The financial crisis and the credit rating agencies: the failure of reputation

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Abstract: *This paper presents a theoretical framework, surveying some reputational game models, to describe the behaviour of the credit rating agencies (CRAs) during the crisis. CRAs have been blamed for the inflated ratings of the new credit risk transfer products (CRTs) and for acting in favour of issuers instead of investors. The paper addresses three key elements to explain the CRAs conduct: firstly, the issue of misaligned incentives – also favoured by the increasing reliance on ratings - , secondly the oligopolistic structure of the ratings' industry and, finally, the inadequacy of the credit risk models used by CRAs to evaluate CRTs. To conclude, some policy initiatives to improve ratings' market efficiency are discussed.*

Keywords: *credit rating agencies, regulation, reputation, reputational games.*
JEL: D22, G01, G11, G24,

Introduction

The credit rating agencies (CRAs) have been blamed for their contribution to the development of the 2007-2008 financial crisis; they have been criticized for the high ratings provided to the new complex Credit Risk Transfer products (CRTs), securities backed by mortgages and loans. When the subprime mortgage defaults started increasing in 2007 (and CRTs started registering high losses), CRAs severely downgraded them, fostering the suspicion that ratings had been inflated in the years before the crisis.

This paper illustrates the role of CRAs in the financial system and, in particular, in the market for CRTs. It relates the main contributions of the microeconomic literature on information intermediaries to the institutional features of the market where CRAs operate and to a set of relevant policy issues.

The presentation is developed around three key issues that have been underlined by the international debate about CRAs: i) the role of reputation as an incentive device and the determinants of its value; ii) the impact of competition among CRAs on the production and the diffusion of information; iii) CRAs' private incentives to adopt efficient credit-risk models.
The paper is organized as follows: after a short description of the main features of the credit rating market and of the role of CRAs in financial regulation and during the crisis (part 1), part 2 illustrates some game theoretic models which formalize reputation-building ideas and the risks of relying too much on the same advisor; part 3 focuses on the structure of the rating market and on its consequences in terms of rating content and welfare; part 4 highlights the consequences of the shortfalls in rating methodologies. Finally, part 5 concludes; it provides a summary of the main issues addressed by the economic theory and discusses some policy initiatives to correct CRAs' incentives.

1. Main institutional features of the rating market: the role of CRAs before the financial crisis

In general, the rating agency's role consists of collecting and processing information about an issuing firm, in order to provide an assessment of the quality of its bonds. A firm may have private information about its ability to repay its bonds and investors may be unwilling to buy or may ask for a high risk premium. Rating agencies provide an independent evaluation of the creditworthiness of the issuer that reduces the gap of information between the firm and the investors.

CRAs had earned a good reputation prior to the financial crisis. They had a long history of producing good ratings and had therefore developed a reputational asset which allowed them to charge accordingly for their services. It was commonly believed that the value of this reputational asset could provide an incentive for the CRAs to continue to produce high quality ratings[1]. Authorities' and financial intermediates' reliance on CRAs had been increasing over the years: financial regulation authorities trusted the ratings for the definition of banks' capital requirements, investment firms' limits and for the portfolio choices of mutual funds[2]. The increasing role of CRAs in relation to financial regulation contributed to the "overreliance" on ratings, as banks, institutional investors and other market participants made mechanical recourse to ratings, without performing the necessary due diligence in their investment choices; over-reliance on ratings reduced their own capacity for credit risk assessment[3].

Financial regulation reliance on rating also created barriers to entry, as CRAs needed to be recognised by authorities before their ratings could be used for regulatory purposes, which in turn favoured a high concentration in the rating market, dominated by the main role of three agencies. However, apart from the initial recognition, CRAs were essentially unregulated despite both regulators' and investors' increasing confidence in, and hence reliance on ratings. As indicated above, the prevailing opinion was that the maintenance of a high level of reputation was an adequate incentive to prevent conflicts of interests[4].

It was already known that a potential source of conflict of interest - regarding every kind of financial product - lies in how CRAs generate revenue. Ratings are generally paid by issuers rather than investors, thus aligning CRAs' interests more with those of securities' issuers than with those of investors. This may result in more favourable ratings than would otherwise be the case[5].

The high share of CRAs' pre-crisis profits from CRT products, combined with the severe downgrades of these securities registered from the very beginning of the crisis[6], has fostered the suspicion that the conflict of interest has played a more important role for CRTs than for other kinds of securities, e.g. bonds[7]. Moreover, CRAs contributed to the development of the CRT market not

[1] SEC (2009). Apart from reputation, another important factor cited by SEC are the economies of scale which are seen as favouring the larger long established rating agencies, as they can allocate the costs of analytical software, administrative, legal, compliance, marketing and support staff, among other costs, across a wider range of ratings. In addition, these rating agencies have large sunk costs in the form of developed ratings, methodologies, procedures and outstanding ratings.

[2] The Net Capital rule and the second Basel Accords on banks' capital adequacy were probably the most important regulatory sources for reliance on rating. The first one established that broker-dealers or companies that trade securities for customers as well as on their own accounts had to refer to CRA agencies' assessment to define market risk and liquidity; the second one, effective in Europe and in several other Countries since 2008, greatly relied on ratings to define the riskiness and capital absorption of the banks' assets in general and of CRT products in particular.

[3] FSB (2010).

[4] Before the crisis, CRAs had just to respect the self regulation issued by the IOSCOs (International Organization of Securities Commissions, Code of Conduct Fundamentals for Credit Rating Agencies, October 2004). This code of conduct - that was revised in 2008 in response to the subprime crisis - consists of a Statement of Principles regarding the activities of credit rating agencies and a Code of Conduct fundamental for credit rating agencies that comprises three parts: Quality and integrity of the rating process, Independence and the avoidance of conflicts of interests and Responsibilities to the investing public and issuers.

[5] CGFS (2008).

[6] Benmelech et al. (2009) estimate that more than half of the CRTs securities rated by Moody's were AAA, but most of these tranches were downgraded during 2007 and 2008, the average downgrade was 4,7 and 5,6 notches.

[7] CRTs products grew at an exponential rate in several industrial countries before the financial crisis. According to the Securities Industry and Financial Markets Association (SIFMA) global CDO issuance rose from 78 billions of dollars in 2001 to 520 in 2006,

just as information providers, but also by participating in the market development, as this industry was essentially based on the creation of rated assets from a pool of unrated loans[8].

The first part of this paper is therefore devoted to the introduction of a theoretical framework to analyse CRAs' reputation building process, and the risk of conflict of interest based on issuers' payments to CRAs. This part tries to understand why CRAs' and investors' incentives were misaligned in the CRT sector and if this entirely depends upon the conflict of interests arising from the model seeing the issuer paying the CRA. It also provides some insights on the incentive mechanisms that allow CRAs to reveal truthful information in the presence of conflict of interest, trying to understand if full revelation can be an equilibrium outcome and when grade inflation emerges as an equilibrium outcome. Finally it tries to explain which economic variables influence the dynamics of equilibrium incentive formation.

As highlighted in the introduction, the international debate following the crisis has pointed out two other main factors to explain the CRAs conduct: the high concentration in the ratings' market and the inadequacy of the credit risk models used by CRAs to evaluate CRT products.

The market for ratings is dominated in many countries by three main agencies: Standard and Poor's, Moody's and Fitch. According to the SEC (2009), in 2008 the three main CRAs issued approximately 96% of CRT ratings and 97% of all outstanding ratings in the U.S. regarding financial institutions, insurance companies, corporate issuers, asset backed securities, government municipal and sovereign securities. CRAs have been blamed for having exploited their market power to increase profits. Nevertheless the impact of competition on ratings' information content is a complex issue. At least theoretically, in a perfectly competitive ratings market, CRAs should produce high-quality ratings to improve their reputation and consequently their future profits. On the other hand, competition could produce distortive effects; in the attempt to preserve or increase their market shares, CRAs may favour the issuing firms, thus providing lower quality ratings. Competition among the three CRAs seems to have favoured the so-called 'rating shopping', i.e. the ability of CRT issuers to exploit credit ratings by choosing the rating agency that would assign the

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abruptly declining to a bit more then 4 billions in 2009 (see SIFMA web site). CDOs (collateralized debt obligations) were probably the most complex type of CRT instruments; a kind of security backed by other types of CRTs securities, by CDSs (Credit default swaps) or other CDOs (so called CDO square).

[8] The banks either originated or purchased the unrated assets (such as residential mortgages, credit card receivables, loans and corporate bonds or synthetic assets like Credit default swaps (CDS)) and moved them to special purpose vehicles (SPEs), legal entities where loans were separated from the other obligations of the bank. The portfolio of assets was typically divided into three tranches (senior, mezzanine and junior): the more subordinated a tranche, the more likely the losses: the equity/first or "toxic waste" tranche absorbed initial losses (their owners are paid only after the owners of the other tranches are), followed by the mezzanine tranche -which took up some additional losses -, to conclude with the senior tranches. Credit rating agencies usually provided AAA rating to the so called super senior tranche, characterized by lower return than the others but by the guarantee of being the first to be paid by the cash flow coming from the underlying assets. The junior tranche was usually unrated. To provide a high rating, credit rating agencies often required banks to grant high level credit enhancement; essentially represented by the amount of principal or total interest of the assets pool in excess of the tranche securities issued.

highest rating or that applied less stringent criteria for awarding a desired rating. In fact, issuing firms used to approach and solicit ratings from more than one CRA in order to select the most favourable. Rating shopping was quite common in the CRT industry, more than in other rating sectors (like financial or corporate bonds), probably because of CRT opacity, which did not allow investors to evaluate appropriately the rating content. It also depended on the issuing firms' ability to affect information revelation to the market. According to the SEC (2008), the July 2007 CRTs downgrades were concentrated in the issues of four firms, suggesting that there were important unobserved differences in underwriting standards across originators, but also that some issuing firms had the influence to obtain higher ratings than they deserved.

Finally it cannot be ignored that an important factor in underestimating CRTs' risk may have been played by the credit risk models used by the agencies. The so-called "model risk" was common to a broad range of products, but it may have played a major role in the rating of CRTs, because of the complexity of these products with respect to other kinds of securities[9].

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2. The theoretical framework

The theoretical framework to analyse CRAs behaviour is partly based on the economic theory literature that describes the relationship between an advisor and an agent[10]. These models are very useful to illustrate several situations in which an agent has to rely on another's advice to make a decision, like a policymaker that relies on an economist advisor, a car-driver on his mechanic, a patient on his physician, a customer on his financial advisor, and, finally, an investor on a rating agency. In all these situations the agent has to decide about the consumption of an *experience good***,** i.e. a product or service whose features such as quality or price are difficult to observe in advance, but can be understood after consumption. The reputation of the advisor plays an important role: the more the agent trusts the advisor, the more likely he/she will make a decision according to its advice. If the advice turns out to be correct, the credibility of the advisor increases. Otherwise the agent can decide not to trust the same advisor anymore[11].

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[9] CRT products are more closely exposed to systemic risk than idiosyncratic risk as their portfolios usually consists of large, well-diversified, homogeneous pools of assets (like residential mortgages or credit card receivables), while individual exposures relative to overall pool size are not significant. The higher the correlation among loans, the greater the sensitivity (and contribution) of the pool to systemic risk, as the probability of default is much more sensitive to common factors and, therefore, to respective obligors' exposure to business cycle risks. Credit risk models for CRT securities combine assumptions about individual assets in the pool of CRTs' underlying assets, with default correlation of the pool of assets and recovery rates. If the actual default correlation is higher than estimated, the rating agencies approach is likely to underestimate expected losses/probability of defaults and, accordingly, overestimate ratings. It has been noticed that the high numbers of downgrades of CRTs tranches can be at least partially seen as the result of under-modeling of both default and recovery rates and, hence, a manifestation of model risk, cfr. Fender I. et al. (2005).

[10] These models began to be developed during the eighties after the publication of Kreps D. and Wilson R.'s work (1982) in which agents exploit uncertainty and take short term losses in order to build a reputation and make long-term gains.

[11] These models are often referred to as "cheap talk games" as the advisor actions do not directly affect any player payoff, but influence payoffs only indirectly via impact on the belief of the decision maker, so its action has no cost. There can also be situations in which the cheap talk is ignored. If players observing cheap talk do not infer any meaning in the messages, then there is no incentive for those sending the messages to fill them. Thus if the advisor, independent of whether it is good or bad and independent

2.1 Building up a reputation: the risk of the conflict of interests

I will try to describe the CRA's reputation building mechanism through Sobel's (1985) model. He considers a situation in which there are two subjects, a sender (that I will call CRA to indicate the rating agency) and a receiver (INV, the investor) who have to play a game a finite number of times. At each stage of the game both players learn the value of a parameter Z, which measures the importance of that period's play of the game (that is, the value of making a correct decision), that can be seen as the CRA's payoff.

CRA observes the state of nature, a binary random variable Ω_t, which is independent, identically distributed, and equally likely to be equal to -1 or 1. CRA sends the INV a signal M ϵ [-1,1], that can be interpreted as the speculative or investment grade rating[12]; INV makes a decision *A* that affects the welfare of both players. After both players learn the consequences of INV's decision, the process is repeated. At each stage INV must decide what action to take. In order to do so he must assess the credibility of CRA. The difficulty arises because INV is uncertain about CRA's preferences when the game starts.

To model the possible conflict of interest between CRA and INV, this model assumes that with positive probability ρ, CRA has identical preferences to INV (CRA is honest, H) and with positive probability (1-ρ) CRA has completely opposed preferences to INV (CRA is opportunistic, O). More specifically, the utility function depends on the distance between the action A the receiver takes and the random variable Ω_t. The solution to the problem:

$$MaxU_{CRA}(A-M,Z) \tag{1}$$

is $A = M$ if CRA = *H*

and $A = -M$ if CRA = *O*.

Therefore the honest CRA and the opportunistic CRA have opposite preferences.

The possibility that CRA is honest increases credibility to what it says, but this credibility may also be exploited by an opportunistic O. At each stage, providing accurate information enhances the opportunistic CRA's reputation, but only at the expense of losing a chance for immediate gain by cheating INV. CRA typically conveys accurate information for the first several periods, according

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of the signal it has observed, simply randomizes its announcing, the decision maker will learn nothing from the message and will continue to believe that each state is equally likely. Given this anticipated response by the decision maker, the advisor has no incentive to deviate from its uninformative random announcements. Such equilibria, in which cheap talk is ignored, are known in the game theory literature as "babbling equilibria."

[12] The threshold between investment and speculative grade has important market implications as ratings play a critical role in determining how many companies and other entities that issue debt, including sovereign governments, have to pay to access credit markets, i.e. the amount of interest they pay on their issued debt. Firms issuing speculative grade bonds, in fact, will have to pay a risk premium in terms of higher interest rates to induce investors to buy their bonds.

to a signalling rule $\delta(Z,\rho)$, which represents the probability that the CRA tells the truth. INV raises the probability he places on CRA being honest after receiving accurate information if he believes that an opportunistic CRA would have lied to him with positive probability. The more important the information, the more likely an opportunistic CRA will attempt to deceive INV. An opportunistic CRA will eventually take advantage of INV by misleading him. When this happens, it is assumed that CRA loses all opportunities for deception in the future.

In the one shot game, Nash equilibrium is reached only if CRA is sufficiently reliable (that is to say $\rho \succ \frac{1}{2}$), otherwise, if INV chooses to ignore CRA signal, then the best response for CRA is not to make informative signals.

In the multistage game INV updates CRA's reputation according to Bayes rule:

$$\rho_t = \frac{\rho_{t-1}}{[\rho_{t-1} + (1-\rho_{t-1})\delta(Z,\rho)]} \tag{2}$$

where the denominator is the probability of an honest signal, i.e. the probability that:

- CRA is honest: ρ_{t-1}

or

- CRA is opportunistic: $(1-\rho_{t-1})$, but provided an honest signal in the previous period: $\delta(Z,\rho)$.

The model shows that CRA typically tries to increase its reputation conveying accurate information for the first several periods. So INV raises the probability he places on CRA being honest after receiving accurate information if he believes that an opportunistic CRA would have lied to him with positive probability. If CRA is opportunistic, he will most probably attempt to deceive INV when the information is more important (*Z* is higher). When this happens, it is assumed that the CRA's reputation drops to zero. It is also shown that INV prefers to deal with a single sender for T periods rather than T senders separately, as repeated plays allow him to better evaluate the usefulness of CRA's information.

The model suggests that CRAs can have incentive to increase their reputation and supply accurate ratings as long as their payoff (the parameter *Z*) is low enough. When revenue coming from ratings is sufficiently high – like it seems to have been before the crisis for the new financial products - the temptation to burst their reputation becomes stronger and rating agencies are induced to provide good ratings for bad bonds. Nevertheless, the model is based on the assumption that the opportunistic CRA has no opportunity to regain its reputation once discovered. This assumption appears unrealistic for rating agencies as their reputation has already been damaged in various occasions, without significantly reducing their role in the financial system.

2.2 Discovering an opportunistic CRA can take time

A different perspective is offered by Benabou at al. (1992)[13], who generalize Sobel's model and identify a sender with noisy information. In this model reputation fluctuates up and down, rather than increasing until the first opportunistic move brings it down to zero forever. More specifically, in the model there is a continuum of agents, indexed by a parameter *a* in [0, 1], that trade a financial asset whose return is contingent upon the state of nature Ω. The asset pays S=1 if Ω = +1 and zero if Ω = -1. Each of these outcomes has probability one half, and only becomes publicly observable at the end of the period. At the beginning of the period the sender privately observes a noisy signal Ω' that predicts the state of nature with probability:

$$p \succ \frac{1}{2}.$$

This information structure is common knowledge. At this point the informed individual sends the message M to "the public," i.e., to agents a in (0, 1]; he reports his signal truthfully (M = Ω') or untruthfully (M = - Ω') using a symmetric mixed strategy, i.e. according to the probability:

$\delta = prob\ [M = \omega \mid \Omega' = \omega]$ for all ω *in {-1,1}.*

Thus, the message space *M* is *{-1, +1}* itself and δ is the probability that the report is truthful; the honest sender always plays $\delta = 1$.

The public is uncertain about the CRA's "honesty" and has prior probability ρ that he always truthfully reports $M = \Omega'$ and $(1 - \rho)$ that he opportunistically maximizes his expected utility gains from trade, manipulating information to his advantage.

It is assumed that the public consists of both well-informed, rational speculators, *a* in (O, α] and traders with noisy information, *a'* in (α, 1]. "Noise" traders are agents who do not correctly receive or take into account the CRA's message and instead act according to a common belief B, drawn from a common knowledge distribution with support in *[1 – b, b]*; the smaller *a*, the less the sender can predict how the market will react to his announcements.

The parameter *a* can represent the degree of reliance of investors on ratings, both for regulatory purposes or for investment decisions. The higher *a,* the wider the overreliance on ratings described in section 1. Rational agents use their prior knowledge on the CRA's type and each type's strategy, and Bayes's rule to infer the credibility of its prediction, i.e. the probability that it will be realized:

[13] They refer to a journalist who writes a financial column, and can trade directly or through namesakes, or a "guru" who issues forecasts or newsletters but is also in the business of trading for his own account, or some investment firms, or a corporate executive who owns or trades stock in his company, and by the very nature of his job periodically makes prospective reports to stockholders and financial analysts.

$$\pi = \rho p + (1-\rho)[p\delta + (1-p)(1-\delta)]$$

(3)

If the CRA announces *M = 1*, they update their belief about the asset's price S, from ½ to a common belief $S = \pi$. If it announces *M = -1*, the posterior belief is $S = (1-\pi)$.

A CRA uses its message to affect the public's belief about the asset's value, but its ability to do so is subject to how credible the public judges the CRA itself. It is assumed that an opportunistic CRA interests are diametrically opposite to those of the receiver INV: if *Ω'* =1 CRA has incentive to announce *M=-1*; if it observes *Ω'=-1*, it announces *M=1*.

It is shown that there is a unique price that clears the market. The one period game has a unique equilibrium. If the sender's credibility ρ is no greater than ½, then there is no information transmission; if the initial reputation is $\rho_t \succ ½$ then $\pi(\rho_t) \succ ½$ even though the opportunistic sender always lies. If the public has sufficient confidence in the CRA's honesty, the opportunistic CRAs can imitate the honest one and manipulate public beliefs.

In the infinite horizon game the sender maximizes the discounted expected sum of his instantaneous utilities. The probability of a correct forecast is $\pi(\rho_t)$ by definition, and the probability that the CRA is honest and makes a correct forecast is $(\rho_t p)$. For an incorrect forecast the corresponding probabilities are $1-\pi(\rho_t)$ and $\rho_t(1-p)$, so the updated reputation is:

$$\rho_{t+1}^{+} = \frac{\rho_t p}{\pi(\rho_t)} \text{ after a correct forecast} \quad (4)$$

and

$$\rho_{t+1}^{-} = \frac{\rho_t(1-p)}{[1-\pi(\rho_t)]} \text{ after an incorrect forecast.} \quad (5)$$

Since ρ_t embodies all the information available to the public at the beginning of period t, here follows, from their subjective point of view, a martingale:

$$E(\rho_{t+1}) = \pi(\rho_t)\rho_{t+1}^{+} + (1-\pi(\rho_t))\rho_{t+1}^{-} = \rho_t$$

(6)

So, even after an incorrect forecast, the reputation of the CRA decreases but does not go to zero. The opportunistic CRA decides its action optimally weighting its profit incentive to lie against its reputational incentive to be truthful. If the discounted expected sum of instantaneous utilities when it lies (tells the truth) is higher than when it tells the truth (lies), it lies (tells the truth) systematically, otherwise it randomizes with probability δ. Benabou et al. show that the equilibrium that arises is unique. In equilibrium the CRA's messages always have some credibility (i.e. $\pi(\rho_t) \succ ½$).

Nevertheless, the reputation converges to 0 (respectively to 1) as t goes to infinity if the CRA is opportunistic (respectively, honest). What enables the public to distinguish the two types (asymptotically) is that the opportunistic one periodically lies, so that his forecasts are inaccurate more often than the honest type's are. In the end the model underlines that, if a significant fraction of investors rely on CRAs' evaluations, reputation is only partly damaged when an opportunistic behaviour is discovered. Like in Sobel's, it also highlights that reputational incentives are not sufficient to prevent CRAs' conflict of interest as CRAs face a trade off between increasing reputation and maximizing their profits.

2.3 The rating industry during the crisis: the impact of high revenues on incentives

Mathis et al. (2009) is an interesting model that tries explaining CRAs conduct during the crisis. It suggests that the crisis was a direct consequence of CRAs opportunistic conduct, as CRAs periodically try to increase their reputation as far as possible and then inflate ratings when reputation is sufficiently high in order to maximize their profits. They show that this cyclical behaviour has important destabilizing consequences.

They adapts Benabou et al. to the rating industry by considering a financial market where, at discrete dates, new firms want to issue a security to finance an investment project with a cost normalized to unity. The project quality is a priori unknown (even to issuers). It is ''good'' with probability θ, or ''bad'' with probability $(1-\theta)$. A monopoly CRA observes the project quality and communicates a rating to the market. No issue takes place if rating is bad or denied. This assumption reflects the idea that CRTs products could be issued only if they had a good rating, because of their complexity. The CRA can be of two types: either it is fully committed to always tell the truth or it is opportunistic (i.e., chooses the rating that maximizes the expected present value of its profits). The reputation of the CRA is measured by the probability ρ that investors assess the CRA being committed to telling the truth.

The strategy of an opportunistic CRA is described by the probability $\delta(\rho)$ that a CRA of reputation ρ will be too lax (i.e. will give a good rating to a bad security). This influences the accuracy $a(\rho)$ of ratings (i.e., the probability that investors believe a good rating to mean a good project, given the reputation of the CRA). The model shows that, when the fraction of the CRA's income coming from sources other than rating complex products and/or the proportion of successful projects are large enough, there is a unique Markov perfect equilibrium (MPE)[14] where an opportunistic CRA always tells the truth. In this case, reputation is a good disciplining device for CRAs. By contrast when the fraction of the CRA income that comes from rating complex products and/or the proportion of unsuccessful projects becomes large, there is a unique MPE where the CRA is always too lax with some probability and lies with probability one when its reputation is good enough.

The model is an illustration of the folk theorem for repeated games, which states that imitating the behaviour of the truthful type is an equilibrium strategy for a patient player. This implies the possibility of what the authors call "confidence cycles": starting from a situation where investors are not very trustful, issuing volumes are low, and credit spreads are high, the CRA tries to increase its reputation by being very strict; investors become more optimistic, the reputation of the CRA increases, spreads decrease, and issuing volume raises. But then CRAs become more lax, the following default provokes a crisis of confidence: the opportunistic CRA is detected, its reputation brutally falls down, spreads become high again and issuing volumes decrease dramatically.

In the end the model shows that reputation can be a good incentives device, and full revelation can be an equilibrium, if most projects are successful and/or the CRAs returns from others sources than rating complex products are high enough to prevent an opportunistic behaviour. If these conditions are not met, the opportunistic behaviour of CRAs can be itself a source of instability, when CRAs find a new profitable rating sector; in fact "confidence cycles" can emerge independently from the fundamentals of the economy.

2.4 Rating inflation and the business cycle

The previous model is related to the impact of CRAs behaviour over the economic cycle; on the opposite, Baar-Isaac and Shapiro's model (2013) tries explaining the effects of the business cycle over CRAs' incentives to produce accurate ratings, and specifically why rating was less precise in the expansionary period preceding the crisis. They model a setting where a single CRA, issuers and investors can interact over an infinite number of discrete periods. Each period, an issuer has a new investment. The investment can be good (G) or bad (B). A good investment never defaults and pays out 1. A bad investment defaults with probability π. If it defaults, its payout is zero, otherwise its pay-out is 1. The probability that an investment is good is θ. The issuer approaches the CRA at the beginning of the period to evaluate its investment. To model rating shopping it is assumed that the CRA is paid by the issuer only if it gives a good rating. The amount

[14] A Markov perfect equilibrium (MPE) is a pair of functions *(δ;a)* that are simultaneously rational from the respective view points of CRAs and investors.

they are paying is fixed at given fee F. In each period, a CRA pays a wage w ϵ *(0;w^)* to get an analyst of ability $r(w_s;\gamma_s)$ ϵ(0;1), where γ_s is a parameter that captures labour market conditions.

As it is harder to attract and retain higher ability analysts, it is assumed that the ability is a non decreasing function of the salary w_s. Regarding the labour market conditions, the authors suppose that when γ_s is larger, the labour market is tighter and it is more difficult to get skilled workers, so that a higher wage must be paid in order to maintain quality (the ability *r* is a decreasing function of the labour market conditions γ_s).

All analysts can identify a good investment perfectly (p(G/G) = 1). They may, however, make an error about the bad investment as they can evaluate as good a bad investment with probability 1-r, i.e. (p(G/B) = 1-r). They also assume that investors will buy the project only if they know that the CRA is investing sufficiently in the ratings quality (r ≥ r^).

Issuers and investors observe three states: a bad rating, a good rating with a return of 1 and a good rating with a return of 0. If the CRA is discovered to have lied, i.e. if it is found to give a good rating to a bad project, it loses its reputation and is forced out of the market.

The economy can take two states: B booms and R recessions and the probability of moving from state i=B,R to the other is τ_i. The probability that an investment receives a good rating is in each state i=B,R is:

$$p_i = \theta_i + (1- \theta_i)(1- r_i) \tag{7}$$

which essentially indicates that the CRA provides a good rating to a good project θ_i or, making a mistake, to a bad project $(1- \theta_i)(1- r_i)$. The probability that the CRA survives in the next period is given by:

$$\rho_i = 1- (1- \theta_i)(1- r_i)\, \pi_i \tag{8}$$

which is the complement to one of the probability that an investment is rated as good and then defaults.

Each period the CRA maximizes its profits choosing the optimal wage according to the following maximization problem:

$$V_i = \underset{Ws}{Max}\; F_i\, p_i - w_i + \lambda\, \rho_i\, E(V_i) \qquad i=B,R \tag{9}$$

Where V_i is the value function from the beginning of the period when the state of the economy is *i* and $E(V_i) = (1- \tau_i)V_i + \tau_i V_j$ is the expected value from the end of that period; λ is the discount

factor. The authors show that there exists a unique solution V^*_B and V^*_R to the maximization problem of the CRA with associated wages w^*_B and w^*_R ;they also demonstrate that $w^*_R \geq w^*_B$.
This last outcome helps explaining why rating quality varies according to the business cycle; in fact it shows that CRAs are willing to invest more in downturns paying a higher wage w^*_R in order to hire a good analyst, as a consequence rating accuracy is lower in booms than in recessions.
The intuition behind this result is that CRAs want to be less precise in booms to collect more fees: in booms, investments' probabilities of defaults are lower and, consequently, the probability of surviving is higher, therefore CRAs have less incentive to invest in rating accuracy.

2.5 Why ratings are represented by synthetic messages

In the models described so far investments are divided in two categories: good and bad, which reflect the investment and speculative grade of rating. As a consequence, CRAs could either assume a completely truthful (providing the same message as the signal collected) or untruthful behaviour (sending a message opposite to the signal). Actually, ratings reflect the continuum of probabilities of default or expected losses of the investments, but are identified by CRAs with several discrete sub categories represented by letters (AA, AAA, etc), slightly different among rating agencies. "A" rating indicates investment grade bonds, that is to say bonds with a relatively low risk of default and that are judged by the rating agency as likely enough to meet payment obligations. Credit ratings for bonds below these designations ('BB', 'B', 'CCC', etc.) are considered low credit quality and are commonly referred to as "junk bonds" or speculative grade bonds.

The models below illustrate that, when the cardinality of the signal space is bigger than two, the CRA can assume a partially informative behaviour instead of the truthful or untruthful behaviour so far analysed. It is shown that synthetic ratings are a consequence of the possible conflict of interest between CRAs and investors; more specifically they are a consequence of the uncertainty about CRA's incentives. Giving synthetic information about a bond represents the CRA's optimal compromise between including enough information in the signal to induce the receiver to respond to it and holding back enough so that his response is as favourable as possible.
In Crawford and Sobel's model (1982), CRA observes the state of nature, represented again by the value of a random variable, Ω, whose differentiable probability distribution function, $F(\Omega)$, with density $f(\Omega)$, is supported on $[0,1]$. CRA has a twice continuously differentiable von Neumann-Morgenstern utility function $U_{CRA}(A,\Omega,b)$,where A, a real number, is the action taken by INV after receiving CRA's signal M and b is a scalar parameter used to measure how nearly agents' interests

coincide. INV's twice continuously differentiable von Neumann-Morgenstern utility function is denoted $U_{INV}(A, \Omega)$. All aspects of the game except *Ω* are common knowledge.

CRA observes its own "type", *Ω*, and then sends the signal *M* to INV; the signal may be random, and can be viewed as a noisy estimate of *Ω*; then INV processes the information in CRA's signal and chooses an action, which determines the players' payoffs. If players' interests are different $(b \neq 0)$, it is shown that the actions induced in the Bayesian Nash equilibrium[15] are countable and finite[16]. Therefore, if interests between CRA and INV are not aligned, CRA prefers to adopt a partition of messages, providing a synthetic rating instead of the value of *Ω* actually observed, as INV would not entirely trust CRAs message. The equilibrium whose partition has the greatest number of elements is Pareto-superior to all other equilibriums and, if agents coordinate on this equilibrium, INV's expected utility rises when agents' preferences become more similar.

The same topic can be found in Morgan and Stocken (2003); their model extends Crawford and Sobel's one to the case where there is uncertainty about the degree of divergence in preferences between the sender and the receiver. In this model, when receivers (or investors) are uncertain of the sender's (or CRA's) incentives, they find a class of equilibria that is partitioned and a class of equilibria where CRAs with aligned incentives can credibly convey unfavourable information about a firm's value, but can never credibly convey favourable information.

The model studies a financial market setting containing a firm, many investors, and an equity analyst who follows the firm. The market participants have identical uniform prior beliefs about the firm's value *S* lying in some bounded interval, which is normalized to be *[0, 1]*. The analyst is employed in the brokerage division of a securities firm that offers brokerage and investment banking services, but the model can be easily adapted to rating agencies. The analyst (or the CRA) is privately informed about the nature of the incentives that he/it faces when preparing his/its stock report.

Investors value the firm upon observing this report. The analyst's payoffs depend on the firm's stock price, its underlying value, and the presence of investment banking opportunities or personal stockholdings in the firm. The analyst's payoff consists of two components: a benefit associated with inflating the rating/stock price *S* above its true value *ω*, and a cost associated with poor performance. Specifically, the analyst's objective function is:

$$U(S, \omega, \beta) = 2\beta S - (\omega - S)^2$$

[15] It consists of a family of signalling rules for CRA, denoted by $\delta(n \mid \Omega, M)$, and an action rule for INV, denoted *A(M)*, such that CRA's signalling rule yields an expected-utility maximizing action for each of his information "types," taking INV's action rule as given; INV responds optimally to each possible signal, using Bayes' rule to update his prior, taking into account CRA's signalling strategy and the signal he receives.

[16] This comes from the concavity and continuity assumption about the utility function and the additional assumption that the partial derivative Ui M,A>0 which is a sorting condition that ensures that the best value of the decision A for a fully informed agent's standpoint is a strictly increasing function of the true value of M.

(10)

The analyst's incentive parameter β is the amount above the firm's true value that an analyst wishes to inflate the stock price. It is assumed that *β* is distributed as follows:

- 0 with probability *g*,
- *b* with probability *1 - g*,

where $b, g \in (0, 1)$.

Thus, when *β* = 0, the analyst/CRA has purely performance-based concerns; that is, the analyst's payoffs are maximized by inducing a stock price that is equal to the firm's value: *S* = ω (i.e. CRA's main concern is preserving the reputation). In contrast, when *β = b*, the analyst's or CRA's payoffs are maximized by inducing a stock price or a rating that is above the firm's value, that is, *S = (ω + b);* i.e. the CRA intends to maximize its profits without considering reputation. With respect to the Crawford and Sobel's model the type space consists now of two components *ω, β* ϵ (0, 1).

The analyst privately observes the firm's value *ω* and issues a stock report *M*, which can be vague or even misleading. All aspects of the game are common knowledge except the analyst's privately observed incentive parameter and the signal of the firm's value.

Investors observe the report *M* and revise their beliefs about the firm's value, which are given by the cumulative distribution function *P(ω / M)*; they then value the firm. The firm's stock price, *S*, equals the firm's expected value given all publicly available information, including any information contained in the analyst's stock report *M*; hence:

$$\mathrm{S}(\mathrm{M}) = \int_0^1 \omega \, d \, P(\omega / \mathrm{M})$$

(11)

Morgen and Stocken define the stock price *S* as:

- fully responsive if, for some realization of *β*, it is continuous and strictly increasing almost everywhere;
- semiresponsive if, for some realization of β and in some nondegenerate interval of *ω* it is continuous and strictly increasing.

Morgan and Stocken show that when incentives are uncertain (i.e. INVs are not aware of CRAs payoff), a fully responsive stock price is impossible. Suppose the contrary, that the stock price is fully responsive. Fix a firm value *ω' > b*. Let *M'* be the stock report inducing price *S = ω '*. When *β = 0*, an analyst who learns that the firm's value is ω' will prefer to induce the stock price *S = ω*' over all other prices and report *M'*. Likewise, when *β = b*, an analyst who learns that the firm's value is *ω" = (ω' – b)* will also prefer to induce the price *S = ω'* and report *M*'. Thus, investor beliefs when hearing the message *M'* yield an expected firm value of:

$$E(\omega \mid m') = g\,\omega' + (1-g)(\omega' - b) < \omega' \qquad (12)$$

fixing a lower price than the report. But this is a contradiction, since [$A(M') = E(\omega \mid M') < \omega'$]. Therefore, it is impossible for an analyst to convey good news about a firm $(\omega' > b)$ when there is uncertainty about incentives. In this case the practice of restricting the message space of the analyst/rating agency to a small number of reporting categories allows reaching the equilibrium even in the presence of uncertainty.

As in Crawford and Sobel's model, there are only a finite and countable number of equilibrium stock prices[17] $\{S_i\}$i=1,N, that can be arranged in ascending order in *i*. In such an equilibrium, an analyst will strictly prefer to induce the stock price S_i over all other prices for any ω that lies in some interval $(\omega_i\hat{}, \omega_{i-1}\hat{})$.

Summing up, Crawford and Sobel show that categorical ranking (like ratings of investment and speculative grades, and related subcategories) represents a useful way to overcome investors' scepticism about the incentives of CRAs.

In the end the two models described in this section show that full revelation can never be an equilibrium outcome, even in case of aligned incentives; in fact, if investors are uncertain about CRAs incentives and remuneration, they will tend to underestimate the CRAs messages; as a consequence ratings are not entirely reflected in assets price; CRAs, in turn, make recourse to categorical ratings to overcome investors scepticisms.

2.6 An investor paid model

One way to eliminate or reduce the conflict of interest is to require investors and not issuers to pay for ratings, going back to the model in use before the seventies. A return to the investor-pay model would solve the conflict of interest problem but would also introduce the free riding issue as some investors would obtain ratings freely from sources other than CRAs. This is likely to result in insufficient revenues for the rating agencies.

Pragyan D. et al. (2009) study a model where investors using credit rating for their investment decisions can choose to be subscribers or free riders. If they choose to be free riders, they do not

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[17] In fact, the concavity of the analyst's objective function ensures that there exists a firm value ω^ such that an analyst with incentives β is indifferent between S_i and S_{i+1} for firm value ω^. Thus:

$$U(S_i, \omega\hat{}, \beta) = U(S_{i+1}, \omega\hat{}, \beta)$$

For a given pair of stock prices S_i and S_{i+1}, an analyst with incentives $\beta = 0$ is indifferent for some firm value $\omega = \omega\hat{}$, then an analyst with incentives $\beta = b$ will be indifferent for a firm value that is lower by exactly b: $\omega = (\omega\hat{} - b)$. Suppose that there are a countable but infinite number of equilibrium stock prices; i.e., prices are "close" to one another. Then, an analyst with aligned incentives will release a report M_i that induces price $S_i = S(M_i)$ only when the firm's value is arbitrarily close to S_i. Further, since investors are unable to infer an analyst's incentives from the report, for an analyst with misaligned incentives, A_i is induced only when the firm's value is arbitrarily close to $(S_i - b)$. Thus, investors, upon hearing report M_i, infer that the firm's expected value is arbitrarily close to [$S_i - (1 - g)b$]. The only way to avoid this contradiction is if equilibrium stock prices are sufficiently far apart. Hence, there is only a finite number of equilibrium stock prices.

have to pay the rating agencies subscription fee *F*. However free riding involves a delay and they assume that the opportunity cost of free riding for the investor is ξ. There exists a continuum of investors with ξ lying between *a* and *b*. Each investor decides whether to free ride or subscribe depending on ξ: if $\xi > F$, the investor is better off subscribing to the rating agency, as the opportunity cost of free riding is too high; if $\xi < F$, the investor prefers to free ride and wait for the information to arrive with a lag. The fraction of investors subscribing to the rating agency is given by:

$$\alpha = \frac{b-F}{b-a} \tag{13}$$

which depends on the subscription fee F. The profit function for CRAs is given by:

$$\Pi = F\alpha - C \tag{14}$$

where *C* represents the cost of rating. If the fee charged is relatively modest and/or the fraction of investors willing to pay *a* is small, (and therefore rating agency's profit are negative $\Pi < 0$), the rating agencies will not survive or will be forced to cut costs and compromise on the quality of ratings. To avoid this scenario, the authors suggest introducing a subsidy τ to the CRAs, to cover rating costs, (i.e. to guarantee at least $\Pi = F\alpha - C + F\alpha\tau = 0$) and given by:

$$\tau^* = \frac{C}{\alpha F} - 1 \tag{15}$$

The authors propose an auction mechanism to determine the optimal subsidy rate for the rating agencies: each rating agency would determine the minimum level of subsidy it requires to break even τ_i^*; if the auction process is properly designed[18], then the most efficient rating agencies (i.e. the ones that are confident of getting higher subscription revenues from the investors and have lower costs) would win the auction and would be entitled to a portion of the tax pool. Finally, to fund the government subsidy, the authors propose the levy of a small tax on issuers.

3. Market structure in the rating industry

3.1 The impact of competition on rating content

[18] They propose an Anglo-Dutch auction, where the price rises until all but two bidders quit and the last two bidders then make a sealed bid. The surviving bidders would then be committed to bid at or below this level of subsidy in a sealed-bid auction in which the four lowest bidders are awarded a licence.

Lizzeri's model (1999) can be useful to introduce the shortfalls related to the market structure of the rating industry. He shows that a monopolist certification intermediary, like a monopolist CRA, can appropriate the entire surplus in the market without releasing any information. This can happen when investors are not willing to buy bonds not certified by an independent and external institution, as happened before the crisis. While in the Akerlof's lemon market the guarantee allows to separate lemons from good cars, in this model ratings allow a "good" bond to be identified and sold even if the rating agency doesn't provide any additional information about its true value. The situation greatly changes if there are several identical CRAs competing to issue the rating to the bond; in this case, like in Bertrand oligopoly, a competitive price and full disclosure of the bond's price will follow.

In the model there are four agents: an informed seller, two uninformed buyers, and one certification intermediary (the CRA). The seller owns an object that is worth *S* to buyers; he knows the value of the object *S*, and buyers and the intermediary have a prior on S represented by the distribution *f(S),* which is assumed to be strictly increasing with continuous density on the closed interval *[a, b],* where: $b \succ a \geq 0$. The intermediary has the technology to test the seller at no cost. If the test is made, the intermediary discovers *S*. This structure is common knowledge to all the participants in the market.

First of all the intermediary sets a fee *F* and credibly commits to a disclosure rule *δ* to maximize expected profits. As a matter of fact, CRAs cannot depend on such a commitment device; as stressed in section 2, they rely on reputational incentives. Despite this important limitation the model can help describing some consequences of the low competition in the ratings market.

The fee *F* can be any nonnegative real number. Then the nature chooses the type *S* of seller according to the distribution *f(S).* Having observed *F, δ*, and *S*, the seller decides whether to go to the intermediary, i.e., whether to pay the fee and have the product tested. If so buyers observe: the disclosure rule, the fee, whether the product was tested and what the intermediary disclosed. Then they bid independently and simultaneously for the product.

Lizzeri shows that, if the intermediary (or CRA) is a monopolist, there is an equilibrium in which it sets:

$$F = E(S) - a, \quad (16)$$

δ = *no disclosure*

and all types go to the CRA; furthermore under the condition that

$$E(S / S \succ x) - E(S / S \leq x) \geq (E(S) - a) \quad (17)$$

this is the unique equilibrium outcome; the CRA reveals nothing with probability one and captures the entire informational surplus in the market: all types go to the CRA and pay a price[19]:

$$F = (E(S) - a).$$

The condition (12) ensures that the difference between the expectation of quality conditional on going to the CRA and the expectation of quality conditional on not going to the CRA is always greater than the price to be paid to be certified. Thus, all seller types are willing to pay the price of certification. This guarantees that the equilibrium unravels downward and all types get certified. Thus, the only optimal outcome for the CRA is the one where the CRA reveals nothing and charges a price of exactly $(E(t) - a)$; all of the CRA's power to extract rents comes from its ability to manipulate information rather than from selling something that the seller values.

Lizzeri also shows that welfare greatly increases when the market for rating is more competitive, that is to say when CRAs can compete in a Bertrand oligopoly as in this case they reach the competitive equilibrium with zero fee (or price equal to marginal cost) and full disclosure of information. Suppose in fact that there are N identical CRAs and that CRA 1 sets a fee of zero and full disclosure, then all types go to CRA 1. No seller type will want to go to any CRA that charges a positive fee as he would have to pay a fee of F_i and, by construction, receive offers that are strictly less than $(S + F_i)$, but he can guarantee himself a payoff of S by going to CRA 1, which is clearly higher. This shows that any subgame in which the seller or the issuer has the option of at least one CRA with full disclosure and zero fee has an equilibrium in which all intermediaries make zero profits. This implies that the best response for other intermediaries is to set a policy of full disclosure and zero fee as well.

In the end the model suggests that, at least in principle, in a competitive setting CRAs should be induced to truthfully reveal the information they collect; welfare would also improve as CRAs could extract rents from issuers.

3.2 Competition and rating shopping

These results completely change if considering a more complex setting, where, apart from market concentration, also rating shopping and overreliance on ratings are modelled. Bolton, Freixas, and

[19] In fact, suppose all seller types are expected to go to the CRA that releases a certificate that says "the seller is certified by this CRA" and nothing else. If the seller does not go to the CRA, buyers' beliefs coincide with the prior f(.), i.e. the buyers believe that he is the worst type (type a). This implies that the highest types will definitely want to go to the CRA. But if only these were to go, then lower types would want to go as well, because going to the CRA would be viewed as a good signal (since the highest types are not revealed with probability one). This means that any equilibrium has a cut-off feature, with types below x not going to the CRA and types above x going.
The CRA has no incentive to deviate from a no disclosure strategy, set (x=a) and price equal F= ((E(S)-a), as it makes the highest possible profit: its profits are F= ((E(S)-a), buyers are making no profits, and the seller is making the minimum possible profit (a). In this equilibrium the CRA appropriates all the informational surplus in the market, no seller type gets any payment above the minimum and no information is revealed.

Shapiro (2012) combine these three sources for rating inflation: CRAs understating risk to attract business, issuers rating shopping behaviour, and the existence of trusting or *naive* investors. They show that competition can make the rating inflation problem even worse, as it facilitates rating shopping; they also demonstrate that rating inflations are more likely to happen during boom when investors are more optimistic.

More precisely, they consider three types of *risk-neutral* agents: issuers, CRAs, and investors with a measure of one. An investment is characterized by its probability of default: a *bad* investment defaults with probability $\pi > 0$, and a *good* investment defaults with probability zero. Either type of investment yields the same return S when not in default, and zero in default. All agents believe ex ante that the investment is good with probability ½.

A monopolistic CRA can collect a signal $\Omega = \{g, b\}$, which is its private information. CRA's technology is modelled assuming that the message can be less or more precise according to the following probability:

$$\Pr(\Omega = g \mid \omega = g) = \Pr(\Omega = b \mid \omega = b) = e \tag{18}$$

i.e. at $e = ½$ the signal is uninformative and agents retain their ex ante beliefs. For $e > ½$, the signal is informative. It is also assumed that the level of precision is common knowledge and is greater than ½, so the CRAs can convey useful information.

The CRA post its fee F at which a rating can be purchased before it receives the signal. When it is approached by an issuer, CRA collects the signal ω and produces a credit report M = G (good) or M= B (bad). To model rating shopping they assume that if it is G, the issuer chooses to pay F to have the CRA's proposed rating published; otherwise it refuses to purchase it. Even the issuer's refusal to buy the CRA's report is a signal that conveys information to investors.

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 P for the investment.

Like in Benabou et al. there are two types of investors, sophisticated and trusting. A fraction $(1 - \alpha)$ of investors is sophisticated. They observe the payoffs of the game for both the CRA and the issuer, and therefore understand the CRA's and issuer's potential conflict of interest and rationally update their beliefs.

Trusting investors instead assume that the CRA always truthfully rate the investment and therefore take CRAs' ratings at face value. If they don't observe a rating, they retain their ex ante beliefs.

To simplify the analysis, the authors assume that both types of investors can perfectly identify whether the CRA lied in the event of a default. Hence, if the CRA receives a signal ω = g and reports M = G, then if the investment fails, the CRA will not be punished, because investors understand that it acted in good faith.

Both types of investors are willing to buy one unit of the investment if they know that it is bad or if they do not know whether the investment is good or bad. They behave differently with regard to a second unit of the investment. If the rating is good (M=G), trusting investors are willing to buy a second unit, while sophisticated investors update their beliefs according to the reliability of information provided by CRAs; a good rating reveals no information to these investors if they believe that the CRA is lying. If the CRA reveals its signal truthfully, the M = G report induces the highest valuations from both trusting and sophisticated investors; both will buy two units of the investment.

The M = B report (which is not published as the issuer refuses to buy it) induces the lowest valuations for sophisticated investors and the ex-ante valuation for trusting investors.

However, a CRA who receives a signal $\omega = b$ and reports $M = G$ will be punished, being forced to leave the rating markets as its reports will be ignored in the future; the reputation cost of this punishment is represented by ξ, the discounted sum of future CRA profits.

Therefore, in a monopoly, the CRA must balance the trade off between lying and paying the expected reputation cost $e\pi\xi$: it maximizes its profits by choosing ratings inflation over truth telling whenever the profits from ratings inflation are larger than the reputational cost. When reputation costs are smaller and the size of the trusting audience larger, the CRA is more likely to take advantage of trusting investors by setting a higher fee and producing an M=G report (i.e. inflating ratings); issuers buy the rating, set high prices that exclude sophisticated investors from the market and take advantage of trusting investors, that will certainly buy a second unit of the investment.

On the contrary, if both the reputation costs and the size of the sophisticated audience are larger, the CRA is more likely to tell the truth and create information for all investors.

As a consequence ratings inflation is more likely in boom times when investors have lower incentives to perform due diligence, as the ex ante quality of investments is higher.

Bolton et al. also consider a competitive setting between CRAs; they show that two possible equilibria can arise where - like in a prisoner's dilemma – CRAs behave identically: either they inflate the rating or truthfully reveal their information about the investment. Like in the monopolistic case, which equilibrium prevails depends on whether the current payoff from inflating ratings is larger or smaller than the expected cost of getting caught. So, even in a competitive setting CRAs face the same trade off between profits maximization and reputational costs; therefore competition among CRAs does not change their conduct. They also demonstrate that competition produces a less efficient outcome than monopoly in terms of welfare as in the competitive setting there are more opportunities for the issuer to shop, taking advantage of trusting investors.

4. The screening technology

The shortfalls in credit risk models have already been partly analyzed in section 2 where it has been shown (Baar-Isaac et al., 2013) that CRAs incentives to invest in screening models and skilled analysts are weaker in boom periods when projects' default probabilities are lower and CRAs revenues higher.

Here follow two other models that illustrate the importance of the screening technology in a competitive setting and also to avoid issuing firms 'opportunistic behaviour. The first one combine competition and model risk, showing that competition and reputational incentives are not a useful device to prevent rating inflation if not accompanied by the improvement of rating models; the second one instead illustrate how issuing firms can exploit CRAs to receive a good rating for a bad project if they are aware of the low quality of screening technology.

4.1 Credit risk model and competition

Mariano (2009) studies the behaviour of two different types of rating agencies, talented and less talented, and shows that:

- reputational concerns are not enough to prevent deviations of a less talented CRA from the private signal and these concerns might end up being the driving force behind these deviations, as less talented rating agencies can have incentive to issue more bad ratings to avoid the project is undertaken and their type revealed;
- reputational concerns combined with competition may induce less talented CRAs to issue too much good ratings, as issuing a bad rating can worsen the agency's reputation because a bad rating cannot be verified, so investors believe that the rating agency is likely to be mistaken or is hiding its type.

More in detail, Mariano considers two different situations: a monopolistic market with one CRA and a more competitive setting with two agencies acting as Bertrand duopolists. The economy lasts two periods and in each period it consists of an entrepreneur asking for a rating about its project and a large group of homogeneous investors. At each time period, the agency's reputation – that is to say the subjective probability that the agency is talented – is updated according to rating correctness. A crucial assumption in the model is that rating is mandatory: if the firm gets a good rating, it can raise the financing from the project by the investors; otherwise the project is not undertaken.

The project is good with an exogenous probability $\theta \in (0,1)$, which summarizes the public information about the project's type.

The monopolistic rating agency is hired by the entrepreneur who pays a fee, and then the agency collects a private signal (ω_G for a good project or ω_B for a bad one) about the project and issue a good or bad rating. If the agency is talented, it correctly identifies the project's type, otherwise it can make small mistakes. In other words the probability that a talented agency correctly identify the project quality (G good or B bad) is one:

$$P\ (\omega_G/G) = P\ (\omega_B/B) = 1 \tag{19}$$

While for a not talented agency these probability are given by:

$$P\ (\omega_G/G) = P\ (\omega_B/B) = p \tag{20}$$

$$P\ (\omega_G/B) = P\ (\omega_B/G) = 1 - p \tag{21}$$

While collecting the private signal, the agency discovers its type (talented or not). Both public and private information are used to issue the rating, but the agency can also issue a rating different from the private signal, in this case, to model the investment in screening technology, it is assumed that the CRA incurs a given and fixed cost C.

The model is solved by backward induction starting from period two: in this period the agency has no reputational incentives, so it will issue a rating correspondent to the private signal not to incur in the fixed cost C.

In the first period it will issue the rating that allows maximizing future profits. Fee at time two depends upon the rating issued at time one: if the rating is correct and the project turns out to be good, the agency reputation grows and it will be able to ask a higher fee in period two; otherwise, if the rating is good but the project is not, it will receive a lower fee. Therefore, while a talented CRA will always issue the private signal as a rating, a less talented CRA can decide to contradict this signal to improve its reputation.

When investors expect a project to be very good or very bad (that is when θ is close to 1 or close to 0), and the CRA signal indicates instead a different quality of the project (that the project is bad or good respectively), the agency can prefer to follow the public information and issue a corresponding rating, as it knows that, had it been a talented agency, it would have been more likely to have collected an equivalent private signal (this behaviour is named *conformism*).

On the contrary, when the public information about the project is good but not strong enough (θ is greater of ½ but close to this value) the agency can decide to contradict this information and issue a bad rating in the attempt to minimize reputational costs (*conservatorism*). Doing so the project is not undertaken and therefore the agency type not revealed. In this way, its reputation remains unchanged as well as its fee.

The results of the model modify in the competitive setting as competition forces rating agencies to be more aggressive to make sure that they continue being hired and are not replaced by the competitor because only the agency with the highest reputational level will be hired at time period two. In this setting there are two identical rating agencies with the same initial reputational level. Like in the Bertrand model, the fee at time one just covers marginal costs (the cost of collecting the private signal).

Like in the monopolistic case a talented CRA issues the private signal in each period and both types of rating agencies issue the private signal as rating in period two not to incur in the fixed cost C. In period one a less talented CRA can issue a better rating than in the monopolistic case. When issuing the rating in period one the agency has to consider the trade-off between the following situation: if the outcome of the project reveals different from the (good) rating, the reputational level of the agency goes to zero and it is not hired again in period two; in the meantime, issuing a bad rating can worsen the agency's reputation because a bad rating cannot be verified, so investors believe that the CRA is likely to be mistaken or is hiding its type.

Especially if investors believe that the project is good, the agency can be induced to issue a good rating to persuade them that it is talented. When the public information about the project is bad there is no reputational cost in issuing a bad rating but even if the agency collects a bad private signal, it can decide to issue a good rating to be hired in the second period[20].

Hence, reputational concerns combined with competition originate boldness, as rating agencies issue too many good rating ignoring private and even public information that indicates that the project is bad. According to Mariano, competition might not solve the incentive problems faced by rating agencies unless it is combined with better models of risk assessment, which would improve the quality of rating agencies assessments, the transparency in that rating's procedures, and the measures to improve monitoring and accountability in the ratings industry[21].

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[20] More in detail, in the first period it plays in mixed strategy according to the following signalling rule:
- for $\theta \in [\theta-, \theta+]$ with $1- p < \theta- < \theta+ < 1/2$ it issues the private signal as a rating;
- for $\theta \in [\theta+, 1]$ it issues a good rating whenever it collects a good private signal, a good rating with probability δ and a bad rating with probability $(1- \delta)$ whenever it collects a bad signal;
- for $\theta \in [1-p, \theta-]$ it issues a bad rating whenever it collects a bad private signal, a bad rating with probability δ and a good rating with probability 1- δ whenever it collects a good signal.

[21] The two types of CRAs can also be seen as the same agency dealing with different rating sectors (corporate, banking, insurance, sovereign, etc.). Having invested in the screening technology mostly in the past, CRAs have been able to provide reliable ratings in the traditional sectors, while their ratings of the new structured products, for which the screening technology - as seen - was not

4.2 The issuing firms' moral hazard

The theme of the moral hazard of the issuing firm (underlined by SEC) and investments in screening technology can be explained by Chemmanur et al's model (1994). They describe the moral hazard of entrepreneurs that approach an external institution (CRA, investment bank, etc.) even if their project is bad, since there is a positive probability that a good evaluation is assigned to a bad project due to the with falls in the screening technology.

They consider an economy that has two dates (time 0 and time 1). There are three kinds of agents, who are all risk neutral: entrepreneurs, investment banks (or CRAs in our case), and ordinary investors. At time 0, entrepreneurs take their private firms public by selling their equity in these firms to outsiders in an initial public offering (IPO). Each entrepreneur chooses to market equity either directly to investors or using the services of an investment bank (the investment bank can also be seen as a rating agency providing the rating before selling). At time 1, a new round of entrepreneurs enters the equity market; then the events at time 0 are repeated. This concludes the game. Each entrepreneur has a single project, which can be of two types, *"good"* $(\omega = G)$ or *"bad"* $(\omega = B)$; the expectation of future cash flows from firms with good projects is 1, and those with bad projects is 0. The market for new issues is characterized by asymmetric information. While entrepreneurs know the type of their own firms, ordinary investors don't. The proportion of good firms is the same at each date, and is denoted by θ, which is common knowledge. CRAs conduct an evaluation of each firm that approaches them. These evaluations have only two possible outcomes, denoted by M: "good" (M = G) or "bad" (M = B).

The CRA can set a different evaluation standard at each date; depending on how strict its evaluation standard is, it may also assign (incorrectly) a good evaluation to a bad firm with a probability r:

$$r = prob(M = G / \omega = B) \tag{22}$$

where $r \in [p, 1],\ p \succ 0$

A higher r corresponds to a less-stringent evaluation procedure (since r is the probability of making an incorrect evaluation). If the CRA sets ($r = 1$), it gives a good evaluation to all firms approaching it. The other extreme, (r = p), corresponds to the most stringent evaluation procedure available; since ($p \succ 0$), mistakes are possible even in this case.

An entrepreneur can refuse to make use of a CRA after learning the evaluation that the CRA will report; each entrepreneur's firm is evaluated by only one CRA. If the entrepreneur chooses not to use the CRA, he has no choice but to market the equity directly to investors.

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sufficiently developed, may have induced them to issue too many good ratings, following the common belief that these products were riskless.

CRAs are of two types, indexed by *I=[H,N]:* while most have to incur a cost *C(r)* to evaluate firms ("high-cost", *I* = *H*), there is a small proportion that can evaluate firms costlessly ("no-cost", *I* = *N*).

At time 0, entrepreneurs and investors have a prior probability assessment $\rho \in (0, 1)$, of each CRA being of the no-cost type. The evaluation cost of the high-cost CRA *C(r)* depends upon the stringency of its evaluation standard. Further, the higher the probability of making an incorrect evaluation (*r*), the lower the expected value of the evaluation cost incurred at each date (i.e. $(C(r) \prec 0)$, while (C(*1*) = 0) i.e. the evaluation cost is zero if the CRA does not produce any information and instead gives a good evaluation to all). The CRA's evaluation cost is unobservable, so the high-cost type is subject to moral hazard as it has an incentive to lower its evaluation standard in order to reduce the evaluation cost. The no-cost type, however, has no such incentive, since it can evaluate firms costless.

CRAs obtain a fee *F* only from firms whose equity they market; the fee is a fraction $k \in (0, 1)$, of the "surplus value" generated for the firm, represented by the difference between the value of equity when the CRA markets equity and the value when the entrepreneur approaches the equity market directly.

At time 1, investors know the true type of firms marketed by CRAs at time 0, and update the CRA's reputation using Bayes' rule. If investors conjecture that the no-cost type sets stricter evaluation standards than the high-cost type in an equilibrium situation, the CRA's reputation goes down if it is revealed that the equity marketed by it at time 0 was of a bad firm and goes up if the equity was of a good firm.

It is shown that in equilibrium, the no cost type CRA always sets the strictest possible evaluation standards at each date ($r = p$), since it can evaluate firms costless. The high cost type minimizes the evaluation cost by setting ($r = 1$) at time 1 (i.e. giving good evaluation to all firms). However, at time 0, the high-cost type faces a tradeoff: setting a lower evaluation standard reduces evaluation costs, but increases the probability of marketing a bad firm with a good evaluation, thereby damaging reputation and lowering time 1 profit.

Since the two types of CRAs behave differently in equilibrium, knowing the firm type at time 1 gives investors information that they use to update their probability assessment of the CRA type. If the firm rated by a CRA at time 0 is revealed as a bad, the CRA's reputation decreases; if it turns out to be a good firm, its reputation increases. In equilibrium, CRAs market equity only in firms that obtain good evaluations. Further, when a good firm is guaranteed a good evaluation, it is always in the interest of entrepreneurs with good firms to use CRAs to reduce the extent of their pooling with bad firms. Given this incentive, investors infer that any firm whose equity is marketed directly by the entrepreneur is a bad firm and therefore price the equity of such firms at the true value of a bad firm; i.e. (S_B = 0). This, in turn, implies that even an entrepreneur with a bad firm will approach an CRA in equilibrium to undergo evaluation, since there is a positive probability that the CRA will incorrectly assign its firm a good evaluation and market its equity. Thus, only entrepreneurs whose firms receive bad evaluations market equity directly.

In conclusion, investing in the screening technology is necessary not only to avoid wrong evaluations but also the issuing firms' moral hazard. As seen, firms can be induced to ask for a rating even for bad projects, if they are aware that the technology is not totally reliable and that there is some probability that their project can be valued as good. Even if there is not direct evidence of this aspect, it may have played a role in the recent crisis as some originating banks can have taken advantage of downfalls in rating methodologies obtaining a good rating for CRT securities even if the underlying pool of assets was not of a high quality.

5. Conclusion: improving rating market efficiency

As seen, several factors can contribute to explain CRAs' behaviour prior to the financial crisis, and the conflict of interest seems one of the most relevant. The analysis suggests that reputation has not represented an adequate incentive to guarantee good quality ratings and highlights the need to restore correct incentives to get high quality ratings, not affected by the temptation to please issuers. More specifically, the analysis indicates that CRAs face a trade-off between profit maximization and reputational incentives, and are tempted to inflate ratings every time profits exceed the reputational costs (Sobel,1985). Moreover, the wider the over-reliance on ratings (i.e. the portion of investors trusting CRAs' evaluations), the longer is the time period necessary to discover an opportunistic CRA, as they can have incentives to choose between telling and withholding the truth in order to take advantage of naïve investors (Bolton et al., 2007).

However, the paper also shows that reputation is a good disciplining device for CRAs when the fraction of income coming from sources other than rating complex products is high and/or the proportion of successful projects is large (Mathis et al., 2009). Moreover, even in case of aligned incentives, CRAs can never be completely truthful if investors are uncertain about CRAs incentives and remuneration, as investors will tend to be sceptical about rating content; hence the CRAs' practice of making recourse to categorical ratings (Crawford and Sobel, 1982, Morgan and Stocken, 2003).

One way to eliminate or reduce the conflict of interest could be to require investors and not issuers to pay for ratings, going back to the model in use before the nineteen-seventies (when CRAs were paid by investors). A return to the investor-pay model would solve the conflict of interest problem but would also introduce the free riding issue, as some investors would obtain ratings freely from sources other than CRAs. As seen, this might result in insufficient revenues for the rating agencies (Pragyan D. et al., 2009). Another argument against the investor pay model is that it could be subject to conflict of interest too, as CRAs might be induced to please investors with strong preferences for highly rated products[22]. Lastly, investor paid (or unsolicited) ratings are generally considered less accurate than issuer paid ones as they are generally based on publicly available information (like firms' balance sheets) without any direct involvement of the issuing firm..

As a matter of fact, some investor-paid CRA ratings already exist and they show that this model is practicable both in Europe and in USA. So far, these CRAs have dealt with the free rider problem generally by communicating their ratings only to subscribers and rated firms. A wider development of this type of CRAs could contribute to reducing the problem of the conflict of interest as investors would have the possibility to compare multiple ratings (solicited and unsolicited), reflecting different incentive schemes. Regarding CRTs, multiple ratings can be obtained if issuer-paid CRAs are required to publicly disclose the information used for their analysis, including information on the assets underlying CRTs, as recently decided by SEC [23].

Another possible way to prevent conflicts of interest (and also the rating shopping) would be to require issuers to pay an upfront fee to the CRA before its initial analyses are conducted. Nevertheless, even this solution could prove inefficient as CRAs and issuers could make a private agreement not to reveal a bad rating. Moreover, the CRA would have no incentive to improve the screening technology, if it were paid before providing the rating.

Mathis et al. (2009) propose instead a model that they call the platform-pays: when a potential issuer wants to apply for credit ratings it should be required to contact a platform, governing the rating process, and would pay an upfront fee to the platform. This in turn would choose the CRA and pay it independently from the rating outcome, and independently of whether the rating is issued or not. The platform would also be in charge of providing licences to CRAs and of revoking them if the realized default rates proved too high. However, this model would require a strict cooperation between issuers and investors, which would be in charge of constructing and governing the platform[24] .

[22] As an example, banks that make recourse to the Basel II – standardised model may require higher ratings for the assets in their portfolio in order to reduce capital requirements.

[23] It is also sometimes argued that CRAs generally issue low unsolicited rating in order to approach the issuing firm and to be hired for a higher issuer paid rating. Even this problem could be overcome if CRAs were authorized by authorities to issue either solicited or unsolicited ratings.

[24] If the platform were owned and governed by the CRAs, it could be used as a collusion device by them.

Regarding competition, as indicated above, the market structure of the rating industry was one of the main causes of rating inflation as it allowed issuers to shop for rating, choosing the most favourable among those offered by CRAs. The latter were, in turn, incentivized to inflate ratings to attract business. As seen, rating shopping is amplified if investors are required by laws and internal regulations to rely on ratings for their portfolio choices, essentially because market discipline is lessened (Bolton et al., 2012).

It has also been shown (Mariano, 2009) that competition is a necessary but not sufficient condition to guarantee good quality ratings if it is not accompanied by the improvement of credit risk models. In fact, if rating is obligatory to undertake a project (like essentially was for CRTs), in a competitive setting CRAs tend to be issue too many good ratings, especially if investors are optimistic about the project outcome; otherwise, a bad rating could be seen as a signal of poor talent (a less talented CRA might provide a bad rating to avoid that the project is undertaken and the shortfalls in its credit risk models revealed).

More competition cannot therefore produce beneficial effects in terms of rating content and welfare unless the over-reliance on rating (i.e. the proportion of naïve investors described in Benabou et al. and in Bolton et al. models) is reduced and the rating methodologies are improved.

Moreover it should be ensured that CRAs' incentives to invest in rating accuracy are constant through the business cycle. As indicated (Bar- Isaac et al. 2013), CRAs tend to invest less in credit risk models and in skilled analysts during expansionary phases (like the pre-crisis perod), when they can more easily maximize their profits (because of investments' lower probabilities of defaults) and when the costs of the factors of production are higher.

Finally, as highlighted in some of the models described above, investors should be guaranteed higher transparency about ratings' models, methodologies and key assumptions, which would allow them to better evaluate ratings' reliability and content. Also, the disclosure of remuneration mechanisms should reveal where potential conflicts can arise.

Bearing in mind all these issues it is important to develop a new regulatory framework for CRAs that reduces authorities' and investors' reliance on ratings, while increasing oversight of CRAs' internal governance and transparency. Regulation typically faces a trade-off when applied to CRAs, as it must not interfere with rating methodologies - in order to guarantee the independence of CRAs' evaluations - whilst ensuring that CRAs act appropriately and make recourse to adequate rating procedures. Since the crisis, several initiatives have been undertaken to strengthen the regulatory framework for CRAs'; other initiatives are under scrutiny. These aim to increase oversight powers for authorities as well as enhance competition, transparency and the internal governance of the CRAs, without limiting their independence. Firstly, regulators have convened that they need to reduce the (over) reliance on ratings in "standard, laws and regulations" and in markets in general[25]. Both in Europe and in the US, new rules, recently implemented, aim for CRAs to guarantee more transparency and better governance, in order to improve market discipline.

Secondly, regulators are now entitled to supervise CRAs' internal governance, in order to ensure that the latters' organizational structure is properly designed to manage and reduce conflicts of interest (essentially separating the commercial functions from the analytical functions to guarantee analysts independence) and also that training, experience, number and competence of rating analysts satisfy given standards.

Last but not least, investors' due diligence is also very important: banks, central banks, investment managers and institutional investors should carry out their own thorough analyses vis-à-vis their investments choices. These should be commensurate with the complexity and materiality of the exposure.

[25] Authorities acknowledge that this will take some time, as no direct substitutes of ratings have been identified so far, notwithstanding that several alternative approaches that remove references to ratings entirely have been considered in the debate (like CDS premia). See Financial Stability Board (2010), "Principles For Reducing Reliance On CRA Ratings".

References

Akerlof A.G. (1970), The Market for Lemons: Quality and the Market Mechanism. Quarterly Journal of Economics.

Bar-Isaac Heski, Shapiro Joel, Ratings quality over the business cycle Journal of Financial Economics Volume108, Issue 1, pp. 62-78

BCE Bullettin (2009), Credit rating agencies: developments and policy issues", pp. 107-117, may.

Benabou R., Laroque G. (1982), Using Privileged Information to Manipulate Markets: Insiders, Gurus, and Credibility. The Quarterly Journal of Economics, vol. 107, issue 3, pp. 921-958.

Benmelech B. E, Dlugosz J. (2009), The credit rating crisis, NBER working paper series. Working Paper No 15045, June.

Boeri T., Guiso L. (2009) The First Global Financial Crisis of the 21st Century. A VoxEU.org Publication.

Bolton P., Freixas X., Shapiro J. (2007), Conflicts of interest, information provision, and competition in the financial services industry. Journal of Financial Economics, Volume 85, Issue 2, p.297–330.

Bolton P., Freixas X., Shapiro J. (2012), The Credit rating game. Journal of Finance, Volume 67, Issue 1, p.85-111.

Cantor R., Packer F. (1995), The Credit Rating Industry. The Journal of Fixed Income, December Vol. 5, No. 3: pp. 10-34.

Chemmanur T.J., Fulghieri P. (1994), Investment Bank Reputation, Information Production, and Financial Intermediation. The Journal of Finance, Vol. 4, No. 1, pp. 57-79, Mar.

Committee on the Global Financial System (2008), Ratings in CRTs: what went wrong and what can be done to address shortcomings? Report submitted by a Study Group established by the Committee on the Global Financial System.

Committee on the Global Financial System (2005), The role of ratings in CRTs: issues and implications, Report submitted by a Working Group established by the Committee on the Global Financial System.

Crawford V. P., Sobel J. (1982), Strategic Information Transmission. Econometrica, Vol. 50, No. 6, Nov., pp. 1431-1451.

Deby P., Murphyz G. (2009), Credit Rating Agencies: An Alternative Model, mimeo.

Fennell D., Medvedev A. (2011), An Economic Analysis of Credit Rating Agency Business Models And Rating Accuracy, FSA Occasional paper, n.41.

Financial Stability Board (2010), Principles For Reducing Reliance On CRA Ratings".

IMF, 2008. Global Financial Stability Report, chapter 2, april.

IMF World Economic Outlook, various editions.

Inderst R., Ottaviani M. (2009), Misselling through Agents. The American Economic Review, Volume 99, Number 3, June, pp. 883-908.

Kiff J., Nowak S., Schumacher L. (2012), Are Rating Agencies Powerful? An Investigation into the Impact and Accuracy of Sovereign Ratings, IMF Working Paper 23.

Kreps D., Wilson R. (1982), Reputation and imperfect information, Journal of Economic Theory. N. 27.

Lizzeri A. (1999), Information Revelation and Certification Intermediaries, The RAND Journal of Economics, Vol. 30, No. 2 (Summer), pp. 214-231.

Mariano B. (2008), Do Reputational Concerns Lead to Reliable Ratings? Discussion Paper No 613, LSE Discussion Paper Series.

Mathis J., McAndrews J. and Rochet J. (2009), Rating the raters: Are reputation concerns powerful enough to discipline rating agencies?, Journal of monetary economics 56.

Moody's Annual Report (2007), (2008).

Morgan J., Stocken P.C. (2003), An Analysis of Stock Recommendations, The Rand Journal of Economics, Vol. 34, No. 1 Spring, pp. 183-203.

Morris S. (2001), Political Correctness, The Journal of Political Economy, vol. 109, no.2.

SEC (2003), Report on the Role and Function of Credit Rating Agencies in the Operation of the Securities Markets As Required by Section 702(b) of the Sarbanes-Oxley Act of 2002, January.

SEC (2008), Summary Report of Issues Identified in the Commission Staff's Examinations of Select Credit Rating Agencies.

SEC (2009), Report on nationally recognized statistical rating organizations as required by section 6 of the credit rating agency reform act of 2006", September.

Sobel J. (1985), A theory of credibility, The Review of economic studies, vol.52, issue 4, pp. 557-573.

Spencer D. (2009), "2009: A review of the economic year", Bank of England, September.