of issuances. This will allow an estimate of the effort of a CRA with converging estimation error, as long as the errors are at least partially independent.

3.2. One CRA

We start by considering what would happen in the original Bolton, Freixas, and Shapiro (2012) if the CRA was allowed to exert some effort at a cost equal to $\frac{c}{2}(e-\underline{e})^2$. In the inflation equilibrium, where the CRA always issues the good report and the fees are paid up front, no additional effort would be deployed, therefore leading to a precision level equal to $\underline{e}$.

On the contrary when dealing with the trust, because the fees are paid upon verification of the outcome, the CRA has some incentive to increase the precision of the signal. We make the assumption that the CRA will exert effort only when truthfully reporting the observed signal. We obtain the following truth telling conditions (derivation is in the appendix):

$$\psi_F^M \leq \frac{1-p+ep}{p-\underline{e}p}\psi_S^M + \left[\rho - \frac{c}{2(p-\underline{e}p)}(e-\underline{e})^2\right] \tag{10}$$

$$\psi_F^M \geq \frac{1-\underline{e}p}{ep}\psi_S^M - \frac{1}{ep}\left[ep\rho - \frac{c}{2}(e-\underline{e})^2\right] \tag{11}$$

Participation constraints for the issuer and the CRA become:

$$\psi_F \leq \frac{1}{ep}\left(2V^G(\underline{e}) + \frac{1}{2}V^B(\underline{e}) - 2V^0\right) - \psi_S\left(1+\frac{1-p}{ep}\right) \tag{12}$$

$$\psi_F \geq \frac{1}{ep}\left(4\alpha V^G(\underline{e}) - 2V^0 - \underline{e}p\rho\right) - \psi_S\left(1+\frac{1-p}{ep}\right) \tag{13}$$

Inequalities (10-13) define the space of feasible fees that the trust can set. We assume that the issuer delegates to the trust to pay the minimum expected fees that maximize the proceeds raised from issuing the security. Therefore, the choice of fees will be on the line that represents the CRA participation constraint: $\left\{\hat{\psi_S^M}, \hat{\psi_F^M}\right\}$, where the superscript M indicates that those are the monopoly fees.

Given the posted fees, we can consider the CRA choice of the optimal signal precision e^* as a function of the payoff and the cost of effort c:

$$e_M^* = \underset{(e>\underline{e})}{\arg\max}\left\{\frac{1-p+ep}{2}\hat{\psi_S^M} + \frac{ep}{2}\hat{\psi_F^M} + \rho - \frac{1}{2}c(e-\underline{e})^2\right\} \tag{14}$$

Taking the first derivative with respect to e and setting it equal to zero gives

$$e_M^* = \underline{e} + \frac{p}{2c}(\hat{\psi_S^M} + \hat{\psi_F^M}) \tag{15}$$

We are quick to note that, regardless of the fees, the optimal precision chosen is higher than $\underline{e}$. The presence of the trust therefore guarantees that the CRA will exert more effort than the situation where no trust is present and issuers face CRAs directly.

Furthermore, equation (15) offers some insight into the optimal choice of fees by the trust. First, as long as fees are positive, the CRA will exert some effort and produce a signal precision larger than the zero-effort level $\underline{e}$. Second, because the optimal precision depends on the sum of the fees, as opposed to the expected value of the fees, the trust can induce a higher effort by choosing an appropriate combination of ψ_F and ψ_S.

It is worth noting that, for the trust (i.e., the issuer) to prefer the CRA to maximize precision, a higher signal precision than $\underline{e}$ has to increase the security issuance amount more than it increases the expected fees:

$$\left(V^G(e^*) + \frac{1}{4}V^B(e^*)\right) - \left(V^G(\underline{e}) + \frac{1}{4}V^B(\underline{e})\right) \geq$$

$$\geq \left[(1-p+e^*p)\ \psi_S^M(e^*) + e^*p\ \psi_F^M(e^*)\right] - \left[(1-p+\underline{e}p)\ \psi_S^M(\underline{e}) + \underline{e}p\ \psi_F^M(\underline{e})\right]$$

Proposition 4. *(Fees trust choice to induce maximum effort) The trust will choose fees,* $\{\hat{\psi}_S^M, \hat{\psi}_F^M\}$*, that induce the CRA to exert maximum effort to increase signal precision such that:*

1) $\hat{\psi}_F^M > \hat{\psi}_S^M$

2) the fees lie at the intersection of the CRA participation constraint and the truth telling condition, evaluated at e^*

We can characterize the optimal choice of fees in two ways. In Figure 3 we suggest a visual interpretation of the problem. The trust wants to move along the CRA participation constraint, which defines the minimum profit of the CRA. Not all choices are the same though. Because of the functional form of the optimal precision level, which depends on the sum of the fees, moving towards the left top corner, towards the truth telling constraint defined by inequality (10), leads to higher levels of effort and hence precision.[8] The economic intuition for increasing ψ_F as high as possible, while decreasing ψ_S is that in our model, as in the real world, success of the issue is more likely than failure. The extent to which ψ_F can be increased is up to the point where the CRA is still incentivized to tell the truth. Therefore the optimal fees will be at the intersection of the CRA participation constraint and truth telling condition inequality (10).

[8]Note that as depicted, Figure 3 is just a simplification. All the constraints, in fact, also depend on the choice of e^*. The choice of the fees and the choice of precision are in fact made simultaneously by the trust and the CRA, respectively, in what is essentially a fixed point problem.

Alternatively, we can apply implicit differentiation to the optimal precision level, and show that the implicit derivative of e^* relative to $\hat{\psi}_F^M$, given a decrease in $\hat{\psi}_S^M$ that keeps the CRA profit the same, is positive (i.e., $\frac{de^*(\hat{\psi}_S^M(\hat{\psi}_F^M),\hat{\psi}_F^M)}{d\hat{\psi}_F^M} > 0$).

$$de^*\left(\hat{\psi}_S^M(\hat{\psi}_F^M),\hat{\psi}_F^M\right) = \frac{\partial e^*}{\partial \hat{\psi}_S^M}\frac{d\hat{\psi}_S^M}{d\hat{\psi}_F^M} + \frac{\partial e^*}{\partial \hat{\psi}_F^M} \tag{16}$$

Obviously the trust does not want to increase the expected transfer (the expected profit of the CRA $\pi(\psi_S^M,\psi_F^M)$), therefore fees are chosen so that

$$d\pi(\hat{\psi}_S^M,\hat{\psi}_F^M) = \frac{\partial \pi}{\partial \hat{\psi}_S^M}d\hat{\psi}_S^M + \frac{\partial \pi}{\partial \hat{\psi}_F^M}d\hat{\psi}_F^M = 0 \tag{17}$$

Solving Eq. (17) for $\frac{d\hat{\psi}_S^M}{d\hat{\psi}_F^M}$ and substituting into Eq. (16), we obtain

$$\frac{de^*\left(\hat{\psi}_S^M(\hat{\psi}_F^M),\hat{\psi}_F^M\right)}{d\hat{\psi}_F^M} = \frac{\partial e^*}{\partial \hat{\psi}_S^M}\left(-\frac{\partial \pi}{\partial \hat{\psi}_F^M}\Big/\frac{\partial \pi}{\partial \hat{\psi}_S^M}\right) + \frac{\partial e^*}{\partial \hat{\psi}_F^M} = \frac{(1-p)p}{2\left(c(1-p(1-\underline{e})) + p^2(\hat{\psi}_F^M + \hat{\psi}_S^M)\right)} \tag{18}$$

which is always bigger than zero. Therefore, when possible (i.e., when it does not violate the truth telling conditions) the trust can push the CRA to exert the maximum effort, by increasing ψ_F^M at the cost of ψ_S^M.

3.3. Two CRAs

Similar to the case with only one CRA, and for the exact same reasons, the equilibrium choice of effort in the original duopoly game of Bolton, Freixas, and Shapiro (2012) is not to exert any effort.

When dealing with the trust, outcome contingent fees will induce some effort: in particular, each CRA chooses the optimal precision level irrespective of the other CRA, thus leading to

$$e_D^* = \underline{e} + \frac{p}{2c}(\hat{\psi}_S^D + \hat{\psi}_F^D) \tag{19}$$

Obviously the level of e^*_D does not have to be equal to e^*_M, as the set of fees chosen in duopoly, $\{\psi^D_S, \psi^D_F\}$, will generally differ from those chosen by the trust when facing a monopolistic CRA, $\{\psi^M_S, \psi^M_F\}$. Similarly to the monopolistic case, though, it is immediately obvious that the effort exerted by a CRA when facing the trust will be higher than in the original issuer-pay world.

Because the optimal precision choice of one CRA does not depend on the other CRA, competition between CRAs does not appear to aid in maximizing social welfare. However, the nature of the mechanism that induces effort from CRA (i.e., outcome contingent fees) can be further exploited to increase welfare by encouraging competition among CRAs to produce more accurate ratings.

In particular, we introduce an additional contingent payment, $2X^D$, that is awarded when one CRA produces a rating accurately predicting success or failure and the other CRA produces an inaccurate rating. The payment is provided from an escrow account where both CRAs deposit X^D if they choose to participate in rating the issue. In expectation, if both CRAs exert equal effort, the payment is simply returned back to each CRA and there is no payoff. However, the additional fee motivates both CRAs to exert more effort to increase the accuracy of the signals to be better than the other CRA. In equilibrium, the CRAs compete over precision of the signal, by exerting more effort.

The truth-telling conditions for the two CRAs are as follows (derivation is in the appendix)

$$\psi^D_F \leq \frac{1-p+ep}{p-ep}\psi^D_S + \frac{1-2p+2ep}{p-ep}X^D + \rho - \frac{c}{2(p-ep)}(e-\underline{e})^2 \tag{20}$$

$$\psi^D_F \geq \frac{1-ep}{ep}\psi^D_S + \frac{1-2ep}{ep}X^D - \rho + \frac{c}{2ep}(e-\underline{e})^2 \tag{21}$$

where e and f represent the level of precision chosen by the two CRAs. The issuer and CRAs participation constraints are as follows

$$\psi_F^D \leq -\frac{(2-2p+ep+fp-2)}{p(e+f)}\psi_S^D + \frac{\alpha(8V^G(\underline{e})-4V^{GG}(\underline{e}))}{p(e+f)} \tag{22}$$

$$\psi_F^D \geq -\frac{1-p+ep}{ep}\psi_S^D + \frac{1}{ep}\left(4\alpha(V^{GG}(\underline{e})-V^G(\underline{e}))+c(e-\underline{e})^2-\underline{e}p\rho^D\right) \tag{23}$$

The above four inequalities define the space of feasible fees that the trust can set. We assume that the issuer delegates to the trust to pay the minimum expected fees that maximize the proceeds raised from issuing the security. Therefore, the choice of fees will be on the plane that represents the CRA participation constraint, $\{\hat{\psi_S^D}, \hat{\psi_F^D}, \hat{X_F^D}\}$, where the superscript D indicates that those are the duopoly fees.

We now consider the CRA choice of the optimal signal precision e_D^* as a function of the payoff and the cost of effort c under a two CRA regime with an additional payment for different ratings:

$$e_D^* = \underset{(e>\underline{e})}{\arg\max}\left\{\frac{1-p+ep}{2}\hat{\psi_S^D} + \frac{ep}{2}\hat{\psi_F^D} + (e-f)p\hat{X^D} + \rho^D - \frac{1}{2}c(e-\underline{e})^2\right\} \tag{24}$$

Taking the first derivative with respect to e and setting it equal to zero gives

$$e = \underline{e} + \frac{1}{2c}\left[p\hat{X_F^D} + p(\hat{\psi_S^D} + \hat{\psi_F^D})\right] \tag{25}$$

Since the effort of both CRAs is symmetric, the equilibrium effort of both CRAs can be solved by substituting e in place of f into the equation, and thus obtaining

$$e_D^* = \frac{2c\underline{e} + p(\hat{\psi_S^D} + \hat{\psi_F^D} + \hat{X_F^D})}{2c} \tag{26}$$

As we noted in the previous section, the precision choice by the CRA and the fee choice by the trust are solved simultaneously.[9]

Note that because the expected payoff for each CRA is unchanged for any given level of X. This is because while the CRA posts this fee up-front, they always expect to break even in expectation. Consequently, $d\pi(X^D)$ is always equal to 0.

3.4. Optimal Effort Level for One vs. Two CRAs

To demonstrate that competition can have a positive effect on the equilibrium signal precision, we need to show that for a level of compensation X^D, the trust can induce a higher equilibrium precision in the presence of another CRA than in the one-CRA case. Comparing the solutions for optimal effort in a duopoly and a monopoly, we need to show that $e^*_D > e^*_M$. From equations (15) and (26), we get that effort in a duopoly will be higher than in a monopoly if X^D that each CRA has to put up is higher than half the difference in expected fees in a monopoly compared to a duopoly:

$$X > \frac{1}{2}\left[(\psi_S^M + \psi_F^M) - (\psi_S^D + \psi_F^D)\right] \tag{27}$$

[9]The trust prefers the CRA to maximize precision if a higher precision increases the amount raised by issuing the security,

$$[e^{*2} + (1-e^*)^2]V^{GG}(e^*) + \frac{1}{2}[e^{*2} + (1-e^*)^2]V^{BB}(e^*) + 2(e^* - e^{*2})V^0 -$$
$$- \left\{[\underline{e}^2 + (1-\underline{e})^2]V^{GG}(\underline{e}) + \frac{1}{2}[\underline{e}^2 + (1-\underline{e})^2]V^{BB}(\underline{e}) + 2(\underline{e} - \underline{e}^2)V^0\right\}$$

more than it increases the expected fees

$$[(1-p+e^*p)\psi_S + e^*p\psi_F + (e^* - e^{*2})pX_F] - [(1-p+\underline{e}p)\psi_S + \underline{e}p\psi_F + (\underline{e} - \underline{e}^2)pX_F]$$

4. Execution of the trust

This section discusses various considerations regarding the execution of the trust mechanism in practice.

4.1. Incentives of the trust

A concern may be that just as the CRAs and issuers have incentives to cooperate to issue inflated ratings presently, the presence of the trust will simply shift the incentive problems to the trust. This concern does not apply because the trust is effectively a light-weight non-strategic actor in this model. The trust receives a fixed transaction fees per issuance, and no additional fees from any other party.

The contract of the issuer with the trust is:
Issuer contracts the trust to (a) Obtain ratings M and (b) pay fees ψ based on aggregating information from observable defaults of issuances. Fees are paid to ensure the following conditions are satisfied:

1. *Expected fees ψ to CRAs is minimum to ensure truth telling and participation.*
2. *Fees maximize efforts by paying additional payment X to CRA who provides correct ratings, while other CRAs who provide incorrect ratings finance payment X.*
3. *The trust receives a fixed transaction fees and no other payment from any other sources.*

Once such a contract is entered, enforcement of such a contract, if necessary can be done through market competition between trusts or by an appropriate regulatory agency such as Securities and Exchange Commission.

4.2. Enforcing Issuer Commitment

An assumption in the model discussed above is that once an issuer chooses to approach a trust, the issuer can credibly commit to purchase a rating. This is irrespective of the rating being good or bad. This assumption can be enforced through a legally binding contract between the trust and the issuer. An issuer, through a legally binding contract, can affirm that it has not informally shopped with any rating agency. The rating agencies that obtain business from the trust can also legally affirm that they have not participated in an informal ratings shopping with the issuer. Such a legal contract will ensure that in case issuers or ratings agencies choose to participate in informal ratings shopping, then such behavior is also illegal. The trust and investors then will have a legal recourse if issuers and ratings agencies do not abide by the contract they voluntarily enter.

This minimal level of possibility of legal enforcement is similar to business clauses that commercial parties regularly enter with each other.

4.3. Enforcing no ratings shopping

An important issue is how can we ensure that the CRA does not informally shop for a rating with a CRA before it approaches a trust. We argue that in presence of a trust, a CRA cannot credibly convey an intention to give a good rating to the issuer if they have a side conversation.

This is because of the signal $\theta = b$, then if the CRA lets the issuer know, then the issuer will not approach the trust. In such a case, no rating will be issued, and the CRA will not receive the fees. Hence, the CRA will benefit from suggesting to the issuer that the rating is $\theta = g$ even if it is not. Once the issuer approaches a trust, the issuer is committed. At this point, the expected payoff by truth telling is higher for the CRA (by Proposition 1). In other words, $\pi(M = B|\theta = b) > \pi(M = G|\theta = b)$.

On the other hand, if the signal obtained by the CRA is actually $\theta = g$, then the side conversation does not change the game.

4.4. *Outcome contingent fees*

A concern may be that it is difficult to obtain good performance metrics about ratings agencies. For example, the number of defaults of issuances is a rare event. Hence, a trust may be unable to distinguish whether a rating was accurate or inflated.

A key point is that the presence of a delegated mechanism such as the trust allows *aggregation* of ratings and outcome contingent fees based on aggregate ratings. Thus, while it is possible that an individual issuance of type B succeeds, if a large number of issuances are rated by the same CRA, then the probability p of failure of type B ratings becomes easier to measure. Thus, aggregation of ratings allows outcome contingent fees to be executable.

4.5. *Resolution of ratings*

A related concern maybe if the model can be extended to more than two ratings. Again, aggregation allows for easy implementation of multiple ratings. The trust aggregates ratings in each category and calculates the probability of failure of ratings in each category. These probabilities can be easily compared with the expected probabilities of default of each rating grade stated ex-ante by the trust. This ensures outcome contingent fees under higher resolution of ratings.

4.6. *Present regulatory proposals*

In 2010, the "Restore Integrity to Credit Rating Amendment" (S.A. 3991) was included in the final "Dodd-Frank Wall Street Reform and Consumer Protection Act" (Pub.L. 111203, H.R. 4173. The amendment attempts to make sure that ratings shopping does not happen, by creating a board, overseen by the Securities and Exchange Commission, which will assign credit rating agencies to provide initial ratings. The amendment suggests that this mechanism will eliminate inherent conflicts of interest.

Unfortunately, the above amendment also removes competition and incentives of ratings agencies regarding optimum due-diligence. The act strengthens the position of incumbent

CRAs by requiring that the board assign an incumbent CRA to each issuance. CRAs have limited incentives to exert effort at all, beyond avoiding audits by the SEC.

The trust alternative on the other hand, fosters competition, and incentivizes CRAs to exert effort to improve accuracy of ratings.

5. Alternative structures and mechanisms

In this section, we separately investigate the main features of the trust and show that they are individually insufficient to ensure participation by all agents and truth telling by CRAs. We also investigate whether ratings inflation and ratings shopping can be solved by an investor-pay model.

5.1. Committed issuer (without a third party)

A commitment from the issuer to take any rating from the CRA might be able to address ratings inflation. Two issues exist however with such an approach. First, given that there is no third party such as the trust to hold the issuer to the commitment, commitment by the issuer to the CRA to purchase the rating is not renegotiation proof. Once a CRA privately informs that the rating is B, then the issuer has the incentives to deviate from the commitment and not purchase the rating. The CRA may then relent, and also inflate the rating to ensure that the issuer purchases, defeating the purpose of the ex-ante commitment.

Second, even if the issuer is able to commit to any rating issued by a CRA, by means of a different mechanism than the trust, since the CRA extracts all the surplus and the fees of the CRA themselves depend on the rating, an inflation equilibrium still exists. In fact, Bolton, Freixas, and Shapiro (2012) make this point directly when they note that pre-commitment to take a bad rating would tighten certain constraints which make inflation more difficult, but it would not eliminate inflation altogether.

The first argument above also suggests a benefit of the trust mechanism which has not been underscored so far, the presence of the trust allows the issuer to enter an ex-ante contract with the CRA that is enforceable by a third party (i.e., the trust). This explicit mechanism solves the first problem directly, while the combination with contingent fees eliminates inflation altogether.

5.2. Contingent fees

Outcome contingent fees, even if set by the CRA instead of by the trust, reduce the incentives of CRAs to inflate, since the payment is more likely to be received if the rating aligns with the signal. The lack of a commitment from the issuer, however, ensures that CRA only gets paid if the outcome predicted is G, since otherwise the issuer chooses not to purchase the rating. Thus the inflation equilibrium persists, if the expected payment is larger than the reputational cost of lying.

Proposition 5. *If the expected fee ψ_S paid by issuer to CRA, when the CRA predicts a successful outcome and is correct, is greater than the expected loss of reputation then the CRA will always inflate:*

$$(1 - ep)\psi_S > ep\rho \tag{28}$$

The condition ensures that the outcome contingent fees, ψ_S, is higher than fees ϕ discussed in Bolton, Freixas, and Shapiro (2012). However, rating inflation remains in this case as well.

5.3. Investor-pays model

Kashyap and Kovrijnykh (2014) find that ratings errors are larger when issuers order the ratings compared to when investors do. Yet, the problem persists with investor paid ratings as well. A symmetric problem in terms of ratings arises with investors preferring lower ratings and CRAs willing to oblige. The sophisticated investor, who pays for the ratings, always prefers a bad rating ($M = B$) over a good rating, since the issue will be priced at a lower level. Thus the problem of systematic rating inflation becomes a problem of systematic *deflation*.

This problem has been widely recognized in academic circles, but has rarely been formally modeled. Demonstrating this problem is fairly simple within the context of our model. The game remains effectively the same as in Figure 1, replacing the issuer information set with the investor's. In the deflation equilibrium, the game will be played on the left had side of the game tree. The CRA always reports B, and to clear the market, the issuer will set the marginal price equal to that of the trusting investors, V_B. The CRA will then charge the issuer a fee equal to the total surplus, which in this case equals $V_0 - V_B$.

While formally modeling the rest of the game is outside of the scope of this paper, we note that this deflation equilibrium may persist for a wide range of assumptions. Hence, switching from issuer to investor-pay model might reduce the inefficiency of ratings but does not ameliorate it and may, depending on the parameters, make the problem worse.

5.4. Regulatory incentives

Opp, Opp, and Harris (2013) show that regulations requiring financial institutions to hold highly rated securities can cause higher demand of highly rated securities by investors. This in turn causes CRAs to inflate ratings. Furthermore, the higher supply and demand creates a larger more liquid market which incentivizes CRAs even more to inflate.

The trust mechanism can generate truth telling by CRAs even under such regulatory incentives. However, in the presence of such incentives, the payments of the trust to CRAs will be higher when CRAs truthfully predict the security to fail, compared to payments when such incentives are not present.

6. Conclusion

Much of the debate surrounding credit rating agencies and the 2008 financial crisis has centered around the conflict of interests existing in the current issuer-pay system. Many research papers and industry expertise depositions have attested at the inadequacy of the status quo.

We offer a possible resolution to some of the problems that affect the credit certification of securities by mean of a market design that involves the introduction of an intermediary between issuer and rating agencies. The approach has several advantages over the various proposals that are currently discussed in the literature. First, it offers a commitment mechanism that guarantees the enforcement of contracts that are currently not renegotiation proof and thus lead to ratings inflation (i.e., issuer strongly prefers to buy only good ratings). Second, by eliminating direct negotiation between principal (i.e., the issuer) and agent (i.e., the CRA), it eliminates the possibility that the principal forces the agent into particular actions by threatening to contract with a different agent (i.e., ratings shopping). Third, because payments are structured as contingent upon outcomes, when the CRA is allowed to exert some costly effort to increase the precision of the signals, the trust promises higher payments for correct prediction of failures, relative to prediction of success, that can lead CRA to maximize the signal precision. Moreover, the precision increase is larger in duopoly than in monopoly, when the trust is allowed to offer to one CRA a fee for a correct prediction of failure, when the other CRA predicts a success.

From a practical point of view, perhaps the most interesting feature of the trust alternative is that it does not require any regulatory intervention on the part of any regulatory authority. Allowing markets to regulate themselves through enforceable contracts secures the desired outcome, without the risk that new regulations could introduce unintended consequences and distortions in capital allocation.

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Figure 1
Game tree with one CRA
This figure presents the sequence of actions of the basic game in Bolton, Freixas, and Shapiro (2012) for the case where there is only one CRA. The sequence is as follows: nature draws a signal, θ, which is observed by the CRA. The CRA compiles a report M. The issuer decides to buy or not buy the report. Investors decides how much of the project they want to finance.

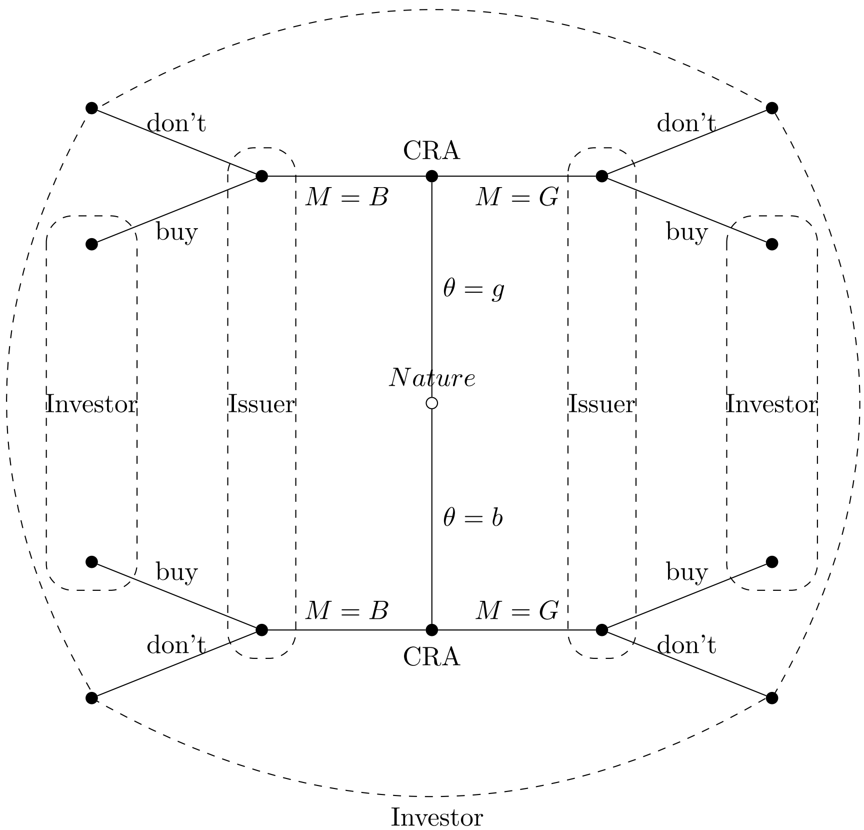


Figure 2
Inflation equilibrium with one CRA and an option to approach the trust

This figure presents the sequence of actions of the modified game with the inclusion of the trust for the case where there is only one CRA and the economy is in an inflation equilibrium. The sequence is as follows: nature draws a signal, θ, which is observed by the CRA. The CRA compiles a report M. The issuer decides to buy or not buy the report, or whether to approach the trust. If the issuer approaches the trust, a set of outcome contingent fees is set so to guarantee truth telling. All investors then fund the project for the maximum amount.

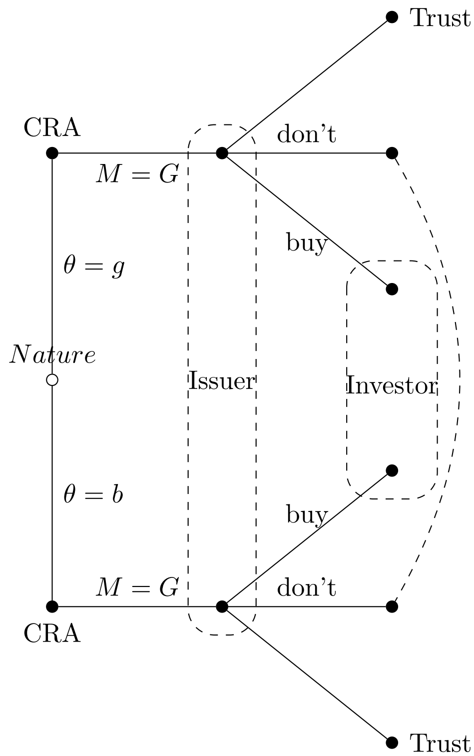
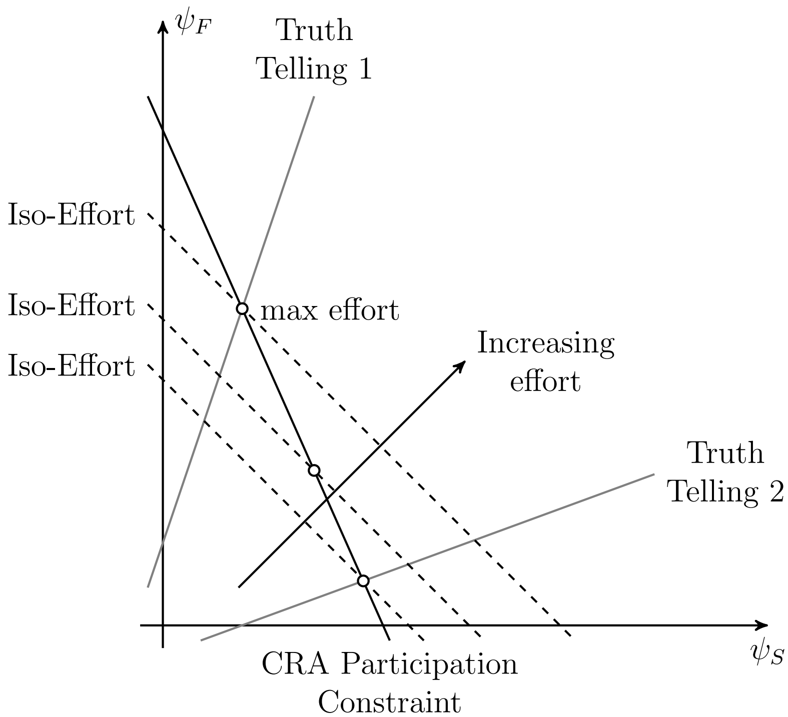


Figure 3
Optimal fees, expected profit, and monopoly CRA effort

This figure shows the fees choice problem of the trust relative to the effort that the CRA can exert to increase the precision of the signal. According to the mandate from the issuer, the trust will choose fees that minimize the expected transfer to the CRA. Such fees lie on the CRA participation constraint. Because the optimal precision choice of the CRA is increasing in the sum of the fees, iso-effort lines have can be drawn in the picture as a family of forty five degree negative slope lines: higher precision will be achieved moving towards the top left corner of the picture. The trust chooses the combination of fees that lie on the CRA and on the highest iso-effort line, which is located on the intersection of the CRA participation constraint and top truth telling condition.



Internet Appendix

A. Proofs

A.1. Propositions

Proposition 2. *(Participation Constraint) The following conditions must hold respectively for the CRA and issuers to choose to participate in the trust:*

$$\psi_F^M \leq \frac{1}{ep}\left(2V^G + \frac{1}{2}V^B - 2V^0\right) - \psi_S^M\left(1 + \frac{1-p}{ep}\right) \tag{3}$$

$$\psi_F^M \geq \frac{1}{ep}\left(4\alpha V^G - 2V^0 - 2ep\rho\right) - \psi_S^M\left(1 + \frac{1-p}{ep}\right) \tag{4}$$

Inequality (3) is derived from the issuer participation constraint. The issuer will participate in the trust if and only if the amount of project financed minus the transfer to the trust, which has to equal to the expected fees that are to be paid to the CRA, is larger than what the issuer gets if she approaches the CRA directly in the inflation equilibrium.

If the issuer approaches the trust then it raises the $2V^G$ when the signal is good, as all investors invest two units in the project, and V^B when the signal is bad, minus the outcome contingent fees to the CRA.

$$\frac{1}{2}2V^G + \frac{1}{4}V^B$$

The transfer to the trust has to be at least as large as the expected fee that the trust will have to pay to the CRA. If the CRA sends a message G, because it is truthfully reporting, it must have observed the good signal, $\theta = g$. Therefore with probability e the project is in fact good in which case the CRA gets paid ψ_S^M. Also, with probability $(1-e)$ the project is bad, but succeeds with probability $(1-p)$, in which case again the CRA gets paid ψ_S^M. If the CRA sends a message B, then it must have observed the bad signal. With probability e the project is in fact bad and hence will fail with probability P, in which case the CRA gets paid ψ_F^M.

$$\frac{1}{2}\left[\left(e\psi_S^M + (1-e)(1-p)\psi_S^M\right)\right] + \frac{1}{2}\left[ep\psi_F^M\right]$$

If the issuer approaches the CRA it raises $2\alpha V^G$ from the trusting investors and pays fees to the CRA

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

We obtain:

$$\frac{1}{2}\left[2V^G - \left(e\psi_S^M + (1-e)(1-p)\psi_S^M\right)\right] + \frac{1}{2}\left[V^B - ep\psi_F^M\right] \geq 2\alpha V^G - (2\alpha V^G - V^0)$$

Rearranging terms and solving for ψ_F^M we obtain (3).

Inequality (4) is derived from the CRA participation constraint. Although not strictly necessary, we impose that to obtain voluntary participation, the CRA revenues generated under the trust must be at least as large as those generated when the issuer approaches the CRA directly. Under the trust mechanism, the CRA is paid only when the rating matches the outcome of the project. With $\frac{1}{2}$ probability the CRA gets the good signal, and report G; with probability e the project is in fact good, and hence the CRA gets paid ψ_S^M. With probability $(1-e)$ the project is bad, but it succeeds with probability $(1-p)$, in which case the CRA again gets paid ψ_S^M. With probability $\frac{1}{2}$ probability the CRA gets the bad signal, and report B; with probability e the project is bad and it fails with probability p, in which case the CRA gets paid ψ_F. The CRA also maintain its reputation.

$$\frac{1}{2}\left[e\psi_S^M + (1-e)(1-p)\psi_S^M\right] + \frac{1}{2}\left[ep\psi_F^M\right] + \rho$$

If the issuer approaches the CRA directly, then, in the inflation equilibrium, the CRA gets paid $2\alpha V^G - V^0$, whether it draws the good or the bad signal. The CRA maintains the reputation only if the project does not fail. We obtain

$$\frac{1}{2}\left[e\psi_S^M + (1-e)(1-p)\psi_S^M\right] + \frac{1}{2}\left[ep\psi_F^M\right] + \rho \geq 2\alpha V^G - V^0 + (1-ep)\rho$$

Rearranging terms and solving for ψ_F we obtain (4).

Proposition 3. *(Participation Constraint in CRA Duopoly) The following conditions must hold respectively for the issuer and CRAs to choose to participate in the trust:*

$$\psi_F^D \leq -\psi_S^D\left(1+\frac{1-p}{ep}\right)+\frac{1}{ep}\left((\frac{1}{2}-e+e^2)(2V^{GG}+V^{BB})+2(e-e^2)V^0-\alpha(4V^G-2V^{GG})\right) \quad (8)$$

$$\psi_F^D \geq -\psi_S^D\left(\frac{1-p+ep}{ep}\right) + \frac{1}{ep}\left(4\alpha(V^{GG} - V^G) - ep\rho^D\right) \quad (9)$$

Inequality (8) is derived from the issuer participation constraint. The issuer will participate in the trust if and only if the amount of project financed minus the fees that are paid to the CRAs is large under the trust than it is if the issuer approaches the CRAs directly in the inflation equilibrium.

Because there are two CRAs, three outcomes need to be considered: both CRAs draw a good signal; both CRA draw a bad signal; the signals are split. The probabilities of these three events are as follow:

$$\begin{aligned}
Prob(\theta_1 = g, \theta_2 = g) &= \frac{1}{2}[e^2 + (1-e)^2] \\
Prob(\theta_1 = g, \theta_2 = b) &= \frac{1}{2}[e(1-e) + (1-e)e] \\
Prob(\theta_1 = b, \theta_2 = g) &= \frac{1}{2}[(1-e)e + e(1-e)] \\
Prob(\theta_1 = b, \theta_2 = b) &= \frac{1}{2}[e^2 + (1-e)^2]
\end{aligned}$$

Therefore, if the both CRAs draw a good signal, they will report the good message. The investors fund two units of the project at a valuation of $2V^{GG}$. If both CRA draw the bad signal, they will post a bad report, and the investors only fund one half unit of the project at a valuation equal to V^{BB}. If the signals are split, so will the reports, and the investors only fund one unit of the project at a valuation equal to V^{0}. The amount funded therefore equals:

$$\frac{1}{2}\big[(1-e)^2+e^2\big]2V^{GG}+\frac{1}{2}\big[(1-e)^2+e^2\big]\frac{1}{2}V^{B}+2(e-e^2)V^{0}$$

The issuer has to pay an upfront amount to the trust equal to expected fees that the trust will have to pay to the CRAs.

$$\frac{1}{2}\big[(1-e)^2+e^2\big]\big[2\big(1-\frac{(1-e)^2}{(1-e)^2+e^2}p\big)\psi_S^D\big]+\frac{1}{2}\big[(1-e)^2+e^2\big]\big[2\big(\frac{e^2}{(1-e)^2+e^2}p\psi_S^D\big)\big]+$$

$$+2(e-e^2)\big[(1-\frac{p}{2})\psi_S^D+\frac{p}{2}\psi_F^D\big]$$

If the issuer approaches the CRA it raises $2\alpha V^{GG}$ from the trusting investors and pays fees to both CRAs

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

We obtain:

$$\frac{1}{2}\big[(1-e)^2+e^2\big]\big[2V^{GG}-2\big(1-\frac{(1-e)^2}{(1-e)^2+e^2}p\big)\psi_S^D\big]+\frac{1}{2}\big[(1-e)^2+e^2\big]\big[\frac{1}{2}V^{B}-2\big(\frac{e^2}{(1-e)^2+e^2}p\psi_S^D\big)\big]+$$

$$+2(e-e^2)\big[V^{0}-(1-\frac{p}{2})\psi_S^D-\frac{p}{2}\psi_F^D\big]\geq 2\alpha V^{GG}-4\alpha(V^{GG}-V^{G})$$

Rearranging terms and solving for ψ_F^D we obtain (8).

Inequality (9) is derived from the CRAs participation constraint. Although not strictly necessary, we impose that to obtain voluntary participation, the CRAs revenues generated under the trust must be at least as large as those generated when the issuer approaches the CRAs directly. Under the trust mechanism, the CRAs are paid only when the rating matches the outcome of the project. With $\frac{1}{2}$ probability the CRA gets the good signal, and report G; with probability e the project is in fact good, and hence the CRA gets paid ψ_S^D. With probability $(1-e)$ the project is bad, but it succeeds with probability $(1-p)$, in which case the CRA again gets paid ψ_S^D. With probability $\frac{1}{2}$ probability the CRA gets the bad signal, and report B; with probability e the project is bad and it fails with probability p, in which case the CRA gets paid ψ_F^D.

$$\frac{1}{2}\left[e\psi_S^D + (1-e)(1-p)\psi_S^D\right] + \frac{1}{2}\left[ep\psi_F^D\right] + \rho^D$$

If the issuer approaches the CRAs directly, then, in the inflation equilibrium, the CRAs get paid $2\alpha(V^{GG} - V^G)$, whether it draws the good or the bad signal. We obtain

$$\frac{1}{2}\left[e\psi_S^D + (1-e)(1-p)\psi_S^D\right] + \frac{1}{2}\left[ep\psi_F^D\right] + \rho^D \geq 2\alpha(V^{GG} - V^G) + (1-ep)\rho^D$$

Rearranging terms and solving for ψ_F^D we obtain (9).

A.2. Truth-telling conditions in monopoly with CRA effort choice

The CRA profits corresponding to a certain report and conditional on a signal are as follows:

$$\begin{aligned}
\pi(M=G|\theta=g) &= (1-p+ep)\psi_S^M + \rho - \frac{c}{2}(e-\underline{e})^2 \\
\pi(M=B|\theta=b) &= ep\psi_F^M + \rho - \frac{c}{2}(e-\underline{e})^2 \\
\pi(M=G|\theta=b) &= (1-\underline{e}p)\psi_S^M + (1-\underline{e}p)\rho \\
\pi(M=B|\theta=g) &= (p-\underline{e}p)\psi_F^M + (1-p+\underline{e}p)\rho
\end{aligned}$$

The truth telling conditions

$$\pi(M = G|\theta = g) - \pi(M = B|\theta = g) > 0$$

$$\pi(M = B|\theta = b) - \pi(M = G|\theta = b) > 0$$

imply that the expected fees generated by truthfully reporting the signal are higher than misreporting the signal. As before, this puts an upper and lower bound on the fee paid in failure relative to the fee paid in success.

$$\psi_F^M \leq \frac{1 - p + ep}{p - \underline{e}p}\psi_S^M + \left[\rho - \frac{c}{2(p - \underline{e}p)}(e - \underline{e})^2\right]$$

$$\psi_F^M \geq \frac{1 - \underline{e}p}{ep}\psi_S^M - \frac{1}{ep}\left[ep\rho - \frac{c}{2}(e - \underline{e})^2\right]$$

A.3. Truth-telling conditions in duopoly with CRA effort choice

We now derive truth telling conditions for two CRAs. In doing so we separate the level of precision achieved by one CRA, e, relative to the precision chosen by the other, f. We make the assumption that the CRA will exert effort only when truthfully reporting the observed signal. The CRA profits corresponding to a certain report and conditional on a signal are as follows:

$$\pi(M=G|\theta_1=g,\theta_2=g)=(1-\frac{(1-e)(1-f)}{(1-e)(1-f)+ef}p)\psi_S^D+\rho^D-\frac{c}{2}(e-\underline{e})^2$$
$$\pi(M=G|\theta_1=g,\theta_2=b)=(1-\frac{(1-e)f}{e(1-f)+f(1-e)}p)(\psi_S^D+2X^D)-X^D+\rho^D-\frac{c}{2}(e-\underline{e})^2$$
$$\pi(M=G|\theta_1=b,\theta_2=g)=(1-\frac{e(1-f)}{e(1-f)+f(1-e)}p)\psi_S^D+(1-\frac{e(1-f)}{e(1-f)+f(1-e)}p)\rho^D$$
$$\pi(M=G|\theta_1=b,\theta_2=b)=(1-\frac{ef}{(1-e)(1-f)+ef}p)(\psi_S^D+2X^D)-X^D+(1-\frac{ef}{(1-e)(1-f)+ef}p)\rho^D$$
$$\pi(M=B|\theta_1=b,\theta_2=b)=\frac{ef}{(1-e)(1-f)+ef}p\psi_F^D+\rho^D-\frac{c}{2}(e-\underline{e})^2$$
$$\pi(M=B|\theta_1=b,\theta_2=g)=\frac{e(1-f)}{e(1-f)+f(1-e)}p(\psi_F^D+2X^D)-X^D+\rho^D-\frac{c}{2}(e-\underline{e})^2$$
$$\pi(M=B|\theta_1=g,\theta_2=b)=\frac{(1-e)f}{e(1-f)+f(1-e)}p(\psi_F^D)+(1-\frac{(1-e)f}{e(1-f)+f(1-e)}p)\rho^D$$
$$\pi(M=B|\theta_1=g,\theta_2=g)=(\frac{(1-e)(1-f)}{(1-e)(1-f)+ef}p)(\psi_F^D+2X^D)-X^D+(1-\frac{(1-e)(1-f)}{(1-e)(1-f)+ef}p)\rho^D$$

We also need the following set of probabilities:

$$\begin{aligned}
Prob(\theta_1=g,\theta_2=g|\theta_1=g) &= ef+(1-e)(1-f)\\
Prob(\theta_1=g,\theta_2=b|\theta_1=g) &= e(1-f)+f(1-e)\\
Prob(\theta_1=b,\theta_2=g|\theta_1=b) &= e(1-f)+f(1-e)\\
Prob(\theta_1=b,\theta_2=b|\theta_1=b) &= ef+(1-e)(1-f)
\end{aligned}$$

From the above two set of equations we can obtain the profit of one CRA conditional on its own signal

$$\pi(M=G|\theta_1=g)=\pi(M=G|\theta_1=g,\theta_2=g)Prob(\theta_1=g,\theta_2=g|\theta_1=g)+$$

$$+\pi(M=G|\theta_1=g,\theta_2=b)Prob(\theta_1=g,\theta_2=b|\theta_1=g)$$

From this we obtain:

$$\pi(M = G|\theta_1 = g) = (1 - p + ep)\psi_S^D + (e + f - 2ef - 2fp + 2efp)X^D + \rho^D - \frac{c}{2}(e - \underline{e})^2$$
$$\pi(M = G|\theta_1 = b) = (1 - ep)\psi_S^D + (1 - e - f + 2ef - 2efp)X^D + (1 - ep)\rho^D$$
$$\pi(M = B|\theta_1 = b) = ep\psi_F^D - (e + f - 2ef - 2ep + 2efp)X^D + \rho^D - \frac{c}{2}(e - \underline{e})^2$$
$$\pi(M = B|\theta_1 = g) = (p - ep)\psi_F^D - (1 - e - f + 2ef - 2p + 2ep + 2fp - 2efp)X^D + (1 - p + ep)\rho^D$$

Solving for the truth telling conditions we obtain:

$$\psi_F^D \leq \frac{1 - p + ep}{p - ep}\psi_S^D + \frac{1 - 2p + 2ep}{p - ep}X^D + \rho - \frac{c}{2(p - ep)}(e - \underline{e})^2 \tag{29}$$

$$\psi_F^D \geq \frac{1 - ep}{ep}\psi_S^D + \frac{1 - 2ep}{ep}X^D - \rho + \frac{c}{2ep}(e - \underline{e})^2 \tag{30}$$