Credit rating agencies, shock and public expectations

Julien Trouillet

February 2015

Abstract

Keywords: Credit Rating Agency, Reputation

This paper studies the behavior of a Credit Rating Agency after a shock. As it has already been discussed, reputation incentives may not be sufficient to discipline a CRA. In a cheap-talk game, I show that a CRA may have incentives to be lax in its ratings when a bubble is about to burst and severe after a shock that has hit its reputation and the economy. The consequences may be severe depending on the economy we are thinking of, emerging markets or an economy with financial disintermediation may be the most threatened. This can be see as one of the factors that may have foster the last financial crisis, especially the south east asian and the subprime ones.

1 Introduction

Credit Rating Agencies (hereafter CRAs) have recently been under the spotlight. After the subprime crisis, they where accused of bearing a strong responsibility because their ratings appeared to have been too generous, and during the European debt crisis they were accused of being too severe when downgrading countries which were facing some difficulties, not helping a recovery. Those two events have shown how influent CRAs can be on the economy. To understand well the issues raised throughout their activity, we need to look back at the history of this industry and on their role in the economy. Credit Rating Agencies first appeard by the end of the nineteenth century. They were providing information for investors about the ability of a firm to honor its debt. At that time, the CRAs were selling books, and were paid by the investors, who needed this information to select in which company to invest. This business model felt during the second part of the twentieth century, where the progress of the information technology created an opportunity of free-riding (it became easier to copy books). This situation led the CRAs to change their business model. They then turned to an issuer-pay business model, and they also received a stronger role to play in the economy through regulation (the grades are needed to evaluate the riskiness of an investment

and are used by the financial regulation to compute regulatory capital needs for banks and pension funds).This activity is handled by an oligopoly. Standard and Poor's, Moody's and Fitch are the three main companies leading this business[1]. Their influence on the economy through the financial sphere is major, especially in a economy where financial disintermediation is practiced, or in an economy sensitive to capital flows which are linked to the grade of the country (emerging countries per example). As I mentioned their role in the subprime crisis and in the European debt crisis, one may also think of the asian crisis of 1997. Actually, In Ferri (1999), the authors argued that the CRAs behavior fostered the magnitude of the business cycle. They demonstrated that credit rating agencies worsened the economic conditions in the East Asian countries by becoming excessively severe in their downgrading. Whereas they were also blamed for not predicting the crisis and for having been too lax previously. To show this change in the behavior of rating agencies, the authors used macroeconomic fundamentals of east asian countries and extrapolate the methodologies used before and after the crisis. It appears that the rating contains an important part of qualitative judgment, especially after the shock. They point out that this judgement may be also be motivated by the reputation of CRAs. Their reputation being hit by the crisis, they acted in a cautious manner to rebuilt it.

This leads us to the point of this article. The goal here is to study the behavior of an opportunistic CRA and see when it may have some incentives to be lax sometimes, and to be more severe after a shock in order to gain back some reputation. This should not be the case if we listen to the CRAs: they affirm that their ratings are independent of the business cycle[2]. The influence of such a behavior on an economy where financing is mainly through direct finance which means a sensibility to the rating activity, may amplify economic cycles, by fostering bubbles and delay recovery.

The rest of this article is build as follow, the next section will review the literature associated. In the third section I will present the model used in Mathis et al. (2009). The fourth section will study the extended game where economic conditions can change.

[1] If there is currently around 130 agencies, the big three, as they're called, share themselves 90 percent of the market

[2] Moody's rating policy:"Since Moody's ratings are intended to measure long-term risk, our analytical focus is on fundamental factors that will drive each issuer's long-term ability to meet debt payments, such as a change in management strategy or regulatory trends. As a rule of thumb, we are looking through the next economic cycle or longer"

2 Related literature

This paper studies the behavior of a Credit rating agency throughout different economic conditions. It belongs to a recent literature which focus on the different incentives leading the specific business model of the CRAs. After the subprime crises a lot of question have been raised to understand why they've made those mistakes. Their business model has been questioned, the conflict of interest may explain why so many financial products got a good rating. One of the main argument used by CRA to defend their behavior is that they cannot permit to be too lax, their reputation being their main asset. As shown in Mathis et al. (2009), the reputation may not be sufficient to discipline the CRA. In a setting inspired by the information transmission literature such as Sobel (1985) and to one of its rare adaptation to the finance, namely Benabou and Laroque (1992), they show that under imperfect information, the CRA may give a good rating to a project in which no investment should take place. They then explain, but not develop, that the behavior of the CRA could be made of confident cycles. When the reputation is high, the probability that the CRA will give a good rating to a bad project turns to be very high, when its reputation is low the CRA can't engage in that kind of behavior. This is the idea I'm digging here and I would like also to see if a CRA with a low reputation may not have the incentives to be more severe than it should in order to gain back some reputational capital.

The idea that ratings' quality may be linked to the business cycles isn't new. Jeffery D'Amato (2003) has made an econometric study for the Bank for International Settlement, they find evidence of a dynamic level of rating quality by looking at the initial ratings and the rating changes that occurs after the issue of debt. An other look into the world of the CRA was provided to us by Bar-Isaac and Deb (2012). They study the quality of ratings over the business cycles as a function of the economic conditions and they show that ratings are of better quality in a recession than in a boom. Their results rely mainly on the labor conditions; it is easier and cheaper to hire good analysts in a recession than in a boom where competition is stronger and incentives to higher better analyst are lower because of a better average quality of projects in the economy. They find that ratings are counter-cyclical, but it appears through the last events that rating quality varies from one asset class to another, or from one geographical area to another.

My work is different in a sense that I study here the role of reputation when economic conditions unexpectedly

change. I argue that as economic conditions are known to vary, it may be better for a CRA to enjoy a high level of reputation by being lax and to be too severe when reputation falls. The idea behind all this is to study the interaction between the business cycles and the confident cycle that the CRA is facing. Its reputation evolves from one period to another leading it to adopt different strategies, which eventually brings a certain latency after a shock, the CRA having lost some reputational capital may be tempted to "play safe" and so gives few good rating. The same idea could lead a CRA to underestimate a possible end of a boom period and gives more good ratings than she should in order to enjoy a big pay-off if its reputation is not to much in danger. This gives me the opportunity to see if the CRA may give more good ratings than it should do when its reputation is high enough and if it may give a bad ratings to projects that should be finance when its reputation is too low. This behavior may have important consequences in the movement of capital flows and return rate, which could then influence the nature of business cycles (magnitude, length).

3 Benchmark: the basic framework

In this section, I introduce the model used in Mathis et al. (2009), which I'll extend in the next section. I consider a model with a single CRA, one issuer and many investors. I study theirs interactions over an infinite number of discrete periods. At each period the CRA is facing a cashless firm (the issuer) who wants to issue a security to finance a project. The project quality is a priori unknown, even for the issuer. It can be good with probability λ (bad with probability $1-\lambda$). All projects, when successful, gives a return of X, the good ones with probability P_G (P_B for the bad ones, with $P_B < P_G < 1$). Without information no issue takes place, $(\lambda P_g + (1 - \lambda P_b)) < 1$. The CRA perfectly observes the quality of the project submitted, even if the good projects may fail and the bad ones may success. A project needs a good rating to be financed. The CRA is a long run player with discount factor $\delta \in (0; 1)$. Issuers and investors are short-run player.

As in many reputation's game, the CRA can be of two types : honest ,committed to tell the truth, or opportunistic ,it can deviate from its private signal in order to maximise its intertemporal profit. In this section, I study the case where an opportunistic CRA may deviate from its private information in only one direction, it can give

a good rating to a bad project. The Issuers and investors have a prior q_0 about the CRA's type, q_t defines the reputation of the CRA (the probability the CRA is honest). The Issuers and investors play only for one period, knowing the current reputation q_t of the CRA. I define the markov strategy of an opportunistic CRA by:

$u : [0,1] \to [0,1]$,

Investors and issuers's behavior is described by the markov belief function.

$p : [0,1] \to [0,1]$,

Where p(q) is defined as the probability of success knowing the reputation q of the CRA. When the CRA is trusted (i.e. its reputation is high enough that is $p(q) \geq 1/X$), the market equilibrium condition is:

$p(q)R(q) = 1$, where R(q) is the nominal return promised to investors. $p(q) = \dfrac{\lambda P_G + (1-q)(1-\lambda)uP_B}{\lambda + (1-\lambda(1-q)u}$.

The probability that a bad project gets a good rating is noted as $a(q,u)$, defining the perceived accuracy of the rating:

$a(q,u) \equiv 1 - (1-q)u(q)$

At each stage, the CRA receives a fixed revenue from its other activities hereafter defined as i_0 and if it gives a good ratings receives a pay-off of function of its reputation $I(q)$, so when the CRA gives a good rating it receives for the period:

$$\Pi_t = i_0 + I(q)$$

Where I(.) is a function equal to 0 if $q < q_l$ and increasing between $q = q_l$ and 1 as in Mathis et al. (2009), q_l is a threshold below which the CRA's reputation is too low, making it useless for investors and so issuers, when the CRA's reputation becomes too low, it lost all credibility and thus, it can't bill its opinion.[3]. The issuers invest in the projects well rated as long as $q > q_l$. The CRA's profit is linked with its reputation, the better it is, the more it can bill, actually if a trustful agent gives a good recommendation it is more valuable.[4] q_l corresponds to the limit such that for $q < q_l$, $p(q) < 1/X$.

[3] In Ferri (1999), they also mention the idea that fees could be higher when the reputation is high and when the economy is doing well

[4] I will test the robustness of this assumption by using different kind of function I(.). It is difficult to evaluate the pricing policy of a CRA, it may depend of the relationship the CRA may have with different types of issuers. But it appears quite intuitive to say that if the reputation of a CRA falls too low, it may not survive.

The investors don't know what kind of CRA they're facing, they have a prior q_0 that the CRA is honest. From one period to another the CRA's reputation evolves following Bayes' rules:

$$q_{t+1} = \begin{cases} q^S = \dfrac{q}{1+(1-q)u(q)\dfrac{1-\lambda}{\lambda}\dfrac{P_B}{P_G}} & \text{given a successful project financed} \\ q^F = \dfrac{q}{1+(1-q)u(q)\dfrac{1-\lambda}{\lambda}\dfrac{1-P_B}{1-P_G}} & \text{given an unsuccessful project financed} \\ q^N = \dfrac{q}{a(q,u)} & \text{when the CRA gives a bad rating} \end{cases} \tag{1}$$

Definition 1 A stationnary Markov perfect equilibrium is a triple (u, p, ψ) such that for all q:

(i) $u(q)$ maximizes the intertemporal profit of the CRA;

(ii) $p(q) = \lambda/(\lambda + (1-\lambda)(1-q)u(q)$; and

(iii) q_{t+1} satisfies (1)

In the latter the notion of equilibrium will refer to such a triple.

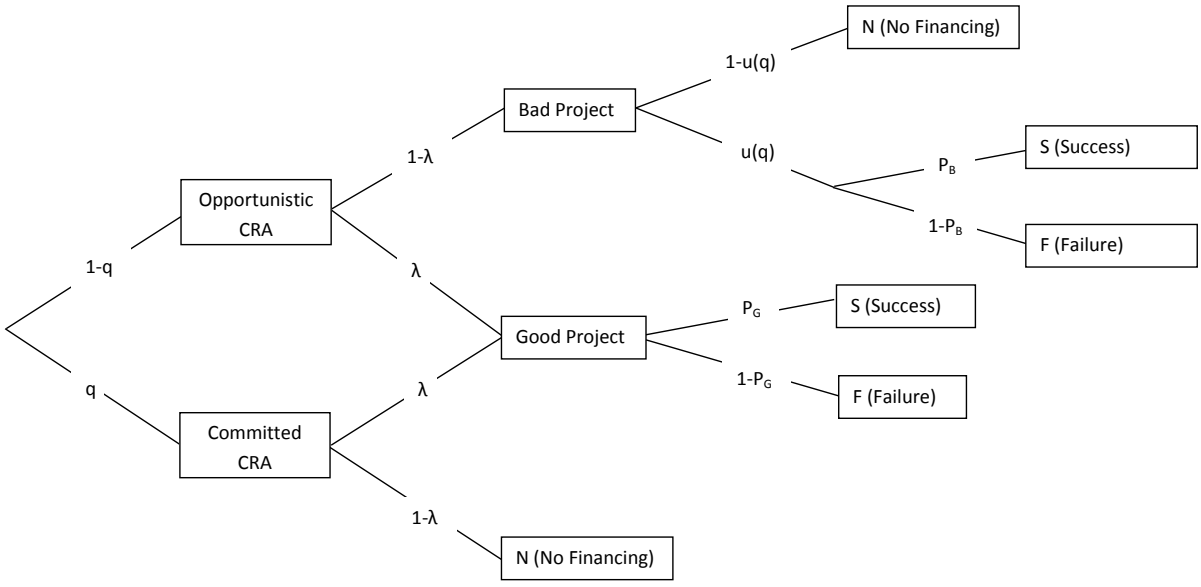

Figure 1: Decision tree for an opportunistic CRA

The Bellman equation characterizes the value function of the opportunistic CRA before observing the project quality:

$$V(q) = i_0 \mathbf{1}_{q>0} + \max_{0\leq u\leq 1} [(\lambda + (1-\lambda)u)I(q) + \delta((\lambda P_G + (1-\lambda)P_B u)V(q^S) + (\lambda(1-P_G) + (1-\lambda)(1-P_B)u)V(q^F) + (1-\lambda(1-u))V(q^N))] \tag{2}$$

According to the one stage deviation, for any q, u is an optimal strategy if and only if for any u' we have:

$$(u(q) - u'(q))[I(q) + \delta P_B V(q^S) + (1-P_B)V(q_F)] \geq \delta(u(q) - u'(q))V(q^N) \tag{3}$$

$u(q) = 1$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1-P_B)V(q^F)) \geq \delta V(q^N) \tag{4}$$

$u(q) = 0$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1-P_B)V(q^F)) \leq \delta V(q^N) \tag{5}$$

$u(q) \in (0;1)$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1-P_B)V(q^F)) = \delta V(q^N) \tag{6}$$

I remind their result, proposition 4 in Mathis et al. (2009):

Proposition 1 *At any equilibrium the opportunistic CRA's always give a good rating to bad project with a positive probability. In this setting the opportunistic CRA lies for sure when q close to* 1 *and with positive probability when its reputation is low.*

Proof: The proof is based on the fact that if the CRA would never lie then any mistake would be considered as honest ones and then gives the incentives to give good ratings to bad projects. The proof is based on the following analysis which would also be useful in the next section.

Step 1: let q $\in$ [0; 1]. Assume per contra that u(q)=0 is part of an equilibrium strategy. By (1) we have $q^F = q^S = q^N$. So by (5), $I(1) \leq 0$, a contradiction.

step 2: From (1) and $V \in C+$ we have $\lim_{q\to 1} V(q^S) = \lim_{q\to 1} V(q^F) = \lim_{q\to 1} V(q^N) = V(1)$

Therefore $\lim_{q\to 1}[I(a(q, u(q))) + (1 - P_B)(V(q^F) - V(q^N))] = I(1) > 0$. Hence (4) holds while (5) and (6) do not hold.

So an opportunistic CRA has incentives to give good ratings to bad projects. The incentive for this behavior comes from two axes:

- The imperfect observation situation allows the CRA to hide behind "honest mistakes" as good project fails, the incentive is also stronger when the probability of success of bad project is higher;
- As its reputation is computed following Bayes' rules, even if the reputation as an asset matters for a CRA, it isn't enough to discipline it. As seen in the proof of proposition (1), if an opportunistic CRA wouldn't give good rating to bad project it wouldn't gain any reputational capital

From this setting, I study the behavior of an opportunistic CRA when economic fundamental may change unexpectedly ,i.e. when λ may suddenly change. This would add an other level of uncertainty and may lead the CRA to adopt a different behavior.

4 CRA's behavior through a dynamic economy

As it has been pointed out, the behavior of a CRA may varies over time. In Bar-Isaac and Deb (2012), they show that ratings' accuracy may be different in a boom than in a recession. They show it through the labor marker condition, in a boom competition to get a good analysis is tougher leading the CRA to lower its quality. Here i study the case where only the proportion of good project may vary over time whereas the audience still makes its inference from the previous parameter. The CRA knows better the state of the world so it can observe a different state of the economy before the public could. If the CRA anticipates the economy get better, its future revenue are higher than estimated by the public which could lead it to act in a precautious way and don't overrate as it would do in the previous situation. Thus I consider that the audience (investors and issuers) can't anticipate the

change in the parameter and make their inferences through the parameter previously known. Moreover I consider this change as permanent.

I also consider that the CRA gets another action, as it could give a bad rating to a good project. This strategy would be denoted as : $l : [0,1] \to [0,1]$. Actually after a negative shock on the economy, CRA's behaviour has been pointed out for being too severe, whereas we think of the european debt crisis (after the subprime crisis) or the east asian countries which were severely downgraded after the shock that hit this area.

Proposition 2 *The CRA won't give a bad rating to a good project ($l = 0$) if it would give with a positive probability a good rating to a bad project, $u > 0$.*

Proof: This results lies on the differences of probability of success of each project. As the CRA is willing to give a good rating to a bad project, and as bad project have lower chance of success it would make no sense for an opportunistic CRA to engage in that kind of behavior where it might give a good rating to a bad project and a bad rating to a good project. In any of the following cases, if $u > 0$, then the CRA never gives a bad rating to a good projet.

When studying the different cases hereafter, I will first study the behavior of an opportunistic CRA considering only its strategy of giving a good rating to a bad project first, and in the cases where this one appears to have a probability null, I will then look at its strategy consisting in giving a bad rating to a good project (i.e l).

Assumption 1 *For $\lambda_a > \lambda_b$, $V_{\lambda_a}(q) > V_{\lambda_b}(q)$, a better economic environment gives higher revenue for the CRA, so its value function is greater.*

This hypothesis goes along with the business model considered, by linking revenue to issuing, CRA's are better off the more they can give good ratings.

4.1 The investors unexpect a better economic environment

The economic conditions appears to have a greater proportion of good project, $\lambda_t > \lambda_{t-1}$, and $\lambda_t^e = \lambda_{t-1}$ (for invesotrs and issuers), $\lambda_t > \lambda_{t-1}$, and for $T > t$, $\lambda_T = \lambda_t$. The idea behind this setting is that some changes in

economic conditions can't be anticipated and it make sense that the CRA could have better information about the current state of the economy. Per example, It appears that the CRA were aware of a deterioration of quality in the subprime mortgages before the bubble crashes, as shown in Ashcraft et al. (2010).

People will use the lambda expected to evaluate the strategy of the CRA. They anticipate a strategy for all the parameters known in the model. Actually, the CRA is facing a different problem than they thought. Given the behavior of the audience, it knows that q_{t+1} will still be computed in the same way and is based on $\tilde{u} > 0$, the strategy used in the previous setting, whatever its real strategy is. The CRA must now maximize its value function which is :

$$\begin{aligned} V(q) = i_0 \mathbf{1}_{q>0} + \max_{0\leq u,l\leq 1} [(\lambda(1-l) + (1-\lambda)u)I(q) + \delta((\lambda(1-l)P_G + (1-\lambda)P_B u)V(q^S) \\ + (\lambda(1-P_G)(1-l) + (1-\lambda)(1-P_B)u)V(q^F) + ((1-\lambda)(1-u) + \lambda l)V(q^N))] \end{aligned} \tag{7}$$

Where q^F, q^N, q^S, are computed following (1) with $\tilde{u}$ and λ^e. First I look at the probability of giving a good rating to a bad project (i.e. $u(q)$).

Proposition 3 *In some equilibrium the CRA will not give a good rating to a bad project with a positive probability, i.e* $u = 0$.

Proof: The investors evaluate the strategy of the CRA from the previous game, i.e. with $\lambda_t^e < \lambda_t$. I recall the results from the previous section, the CRA would always give a good rating to a bad project with positive probability that is there is $\tilde{u} > 0$ and so q_{t+1} will be computed following (1) with $\tilde{u}$ and λ_t^e, so we still have $q^N > q^S < q^F$. So if we note $\underline{V}(q^i)$ the value function associated with λ_{t-1} and $\bar{V}(q^i)$ the one associated with λ_t we have according to equation (6).

$$I(q) + \delta(P_B \underline{V}(q^S) + (1-P_B)\underline{V}(q^F)) = \delta \underline{V}(q^N) \tag{8}$$

However the CRA consieders the actual situation, with $\bar{V}$, so we have, $\bar{V}(q^N) > \underline{V}(q^N)$, $\bar{V}(q^S) > \underline{V}(q^S)$ and $\bar{V}(q^F) > \underline{V}(q^F)$.

If $\bar{V}(q^N) - \underline{V}(q^N) > P_B(\bar{V}(q^S) - \underline{V}(q^S)) + (1-P_B)(\bar{V}(q^F) - \underline{V}(q^F))$ Then for δ high enough and $I(q)$ small

enough:

$$I(q) + \delta(P_B \bar{V}(q^S) + (1 - P_B)\bar{V}(q^F)) \leq \delta \bar{V}(q^N) \tag{9}$$

which implies $u = 0$.

Proposition 4 *In some equilibrium, the CRA may give a bad rating to a good project i.e.* $l > 0$.

Proof: The proof is based on the same principles that in the last proposition. I consider that the CRA may now give a bad rating to a good project that is l_q. The equations defining the value of l_q are the same than the one used for u in equation (4),(5) and (6) as long as $u = 0$ with the "opposite value" taken by l, details are in the appendix. As the audience didn't expect the economic condtions to change, they expect the opportunistic CRA to deviate, that is there expect an $\tilde{u} \in (0; 1)$ and if we note $\underline{V}(q^i)$ the value function expected from the previous game, then we have:

$$I(q) + \delta(P_B \underline{V}(q^S) + (1 - P_B)\underline{V}(q^F)) = \delta \underline{V}(q^N) \tag{10}$$

And so, if q, $I(q)$ low enough we have :

$$I(q) + \delta(P_B \bar{V}(q^S) + (1 - P_B)\bar{V}(q^F)) = \delta \bar{V}(q^N) \tag{11}$$

Which means $l \in (0, 1)$. Actually we could have $I(q) + \delta(P_B \bar{V}(q^S) + (1 - P_B)\bar{V}(q^F)) \leq \delta \bar{V}(q^N)$ which would lead to $l = 1$ As the proportion of good project in the economy increases, the value function does too, we have $\underline{V}(q^i) < \bar{V}(q^i)$ for all I. and we have $q^N > q^S > q^F$ as $\bar{u} > 0$ even if the actual strategy of the CRA doesn't consider giving a good rating to a bad project. This explains why the CRA could be lead to deviate towards giving a bad rating to a good project. As seen in the previous proof, the key condition is the equation $\bar{V}(q^N) - \underline{V}(q^N) > P_B(\bar{V}(q^S) - \underline{V}(q^S)) + (1 - P_B)(\bar{V}(q^F) - \underline{V}(q^F))$, it means that the value function of the CRA must respect the following property: for two level of λ (λ_a and λ_b) the difference in revenue for the CRA between the two states is greater when its reputation is higher, which could be seen as :

$$\frac{\partial V_{q_a}}{\partial \lambda} > \frac{\partial V_{q_b}}{\partial \lambda} \qquad \text{for } q_a > q_b \tag{12}$$

So the way the reputation influence CRA's revenue may have different consequences on its behavior. Also when

δ is high enough and q low enough it may have the intention to save its reputation for future revenues, then $u = 0$. An other parameter that play an interesting role in this equation is P_B, the fact that good project can fail help the opportunistic CRA to hide behind honest mistakes. But it also represent a risk of loss in reputation, so the smaller P_B is, the more the CRA could be tempted to underrate as it appears in equation (11).

This situation must been seen as a particular point in the long-run behaviour of the CRA. It explains why after a shock, a CRA may take a longer time to give good ratings again, as its reputation is low and public expectation about current the state of the economy is pessimistic.

We can see there that the CRA's behavior is changed because of an unexpected proportion of good project. In order to ensure future gains, the CRA may act in a cautious manner. If the unperfect observation setting of the previous section (the good project could success as the bad ones could fail) was leading the opportunistic CRA to give a good rating to a bad project, this time the cost of a failure (even from a good project) could be seen too heavy in front of future revenues which appears to be higher than expected.

Even if we consider that investors are aware of potential economic changes, as long as they don't have a perfect knowledge of the current economic condition and the CRA does, they can't perfectly anticipate its behaviour, leaving it enough space to deviate in a different direction than expected.

Economic interpretation:

During the east asian crisis, the CRA downgraded severely some countries (South Korea per example) more than they should have, see Ferri (1999), after a shock which lead most CRAs to face a big loss in reputation capital. We could also think of the European debt crisis, anticipating that the economic condition would get better, the opportunistic CRA may have interest in protecting its reputation to acquire higher revenues later. As the public can't anticipate the change in the economic condition they can't forecast the behavior of an opportunistic CRA making it possible for it to foster its reputation in the short-term. The CRAs have often been criticized, but those critics came after a shock which the public hasn't expected. Through out normal times, there behavior is less pointed out. The fact that the deviation of the CRA happen after a shock may give a certain latency for getting out of a recession. Actually, the pessimistic estimation of the economy by the audience lead the CRA to act this way

in line with papers studying the behavior of expert in front of public audience, such as in Ottaviani and Sorensen (2002).

4.2 The investors unexpect a worsening economic environment

By symmetry, this will give incentive to the opportunistic CRA to enjoy the current economic condition by deviating more than in the previous section. In this situation the opportunistic finds that it may be even more interesting than the audience think to deviate towards giving good rating to bad projects as the economic condition are worsening and it wants to enjoy short term profit.

Proposition 5 *In this setting, the CRA will give a good rating to a bad project with a greater probability than in the previous section i.e* $u > \tilde{u}$

Proof: The proof is based on the same principle than in the previous situation. The opportunistic CRA see that economic conditions are worsening, it may tempted to enjoy this brief moment of acknowledge of the economic condition by the audience by increasing its short-term revenue. the details of the proof are in the appendix.

Economic interpretation: Recently, the Credit rating agency Standard and Poor's has been fined by the U.S. authorities for its rating in the MBS market (mortgage back securities). As it has been largely studied, it appears the CRA had information about the poor quality of financial product but was still giving good ratings. With this setting I show that anticipating a fall in this market, the CRA had even higher incentive to deviate because of the optimistic audience.

4.3 CRA's Behaviour and business cycles

Actually this setting could represent the behaviour of an opportunistic CRA through the business cycles. The actual value of the economic parameter defining this economy may change from one period to another. The differences between the expectations of the audience and the real realizations of some parameters could be seen as the uncertainty that appear in this model. Per example this could appear with an economy which could be in two states, a boom and a recession, if there is persistence (or anticipation of persistence at least) any change could surprised the audience, leading an opportunistic CRA to adopt the behavior seen in this section.

The idea that investors and issuers may see economic condition to last can be seen in Gennaioli et al. (2010). There model shows that financial fragility could come from a undervaluation of risk, leading to an excessive issuance of securities. Then I think of cyclical economy where the financial market "forgot" that the economy could collapse or recover.

5 Discussion

Through this paper I've investigated how the behavior of an opportunistic CRA may change after a shock. Actually most of the literature studying this subject have studied the behavior without any business cycles or in case of business cycles whether the behavior of an opportunistic CRA is the same in a boom or in a recession. However most of the trouble regarding the ratings seem to appear when a bubble collapse or during the recession following a shock. Business cycles and reputation cycles may explain the behaviour of the CRA. However this behaviour is mainly influenced by the inference made by the audience. Future research should better understand the behavior and inference of investors, especially through out opaque markets. We've seen that reputation isn't enough and moreover imperfect observation increase the eventual deviation of an opportunistic agent. It is also interesting to note that reputation may lead to different behavior function of the level of imperfect information and reputation sensitiveness. In terms of public policy, this papers implies to avoid multiple level of imperfect information which should be seen as a warning towards shadow banking. Moreover we see that financial disintermediation could lead to amplify economic cycles if the risk analysis is always externalised and entrust few experts (credit rating agencies per example) to do it.

References

Ashcraft, A., Goldsmith-Pinkham, P., and Vickery, J. (2010). Mbs ratings and the mortgage credit boom. (449).

Bar-Isaac, H. and Deb, J. (2012). Reputation for a servant of two masters.

Benabou, R. and Laroque, G. (1992). Using privileged information to manipulate markets insiders, gurus, and credibility. *The Quarterly Journal of Economics*, 107(3):921–58.

Ferri, Liu, S. (1999). The procyclical role of rating agencies: Evidence from the east asian crisis. *Economic Notes by Banca Monte*, 28(3):335–355.

Gennaioli, N., Shleifer, A., and Vishny, R. (2010). Financial Innovation and Financial Fragility.

Jeffery D'Amato, C. H. F. (2003). Are credit ratings procyclical. *BIS Working paper*.

Mathis, J., McAndrews, J., and Rochet, J.-C. (2009). Rating the raters: Are reputation concerns powerful enough to discipline rating agencies? *Journal of Monetary Economics*, 56(5):657–674.

Ottaviani, M. and Sorensen, P. N. (2002). Professional advice: The theory of reputational cheap talk. (02-05).

Sobel, J. (1985). A theory of credibility. *Review of Economic Studies*, 52(4):557–73.

A Appendix

Details for the proof of proposition 4: If we look at the value function of the CRA described in equation (7). According to the one stage deviation, for any q, when $u = 0$, l is an optimal strategy if and only if for any l' we have:

$$(l(q) - l'(q))[I(q) + \delta P_B V(q^S) + (1 - P_B)V(q_F)] \leq \delta(l(q) - l'(q))V(q^N) \tag{13}$$

$l(q) = 1$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1 - P_B)V(q^F)) \leq \delta V(q^N) \tag{14}$$

$l(q) = 0$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1 - P_B)V(q^F)) \geq \delta V(q^N) \tag{15}$$

$l(q) \in (0; 1)$ is part of an equilbrium strategy if and only if

$$I(q) + \delta(P_B V(q^S) + (1 - P_B)V(q^F)) = \delta V(q^N) \tag{16}$$

Leading to the proof of proposition 4.

Proof of proposition 5:

The investors evaluate the strategy of the CRA from the previous game, i.e. with $\lambda_t^e > \lambda_t$. I recall the results from the previous section, the CRA would always give a good rating to a bad project with positive probability that is there is $\tilde{u} > 0$ and so q_{t+1} will be computed following (1) with $\tilde{u}$ and $\lambda_t^e > \lambda_t$, so q^N, q^S, q^F don't change. So if we note $\underline{V}(q^i)$ the value function associated with λ_{t-1} and $\bar{V}(q^i)$ the one associated with λ_t we have according to equation (6).

$$I(q) + \delta(P_B \underline{V}(q^S) + (1 - P_B)\underline{V}(q^F)) = \delta \underline{V}(q^N) \tag{17}$$

If $\bar{V}(q^N) - \underline{V}(q^N) < P_B(\bar{V}(q^S) - \underline{V}(q^S)) + (1 - P_B)(\bar{V}(q^F) - \underline{V}(q^F))$ Then there exist $\tilde{u}$

$$(u(q) - \tilde{u}(q))[I(q) + \delta P_B \bar{V}(q^S) + (1 - P_B)\bar{V}(q_F)] \geq \delta(u(q) - \tilde{u}))\bar{V}(q^N) \tag{18}$$

We find also that the "reputation's sensibility" of the CRA may lead it to enjoy a wrongly optimistic environment.