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Regulating Credit Rating Agencies

Aljoscha Janssen*

The credit rating industry is characterized by a conflict of interest for credit rating agencies (CRAs). Although they should act as a neutral screening institution between issuers and investors, issuers of securities pay them. As a result, CRAs are incentivized to inflate ratings and issuers shop for favorable ratings. This thesis analyzes the two-sided credit rating market using an applied game theoretical framework, considering both payment streams and the concern CRAs have for their reputation. Furthermore, this thesis investigates the market outcome without any governmental intervention, as well as the simplification of the empirically observable inefficiency in the market (e.g., inflated credit ratings, rating shopping by issuers, inconsistencies in rating's quality over the economic cycle), then evaluates different regulation mechanisms. These mechanisms include those recommended by economic research (i.e., introducing an upfront fee for issuers and a mandatory rating publication), mechanisms implemented by the European Commission in 2013 (i.e., randomly allocating issuers to CRAs, increasing the accountability for CRAs, and less reliance on credit ratings), and regulations discussed in the media (i.e., a public certification institute as a reference CRA). The results show that a mandatory rating publication provides the greatest efficiency in the market, but is not feasible. The regulations implemented by the European Commission are promising and are shown to reduce failures in the credit rating industry. In contrast, a public certification institute does not significantly reduce the conflict of interest for CRAs because the institute is not able to act as a competitive actor in the market.

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Examiner: Karl Wärneryd

*40432@student.hhs.se

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1 Introduction

The system of credit rating agencies (CRAs) is prone to several inefficiencies, which decreases the liquidity of fixed income markets significantly. Therefore, an intervening regulation by governmental authorities is necessary. However, economic literature and recent practical experiences show various regulation mechanisms. The discussion about the most promising regulation mechanism is ongoing. To analyze differences, advantages as well as disadvantages of different regulation mechanisms this thesis builds up a comprehensible model and analyzes the effect corresponding welfare changes of different regulation mechanisms. Surprisingly, the effectiveness of regulations differs substantively.

Since the Enron scandal in 2001, CRAs have been exposed to persistent public criticism.[1] Public opinion then worsened during the U.S. subprime mortgage crisis in 2008 and the ongoing European debt crisis since 2009. In addition, critics believe CRAs rate corporate bonds, government bonds, or structured securities to increase their own profit and the profit of leading financial actors in the global market, and not according to the likelihood of default. Finally, the oligopolistic structure of the big three credit ratings (Moody's, Standard and Poor's, and Fitch Ratings) decreases the reliability of the credit rating system.

Nevertheless CRAs play a crucial and unique role in the financial system. They act as intermediaries between debtors and investors and can reduce both transaction and information costs for both sides significantly. Debtors are incentivized to reduce their financial risk because they are rated regularly, and lenders are able to invest according to how risk averse they wish to be. Furthermore, regulation authorities may evaluate the systemic risk of large commercial investors and connect capital requirements to credit ratings. However, although there are theoretical efficiency gains, the credit rating industry is also characterized by disincentives, which result in undesirable effects. CRAs are paid by issuers of a security, which creates a conflict of interest. On the one hand, they need to act as a screening institution for investors, while on the other, they have an incentive to grant favorable ratings to security issuers. Issuers can choose which rating to publish, so they typically select those that are most favorable. Finally, investors rely on credit ratings or decrease their own due diligence of securities to avoid costs. These effects all contribute to a significant decrease in the efficiency of the system.

Recently, government authorities have begun to strengthen the intervening in the credit rating industry. Their goal is to increase the reliability of credit ratings, to decrease the conflict of interest for CRAs, and to increase the general efficiency of the industry. The most recent set of stronger rules for both CRAs and investors was implemented by the European Commission in June 2013. However, no empirical evaluation of the success of the regulations is yet available. Although the foundation of a public credit rating industry within the European market has been widely discussed, such an institution has not been implemented. Therefore, a detailed theoretical analysis of these regulation mechanisms is important.

Prior theoretical economic studies provide suitable approaches to model the disincentives and drawbacks of the credit rating industry. Depending on the model framework, authors usually recommend a particular policy intervention. However, no research has evaluated all possible regulations within a specific and comprehensible model. Therefore, this thesis presents a model able to describe all incentives for all agents. Furthermore, I present different possible regulations, and show how each impacts the actors within the credit rating game and how it might improve the efficiency of the industry. Here, I consider those regulation mechanisms discussed and recommended in economic research (i.e., introducing upfront fees and mandatory rating publications), the regulations implemented by the European Commission in 2013 (i.e., randomly allocating issuers to CRAs, increasing the accountability for CRAs, and less reliance on credit ratings), and regulations discussed in the media (introducing a public certification institute as a reference CRA). The scope of this thesis includes the model with which to analyze various regulations, the advantages and disadvantages of each regulation, as well as an evaluation of each from a regulator's point of view. I examine whether the regulations implemented by the

[1] For a discussion of the role of CRAs in the Enron scandal, see for example Hill (2004).

European Commission show promise or whether other regulations might be more suitable. Finally, I address the question of whether a public credit rating agency is able to improve the market efficiency.

The remainder of this thesis is organized as follows. Section 2 provides a general overview of recent empirical, theoretical, and regulation-related economic articles. Section 3 presents reference models from which I gathered ideas for the theoretical base model presented in this thesis. Next the model and game theoretical framework is explained in section 4, while section 5 presents the analysis of the model results in the absence of any regulations. In section 6, several regulations are implemented within the model and the effects are analyzed in detail. Finally, section 7 compares the regulations described in the previous section, while section 8 concludes the thesis.

2 Literature Overview

2.1 Empirical Investigations

The recent financial crises and European debt crisis have substantially increased the interest of academia, policy makers, and media in CRAs and the failures of the ratings market, resulting in the publication of several empirical studies on the subject. There are three main problems in the ratings market. The first is that the bias of ratings provided by CRAs on the risk of an asset defaulting vary across economic cycles. This is a clear contradiction of the basic function of credit ratings. In contrast to other market indicators (e.g., revenues or cash flow analyses in the case of typical corporate bonds), a credit rating should provide information about the default risk of a project/investment/bond independently of economic booms or downturns (Bar-Isaac and Shapiro, 2013). The study by Hau et al. (2013) showed empirically that ratings are less accurate in boom periods then in depressions. Using a similar approach, Ashcraft et al. (2010) found that the quality of ratings for mortgage-backed securities (MBS) between 2005 and 2007 (a boom period in the American housing market) declined significantly.[2]

A second problem in the ratings market is that issuers consider the ratings from different rating agencies, then publish the best rating, essentially shopping for the best rating. The main reason this is even possible is that CRAs are paid by the issuers, who can then choose which ratings to publish. Although the rating process is regulated,[3] there is strong evidence that rating shopping causes a conflict of interest and contributes to the failure of the market (Baklayar and Galil, 2014; Jewell and Livingston, 1999). This evidence suggests that rating shopping has an impact on the assessment of competition in the credit ratings market. Becker and Milbourn (2011) investigated the entry of Fitch as a third player in the market, finding that the extra competition led to higher ratings. Here, competition meant a greater potential for rating shopping among the issuers, which led to CRAs inflating their ratings, whether intentionally or unintentionally.

The third problem in the ratings market is more general, but is able to explain the first two problems and why CRAs explicitly inflate their ratings. First one needs to mention that such behavior is difficult to measure empirically. However, several empirical investigations have shown that CRAs may increase ratings intentionally. As previously mentioned, the increase in the quality of ratings due to competition could also be explained by CRAs needing to provide higher ratings to attract issuers (Becker and Milbourn, 2011). Another interesting empirical study is that of He et al. (2011), which shows that MBS tranches from larger issuers perform worse than those from smaller issuers, even though they have the same rating.[4]

A theoretical model able to describe all actors in the credit ratings market and evaluate regulation mechanisms should explain the following key empirical findings with regard to the rating industry: (1) lower quality of ratings during boom periods; (2) the possibility of rating shopping by issuers; and (3) whether CRAs intentionally inflate their ratings.

2.2 Theory

Economic theory mainly focuses on three different channels in which CRAs play a crucial role in the credit rating industry. In each case, the market involves an issuer of a financial instrument and an investor who is

[2] More specifically, the authors observed a "significant time variation in credit ratings, with ratings becoming progressively less conservative around MBS market peak between 2005 and 2007." (Ashcraft et al., 2010, p. 1).

[3] Note that different asset classes have their own rating system. For example, the rating procedure is more complicated for some asset classes, and some assets (e.g., corporate bonds) are almost always rated by the two big players, Standard and Poor's and Moody's.

[4] "All three major rating agencies were more optimistic for securities sold by large issuers during the boom years." (He et al., 2011, p. 135). As stated by the authors, this finding cannot be used as evidence that CRAs inflate their ratings, but it seems reasonable to include this possibility in a theoretical background. He et al. conclude "that the conflict of interest problem of rating agencies likely played a significant role in the evolution of the MBS markets." (p.135).

willing to invest in the instrument.[5] In economic theory, the financial market for credit ratings is simplified by an issuer that has an investment/project and needs external financing. In the case of a corporate bond, the project/investment is typically a business. The investor in the market is able to provide the finance required for the project/investment.[6] A good overview of the different channels and research approaches can be found in Jeon and Lovo (2013).[7] The three channels are the regulation channel, the coordination channel, and the information channel.

In the regulation channel, the CRAs were established to regulate investors. Especially large investors invest large amounts of financial resources in the security markets. Therefore, regulation authorities need to gather information about the risk to the investor of defaults to observe the systematic risk of the financial system. By reliable ratings a authority is able to evaluate the risk of an investor's portfolio. The CRA is not only an intermediate, but also a regulation institution. Kisgen and Strahan (2010) identified the importance of the regulation channel. Regulation decreases investors' demand for investments with bad ratings since those ratings are connected to higher capital requirements.[8]

The coordination channel relies on the assumption that issuers can influence the risk of a project or investment (Jeon and Lovo, 2013, p. 14). In such a case, a CRA acts as a coordinator between the incentives of an issuer and investors who have different levels of risk aversion. Models that analyze the impact of the coordination channel include those of Manso (2013).

In the information channel, the risk of a project or investment defaulting is given exogenously. However, the issuer of the project either does not know the default risk or prefers to state a lower default risk to receive financing at a lower cost (i.e., a lower interest rate)(Jeon and Lovo, 2013, pp. 15-16). A CRA acts as a screening institution to help investors gather information about the unknown default risk.

As described by Jeon and Lovo (2013), the three channels are not independent, and several economic articles have analyzed the connection between channels. For example, Opp et al. (2013) model the connection between the information and regulation channels, and Manso (2011) connects the information channel and the regulation channel. The model presented in this thesis assumes that the risk of a project is given exogenously, but that issuers have an incentive to understate the risk. Some investors are able to evaluate the risks of an investment, but others are not. However, all investors need the credit rating for regulatory proposes. Therefore, the model incorporates the information channel and the regulation channel. The different approaches imply that the value added by CRAs varies (Jeon and Lovo, 2013, p. 17). By solely considering the regulation channel, the CRA would not improve efficiency, whereas the coordination and information channel do provide an efficiency gain (Jeon and Lovo, 2013, pp. 17-18). However, the regulation channel helps to improve the stability of the financial market. In the case of the information channel, a CRA could explicitly solve the incentive problem face by issuers by providing an honest and reliable rating. Issuers would then have a lower incentive to understate the risk of an investment. Furthermore, a CRA may prevent the problem of adverse selection, which arises when investors cannot distinguish between low-risk and high-risk projects. Investors offer financing (e.g., an interest rate) in accordance with the expected risk of the investment. Therefore, it is possible that investors will only provide finance for projects/investments with a greater risk because a low risk means a lower return. A CRA

[5] Financial instruments related to ratings are usually debt securities, such as a corporate bond. However, debt securities can also be more structured products related to a corporation's debt, and may also include sovereign credits such as government bonds/bills, and so on.

[6] Note that the investor is investing in debt financing. Therefore, the return for the investor is independent of the success of the issuer. In the case of a bankruptcy, a creditor has preferential rights, but still faces some risk of default.

[7] The work by Jeon and Lovo (2013) is an overview of recent developments. "The objective of this survey is to introduce readers to the key stylized facts of the credit rating industry and to the recent theoretical economic literature of the industry." (Jeon and Lovo, 2013, p. 1)

[8] There is a difference between the credit ratings markets of the U.S. and Europe. In the U.S., rating-based regulation mechanisms were already established in the early 20th century. However, only the new capital requirements (mainly Basel II and Basel III) implemented in Europe are based on ratings. For more information, see Utzig (2010) and the Basel III regulatory consistency assessment (2012).

should also be able to increase the efficiency of the market.[9] Analyzing the efficiency gains provided by a CRA within the coordination channel is more complex. However, Boot et al. (2006) showed that CRAs can improve the market efficiency because the economy would be coordinated in a more efficient equilibrium.

Economic models further distinguish between CRAs that can commit to a contractible rating policy, and models in which a rating policy is not contractible (Jeon and Lovo, 2013, pp. 19-23). If CRAs can commit to a specific rating policy, the decision problem of a rating procedure may simplify to a static game: A CRA can commit to a rating policy (e.g., inflate ratings or be honest).[10] The added value of a CRA depends on the model parameters. Opp et al. (2013) analyze the effect of informed issuers (issuers who know the default risk of their project) and Boot et al. (2012) describe the effect of trusting investors, who rely on a rating without an internal risk analysis. Furthermore, the effect of rating shopping by issuers, which means that issuers can observe the ratings provided by different CRAs before deciding which to publish, influence the added value of a CRA (Skreta and Veldkamp, 2009). Models of a CRA with a contractible rating policy are promising because they simplify the market into a static framework and may explain several empirical investigations.[11] Another approach is that in which a CRA cannot commit to a specific contractible rating policy. In general, the models within this setting are more complex, because they need to involve a dynamic framework. Here, the reputation of a CRA plays a crucial role. Usually CRAs are paid by issuers. In a static framework without the possibility of commitment, the CRA would not have an incentive to rate an investment honestly. Within a dynamic framework in which a CRA's reputation matters, the incentives may change. In this case, an honest rating regime is possible (Jeon and Lovo, 2013, pp. 22-23).

The theoretical approach of Bolton et al. (2012) cannot be classified using these two categories and so is an interesting new approach. Although their model is static, they assume that a CRA cannot commit to a rating regime. The authors measure reputation as a discounted value of future profits and are able to show the empirical failures of the credit rating industry, namely issuer shopping, the conflict of interest for CRAs, inflated ratings, and the inconsistency of rating's quality over the economic cycle.

2.3 Regulation of CRAs

As a result of the recent instability of the financial market, the regulation of CRAs has become an important topic, both economically and politically. First of all, regulation is strongly connected to the effect of competition between CRAs in the credit rating industry. An example is the regulation of entry barriers: If competition between CRAs increases the efficiency of the market, entry barriers for new CRAs are not a suitable regulation mechanism, and vice versa. Competition between CRAs is evaluated in several economic articles. However the results are ambiguous. The majority of articles argue that competition is socially not desirable (Bolton et al., 2012; Bouvard and Levy, 2012; Skreta and Veldkamp, 2009). The main argument against competition is the greater possibility of rating shopping among issuers. In contrast, the effect of CRAs having a greater incentive to attract issuers by inflating ratings is inconclusive. Camanho et al. (2010) show that CRAs have a greater incentive to inflate ratings with increased competition, but not only because of rating shopping. On the other hand, Doherty et al. (2012) argue that new entries in the credit rating industry may decrease the problem of rating inflation. Beyond the effect of rating inflation and rating shopping, the study of Strausz (2005) describes how CRAs are prone to bribery because of increasing competition. In general, the effect of competition in a theoretical framework depends on several parameters, and it is not impossible that competition may be beneficial. If several CRAs rate an investment honestly (no inflation), the efficiency of an aggregate rating would increase compared to a market with just one CRA (Bolton et. al, 2012). The aforementioned empirical investigations show a tendency for greater costs when there is competition in the credit ratings market.

[9] However, greater efficiency does not necessarily mean a higher social welfare. For more information, see Kurlat and Veldkamp (2012).

[10] For example, see the models of Opp et al. (2013) or Skreta and Veldkamp (2008).

[11] Refer to the empirical section of the literature review (rating shopping, inconstancy of ratings over the business cycle, and intentional rating inflation).

Regulation mechanisms discussed in academia and media are diverse, focusing on small changes in the payment structures or even a radical change of system (Jeon and Lovo, 2013). The first extensive regulation change would be from an issuer-pay model to an investor-pay model. As in the early history of the market, CRAs would be paid by investors rather than issuers. Here, investors would ask a specific CRA to rate a project/bond. The CRA would not benefit from inflating ratings because issuers are not paying for the rating. Furthermore, the problem of rating shopping may be mitigated (Jeon and Lovo, 2013). However, the change of the payment model may also have negative impacts. The main reason for shifting from an investor-pay model to an issuer-pay model in the 1970s was the increasing problem of free-riding by investors. Investors have the incentive to wait until another investor is paying for a credit rating. There is a high chance that free-riding still exists, and a collapse of the market is possible. Furthermore, a new conflict of interest arises for CRAs. Investors prefer good ratings because of lower capital requirements and may try to influence a CRA. The effect of a change from an issuer-pay model to an investor-pay model cannot be determined with certainty. Although possibly avoiding inflated ratings or issuer shopping, Stahl and Strausz (2010) showed that a shift in payment model may result in a lower level of social welfare.

A second interesting regulation mechanism is the so called Cuomo plan.[12] This plan should prevent possible rating shopping by using a new payment structure.[13] The initial idea of the Cuomo plan was to implement a mandatory upfront fee. A fee should be paid by an issuer before the rating outcome is observed (Jeon and Lovo, 2013, p. 31). According to some economic articles, such an upfront fee would mitigate the incentive to shop for different ratings significantly (Jeon and Lovo, 2013). Other economic evaluations are not as optimistic. Bolton et al. (2012) show that the upfront fee has to be accomplished by making the publication legally mandatory. Pagno and Volpin (2010) argue that an upfront fee does not decrease the possibility of inflated ratings since issuers still choose the CRA. If an issuer had a good experience with a CRA in the past, it is likely that the issuer will ask the same CRA again. Finally there is still the possibility of informal negotiations and informal payments between issuers and a CRA.

After the European debt crisis, more specialized regulations for CRAs in the European market were discussed and partly implemented.[14] The latest decisions on regulating CRAs were implemented by the European Commission in June 2013 and include five main aspects (European Commission Press Release, 2013). Initial investors and European institutions should not rely only on external ratings. Regulators try to motivate investors to strengthen their own risk management to decrease the percentage of naïve investors. A second regulation only impacts ratings for governmental/sovereign bonds: to avoid market disruptions, agencies need to implement a clear timetable describing when they will rate EU Member states (limited to three times a year). Third, rating agencies are more accountable for their ratings. If a CRA inflates ratings intentionally, investors and issuers who suffer substantial losses as a result have a right to direct compensation. Fourth, regulators decrease the conflict of interest for CRAs. This is done by rotating the CRA for a specific complex of products, which means that a CRA is allocated randomly to rate this type of product and an issuer does not have the opportunity to shop for other ratings. Furthermore, the independence of CRAs is decreased by ensuring that a CRA that rates a certain bond is not allowed to have any of the issuer's shares. One final point in the European decision is that all available ratings are published on a European rating platform. However, this rating has to be published in advance by a CRA, before the payment of a rating fee.

One regulation that was not implemented by the European Commission or Union is that of a public certification institution (PCI). Such an institution was widely discussed in the European media, and several politicians demanded a PCI as a counterweight to the American private rating agencies (Sénat, 2012). A final academic assessment of the effectiveness of a PCI is not available, however, several research projects are trying to evaluate

[12] An agreement between the New York attorney A. Cuomo and the three big CRAs. The plan was not realized perfectly since there are still possibilities of special agreements between issuers and CRAs.

[13] The plan was to make the publication mandatory. The development has showed that the details of the regulation determine if the publication of a rating is mandatory or not.

[14] In general, one needs to consider that the regulation mechanisms differ between the American and European market. This results in further problems, as described by Utzig (2010).

the effect of a PCI (Lynch, 2010; Noh, 2014). Essential questions include how a possible PCI should be financed and how the incentives differ from private rating agencies. Some first promising ideas are described by Lynch (2010). A PCI should be financed by the public, preferably by taxes, not by the issuers. In addition, it is important that a PCI has enough power to resist political and lobbying pressure and to receive all information about issuer investments (Lynch, 2010). Furthermore, one needs to evaluate the relationship between a PCI and private CRAs. As a result of the high market share of the big three private CRAs, critics of a PCI argue that a PCI would not mitigate the failures of the market. This is based on the European market, which includes several smaller CRAs, but through a lack of reputation, they have low market shares (Schrooten, 2011). It may be possible that a PCI would not play a crucial role in the credit ratings market without significant legal rights. Those rights would correspond to a strong governmental intervention in the market. A PCI needs finance. If a PCI receives fees from issuers, it is likely that the same conflicts of interest will exist, as is currently the case (Beck and Wienert, 2010). On the other hand, it is also possible for the European governments to finance the PCI. However, because many of the issuers are partly or fully owned by these governments, there could be new conflicts of interest (Beck and Wienert, 2010). The PCI is still an interesting possibility, and should be evaluated in detail. In particular, the different parameters describing how a PCI would operate should be determined and investigated.

3 Reference Models

3.1 *The Credit Ratings Game*, Patrick Bolton, Xavier Freixas, and Joel Shapiro (2012)

In this section, I introduce the model of Bolton et al. (2012). As mentioned earlier, Bolton et al. (2012) published an extensive and quite complex two-sided market model, which explains and analyzes the observable failures of the credit ratings market. Their article has been published in the Journal of Finance, although they follow a typical approach of applied game theory and industrial organization. In what follows, I explain the key elements of the model and the analysis of Bolton et al. (2012). In addition, I present the main conclusions and provide a personal critique and ideas for improvement.

3.1.1 Setting of the Model

The model of Bolton et al. (2012) is a two-sided market model. On one side are issuers of a hypothetical investment and on the other side are investors who may invest resources in an investment possibility. In between, CRAs act as intermediaries. Bolton et al. (2012) describe their model using six key building blocks: "*(1) Issuer payments for ratings*, *(2) Issuers shopping for ratings*, *(3) CRA credit models may vary in precision*, *(4) CRAs can make adjustments to their credit risk model outputs*, *(5) Barriers to entry in the credit rating industry exist*, *(6) Sophisticated and trusting investor clienteles* (pp. 86-87)." These key building blocks should reflect the actual situation of the credit ratings market. (1) The issuer is paying a CRA for a rating in the form of fee, which is not regulated by an authority, but is the result of a negotiation process between the issuer and CRA (Bolton et al., 2012, p. 86). (2) However, this fee is only paid if a rating is published, so issuers can approach several CRAs and shop for a preferred rating outcome (Bolton et al., 2012, p. 86). (3) A CRA does not have perfect information about the default risk of an investment, and so faces some uncertainty (Bolton et al., 2012, p. 87). (4) The credit risk model used by a CRA is sensitive to its own adjustment. Bolton et al. (2012, p. 87) mention that some empirical observations show that CRAs tend to improve their ratings. (5) Reputation plays a crucial role for CRAs. Therefore, CRAs are concerned about public opinion (investors), who evaluate the historical performance of the CRAs (Bolton et al., 2012, p. 87). (6) Several governmental regulations for new CRAs result in high entry barriers (Bolton et al., 2012, p. 87).[15] (7) Investors are either sophisticated or trusting. Sophisticated investors are aware of the potential conflict of interest for CRAs, whereas trusting investors generally believe in a working system of credit ratings. Bolton et al. (2012) argue that the difference is due to the incentive of an own due diligence (p. 87).

The model of three risk-neutral agents (issuers, CRA, investors) is static, which means that the authors use a single period for analysis (Bolton et al., 2012, p. 91).[16] The issuer has an investment, which is either *good* or *bad* ($\omega \in \{g, b\}$), with a probability of default of $p = 0$ and $p > 0$, respectively. The returns for both investments are the same and constant. The uniform price for an investment for all investors is T. Issuers and investors ex-ante assume that half of the investments are good (Bolton et al., 2012, p. 91). The existence of CRAs may increase the efficiency of the market since they are able to screen a project using technology. By using this technology, a CRA receives a private signal of $\theta \in \{g, b\}$. The quality of the signal is denoted by e and $Pr(\theta = g|\omega = g) = Pr(\theta = b|\omega = b) = e$, which means the conditional probability of a true value of the observed signal is the same for good and bad investments. The authors assume that $e \in (\frac{1}{2}, 1)$, so the technology provides some additional information (Bolton et al., 2012, p. 91). A CRA is paid by the issuer of an investment,

[15] Bolton et al. (2012) mainly focus on the American credit ratings market, and the situation in Europe is quite different. In Europe, the market has fewer regulations for new CRAs and there are more players in the market. However, the high degree of globalization in the financial markets has the effect that regulations in the U.S. have strong external effects.

[16] For a detailed discussion about a dynamic framework (over periods), see Hirth (2013), who analyzes the model of Bolton et al. (2012) in a dynamic environment.

however, only the CRA observes the signal and can decide which message (rating) to provide. A key aspect of the model of Bolton et al. (2012) is that not every message is published, and the issuer decides whether to publish a message to the public (in particular, to investors). The sequence of steps in the game are as follows. First, the CRA publishes a rating fee. Second, an issuer asks a CRA for a rating. Third, the CRA uses its technology and provides a message to the issuer. Fourth, the issuer decides either to buy the message/rating, pay the rating fee, and publish the message, or to decline the message from a CRA and avoids paying the rating fee. Using this procedure, the issuers are able to ask several CRAs for a rating and so shop for a rating (issuer shopping for ratings). After a possible publication of a rating, investors are able to buy investments at price T (Bolton et al., 2012, pp. 91-92). As previously mentioned, Bolton et al. (2012) distinguish between two groups of investors. A fraction of α of the investors are totally trusting. These investors assume the credit ratings market is working and so take the rating of a CRA as a possible true value of the investment. A remainder $(1-\alpha)$ are sophisticated investors. These investors know about the conflict of interest for CRAs and issuers, since they know about the payment structure and the game theoretical setting. They update their beliefs and may assume that a rating does not provide any added information. Sophisticated investors cannot evaluate the characteristics of an investment on their own (Bolton et al., 2012, p. 92). A further element of the model is that CRAs are dependent on their reputation. This reputation may be interpreted as the discounted sum of future profits (Bolton et al., p. 93). Since the authors build up a static model, the reputation provides a long-term incentive, which would exist in a multiple period setting. The reputation, ρ, comes from the investors, and Bolton et al. (2012) assume that it is a kind of punishment if investors decide to withhold the reputation. At this point, Bolton et al. (2012) make a crucial assumption: if an investment defaults, investors may investigate ex-post if a CRA has reported a rating in accordance with their own signal or if a CRA has inflated the rating. In the latter case, a CRA has reported a message of $M = G$, even though the own signal was $\theta = b$. Only if an investment defaults and a CRA has reported an inflated rating, will the investor withhold the reputation and therefore lower the profit of a CRA (Bolton et al., 2012, p. 93). Furthermore, it is assumed that the CRA cannot be sure about the actual value of its reputation, ρ.[17] Note that the time frame of the model is crucial, as described in the next section.

Investors can invest in either one or two units of the investment (Bolton et al., 2012, p. 93). Bolton et al. (2012) argue that investors have an increasing reservation utility for higher investments. So the reservation utility for one unit is denoted by u, and for the second unit, is denoted by U. The reservation utility for the second unit is higher than that of the first, so $U > u$ (Bolton et al., 2012, p. 93).[18]. From this point, the authors make three assumptions about the investments, depending on the rating. First, investors who know that an investment is bad ($\omega = b$) would invest one unit, so $(1-p)R > u$. Second, investors who assume that an investment is good would invest in two units, so $(1-(1-e)p)R > U$. Third, investors who have no information about the characteristics of an investment are not willing to invest in two units, so $(1-\frac{p}{2})R < U$(Bolton et al., 2012, p. 94).[19] The regulation channel is not considered. An investor does not need a rating because of capital requirement regulations.

[17] Bolton et al. (2012) assume that $\rho \in [\tilde{\rho}-\epsilon, \tilde{\rho}+\epsilon]$ with $\epsilon \to \infty$. After receiving a signal, a CRA does not face any further uncertainty. The main reasoning behind this assumption is that Bolton et al. (2012) want to ensure that CRAs are not indifferent between providing both messages. So, more generally, this assumption ensures that one can solve the whole model using pure strategies.

[18] The reasoning for this assumption is that investors are risk averse and by investing larger amounts of resources in one investment, the return has to be higher (Bolton et al., 2012, p. 93)

[19] Note that an investor with ex-ante beliefs assumes that half the investments are good and half are bad. Therefore, $\frac{1}{2}(1-p)R+\frac{1}{2}R = (1-\frac{p}{2})R$.

3.1.2 Analysis

Monopolistic CRA

First, the authors analyze the outcome of the model if there is only a single CRA. As previously stated, the following sequence of the game is crucial. First a CRA publishes the rating fee, ϕ. Second, the CRA is asked for a rating by an issuer, uses technology to generate a signal, and makes a report of either $m = G$ or $m = B$ (the signal is still private). Third, the issuer can now buy the report and pay the rating fee. If the report is bought, it will be published as a rating and the issuer sets a price, T, for a marginal unit of the investment. Fourth, investors (after investigating the information on the rating and the price, T) decide how much to invest. Finally, the investment is realized (Bolton et al., 2012, pp. 94-95).

In the framework of a single CRA, there is no possibility for the issuer to shop for ratings. In general, there are decisions for all three actors. First, the issuer has to decide whether to pay for a rating, and in the case of a published rating, has to set the price, T, for a unit of the investment. Second, the CRA has to decide either to inflate a rating or report a truthful rating in accordance with the signal. Third, sophisticated investors update their beliefs about the characteristics of the investment and show their willingness to pay. In contrast, trusting investors take each rating as given, and invest two units in an investment with a good rating, and one unit in an investment with a bad rating or with no rating (Bolton et al., 2012, p. 95). To solve the model, Bolton et al. (2012) use backward induction (p. 95). I omit the detailed game theoretical analysis here, but the proofs and detailed intuition behind the solution can be found in the Appendix of Bolton et al. (2012).

The main result of the analysis with a monopolistic CRA is that the CRA will inflate a rating (always provide a message of G) if the fee is $\phi > ep\rho$, and will report truthfully if $0 < \phi < ep\rho$ (Bolton et al., 2012, p. 95). The reasoning is that issuers will only pay a fee for a good rating, since bad ratings will not increase the valuation of trust of sophisticated investors. The issuer only buys a good rating and pays the rating fee. If the rating fee (ϕ) is larger than the loss of reputation (ρ) in the case of a default of a bad investment (ep), it is rational for the CRA to inflate the rating. On the other hand, a CRA has no incentive to inflate a rating if the rating fee is smaller than such a possible loss (Bolton et al., 2012, p. 95-96).

However the rating fee is not given exogenously in the analysis of Bolton et al. (2012). Therefore, they also derive the equilibrium of the fee for an inflating CRA and a truthful CRA. V^0, V^G and V^B correspond to the marginal values for investors' ratings (V^0 for the ex-ante belief, so no rating; "V^G and V^B represent the marginal value to sophisticated investors when the CRA reports truthfully $m = G$ and $m = B$ [...]. They also represent the the marginal value to trusting investors when the CRA reports $m = G$ and $m = B$ whether truthfully or not." (Bolton et al., 2012, p. 94))[20], further proofs and explanations can be found in the Appendix of the authors. In the case of an inflated rating, the CRA will set the fee to $\phi = \alpha 2V^G - V^0$. Therefore, under the condition $\alpha 2V^G - V^0 > ep\rho$, the CRA always reports a good rating (inflating). The CRA will rate truthfully if $\alpha 2V^G - V^0 < ep\rho$ and would set the rating fee to $\phi = min[2V^G - max[\alpha V^0, V^B], ep\rho]$ (Bolton et al., 2012, pp. 95-96).

The main conclusion of the analysis for a monopolistic CRA is that the CRA inflates a rating if $\alpha 2V^G - V^0 > ep\rho$. Therefore, with an increasing fraction of trusting investors and with a lower reputation value, the CRA is more likely to inflate a rating (Bolton et al., 2012, p. 96). Furthermore, in boom periods, the possibility of inflated ratings may increase because of a higher fraction of trusting investors and because more investors have a lower incentive to perform their own due diligence (Bolton et al., 2012, p. 96).

Competition among CRAs

One of the main purposes of the study by Bolton et al. (2012) is to evaluate how competition between CRAs affects the outcome in the credit ratings market. In the second step of their analysis, Bolton et al. (2012)

[20] Bolton et. al (2012) describes the expressions by: $V^G = (1 - (1 - e)p)R - U$, $V^B = (1 - ep)R - u$ and $V^0 = (1 - \frac{p}{2})R - u$ (p. 94).

solve the model in the case of competition between two CRAs (i.e., a duopoly). As a result of the new market characteristic, the sequence of the game changes slightly. First, each CRA publishes a rating fee ϕ, which may differ. Second, a CRA uses technology to provide a rating. Third, the issuer of an investment decides to publish one rating, two ratings, or neither rating. Again, the price of T per unit of investment is published in this step. Fourth, the investor evaluates all provided information and makes an investment decision. Finally, the investment is realized (Bolton et al., 2012, p. 96). Note that issuers can now shop for ratings by purchasing a favorable rating. However, the analysis is more complex, since an issuer can also purchase both reports.

As before, Bolton et al. (2012) solve the model using backward induction, starting with the investors. Again, a detailed analysis, including relevant proofs and assumptions (which are indeed needed in the case of a duopoly of CRAs), can be found in the Appendix of Bolton et al. (2012). The main outcome of the model is that a CRA will still inflate a rating if the condition described previously holds; that is, the rating fee, ϕ, is larger than $ep\rho^D$. In the case of $\phi < ep\rho^D$, the CRA reports a truthful rating[21] (Bolton et al., 2012, p. 98). However the sub-game of the fee setting changes according to the new situation. V^{GG} is the marginal value for a second good rating for an investor (Bolton et al., 2012, p. 98)[22], again Bolton et al. (2012) provide a detailed description in their Appendix. The authors find two equilibria. In the first equilibrium, both CRAs always report an inflated rating, and in the second equilibrium, both CRAs report a truthful rating. However, the cutoff point at which a CRA inflates a rating changes. The proof of the following result is reported in the Appendix of Bolton et al. (2012). Both CRAs will always inflate the rating if

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

Therefore, the corresponding fee is $\phi = \alpha 2(V^{GG} - V^G)$ (Bolton et al., 2012, p. 98). In the other equilibrium, both CRAs will provide a truthful rating if

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

Here, the corresponding fee is $\phi = min[2(V^{GG} - V^G), ep\rho^D]$ (Bolton et al., 2012, p. 98). As before, a CRA is more likely to increase a rating for more trusting investors (i.e., a higher α) and for a lower reputation, ρ^D (Bolton et al., 2012, p. 98). More interesting, however, is the comparison of the outcome between the case of a monopolistic CRA and a duopoly. Here, the cutoff for inflating a rating (inflating if: $\alpha 2V^G - V^0 > ep\rho$) is larger in a monopoly than in a duopoly (inflating if: $\alpha 2(V^{GG} - V^G) > ep\rho^D$) making it more likely that a rating will be inflated in a market with a monopolistic CRA than in a market with two CRAs (Bolton et al., 2012, p. 98). However, Bolton et al. (2012) state that it is likely that $\rho > \rho^D$ is caused by a larger dependence on reputation in a monopolistic market (p. 98).

Outcome and Market Efficiency

The previous section determined the conditions in which rating are inflated in each market structure. Bolton et al. (2012) showed that the cutoff for the equilibrium in which the CRA inflates a rating differs. It is more likely that a CRA in a monopoly inflates a rating than in a duopolistic CRA setting (Bolton et al., 2012, p. 98). This section describes how the profits of trusting and sophisticated investors differ in each equilibrium (Bolton et al., 2012, p. 99). Furthermore, Bolton et al. (2012) evaluate the market efficiency and so calculate the total surplus of all agents in the equibiria. The total surplus (or welfare) consists of the added value for the issuers, the CRA(s), and the investors. However, the rating fee is paid by issuers and is received by CRAs, under the assumption of non-existing transaction costs (Bolton et al., 2012, p. 100). Reputation is not considered in the analysis of market efficiency since Bolton et al. (2012) are mainly interested in the short-term efficiency. The market efficiency is evaluated from a paternalistic point of view, meaning it is evaluated based on all agents (including trusting investors) (Bolton et al., 2012, p. 100). However, the authors use an additive welfare

[21] ρ^D in this case is simply the reputation in a duopoly.

[22] V^{GG} is the marginal value for a sophisticated investor for a honest CRA and the marginal value for a good rating for a trusting investor (independent on the policy of a CRA), Bolton et. al (2012) express the term as $V^{GG} = (1 - \frac{(1-e)^2}{(1-e)^2+e^2}p)R - u$ (Bolton et al., 2012, p. 96).

function. Therefore, it is possible that in an efficient market, trusting investors have negative profits, since sophisticated investors have high benefits. Again, I will just present the main results. The detailed calculation can be found in the Appendix of Bolton et al. (2012).

The first and expected result of Bolton et al. (2012) is that the surplus in a monopolistic market is higher with a truthful CRA than if the CRA inflates its ratings. The intuition is that, in the latter case, issuers will buy an inflated rating, set a high price for the investment, and take advantage of the trusting investors (Bolton et al., 2012, p. 100). However, sophisticated investors do not pay the high price for the investment. The surplus of this scenario is lower than in a situation without a CRA. This outcome is equivalent to the case of a duopoly of CRAs. Again, a truthful duopoly is more efficient than two CRAs that inflate their ratings (Bolton et al., 2012, pp. 101-102). It is more interesting to compare the outcomes between the two market forms. The surplus when ratings are inflated in a monopolistic CRA setting and a duopoly is the same. Therefore, both are inefficient on the same level.[23] On the other hand, a truthful monopolistic CRA has a higher surplus than two truthful CRAs (Bolton et al., 2012, p. 101). As described previously, the rating is imprecise (probability e). Therefore, issuers have a higher chance of shopping for ratings and so can get financing under better conditions from trusting investors in a duopoly. In a monopoly, the issuers only can shop by not purchasing a bad rating, and make a profit equivalent to the market without a CRA. With two CRAs, and a situation in which one provides a good rating and the other a bad rating, the issuer would only purchase the good rating and take advantage of trusting investors (Bolton et al., 2012, p. 101). If both CRAs report a bad rating, the issuer would not purchase either rating. In conclusion, there are more possibilities for rating shopping in a duopoly. Only in case of a non-inflating duopoly and a inflating monopoly there are benefits of competition (Bolton et al., 2012, p. 102). Such a situation arises if $\alpha 2(V^{GG} - V^{G}) < ep\rho^{D}$ (Incentive for a CRA in a duopoly to tell the truth) and $\alpha 2V^{G} - V^{0} > ep\rho$ (Incentive for a monopolistic CRA to inflate). However the authors point out that it is very unlikely that both in equations hold at the same tame and further the negative effects of issuer shopping are persistent (Bolton et al., 2012, pp. 102-103). All in all, Bolton et al. (2012) conclude that a duopoly is less efficient than a monopoly.

3.1.3 Conclusion

The analysis of Bolton et al. (2012) shows two results: (1) There exist an equilibrium where a CRA inflates ratings and an equilibrium where a CRA does not. The reason for inflating is that a CRA has the possibility to take advantage of trusting investors. The cutoff for an non-inflating or inflating decision is defined in the cutoffs. A larger fraction of trusting investors corresponds to higher inflation probability. Further the cutoff for a monopolistic CRA is larger than for a duopolistic CRA. For a certain fraction of trusting investors it is possible that a monopolistic CRA inflates and a CRA in a duopoly does not. (2) Although the differences in cutoffs, a market form with a monopolistic CRA is more efficient than a duopoly (two CRAs). The main reason is that, in a duopoly, issuers have more possibilities to shop for ratings and receive investments from trusting investors (Bolton et al., 2012, p. 109). This result is mainly caused by the connection between the possibility for rating shopping, the existence of trusting investors, and the reputation, which is only withhold in case of a default. The analysis is further supported by a short introduction of an endogenous reputation (Bolton et al., 2012, pp. 103-104). Bolton et al. (2012) suggest solving the conflict of interest for CRAs by introducing an upfront fee connected to the automatic disclosure of ratings (pp. 109-110).

3.1.4 Critique

Bolton et al. (2012) provide an interesting approach and are able to model the failures of the market of CRAs. The added value of Bolton et al. (2012) is the reputation term, which allows them to specify the model

[23] Under the assumption of fixed operation costs for CRAs, the duopoly may be less efficient due to competition. However this would be a further assumption (Bolton et al., 2012, p. 101).

setting in a static framework, and the differentiation between trusting and sophisticated investors. Several economic articles use the ideas of Bolton et al. (2012) (e.g., Hirth (2013), Freytag and Zenker (2012), and Xia (2014)), which is an indication that their article has had a wide scientific impact. However, one may still criticize some of the assumptions in their model.

The first criticism is the complexity of the model. As a result of the high complexity, the level of traceability decreases, and several assumptions are needed. An example for the complexity is that the investor is able to buy two units of an investment. As a result, the model outcome has to be calculated under the assumption of marginal values. A design with only one possible investment purchase would decrease the complexity of the model substantially, and would not decrease the impact and outcome. A second example is the pricing. Issuers price the investment at T and the CRAs price their ratings at ϕ. Both pricing games are directly connected and are a subgame of the main game between all three actors. It may be possible to construct a model without the pricing subgame. Even by including the fee setting subgame and the corresponding investment pricing, it would be an advantage to analyze the equilibrium of the whole model on its own to improve the comprehension for the reader.

The division of investors into those who are sophisticated and trusting is one of the main reasons for the model outcome. It further explains that ratings in boom periods may have a significantly lower quality Bolton et al. (2012) assume that sophisticated investors cannot evaluate an investment, but know about the conflict of interest for CRAs. This leads to the conclusion that a market consisting only of sophisticated investors would mitigate the typical failures (i.e., rating shopping, inflated ratings). The reasoning supplied by the authors is that sophisticated investors may have a higher incentive to conduct due diligence. An example provided by Bolton et al. (2012) is that sophisticated investors could use "personal funds where the own profit is closely connected to the realized returns, whereas trusting investors may be investment institutions, where the own profit is only marginally related to the realized return" (p. 92). So the characteristic is correlated with the risk exposure of the actors. In my opinion, it would be more realistic if some investors have the technology available to evaluate the characteristics of the investment, while others do not. Using the approach of Bolton et al. (2012), this would result in an outcome in which some investors do not rely on a rating at all, since a rating is not needed. However, in reality, a rating is not only used for informational reasons, but also for regulatory reasons, so investors simply need a rating.[24] Therefore, their approach may be improved by introducing some investors who are able to evaluate the characteristics of an investment, but still need a rating.

Bolton et al. (2012) mention the upfront fee, a form of the Cuomo plan, in connection with an automatic disclosure of a rating as the most promising regulation approach in their model (pp. 105-106). Furthermore, they describe how there is a possible risk of a moral hazard (since CRA have no incentive to provide an accurate rating after receiving an upfront payment). In my opinion, it would be an interesting extension to show the success of these regulations (i.e., an upfront fee only, and an upfront fee and mandatory disclosure) within the model. The main purpose of the article is to show the efficiency loss due to a duopoly. However, further discussion about the regulation would be necessary before finally evaluating an upfront fee in connection with automatic disclosure. So there is still the question of whether an automatic disclosure is feasible, and how a regulation authority could control the internal negotiations between CRAs and issuers. In addition, a discussion about an upfront fee without an automatic disclosure would be interesting.

Bolton et al. (2012) restrict the negotiation between issuers and investors to the monetary rating fee. In contrast, it seems reasonable to assume that issuers and CRAs have a more intense and unofficial relationship. So CRAs may also evaluate some structured products for issuers for business proposes. Alternatively, both actors might have an informal, but stable relationship that includes general information exchange. Even some ownership connections have been possible in the past (e.g., a CRA that holds shares of an issuer). These relations would increase the conflict of interest further. Hau et al. (2012) show "that rating agencies assign more positive

[24] See the discussion about the regulatory channel. For example, banks are committed to evaluate their portfolio in bond markets (Basel capital requirements based on ratings).

ratings to large banks and to those institutions more likely to provide the rating agency with additional securities rating business" (Hau et al., 2012, p. 1). One may also consider a market where some investors (e.g., investment banks) are also issuers. The issuer/investor acts as an engineer of a specific structured product, and would like to have the best possible rating, since a good rating is connected to lower capital reserves. As a consequence, a CRA has a strong incentive to provide a good rating, although understated risks are associated with a systemic risk of the financial system.

3.2 *The Credit Rating Market - Options for Appropriate Regulation*, Andreas Freytag and Martin Zenker (2012)

In this section, I briefly describe the proposal by Freytag and Zenker (2012) before adding a personal evaluation. I do not reproduce the detailed model here, but the model of this thesis uses several of the ideas proposed by Freytag and Zenker (2012), as shown in the next section.

Freytag and Zenker (2012) focus on one specific regulation mechanism in the credit rating industry. Therefore, they simplify the model of Bolton et al. (2012) and discuss the impact of a random rating allocation, which means that one or two CRAs are randomly allocated to an issuer. The simplification of the complex model by Bolton et al. (2012) is very promising, and I will adopt several ideas. However, in my view, the analysis of Freytag and Zenker (2012) has some drawbacks and is not complete.[25] First, the random allocation of an issuer to one CRA implicitly assumes that "the evaluation of the CRA will be issued, independent of the final outcome" (p. 10). Therefore, the random allocation does not only involve the allocation, but also the automatic disclosure in connection to an upfront fee, as recommended by Bolton et al. (2012). However, it is more realistic that an issuer still has the possibility of denying a rating. This case is not evaluated by Freytag and Zenker (2012). Furthermore, Freytag and Zenker (2012) do not discuss the problems related to an upfront fee in connection with an automatic publication. Indeed, a moral hazard may arise, especially if the rating technology is costly. As a result, a CRA may have less incentive to use an appropriate rating methodology and simply publish a rating without analyzing the default risks.

A more serious drawback in Freytag and Zenker's (2012) model exists in the described strategy of a CRA. In their status quo analysis (no regulation), the authors describe inflated ratings as a behavior in which CRAs report a good rating even when their own signal indicates that the rating is bad (Freytag and Zenker, 2012, p. 7). However, the situation in which CRAs report a bad rating after receiving a good signal is excluded: "An alternative scenario, in which a CRA works negligent, i.e., that a good investment receives a negative rating grade, is not considered, because a CRA is only paid for good ratings (Hirth, 2012)." (Freytag and Zenker, 2012, pp. 8-9). During their analysis of the random allocation of issuers to one or two CRAs, the authors change this assumption: "Due to the varied payment structure [an upfront fee] it is possible that the CRA evaluates a good investment as bad. In this case the CRA would rate negligent than rather inflating." (Freytag and Zenker, 2012, p. 10). However, it is never optimal to provide a negligent rating. By reporting a bad rating when the private signal indicates the rating is good, the profit of the CRA will be lower than when reporting a good rating. Although a CRA receives an upfront free independent of the rating, investors will not finance an investment with a bad rating. So the CRA precludes any reputation from investors by reporting a bad rating. A good investment will not default, so providing a good rating for a good project will yield a higher profit because of the reputation of investors. Independent of the analysis and in comparison to a totally truthful rating regime (i.e., reporting a bad rating in the case of a bad signal, and a good rating in the case of a good signal), it is never optimal to report a bad rating. Therefore, the analysis of Freytag and Zenker (2012) is based on this problematic assumption. In my opinion, this is a major drawback of their work and decreases the validity of their model substantially.

[25] The model of Freytag and Zenker (2012) is a working paper, therefore the described inconsistency may be solved in a final version.

Freytag and Zenker (2012) mainly focus on one regulation, namely the random allocation of an issuer to one or two CRAs. To compare regulation mechanisms in such a specific model it may be advantageous to use more general mechanisms (e.g., just an upfront fee) as a reference. In addition, the game theoretical analysis of Freytag and Zenker (2012) may be extended. As in Bolton et al. (2012), it would be advantageous to show the exact condition under which it is optimal for a CRA to inflate a rating (these conditions are not explicitly mentioned in their study). Such a condition would provide the possibility of an intuitive comparison between the effects of the variables and would simplify the comparison of different regulations. Furthermore, Freytag and Zenker (2012) reduce their analysis of a game theoretical approach to a game between CRAs and investors (p. 7). For a more comprehensive analysis of rating shopping by issuers, a description of issuers' incentives would be beneficial. Finally, Freytag and Zenker (2012) do not include a discussion on welfare, as is provided by Bolton et al. (2012). It would be interesting to know which regulation mechanism would maximize the efficiency of the market. In addition, it would be possible to include a social welfare discussion and answer the question of how a regulator would interpret the different regulations. All in all, Freytag and Zenker (2012) provide an interesting approach by simplifying the model of Bolton et al. (2012), but their analysis has some inconsistencies, is not complete, and may be extended to provide a comprehensive evaluation of the regulations.

4 A Model of the Credit Rating Industry

4.1 Similarities and Differences to the Reference Models

The base model that is used to evaluate different regulation mechanisms mainly relies on two theoretical approaches. The first is the model of Bolton et al. (2012) and the second is the model of Freytag and Zenker (2012). I start by presenting the ideas I gathered from both models. Then, I describe the main differences between my model and the originals, including why I chose to deviate from the existing models. In addition, I briefly mention the new features in my analysis, as well as those regulations that have not been covered in the articles so far.

As in Bolton et al. (2012), my model is a two-sided market model with the same actors (i.e., issuers of an investment, CRAs, and Investors). I also distinguish between sophisticated and trusting investors, however, the characteristics of sophisticated investors deviates from those in Bolton et al. (2012). They assume that sophisticated investors know about the conflict of interest for CRAs and therefore can anticipate an inflated rating. Their reasoning is that the personal profit of sophisticated investors has a strong correlation to the realized returns. So sophisticated investors have a greater incentive to perform their own due diligence (Bolton et al., 2012,). In contrast, I assume that sophisticated investors are able to identify if an investment is either good or bad. Here, I follow the approach of Freytag and Zenker (2012): "Sophisticated investors, on the other hand, can be assumed as professional market participants, such as banks, insurance companies, investment firms, pension funds. It is assumed that these investors are abele to assess immediately whether a CRA is working correctly" (Freytag and Zenker, 2012, p. 8). It seems reasonable that several professional institutions in the market can evaluate ratings because of experienced risk management. However, they may still need a rating, especially those institutions that are highly regulated (e.g., the minimum capital requirements of Basel regulations). Therefore, I include the previously described regulation channel. I assume that this ability to scan an investment is costly[26], and in boom periods with lower capital requirements or with higher profit margins, investors try to avoid these costs. The fraction of sophisticated investors decreases, whereas the fraction of trusting investors increases.

Another main aspect that deviates from the model of Bolton et al. (2012) is the reputation. As in Freytag and Zenker (2012), I differentiate between the reputation that comes from trusting investors and the reputation that comes from sophisticated investors. First, this provides an interesting possibility to compare the importance of the two reputations to a CRA. Second, it may be possible that a CRA is more interested in the reputation from sophisticated investors. It is only possible to analyze such a case by differentiating between the two types of reputation. Finally, I follow the approach of Freytag and Zenker (2012) and assume that investors can only purchase one unit of an investment. Recall that Bolton et al. (2012) assume an investor can invest in either one or two units. This simplification makes the analysis much more straightforward, as one does not have to set up several assumption about the marginal values of investors. In contrast to Bolton et al. (2012), Freytag and Zenker (2012) assume that the technology used by a CRA to evaluate an investment is perfect and does not involve any uncertainty. I too use this simplification in my model. Finally, I use the simplification ideas in my own model to evaluate different rating mechanisms.

In addition to the simplifications of Freytag and Zenker (2012), I directly address the described drawbacks of their model. The critical assumption of negligent behavior (reporting a bad rating for a good investment) is not used. The model changes substantially. In addition, I do not reduce the two-sided market in a two player game between a CRA and investors, as do Freytag and Zenker (2012). In my model, the incentive for issuers are modeled in detail. This has two advantages. On the one hand, the possible rating shopping of issuers can be evaluated. On the other hand, I can model the exact conditions in which inflated ratings occur without further

[26] Freytag and Zenker (2012) mention that "this ability, however, is cost intensive and thus investors spend cost in shape of $C > 0$." However they do not include this cost in their further analysis.

assumptions of exogenous variables.[27] Finally only in an analysis of the entire two-sided market all regulations can be evaluated suitable, since several regulation work in the interaction between issuers and CRAs and other in the interaction between CRAs and investors.Ï In conclusion, the model uses the simplification of Freytag and Zenker (2012), but extends the analysis by modeling the issuers' incentives. These incentives are integrated in Bolton et al. (2012), but have a different form. The conditions of rating inflation allow me to solve the game theoretical setting entirely, and offer the possibility of a welfare discussion, which is not part of Freytag and Zenker (2012). I integrate such a welfare discussion, similar to Bolton et al. (2012). However, in contrast to Bolton et al. (2012), I use a more social point of view by implementing a welfare function that tries to minimize the losses of investors. The reasoning here is that a regulation authority is interested in protecting the trusting investors from losses that are caused by an economic exploitation.

The main intention of this thesis is to discuss different regulation mechanisms. In this regard, I am breaking through the research frontier of the theoretical analysis of regulations in the credit ratings market. In contrast to Freytag and Zenker (2012), the model does not only discuss the random allocation of a CRA to an issuer, but also the regulations implemented by the European Commission (2013) and those regulation ideas that have been a central aspect of political discussions in the past. So for example, should one regulate the market by randomizing the allocation of CRAs? Should one establish a public institution (PCI) that acts as a reference institution? Is an upfront fee for ratings the solution? Would it be enough to increase the accountability of CRAs? Which of the regulations would provide the highest welfare in a theoretical framework from the regulator's point of view?

4.2 Actors

Before analyzing the interactions and incentives of the risk neutral actors in the model, I describe their general characteristics. The first actor is the issuer of a project. The issuer has a project and want to get this project financed. The required investment is $I > 0$. For simplicity, I assume that the project can have two different characteristics, namely bad and good. A good project has a return of $R > 0$ and defaults with a probability of $p = 0$. A bad project has a probability of default of $p > 0$. In case of default, the return is 0, and in the case of non-default (which occurs with probability $(1 - p)$), the return is R. Therefore, an issuer has an incentive to finance every project with debt, since I assume that a default will not be connected to the issuer's own monetary loss. The issuer of the project (in Freytag and Zenker (2012) called "an investment") knows about the characteristics of the project. The general probability of a good project is $0 \leq \lambda \leq 1$.

On the other side of the market are the risk-neutral investors, who have infinite financial resources. To finance a project they need to invest resources of amount I. As in the benchmark models, I assume there are two types of investors in the market: (1) sophisticated investors, who have great knowledge about the market and projects (e.g., investment banks, professional funds, etc.) and (2) trusting investors, who are mainly smaller institutions and non-commercial investors. The main difference between the two kind of investors is that a sophisticated investor has the possibility and knowledge to evaluate an investment on his own without any costs, whereas a trusting investor cannot distinguish between a good and a bad investment. Trusting investors assume that the CRAs are working correctly and rely on the ratings. All investors need a rating for regulatory purposes. The proportion of trusting investors is α, with the remainder being sophisticated investors, $(1 - \alpha)$. Both kinds of investors are only willing to invest in a good project. The reason is that an investor only earns $(1 + r)I$ in the case of a non-defaulting investment (r is the exogenously given interest rate). If a project is bad, the expected payoff for the investor would be $p(-I) + (1 - p)(1 + r)I$ and an investor would not invest.[28]

[27] Freytag and Zenker (2012) do not include exact conditions for inflated ratings. Therefore, they do not need to model the incentives for issuers.

[28] Refer to Appendix 9.1 for a discussion of this assumption.

Assumption 1:

$$p(-I) + (1-p)(1+r)I < 0.$$

Furthermore, I assume that investors would not invest in an unknown project, which means that:[29]

Assumption 2:

$$\lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I - pI] < 0.$$

Together, the assumptions imply that $\lambda < 1$.[30]

CRAs are a third kind of risk-neutral actor in the model and play a crucial role as an intermediary. In addition to the approximation of reality, there are two reasons for including CRAs in the model. First, investors, who are mainly sophisticated investors, invest large amounts of borrowed capital and so are prone to the moral hazard and have the systemic risk of the whole financial market and economy. Therefore, a regulation to indicate the risks of investments for sophisticated investors may be necessary (regulation channel). A second aspect is that issuers are not able to state the risk of a project honestly. The CRA acts as a screening institution, which helps investors gather information about projects (information channel). However CRAs are profit maximizing institutions with their own incentives. In the basic model, it is assumed that there is an endless number of CRAs. A CRA has the possibility of obtaining a perfect signal, $s \in \{g, b\}$, about the characteristics of a project and may publish it. Furthermore, a CRA may also inflate a credit rating and report a good rating for a bad project. A CRA cannot commit (legally) ex-ante to a specific rating regime. As usual in the credit rating industry, a CRA is paid by the issuer. In addition to a rating fee by an issuer, the CRA is dependent on reputation. Here, the reputation may be interpreted as the future discounted profit of a CRA, although it is described as an exogenous parameter. I assume that the investors as the customers of the CRA pay the reputation. Payment in this terms can be seen as a zero-cost incentive mechanism of investors and is therefore not connected to any costs for an investor. The reputation is solely paid by an investor if a rating is published. A sophisticated investor does not pay the reputation premium, σ, to the CRA if it has inflated its rating, whereas a trusting investor does not pay the reputation premium, τ, when investing in a project that defaults. Both investors would pay the reputation for a bad rating, even though they do not invest.[31] Therefore, the CRA can obtain an overall reputation of $\rho = \alpha\tau + (1-\alpha)\sigma$. A mapping as an overview of the two-sided market in the rating industry can be found in Figure 1.The incentives and related behavior of the CRA are part of the game setting and the relation between the actors is described in detail in the next section.

4.3 Sequence of the Game

The steps of the game are as follows:

- The issuer has a project that needs finance. Since there is no possibility to approach an investor directly, the issuer asks a CRA to rate the project. In the basic setting, it is assumed that issuers do not have a stable relationship with CRAs, and so choose a random CRA.

[29] Calculation and discussion about this assumption in Appendix 9.2.
[30] Proof in Appendix 9.3.
[31] The reputation in the case of a bad rating may be interpreted as an incentive provided to the CRA by investors. Investors have an incentive to ensure the CRA is working honestly and show this by also paying the reputation even when not investing.

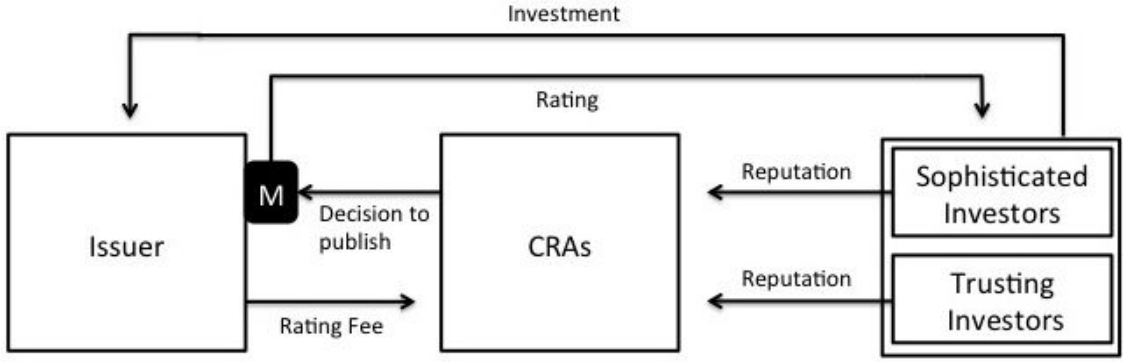


Figure 1: Structure of the Credit Rating Market

- The CRA receives a perfect signal of $s \in \{g, b\}$ about the project with a cost of c, which is zero for simplicity. Afterwards, the CRA can decide between two options: (1) rate the project honestly and report a message of $m = G$ for $s = g$ and $m = B$ for $s = b$ to the issuer, or (2) inflate the rating and always report a message of $m = G$ (also in the case of a bad rating with a signal of $s = b$) to the issuer.[32] The rating is not published in this step of the game.

- The issuer observes the possible message of the CRA and can decide to publish the rating for a rating fee ϕ, which is paid to the CRA. If the issuer decides not to publish the rating, he has the possibility to go to the next CRA and start from the first step. This behavior is known as *rating shopping*.

- The rating is published by agreement of an issuer, and the CRA receives the rating fee, ϕ, from the issuer.

- A random investor observes the credit rating (the message m) provided by the CRA. Now there is a major difference between the sophisticated and the trusting investor. Sophisticated investors know the characteristics of the project and decide if a CRA has inflated the rating (reported $m = G$, although it is a bad project). If the rating is bad, the sophisticated investor will not invest and will punish the CRA by withholding the reputation. In the case of a good project, a sophisticated investor will invest. A trusting investor will invest in all projects that have a good rating.

- Suitable projects are financed and realized.

- Projects that do not default get a return of R, and investors have a revenue of $(1 + r)I$. Projects that default have no return. Trusting investors that invested in a defaulted project have a negative profit of $(-I)$. Since they invested in a project that was rated as a good project, they will punish the CRA at this stage by withholding the payment of reputation. Sophisticated investors only invested in good projects.

[32] This is an essential deviation from the model of Freytag and Zenker (2012), as they assume that in an inflating rating regime the CRA also reports a bad rating in the case of a good message (p. 11) if there is an upfront fee. This negligent behavior is not rational.

5 Benchmark Model in Absence of Regulation

In this section, I solve the game using backward induction, starting with the investors, continuing with the decision of the CRA, and then analyzing the behavior of the issuers. Every decision will be discussed in detail. In the end, I will resume the dependency of the outcome.

5.1 Investors

As previously described, both types of investors are generally only willing to invest in good projects. Sophisticated investors have the ability to analyze the characteristics of a project without costs, but need a good rating for regulatory reasons. Therefore, they invest in a project that is good and has a good rating ($m = G$). In addition to the investment, a sophisticated investor pays the reputation, σ, to the CRA that provides a truthful rating. They pay the reputation only for a rating that is published. However, they do not distinguish between the actual rating regime of a CRA. Sophisticated investors would also pay a reputation for a bad project with a bad rating, even though they do not invest. All in all, sophisticated investors will only invest in good projects, with a profit of $U_{S1} = (1 + r)I$. With the ex-ante probability of a good project (λ) and the assumption that all projects are rated and are therefore in the market for the investor, the expected profit is $U_S = \lambda(1 + r)I + (1 - \lambda)0$.[33]

For trusting investors the situation is different. As explained earlier, trusting investors will invest in projects that are rated with $m = G$, irrespective of whether the rating is good or bad. One may argue that even trusting investors have expectations about inflated ratings and rating shopping. However, as in the aforementioned models, I assume that trusting investors are totally naive and so are not able or willing to analyze the capital markets. Therefore, one has to distinguish between two possibilities: (1) a trusting investor invests in a good project with a rating of $m = G$, and (2) a trusting investor invests in a bad project when the rating has been inflated and $m = G$. In the first case, the investor has a profit of $U_{T1} = (1 + r)I$. In the latter case, the investor will only have a loss in the event of a default, which occurs with probability p. Therefore, the profit would be $U_{T2} = p(-I) + (1 - p)(1 + r)I$. The expected return depends on the probability that a rating is inflated, a probability that an investor is trusting cannot calculated. For now, I assume that a bad investment is rated as good with a probability of ω (the probability of inflation, especially considering the possibility of rating shopping, will be described in the analysis of issuers). Here the probability of rating inflation is solely exogenous to show the possible profit of a trusting investor. If all projects are in the market, some are good and get a good rating, some are bad and get an inflated rating, and some are bad and get a bad rating, then the expected profit is[34]

$$U_T = \lambda I(1 + r) + (1 - \lambda)\omega[p(-I) + (1 - p)(1 + r)I] + (1 - \lambda)(1 - \omega)0.$$

To conclude, a sophisticated investor is able to distinguish between a good and bad project for zero costs, whereas a trusting investor cannot. A trusting investor has no expectations about his profits. I assume that he will be totally trusting and will invest in projects with a good rating. In the case of a published good rating, a trusting investor pays the reputation τ to a CRA if a project does not default. Either if it is a good project (probability of default is $p = 0$) or is a bad project that was rated with $m = G$ and does not default (probability

[33] If all ratings are in the market, I assume a random allocation to an investor. If a sophisticated investor is allocated to a bad project, he cannot move to another project. In a market with only good projects, an issuer would be allocated to a good project with certainty. Therefore, the hypothetical profit would be $U_S = (1 + r)I$.

[34] For a detailed description and calculation see Appendix 9.4.

$1-p$). If a bad rating was published, a trusting investor does not invest but pays the reputation to a CRA. Investors are static actors in this model. Their reactions on ratings is perfectly predictable.[35]

5.2 CRAs

A CRA gets the order for a rating by the issuer. Afterwards a CRA has to decide whether to rate the project honestly or to inflate the rating and always report $m = G$, even in case of a bad signal ($s = b$). As previously mentioned, a CRA cannot commit ex-ante to a specific rating policy. Both rating regimes are connected to different profits. This section presents the profits of each rating regime. The CRA chooses the rating regime with the higher profit. This section also show the condition for a rating inflation by CRAs.

1. An honest rating regime: The CRA receives a signal, $s \in \{g, b\}$, and reports an honest message of $m \in \{G, B\}$. However, CRAs only get paid for a positive rating. The reasoning is that sophisticated and trusting investors only invest in a project with a positive rating. Issuers know that a bad rating has no additional value, since no investor invests in such a rating.[36] As a result, a bad rating is never published. A good rating is published by the CRA. In the case of a good project (and therefore a good rating) the CRA receives the full reputation premium from both types of investors. A sophisticated investor sees that the CRA worked correctly. A trusting investor always pay the reputation, since the default risk of a good project is $p = 0$. So the profit of a CRA in the case of meeting a trusting investor is

$$X_{HT} = \lambda(\phi + \tau).$$

In the case of meeting a sophisticated investor, the profit is

$$X_{HS} = \lambda(\phi + \sigma).$$

So the expected payoff of an honest rating regime is

$$\begin{aligned} \pi_H &= \alpha\lambda(\phi + \tau) + (1-\alpha)\lambda(\phi + \sigma) \\ \Leftrightarrow \pi_H &= \lambda\phi + \lambda(\alpha\tau + (1-\alpha)\sigma). \end{aligned}$$

2. An inflating rating regime: In an inflating rating regime, a CRA always reports a good message, irrespective of the signal. Issuers have an incentive to publish a good rating, so the CRA will always receive the rating fee ϕ.[37] A trusting investor will invest in the project. If the project is good, it will not default and so the CRA will receive the whole reputation premium. However, if the project is bad, the CRA will only receive the reputation premium in the case of a non-default, which occurs with probability $(1-p)$. Therefore the expected payoff from a trusting investor is

$$X_{IT} = \phi + \lambda\tau + (1-\lambda)(1-p)\tau.$$

[35] Note that this is a strong assumption that trusting investors have no knowledge about inflating CRAs. However, recent studies have shown that there is a significant fraction of naive investors in the market (e.g., Elton et al., 2004).

[36] Note the chronology of the different actions: since issuers decide whether a rating is published, the backward induction also includes the actions of an issuer.

[37] These assumptions are described in the section on the analysis of issuers.

If the CRA meets a sophisticated investor, the investor is able to observe if the rating is inflated. So in the case of a good project, the sophisticated investor will invest and the CRA wil receive the reputation premium directly. However, if the project was bad and the CRA inflated the rating, the sophisticated investor will not invest in the project and the CRA will not receive any reputation premium. So the expected payoff when receiving a sophisticated investor is

$$X_{IS} = \phi + \lambda\sigma.$$

Therefore, the expected payoff of an inflating rating regime is

$$\pi_I = \phi + \alpha(1 - p + \lambda p)\tau + (1 - \alpha)\lambda\sigma.$$

The essential question is whether it is profitable for a CRA to inflate a rating. The following inequality determines when it is profitable for a CRA to inflate ratings.

Lemma 1:[38] *A CRA inflates the rating if the following condition holds:*

$$\phi - \alpha\tau(p - 1) > 0.$$

Since $p \in (0, 1)$ $\phi \geq 0$, $\alpha \geq 0$, and $\tau \geq 0$, the condition holds and a CRA inflates the rating in absence of regulation.[39]

In general, the results show the conflict of interest for CRAs. On the one hand, they only receive a full payment of the rating fees if they publish a positive rating. On the other hand, they may have future losses (here, reputation losses) by inflating the ratings, since investors punish rating agencies if an investment defaults.[40] However, in the setting of the game, a CRA cannot publish a bad rating, so a CRA never receives the full reputation. The separation between sophisticated and trusting investors is therefore realistic. A sophisticated investor, such as big investment banks, mainly need a rating for regulatory reasons. Therefore, the reputation is the same for each rating regime. Trusting investors rely on the information in a rating. If they observe that a CRA is not trustworthy, they deny the reputation. However, the CRA has the chance that even a bad rating will not default and here they receive reputation even though they inflated the rating.

Further aspects that may increase the problem of the described conflict of interest are not considered. An example would be that CRAs have an intense relationship with issuers. Right now, it is assumed that issuers approach a random CRA. If issuers have a preferred CRA, which inflate the rating with a higher probability, the chance of inflated ratings increase further. The phenomenon of rating shopping is discussed in the last step of the game analysis.

[38] See calculation in Appendix 9.5.
[39] See discussion section.
[40] In the discussion section, it is shown that the reputation premium actually has an opposite effect.

5.3 Issuers

Each issuer has an incentive to get financing from an investor. I assume that the default of a project is connected to the bankruptcy of the corporate project and the issuer. So in the case of a default, the invested financial resources of the investor are sunk costs. Issuers approach a CRA, because they know about the information and regulation channels. All investors need a rating for regulatory proposes. Therefore, the issuer has to pay a rating fee to get a credit rating. Again, one has to distinguish between two different situations: (1) a project is good and an issuer knows this ex-ante and (2) the project is bad. In the first case, the rating fee has to be lower than the expected payoff for the issuer. Otherwise, the issuer would not invest in a credit rating.[41] As previously mentioned, a CRA always provides a good rating for a good project. Therefore, each good project is financed. The assumption that an issuer approaches a CRA is

Assumption 3:

$$\phi < R - (1 + r)I.$$

The profit of the issuer is

$$\theta_g = R - (1 + r)I - \phi.$$

The situation is different when an issuer has a bad project. A rating fee is only paid if the issuer meets an inflating CRA. With a holding condition in *Lemma 1*, the CRA inflates the rating. The issuer anticipates the condition and the probability of an inflated rating. However, the project is only financed if the the issuer meets a trusting investor. Otherwise the project is not financed, even if it had a positive rating. I assume that the rating in this case has no more value.[42] Therefore the assumption for paying a fee for a bad project is

Assumption 4:

$$\phi < \alpha(1 - p)[R - (1 + r)I].$$

The profit of the issuer is therefore:

$$\theta_b = \alpha(1 - p)[R - (1 + r)I] - \phi.$$

Further to the outcome of this basic model (it has been shown that with a positive rating fee, the rating will be inflated with certainty) one should discuss the ***hypothetical*** situation that rating shopping occurs. The rating fee only has to be paid if a rating is published. So under *Assumption 4*, it is optimal for an issuer with a bad project to approach several CRAs and ask for a rating. An issuer with a bad project that receives a bad rating will try to get a new rating with $m = G$ from another CRA. *Rating shopping* would occur with certainty. The only effect that may mitigate the problem of rating shopping would be a behavioral effect. Here,

[41] One could extend this model and include the pricing behavior of the CRA. However, my main aim is the regulatory aspect. Other approaches include the pricing aspect. See, for example, the discussion in Bolton et al. (2012).

[42] One may argue that even if the investor is sophisticated, and does not invest, the rating may still have value since a new (maybe trusting) investor would invest in the project. However, I assume that such a case is not reasonable since other investors see the low demand of financing the project. So the project will not be financed, even though it has a good rating.

an issuer with low expectations of inflation behavior may stop the rating shopping after receiving some bad ratings for a project. This behavior is driven by an effect of disappointment. The possibility that a CRA inflates a rating was previously described with the exogenous parameter ω. The possibility of having an inflated rating after approaching n different CRAs could easily be calculated. Under the setting of a market with n CRAs and $n = \infty$, it is therefore sure that a bad rating will be given a good rating.[43] An interesting extension of rating shopping is the implementation of a herding effect for CRAs. If CRAs are in contact and share some information, it may be possible that a first internal rating has an effect on a second rating by a different CRA, even though the first rating was not published. Here, ω (the probability of an inflating CRA) may decrease with the number of CRAs asked for a rating (herding effect).

5.4 Outcome

The following points characterize the outcome of the model:

- Under *Assumptions 3* and *Assumption 4*, investors ask a random CRA for a rating. If the rating is bad they ask another CRA, meaning they shop for ratings. I assume an exogenous ω to illustrate rating shopping. Indeed, under *Assumption 1*, *Assumption 2*, and with a positive rating fee, ϕ, all ratings are good, irrespective of the project's characteristic.

- A CRA cannot commit ex-ante to a possible rating regime.[44] CRAs have an incentive to inflate ratings as long as the condition in *Lemma 1* holds. As previously mentioned, *Lemma 1* holds because of *Assumption 1*, *Assumption 2*, and a positive rating fee.

- Sophisticated investors will only invest in good projects. Trusting investors will invest in all projects (all projects have a good rating $m = G$) because they are totally trusting and have no expectations about the own profits. Sophisticated investors pay the reputation to a CRA for good projects, whereas trusting investors pay the reputation for a project that does not default.

- The rating fee is $0 < \phi < \alpha(1-p)[R-(1+r)I]$.

- The average profit for an issuer (some have good and some have bad ratings) is
$$\theta = \lambda[R-(1+r)I-\phi] + (1-\lambda)[\alpha(1-p)(R-(1+r)I)-\phi].$$

- The profit for a CRA is
$$\pi_I = \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma.$$

- The profit for a sophisticated investor is[45]
$$U_S = \lambda(1+r)I + (1-\lambda)0.$$

- The profit for a trusting investor is[46]

[43] For further analysis, see the discussion section.

[44] The profit for a CRA would be higher if it could commit to an honest rating. The reasoning is that issuers of a bad project would not order a rating and only good projects are rated by CRAs. However, a CRA has still the incentive to change from an honest rating regime to an inflating rating regime after receiving an order to rate a bad project. There is an incentive to deviate from the commitment. Since the commitment is, by assumption, not legally contractible, a commitment is impossible.

[45] All projects are in the market and an investor is randomly allocated to a project. If the project is bad, the investor has no opportunity to invest in another project.

[46] $U_T = \lambda I(1+r) + (1-\lambda)\omega[p(-I) + (1-p)(1+r)I] + (1-\lambda)(1-\omega)0$, with $\omega = 1$.

$$U_T = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I].$$

- The profit for a trusting investor is negative and stand in opposition to *Assumption 2*. They only stay in the market because they are totally trusting.

5.5 Discussion

The proposed model simplify the key failures of the credit rating industry: (1) the conflict of interest for rating agencies and, therefore, inflated ratings, and (2) the incentive for rating shopping. Further aspects may be observable by analyzing the results in detail. I begin with the analysis of inflated ratings. In this basic framework, a CRA will inflate a rating if $\phi - \alpha\tau(p-1) > 0$ (*Lemma 1*). Therefore, if one interprets the equation as a probability of inflation (e.g., because of the variability of some variables), comparative statics show that a higher rating fee ϕ means a higher probability of an inflation. The intuition here is that an inflating CRA always receives the fee, irrespective of the characteristic of the project, whereas an honest CRA will only receive the fee in the case of a good project. Therefore, an increasing fee results in a higher absolute difference between the revenue from rating policies and so it is more profitable for the CRA to inflate ratings.

The next parameter to be analyzed is α, the proportion of investors who are trusting. Again, one sees in *Lemma 1* that an a higher value of α means a higher probability of rating inflation. The reasoning in this case is that the more trusting investors there are in the market, the higher is the chance that a project is realized, because sophisticated investors would not invest in a bad project, even if the rating is good. Since even bad projects have a possibility of being successful, the CRA has a higher chance of receiving a reputation premium when meeting trusting investors. This is one of the main analytic aspects of the basic model. A trusting investor is able to punish a CRA by withholding their reputation. However, an honest rating regime would not result in any reputation, since the rating is not published. So the punishment in this model does not work, and even strengthens the problem of rating inflation. It is important to analyze this aspect in detail. Is it reasonable that CRAs do not get a higher punishment if they inflate a rating and the project fails? As in Bolton et al. (2012), I define the reputation in terms of the future discounted profits, or how those profits are influenced by the reputation. By looking at the actual credit ratings market, I think it is reasonable that CRAs gain a profit from inflated ratings, not only because of the rating fee. An example could be the inflated rating for government bonds/bills: If a CRA inflates a rating and the bond/bill is serviced during the entire period, the reputation and market share during future periods may increase. On the other hand, if the bond/bill is not serviced after some periods, the CRA is not blamed directly. Therefore, the reputation in this case strengthens the problem of inflation. With regard to the proportion of trusting investors, α, one can conclude that a higher α means a higher profitability and probability of inflating ratings. Another empirical observation in the market of credit ratings can be explained. In boom periods, the share of trusting investors may increase, and therefore, the problem of inflated ratings increases.

As previously mentioned, the reputation parameter, τ, increases the problem of rating inflation. So the higher the reputation premium of trusting investors (the discounted profit of future periods), the higher the probability of inflation behavior. The reputation premiums of sophisticated investors do not play a role in the model outcome, since sophisticated investors only need the rating for regulation purposes and are not investing in a bad project. They just pay a reputation for a good project with a good rating.

Analyzing parameter p, the default risk of a project, the result is simple. The higher the default risk of a bad project, the less likely it is that a CRA will inflate the rating. This result can be seen from the first derivative of *Lemma 1* with respect to p, which is $-\alpha\tau < 0$. The intuition is that only a bad project has a default risk of $p > 0$, and a good project has no default risk $p = 0$. Therefore, the chance of receiving reputation premium τ

from trusting investors is lower. Recall that the reputation premium is only paid in the case of a bad project that is successful, with probability $(1-p)$.

The problem of rating shopping by issuers is caused by the payment structure and the perfect competition in the market. An issuer can deny the publication of a bad rating without any cost. Even if one assumes that some CRAs do not inflate ratings, an issuer can ask another CRA for a new rating.[47] This result may be mitigated by behavioral effects. First, issuers may stop ordering new ratings after some first honest rating reports. Second, the effect of herding behavior by CRAs, which is motivated by the idea that CRAs have formal or informal information exchange, and further influence each other. Both effects are irrational, and the model predicts that all ratings are inflated by the CRAs.

5.6 Welfare Analysis

In this section, I present an evaluation of the model outcome from a policy point of view. I will use a social welfare function that a regulator tries to maximize. After each regulation mechanism, I will present the corresponding social welfare and evaluate the regulation. The first essential question is the structure of the welfare function.[48] Bolton et al. (2012) use the total ex-ante surplus to evaluate the market efficiency. My approach tries to approximate the regulator point of view: It is reasonable that regulators try to protect investors, since those are the agents that may suffer from inflated ratings and rating shopping. I assume that regulators are interested in sophisticated and trusting investors. However, a regulator is also interested in equality. Maximizing the sum of the profits of the two types of investors of the form $W = \alpha U_T + (1-\alpha)U_S$ would not be suitable. A regulator could tolerate losses from trusting investors if there are enough profits for sophisticated investors. It is more convenient to use a social welfare function that is similar to a classic Rawlsian welfare function of the form $W = min(U_S, U_T)$. A regulator is mainly interested in increasing the profits of those investors who have the lowest profits in the credit ratings market. Usually, trusting investors are investors who have the lower profits, since they are prone to rating inflation. If there are trusting investors who suffer from high losses and sophisticated investors (such as banks or professional funds) that have high profits, the main intention of a regulator is to cut the losses of trusting investors.

The outcome of the model is that the profit for a sophisticated investor is $U_S = \lambda(1+r)I + (1-\lambda)0 > 0$ and the profit for a trusting investor is $U_T = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I] < 0$. Therefore, the welfare function from the regulator point of view is

$$W = min(U_S, U_T)$$
$$W = min(\lambda(1+r)I + (1-\lambda)0, \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I])$$
$$W = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I] < 0.$$

This social welfare is used as a benchmark value when comparing the outcomes of different regulation possibilities.

[47] In the model, all CRAs inflate ratings.

[48] The welfare function may vary from the classic economic textbook definition in which the welfare usually integrates the profits or utility of all agents.

6 Regulations

6.1 Upfront fee - Adjusted Cuomo plan

The first traditional and widely discussed regulation possibility is the introduction of an upfront fee. The Cuomo plan, an agreement of the New York attorney, A. Cuomo, tried to implement this payment fee structure between an issuer and the three big CRAs (Standard and Poor's, Moody's, and Fitch) in the U.S. market. The agreement was implemented in 2008, with ambiguous results. It is still possible for issuers to pay fees to the CRA after a rating publication and therefore increase the conflict of interest for CRAs. In my model, I assume a form of a strong Cuomo plan, in which only upfront fees by issuers are allowed. After the CRA receives the message and sends the rating to the issuer, the issuer decides whether to publish the rating. No additional fee after reporting the message is possible. Although an issuer has still the possibility to shop for a rating, another upfront fee has to be paid. In the following, I will discuss the results of the model in detail. As before, the model is solved by a backward induction. Lastly, I will give an overview of the results and present the policy implications of the results and the welfare analysis.

6.1.1 Investors

The upfront fee does not change the incentives of an investor. A sophisticated investor only invests in good ratings and has a profit of $U_S = (1 + r)I$. For an investment with a good rating, the default rate is $p = 0$ and the sophisticated investors will pay the CRA the reputation for good projects with a good rating. If a bad rating for a bad project is published, a sophisticated investor does not invest (*Assumption 2*), but still pays the reputation. Trusting investors are again totally naive, and do not have any expectations about inflating behavior. Therefore, they are going to invest in all projects that have a good rating. If they invest in a good project, they will pay a reputation to the CRA with certainty. If they invest in a bad project with a good rating, there is still a possibility that the CRA receives reputation, namely if the project does not fail, which occurs with probability $(1-p)$. In the case of a published bad rating, trusting investors will pay the reputation, but not invest. As shown in the next section, investors never observe a bad rating, because issuers do not have an incentive to publish a bad rating and the CRA still has an incentive to inflate ratings.

6.1.2 CRAs

The CRA's profit changes by introducing an upfront fee. Again, the incentives and profits for a CRA in both rating regimes are presented:

Honest rating regime: The CRA reports a rating m in accordance with the signal s. The main difference to the first situation is that an issuer has to pay the rating fee ϕ in all situations, even if a rating is bad. As before I assume that only good ratings are published since issuers know that bad ratings are not financed. There is no additional value to publishing a bad rating, even with an upfront fee.[49] A CRA know that a bad rating is not published by an issuer! For a good project and a good rating, the CRA will receive the full reputation from the investors. Therefore, the respective profit for a CRA in the case of an allocation to a trusting investor and to a sophisticated investors is

$$X_{HT} = \phi + \lambda\tau$$
$$X_{HS} = \phi + \lambda\sigma.$$

[49] Furthermore, one may assume that a bad rating has a negative impact on the image or brand of an issuer. Therefore, an issuer tries to avoid a bad rating.

Therefore, the expected profit for a CRA from an honest rating regime is

$$\pi_H = \phi + \lambda(\alpha\tau + (1-\alpha)\sigma)$$

Inflating rating regime: Again, the CRA receives the rating fee irrespective of the project characteristic. For a good project, the CRA receives the full reputation from both investors. For a bad project (rated with $m = G$), the CRA receives only the reputation of trusting investors when the project does not default (probability $1-p$). The respective payoff for a CRA in an allocation to a trusting and a sophisticated investor is

$$X_{IT} = \phi + \lambda\tau + (1-\lambda)(1-p)\tau$$
$$X_{IS} = \phi + \lambda\sigma.$$

The expected profit from an inflating rating regime is

$$\pi_I = \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma$$

As previously, one may compare the profits for both rating regimes and provide a condition when it is optimal for a CRA to inflate a rating.

Lemma 2:[50] *A CRA inflates the rating if the following condition holds:*

$$\alpha\tau(p-1)(1-\lambda) < 0.$$

With *Assumption 1* and *Assumption 2*[51], and with $\alpha \geq 0$, $\tau \geq 0$ and $p \in (0,1)$, the condition holds and a CRA inflates a rating. The comparison of *Lemma 1* and *Lemma 2* is provided in the discussion section.

The Issuers

The decision of the issuer does not change as a result of introducing an upfront fee. One has to distinguish between whether an issuer has a good project or a bad project. If an issuer has a good project, the decision is the same as in the benchmark model. With *Assumption 3:* $\phi < (1-r)R$, the issuer has an incentive to order a rating from a random CRA and the project gets a good rating. Therefore, the corresponding profit is

$$\theta_g = R - (1+r)I - \phi.$$

If a project is bad, the incentive for an issuer does not change either. However, it is crucial that one assumes that the issuer knows that a CRA is likely to inflate a rating (more formally, issuers know that *Lemma 2* holds in equilibrium). I assume that an issuer knows about the incentive of a CRA and so knows that a CRA inflates

[50] See calculation in Appendix 9.6.
[51] Proof in Appendix 9.4.

a rating.[52] Since the issuer can be sure that a CRA will inflate a rating, he orders a rating under *Assumption 4*: $\phi < \alpha(1-p)(1-r)R$. The profit for an issuer is as before:

$$\theta_b = \alpha(1-p)(R-(1+r)I) - \phi.$$

One may analyze a situation in which it is not sure that a CRA inflates a rating for a bad project (**hypothetical**). The issuer would only approach a CRA if $\phi < \omega\alpha(1-p)(1-r)R$. If the first rating is not inflated (probability ω) the rating fee ϕ is gone. Recall, an issuer does not publish a bad rating since it does not have any added value and probably negative consequences though an informal channel of an issuer's reputation. The issuer can now order a second rating from a new CRA. By the economic theory of sunk costs, the issuer will order a second rating as well. In addition, there are three other effects. First, there may be behavioral effects because an issuer interprets the bad results as a sign that the chance of getting a good rating is very low. Therefore, the expectation of an inflated rating decreases. Second, there may be financial constraints for the issuer. After suffering a first loss because of the rating fee, the issuer has fewer or no resources with which to order a second rating. Third, there is still the possibility of the previously described herding behavior of CRAs. If the probability of inflating ratings ω decreases, an issuer does not order a new rating ($\phi < \omega\alpha(1-p)(1-r)R$ no longer holds). If the issuer receives a bad rating, it is not published because the issuer knows that a bad rating would have no additional value. No investor will invest in a bad project and the issuer has no profit.

6.1.3 Outcome

- Under *Assumption 3* and *Assumption 4*, issuers have the incentive to order a rating independent of the characteristic.
- Since CRAs inflate the rating, there is no need for rating shopping. However, it may be assumed that an exogenous ω rating shopping would still occur because of a rating fee, which acts as sunk costs. Financial restrictions may mitigate the problem of rating shopping.
- CRAs inflate ratings as long as the condition in *Lemma 2* is fulfilled. The incentive to inflate ratings is lower than that in the case with no upfront fee because CRAs receive a fee even for an honest rating regime (Although a bad rating is not published).
- Sophisticated investors only invest in good projects. Trusting investors invest in all projects (all project have a good rating $m = G$) because they are naive.
- The rating fee is $0 < \phi < \alpha(1-p)(R-(1+r)I)$.
- The average profit for an issuer is
$$\theta = \lambda[R-(1+r)I-\phi] + (1-\lambda)[\alpha(1-p)(R-(1+r)I)-\phi]$$
- The profit for a CRA is
$$\pi_I = \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma$$
- The profit for a sophisticated investor is
$$U_S = \lambda(1+r)I + (1-\lambda)0$$

[52] It would be an interesting extension to assume that an issuer is not totally informed about the incentives of a CRA. If an issuer is uninformed, the expectation about the proportion of CRAs that inflate ratings is crucial. With the expectation of ω, the condition that an issuer with a bad project orders a rating changes from *Assumption 4* to $\phi < \omega\alpha(1-p)(1-r)R$.

- The profit for a trusting investor is

$$U_T = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I]$$

- The profit of a trusting investor is negative and is in contrast to *Assumption 2*. They stay in the market only because they are totally trusting.

6.1.4 Discussion

The outcome of the model with an upfront fee is the same as before: (1) rating inflation and (2) incentive for rating shopping remain persistent. However, some effects may mitigate the failures in the market for credit ratings. One may start by analyzing the incentive for a CRA to inflate ratings. As shown earlier, a CRA inflates a rating if the condition in *Lemma 2* holds, and thus, if $\alpha\tau(p-1)(1-\lambda) < 0$. As explained previously, the condition holds and a CRA certainly inflates ratings. To interpret the effect of a variable change as before, one can rewrite the equation as $-\alpha\tau(\lambda + p - \lambda p - 1) > 0$. From here, one can see that the interpretation for the different variables remains unchanged. An increasing α and τ result in a higher probability[53] for an inflated rating, whereas an an increasing p and λ decrease the probability of an inflated rating. It is more interesting to compare the probability of rating inflation in the benchmark model with the probability of rating inflation in the model with an upfront fee, and thus, we compare *Lemma 1* with *Lemma 2*. It can be observed that for the values $\phi > 0$ and $\lambda > 0$, it is more likely that the condition in *Lemma 1* holds than the condition in *Lemma 2*. The main result is that the probability of rating inflation decreases because of the implementation of an upfront fee. This result is reasonable since the CRA receives a fee even in case of an honest rating, and thus, the relative advantage of inflating a rating decreases.

Again, the second failure of the credit rating market is the incentive for an issuer to shop for ratings. The outcome of the model predicts that each CRA inflates ratings. Therefore, no rating shopping would occur because it is simply not needed. However, by assuming an exogenous probability of rating inflation, rating shopping would still exist. Compared to the benchmark model, the problem of rating shopping is mitigated. The first reason for this is the incentive for an issuer to shop for a rating. Unlike in the benchmark model, an issuer with a bad project cannot order a rating and observe the outcome before publication. The issuer has to pay the fee upfront. Therefore, he only orders a rating when the expected profit is higher than a rating fee ($\phi < \omega\alpha(1-p)(1-r)R$). This assumption is harder than *Assumption 4*, and thus, it may be less likely that an issuer with a bad project orders a rating. After an issuer receives the first bad rating, the issuer would not publish the rating, since no investor invest in a project with a bad rating). According to traditional economic theory, the first rating would be seen as sunk costs and the issuer would order a new rating from another CRA. As previously mentioned, financial restraints may decrease the probability of rating shopping. Further, a herding behavior by CRAs and a corresponding decreasing probability of rating inflation (ω) could further decrease the problem of rating shopping. All in all, the incentive of rating shopping may decrease but would be existent.

6.1.5 Welfare Analysis

The outcome of the welfare analysis can be obtained from the benchmark model. Since all issuers have an incentive to get the rating for a project and all CRAs have an incentive to inflate ratings, all ratings will be inflated. Trusting investors continue to suffer from this outcome, and the welfare function is given by

[53] As in the analysis of the benchmark model, I assume *Lemma 2* as a probability.

$$W = min(U_S, U_T)$$
$$W = min(\lambda(1+r)I + (1-\lambda)0, \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I])$$
$$W = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I] < 0$$

Thus, from this welfare function, one can conclude that the upfront fee has no positive effect on the profitability of the suffering trusting investors. However, one may still discuss the two mentioned effects: (1) lower probability of inflating ratings and the hypothetical, and (2) lower incentive for rating shopping. Both effects would increase the profitability of investors because the value of λ for the investors (the probability that the project is good) would increase. The intuition is that lower rating shopping would mean that some bad projects are not receiving an inflated rating because not all issuers shop until they get a positive rating. Together with the effect that a probable lower percentage of CRAs would inflate ratings, the overall probability of positive projects from the investors' perspective would increase. However, one has to note that this effect is a hypothetical one. The model predicts inflating ratings by all CRAs, and thus, no rating shopping is needed and the profits for both types of investors are as in the benchmark model.

6.1.6 Policy Implications

The essential question that should be answered in this section is whether the model theoretical outcome is in line with the empirical investigations. Furthermore, I would like to examine whether the policy of implementing an upfront fee is a suitable regulation to address the failures of the market for credit ratings. The upfront rating fee as introduced in the model is not observable in reality, although several similar plans have been discussed.[54] An upfront fee is not a successful approach according to the model outcome. Because of the structure of the reputation premium, it is still profitable for a CRA to inflate ratings, although the profitability of an honest rating regime increases. Therefore, in general, the same problem seems to persist: for a CRA, merely the chance to profit from an inflating rating fee due to a non-defaulting project leads to the incentive to inflate ratings. This problem is higher in economic boom periods (more trusting investors).

I have explained that there remain effects that may influence the evaluation of the policy positively: first, the incentive for inflating ratings is lower and second, the incentive for rating shopping may be lower. The well-discussed Cuomo plan mainly focused on preventing both failures of the market but the realization was not perfect.[55] As shown by the realization of the Cuomo plan, the details of a policy of an upfront fee are important. In Bolton et al. (2012), the upfront fee would be a successful alternative if it is combined with a ban on rating shopping by making rating mandatory. However, even the approach of Bolton at al. (2012) neither mentioned the possibility that issuers may still choose a favorable CRA because of past experiences nor analyzed the rating procedure (Pagno and Volpin, 2010).

The feasibility of an upfront fee is even lower. A regulator would have to ensure that there are no agreements between the issuers and CRAs. Any contingent aspect of a fee would lower the chances of success in such a policy reform. While the realization of the Cuomo plan has shown that the upfront fee is an interesting regulation mechanism that may mitigate the conflict of interest for CRAs and lower the probability of rating shopping, there are indicators that an upfront fee does not entirely solve for the failures of the credit rating market.

[54] An example is the aforementioned Cuomo plan.
[55] For example, it is still possible for the CRA to reach agreements about payments after observing the rating outcome.

6.2 Mandatory Rating Publication

Bolton et al. (2012) mention an upfront fee in connection with a mandatory rating publication as the most promising regulation possibility to increase efficiency in the rating industry. Freytag and Zenker (2012) analyze the regulation of a random allocation of an issuer to a CRA, but their regulation proposal implies the mandatory publication of a rating. In this section, the regulation of a mandatory rating publication is evaluated. The mandatory rating publication may not be officially connected to an upfront fee, but indeed the publication of a rating fee always implies the payment of a fee. Given that all ratings have to be published, an issuer has to pay the rating fee irrespective of the outcome of the rating. The mandatory rating publication simplifies the credit rating game significantly. An issuer does not face the decision of a rating publication. After the order of a credit rating, the issuer is committed to publishing the outcome. Therefore, the issuer only has to decide whether or not to order a rating. The main critique of the regulation is feasibility, as discussed in the section on policy implications.

Again, the model is solved backwards. To avoid unnecessary repetition, the explanation for investors is omitted. *Assumption 1* and *Assumption 2* are still valid. One has to emphasize that investors pay a reputation fee for a bad rating, although they are not investing. The decision of CRAs as well as issuers changes due to the new regulation mechanism. Again, I present an overview of the results and the implications of the results along with a welfare analysis.

6.2.1 CRAs

The major change in the context of the mandatory rating is that CRAs can publish a bad rating. In the benchmark model and in the model with an upfront fee, the issuer never decides to publish a bad rating since a bad rating does not have any added value for an issuer. Now, the CRA is independent of the issuer's decision. After receiving an order for a rating, the CRA independently decides either to publish an inflated rating or an honest rating. In the following, the profits for the two different rating regimes are described.

Honest rating regime: In the honest rating regime, the CRA publishes a rating that is in accordance with signal s. Since the publication of a rating is mandatory, good and bad ratings are published and therefore the CRA receives a rating fee for all ratings. Sophisticated and trusting investors pay the reputation fee irrespective of the credit rating. On one side, sophisticated investors are able to observe that the CRA rated honestly. On the other side, trusting investors pay the reputation fee directly for bad ratings and the reputation fee for a good rating if the project does not default. Since a good project never defaults ($p = 0$), the reputation fee from a trusting investor is certain. Concerning the behavior of a trusting investor in case of a bad rating, I assume that a trusting investor interprets the bad rating as a sign of protection by the CRA. Although all investors do not invest in a bad rating, they pay the reputation fee. Therefore the profit for the CRA when meeting a trusting and sophisticator investor is

$$X_{HT} = \phi + \tau$$
$$X_{HS} = \phi + \sigma.$$

Thus, the expected profit for the CRA from an honest rating regime is

$$\pi_H = \phi + \alpha\tau + (1 - \alpha)\sigma.$$

Inflating rating regime: When the CRA is inflating a rating, the situation is exactly like in the benchmark model. The CRA always receives a rating fee and the reputation fee if the project is good. In case of a bad project, the sophisticated investor denies the payment of the reputation fee and the trusting investor only pays if the bad project does not default. The profits for the CRA when meeting trusting and sophisticated investors are

$$X_{IT} = \phi + \lambda\tau + (1-\lambda)(1-p)\tau$$
$$X_{IS} = \phi + \lambda\sigma.$$

The expected profit from an inflated rating regime is

$$\pi_I = \phi + \alpha(1 - p + \lambda p)\tau + (1-\alpha)\lambda\sigma.$$

One may further think about a *negligent rating regime*, similar to the negligent behavior that is connected to an inflated rating regime in Freytag and Zenker (2012).[56] The CRA always publishes a bad rating, even if the signal was good. Given the regulation, the CRA always receives a rating fee. Further, a trusting investor would always pay the reputation fee. However, if the CRA provides a bad rating for a good project and meets a sophisticated investor, the investor would not pay the reputation fee since the sophisticated investor observes that the CRA was dishonest. Thus, the honest rating regime strictly dominates the negligent rating regime. Especially by assuming that the cost for gathering information of a project (signal of message) is low (I have assumed these costs are zero) it never makes sense for a CRA no publish a bad rating for a good project. However, one should discuss a problem of moral hazard. It may be the case that a CRA has no incentive to gather information for a rating at all because the connected costs are to high. But there are again some governmental regulations and even if a problem of moral hazard arises the CRA would not intentionally choose a negligent rating regime. In the policy discussion I address the theoretical problem of moral hazard for a CRA. Therefore, one can pre-exclude the negligent rating regime.

Lemma 3:[57] *The CRA inflates the rating if the following condition holds:*

$$\sigma + \frac{\alpha}{1-\alpha}\tau p < 0.$$

Since $\sigma \geq 0$, $\alpha \geq 0$, $\tau \geq 0$, and $p \geq 0$, the condition is never fulfilled. The CRA never inflates a rating since the trusting rating regime strictly dominates the inflated rating regime. A detailed reasoning is provided in the discussion section.

6.2.2 Issuers

Given the mandatory rating regulation, the issuer cannot withhold the publication of a rating. Further, an issuer knows that the CRA works honestly and rates a project in accordance with own signal. Thus, if the issuer has a good project, the rating is good and both kinds of investors finance the project. Given *Assumption 3* ($\phi < (1-r)R$), the issuer orders a rating and has profit $\theta_g = (1-r)R - \phi$. If a project is bad, the issuer has

[56] The negligent behavior in Freytag and Zenker (2012) is connected to an inflated rating regime. Thus, the CRA reports a bad rating in case of a good project and a good rating in case of a bad project.
[57] For calculations, see Appendix 9.7.

no chance to get a good rating. The order of the rating would be connected to the loss of $-\phi$, and the issuer never orders a rating for a bad project. Thus, only issuers with a good project order a rating.

Furthermore, the regulation of a mandatory rating restricts the possibility of rating shopping for an issuer. Only one rating for a project is allowed and rating shopping does not exist.[58]

6.2.3 Outcome

- Issuers cannot withhold the publication of a rating, since publication is mandatory. They anticipate that the CRA is working honestly. An issuer with a good project orders a rating whereas an issuer with a bad project does not approach the CRA. Issuers also cannot shop for a favorable rating.
- The CRA always works honestly since the condition in *Lemma 3* does not hold. Only issuers with a good project order a rating. Therefore, all projects in the market are good.
- CRAs only have to rate good projects. Only good projects with good ratings are in the market. Thus, both types of investors invest in a project. The CRA receives the reputation fee from both investors.
- The average profit for the issuer is
$$\theta = \lambda[(1-r)R - \phi] + (1-\lambda)0.$$
- The profit for the CRA is.
$$\pi_H = \phi + \alpha\tau + (1-\alpha)\sigma.$$
- The profit for a sophisticated investor is[59]
$$U_S = (1+r)I.$$
- The profit for a trusting investor is
$$U_T = (1+r)I.$$

6.2.4 Discussion

The outcome under mandatory rating publication is promising. The conflict of interest for CRAs is mitigated significantly and therefore CRAs mainly act as a screening institution for the investors. As a result, only the issuers with a good project order a rating since they have no possibility of taking advantage of trusting investors. The intuition is that mandatory publication offers the CRA, the possibility to publish even a bad rating for a bad project. The CRA receives the reputation fee even for a bad project. In contrast, inflating a rating would decrease the profit for the CRA since sophisticated investors only pay the reputation fee for a good project and trusting investors would only pay the reputation fee if a bad project does not default. The issuer anticipates the behavior of the CRA. A bad rating is connected to a loss, and only issuers with a good project order a rating. Thus, as can be easily seen, in a market with an upfront fee, the CRA has no say over publication and an issuer never publishes a bad rating. Therefore, the CRA never receives the reputation fee from a bad rating. Further, the CRA is not able to reliably ex-ante commit to an honest rating regime. All in all, the CRA always has an incentive to inflate a rating when getting an order to rate a bad project. Given mandatory rating publication, a CRA does not have to rate a bad project honestly. The profit for the CRA and for the investors increases due to the new regulation mechanism. If the CRA gets the order of providing a rating or the issuer finds an investment opportunity, the project is always good. On the other side, the issuers can only profit from good projects, and therefore the expected profit decreases.

[58] Even in an extension of the model wherein several ratings are allowed, it is highly probable that CRAs do not deviate in their ratings significantly.

[59] There are only good projects with good ratings in the market. Thus, an investor is always randomly allocated to a good rating.

An implementation of the new regulation mechanism directly prevent issuers from shopping for ratings. Each rating has to be published and issuers do not have the possibility of observing different rating outcomes and choosing the best. Finally, the effect of an increased fraction of trusting investors is different. One can reorder *Lemma 3* to $(\alpha - 1)\sigma - \alpha\tau p > 0$ and see that even in a market with solely trusting investors ($\alpha = 1$), the condition for a profitable inflated rating regime does not hold. The CRA does not inflate ratings in a market of only trusting investors. However, it is still possible to use comparative statics to see the likelihood of a holding condition in *Lemma 3*. The first derivative is $\sigma - \tau p$. If the reputation fee from trusting and sophisticated investors has the same value for the CRA ($\sigma = \tau$) and a bad project does not always default ($p < 1$), the derivative is positive. Thus, an increasing fraction of trusting investors still increase the probability of the CRA inflating ratings. This increase in probability is strengthened if one assumes that the reputation fee for sophisticated investors is more important that the reputation fee for trusting investors ($\sigma > \tau$). The underlying intuition is that the more important the reputation fee for sophisticated investors is, the higher is the advantage of rating inflation if there are less sophisticated investors in the market because of a larger decrease in profits.

To conclude, a mandatory rating publication decreases the conflict of interest for the CRA. The CRA has no further incentive to inflate ratings, even in a market with only trusting investors. Further, the issuer cannot shop for a better rating.

6.2.5 Welfare Analysis

As previously mentioned, only good projects with good ratings are in the market. Both sophisticated and trusting investors get randomly allocated to such a project and are investing. The project does not default and therefore the profits for both investors are $(1 + r)I$. One can criticize this approach since there are less projects in the market and some investors are unable to invest. However, I assume that there are endless investors in the market with the same level of risk adversity. A random investor is allocated to a project and I am primary interested in the outcome for those investors with a monetary investment. Even if a non-investing sophisticated or trusting investor is allocated to a bad project, the allocation can be interpreted as inefficiency. Therefore, sophisticated investors prefer an allocation to solely good projects, although they are able to evaluate the project characteristic. According to the model outcome, the welfare function has the following form:

$$\begin{aligned} W &= min(U_S, U_T) \\ W &= min((1 + r)I, (1 + r)I) \\ W &= (1 + r)I > 0. \end{aligned}$$

Compared to the benchmark model and the model with an upfront fee, welfare is higher and is positive. Trusting investors now have the same profits as sophisticated investors and do not face the risk of a financial loss. In addition, the profit for sophisticated investors increases since they are solely allocated to good projects.

6.2.6 Policy Implications

The model outcome not only shows that social welfare increased substantially due to the regulation mechanism but also that there is a change in public opinion about CRAs. The CRA is a profit-maximizing institution in the credit rating industry but it is also concerned about its own reputation. Given suitable regulation, even a private CRA can increase the efficiency of the market and protect trusting investors.

Although the mandatory rating publication seems to be the most successful approach in the model theoretical framework, the feasibility of this approach is questionable. The interaction between issuers and CRAs is private. For a regulator, the interaction is a black box and it is hard to control that the publication of a rating is mandatory. An issuer could offer the CRA an additional fee or other monetary advantages after the publication

of an inflated rating. If this additional fee is larger than the weighted average of the reputation fee from sophisticated investors and the certain reputation minus the possible reputation in case of a non-default of trusting investors ($(1-\alpha)\sigma + \alpha(\tau - (1-p)\tau)$), the CRA will still inflate the rating. Furthermore, a regulator has no control over the CRA asking an issuer for a confirmation before publication in hopes for future rating orders. Such informal connections would decrease social welfare since there are again higher chances of the issuer taking advantage of trusting investors. Possible legal penalties would be strong regulatory intervention but this entails high administrative costs.

Finally a problem of moral hazard arises in the credit rating industry. The rating fee under regulation in certain for the CRA. If the reputation from investors is sufficiently low and the costs from gathering information of a project for CRAs is sufficiently high (Recall, I have assumed these costs are zero), it is possible that CRAs has no incentive to gather own information and solely publish bad ratings. However, several aspects mitigate the theoretical construct of a possible moral hazard. First the reputation is the future discounted profits of a CRA, therefore these reputation are sufficiently high. So it is reasonable to assume that the possible reputation are much higher than the costs of gathering information. Second, a market with solely bad ratings would collapse immediately and because of the pressure from investors regulators would intervene. All in all I think a problem of moral hazard for CRAs under this regulation is highly improbable.

6.3 Increasing Accountability for CRAs

In June 2013, the European Commission adopted stricter rules for credit rating agencies. One of the five implemented regulation mechanisms is the that "Credit rating agencies will be more accountable for their actions" (European Commission, 2013):

"The new rules will make rating agencies more accountable for their actions as ratings are not just simple opinions. Therefore, the new rules ensure that a rating agency can be held liable in case it infringes intentionally or with gross negligence the CRA Regulation, thereby causing damage to an investor or an issuer." (European Commission, 2013)

The European Commission mainly refers to the Regulation (EC) No 1060/2009, a document which describes the commitment of a CRA in detail (integrity, methodologies, data resources, etc.). In general, a CRA is committed to work honestly and should not intentionally inflate or deflate credit ratings. With the new rules, the European Commission increases the possibility for an actor (investor, issuer) to get reimbursed directly by a CRA if an inflated rating is connected to a loss. I implement the regulation by the European commission in the model through a new negotiation parameter between CRAs and investors. If an investor is investing in a project with an inflated rating, the investor has the possibility to get reimbursed by a CRA. I label the amount of reimbursement as η, and the difference between I and η as ϵ ($I - \eta = \epsilon$). The reimbursement is not equal to the actual loss because of several reasons. First, the reimbursement is paid ex-post, and thus has to be discounted. Second, the legal process is connected to some monetary costs. Third, it is possible that not all investors (especially private and uncommercial investors) try to get reimbursed or that not all legal processes are successful.

Assumption 5:

$$\eta < I.$$

The model is solved by backward induction. I present the incentives as well as the outcome of the model. Further, I discuss the analysis, show how the regulation effects welfare, and describe policy implications.

6.3.1 Investors

The general assumptions for investors remain stable. Both investors do not invest in a bad project with a bad rating (*Assumption 1.* Further, investors would not invest in an unknown project (*Assumption 2* and for regulatory reasons). The incentive to invest in an unknown project with a reimbursement right, however, may change.

First, trusting investors still invest in every project with a good rating. In case of a good project, they obtain profit $I(1+r)$. If the rating was inflated and the project is indeed bad, a trusting investor still invests. The main difference as compared to the benchmark model is that the investor can get reimbursed if the project defaults. Since the probability of default for a good project is zero, a default is a proof that the rating was inflated. The expected profit from investing in a bad project with an inflated rating is therefore $p(-I+\eta)+(1-p)(1+r)I$. If a project with a good rating defaults, the issuer withholds the reputation fee. Otherwise, the reputation fee is paid since a trusting investor cannot evaluate the characteristic of a project ex-ante.

A sophisticated investor is able to evaluate the characteristic of a project but needs a rating for a project. For a good project with a good rating, the investor invests, pays the reputation fee, and makes profit $I(1+r)$. If a rating is inflated, the investor withholds the reputation fee. However, it may be profitable for the investor to invest in an inflated rating because of the possibility of damages.

***Lemma 4**: It is profitable for a sophisticated investor to invest in a project with an inflated rating if the following condition holds:*[60]

$$(1-p)(1+r)I > \epsilon p.$$

A sophisticated investor invests in a bad project that was rated as good if the profit in case of a non-default is higher than the loss in case of a default. The loss if a project defaults is the actual loss of investment minus the amount of reimbursement ($I-\eta=\epsilon$).

In the following game theoretical analysis, I describe both possible equilibria. First, the equilibrium in which sophisticated investors do not invest in a bad project with an inflated rating, and second, the equilibrium in which sophisticated investors invest intentionally in a bad project that has a good rating.

6.3.2 CRAs

The new regulation directly increases the accountability for CRAs. As compared to the benchmark case, the profitability of an inflation rating regime decreases since the CRA that is inflating ratings, faces the persistent risk of damage claims by investors. This accountability has an effect on the profits of an inflating CRA.

Honest rating regime: The profit from an honest rating regime remains unchanged. The CRA receives the rating fee and the reputation fee only for good projects. Issuers do not purchase a bad rating, and therefore bad ratings are not published. As in the benchmark model, an issuer does not have to pay an upfront fee and thus, the CRA does not receive the rating fee for a bad rating. Without the publication of a rating, the CRA also has no chance to receive any reputation fee. The profit for an honest CRA in case of allocation to a trusting or sophisticated investor is

[60] For calculations, see Appendix 9.8.

$$X_{HT} = \lambda(\phi + \tau)$$
$$X_{HS} = \lambda(\phi + \sigma).$$

Thus, the expected payoff of an honest rating regime is

$$\pi_H = \lambda\phi + \lambda(\alpha\tau + (1-\alpha)\sigma).$$

Inflating rating regime: As mentioned earlier, the CRA always reports a good rating, for both good and bad projects. To calculate the profitability of an inflated rating regime, one has to differentiate between the two investment strategies of a sophisticated investor explained in *Lemma 4*: the equilibrium in which a sophisticated investor intentionally invests in a bad project with a good rating, and the equilibrium in which a sophisticated investor behaves as in the benchmark model and does not invest in a bad project.

1. Equilibrium: $(1-p)(1+r)I > \epsilon p$. The CRA that inflates ratings always receives a rating fee. Further, one has to distinguish between the CRA being allocated to a trusting investor and to a sophisticated investor. If the CRA is allocated to a trusting investor, the investor always finances the project. For good projects, the CRA receives the reputation fee. For bad projects, the CRA receives the reputation fee if a project does not default (probability $1-p$). Further, the CRA faces the risk of reimbursement if a bad project defaults (probability p, cost η). In case of allocation to a sophisticated investor, the CRA only receives the reputation fee for a good project. A sophisticated investor can evaluate the characteristic of a project and withhold the reputation if a rating is inflated. However, a sophisticated investor intentionally invests in a bad project with a good rating. If a bad project defaults (probability p), the sophisticated investor can also get reimbursed. Thus, the CRA faces cost η. The profits for the CRA in case of allocation to a trusting investor and to a sophisticated investor are

$$X^A_{IT} = \phi + \lambda\tau + (1-p)(1-\lambda)\tau - (1-\lambda)p\eta$$
$$X^A_{IS} = \phi + \lambda\sigma - (1-\lambda)p\eta.$$

Thus, the expected payoff of an inflated rating regime is

$$\pi^A_I = \phi + \alpha(1-p-\lambda p)\tau + (1-\alpha)\lambda\sigma - (1-\lambda)p\eta.$$

2. Equilibrium: $(1-p)(1+r)I < \epsilon p$. The analysis for an allocation to a trusting investor is as in the first equilibrium. However, it is not profitable for a sophisticated investor to invest intentionally in a bad project with a good rating. Thus, if the CRA inflated a bad project, the sophisticated investor does not invest. Further, the CRA does not face the risk of an ex-post reimbursement. The profit for the CRA in case of an allocation to a trusting or sophisticated investor is

$$X^B_{IT} = \phi + \lambda\tau + (1-p)(1-\lambda)\tau - (1-\lambda)p\eta$$
$$X^B_{IS} = \phi + \lambda\sigma.$$

Thus, the expected payoff of an inflated rating regime is

$$\pi_I^B = \phi + \alpha(1 - p - \lambda p)\tau + (1 - \alpha)\lambda\sigma - (1 - \lambda)\alpha p\eta.$$

For both equilibria, one can establish a condition that the CRA inflates a rating.

Lemma 5A:[61] *With* $(1-p)(1+r)I > \epsilon p$ *(Lemma 4), the CRA inflates the rating if the following condition holds:*

$$\phi - \alpha\tau(p - 1) - p\eta > 0.$$

Lemma 5B:[62] *With* $(1-p)(1+r)I < \epsilon p$ *(Lemma 4), the CRA inflates the rating if the following condition holds:*

$$\phi - \alpha\tau(p - 1) - \alpha p\eta > 0.$$

The intuition underlying *Lemma 5A* and *Lemma 5B* is provided in detail in the discussion section. In general, one observes that the condition in *Lemma 5A* is stronger than the condition in *Lemma 5B*. In general, the conditions hold for lower values of p and η. In my opinion, it is reasonable that the investment required for financing a project are very high (I). Further, one may argue that the costs from reimbursement for the CRAs are very high and presumably higher than the profits in case of a non-default and the rating fee. This argument is more problematic when sophisticated investors do not invest in an inflated rating and there are less trusting investors in the market (small values of α).[63] The strategy of a CRA is not obvious, therefore I present the critical values of η. The critical value of η presents the threshold for which the CRA is indifferent between an inflated and an honest rating regime. Again, one has to differentiate between the two equilibria (critical values: η^A and η^B). One in which a sophisticated investor invests intentionally in inflated ratings and one in which a sophisticated investor does not invest.[64]

$$\eta^A = \frac{1}{p}(\phi + \alpha\tau(1 - p))$$
$$\eta^B = \frac{1}{p}(\frac{\phi}{\alpha} + \tau(1 - p)).$$

If $\eta < \eta^A$ or $\eta < \eta^B$, the CRA inflates ratings, whereas for $\eta > \eta^A$ or $\eta > \eta^B$, the CRA rates honestly.

6.3.3 Issuers

The general assumptions for the issuer are still valid. the issuer always orders a rating for a good project (*Assumption 3*) and obtains profit $\theta_g = R - (1 + r)I - \phi$. Because of the fee structure (fee is paid only in case of publication), the issuer has an incentive to order a rating for a bad project, independent of the outcome. The publication of a rating is however dependent on the equilibrium.

[61] For calculations, see Appendix 9.9.
[62] For calculations, see Appendix 9.10.
[63] Note that *Lemma 5B* can be reordered to $\phi + \alpha(\tau - \tau p - p\eta) > 0 = \phi + \alpha(\tau - p(\tau + \eta))$.
[64] Calculations in Appendix 9.11.

In the first equilibrium, all investors finance a bad project with an inflated rating. Only if the condition in *Lemma 5A* holds, the CRA inflates the rating. The issuer publishes the rating if the profit is higher than the rating fee:

Assumption 5:

$$\phi < (1-p)[R-(1+r)I].$$

The profit of the issuer is $\theta_b^A = (1-p)[R-(1+r)I] - \phi$. If the condition in *Lemma 5A* does not hold, that is, $\eta > \eta^A$, the CRA does not inflate the rating. A publication is connected to a loss of $-\phi$, and therefore the issuer does not publish a rating for a bad project. Thus, only good projects are in the market.
In the second equilibrium, only trusting investors finance a bad project with an inflated rating. Sophisticated investors are not willing to invest. Only if the condition in *Lemma 5B* holds, the CRA inflates the rating. The assumption that the issuer publishes a rating is therefore the same as in the benchmark model.

Assumption 4:

$$\phi < \alpha(1-p)[R-(1+r)I].$$

The profit of an issuer would be $\theta_b^B = \alpha(1-p)[R-(1+r)I] - \phi$. If the condition in *Lemma 5B* does not hold, that is, $\eta > \eta^B$, the CRA works honestly. The issuer does not publish a bad rating for a bad project. Therefore, only good projects are in the market.
I have already assumed that *Assumption 4* holds. *Assumption 4* is stricter than *Assumption 5*, and as such, *Assumption 5* always holds. The essential criterion for the final equilibrium is the critical value of η. If η is sufficiently high, the CRA has no incentive to inflate the rating. Issuers have no possibility of publishing an inflated rating.

The regulation mechanism does not include an upfront fee. Issuers have a strong incentive to shop for ratings, since rating shopping is not connected to any further cots. After the observation of a first bad rating for a bad project, an issuer orders another rating from a new CRA. Note that issuers shopping for ratings, remains a failure even now.

6.3.4 Outcome

In contrast to the benchmark model and the regulations presented previously, the outcome of the model is ambiguous. First, one has to differentiate between an equilibrium in which sophisticated investors finance bad projects with good ratings and an equilibrium in which sophisticated investors only finance good investments with good ratings. Sophisticated investors may invest in bad projects because eventual damages can be claimed. Further, there is still the possibility that a bad project does not default. Together, the costs from a default are lower than the expected profits. Damage claims are only possible for inflated ratings. If the costs of default are still larger than the possible profits, a sophisticated investor behaves like in the benchmark model.

The two equilibria directly effect the decision of the CRA. However, irrespective of an investing or non-investing sophisticated investor, the incentive of the CRA to inflate ratings is lowered. The reasoning is that the CRA faces potential damage claims from trusting investors. It is not profitable for a CRA to inflate ratings if the potential losses from damage claims are sufficiently high (critical value η). The exact critical value of η, namely η^A and η^B, is dependent on the behavior of sophisticated investors. In a market equilibrium in which

all investors are financing bad projects the risk of a damage claim, the critical value of η^A is higher: here, it is less likely that the CRA inflates a rating.

The issuer has an incentive to publish an inflated rating. The assumptions are the same as in the benchmark model. In an equilibrium in which sophisticated investors are investing intentionally in projects with inflated ratings and CRAs inflate ratings, the expected profits for the issuer are even higher. Therefore, the issuer would have an even higher incentive to publish inflated ratings. In the following, I shortly give an overview about the four different outcomes.

1. Equilibrium: $(1-p)(1+r)I > \epsilon p$ *(Lemma 4) and* $\phi - \alpha\tau(p-1) - p\eta > 0$ *(Lemma 5A)*

- The issuer knows that the CRA has an incentive to inflate ratings and that all investors are investing in an inflated rating. Under *Assumption 5* (which is less strict than *Assumption 4*), the issuer publishes a good rating for any project. Further the issuer has a strong incentive to shop for a good rating.
- Since the condition in *Lemma 5A* holds, the CRA has an incentive to inflate ratings. The CRA receives the reputation fee from all investors for good projects and only from trusting investors if a bad project does not default. However, the CRA expects losses from damage claims by all issuers.
- Trusting investors invest in all projects with good ratings. In case of a good project or a non-defaulting bad project, they pay the reputation fee to the CRA. In case of a default, they get reimbursed by η.
- Sophisticated investors invest intentionally in all projects with a good rating. They only pay the reputation fee for good projects. If a bad project defaults, they get reimbursed by η.
- The expected profit for the issuer is
$$\theta^A = \lambda[R - (1+r)I - \phi] + (1-\lambda)[(1-p)(R-(1+r)I) - \phi].$$
- The profit for the CRA is
$$\pi_I^A = \phi + \alpha(1-p-\lambda p)\tau + (1-\alpha)\lambda\sigma - (1-\lambda)p\eta.$$
- The profit for a trusting investor is
$$U_S^A = \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon].$$
- The profit for a sophisticated investor is
$$U_T^A = \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon].$$

2. Equilibrium: $(1-p)(1+r)I < \epsilon p$ *(Lemma 4) and* $\phi - \alpha\tau(p-1) - \alpha p\eta > 0$ *(Lemma 5A)*

- The CRA inflates ratings, but sophisticated investors do not invest in bad projects. Given *Assumption 4*, the issuer publishes a rating. Furthermore, the issuer has an incentive to shop for ratings.
- The condition in *Lemma 5B* holds. The CRA inflates a rating and reports a good rating for a bad project, and receives the full reputation fee for good projects. However, only when a bad project does not default does the CRA receive the reputation fee from trusting investors. However, the CRA has to reimburse trusting investors if a bad protect defaults.
- Trusting investors finance every good-rated project. They pay the reputation fee for good and non-defaulting bad projects. In case of a default, they withhold the reputation fee and also get reimbursed by the CRA (η).
- Sophisticated investors evaluate the characteristic of a project. They only invest in good projects since the condition in *Lemma 4* does not hold. For bad projects with a good rating, they withhold the reputation fee. Since good projects never default, sophisticated investors do not claim damages.

- The expected profit for the issuer is
$$\theta^B = \lambda[R - (1+r)I - \phi] + (1-\lambda)\alpha[(1-p)(R-(1+r)I) - \phi].$$
- The profit for the CRA is
$$\pi_I^B = \phi + \alpha(1-p-\lambda p)\tau + (1-\alpha)\lambda\sigma - (1-\lambda)\alpha p\eta.$$
- The profit for a trusting investor is
$$U_T^A = \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon].$$
- The profit for a sophisticated investor is
$$U_S^A = \lambda(1+r)I + (1-\lambda)0.$$

3./4. Equilibrium: $(1-p)(1+r)I > \epsilon p$ *(Lemma 4) and* $\phi - \alpha\tau(p-1) - p\eta < 0$ *(Lemma 5A) or* $(1-p)(1+r)I < \epsilon p$ *(Lemma 4) and* $\phi - \alpha\tau(p-1) - \alpha p\eta < 0$ *(Lemma 5B)*

- The CRA does not inflate the rating since the condition in *Lemma 5A or 5B* does not hold. The issuer cannot receive a good rating for a bad project. Since the publication of a bad rating is connected to a loss, bad ratings are not published. To conclude, only good projects with good ratings are in the market. However, rating shopping is rational (no upfront fee), and therefore, the issuer orders a rating from each CRA in the market. For good projects, the issuer publishes a rating.
- It is not profitable for the CRA to inflate ratings. The main reason is that it is committed to reimbursing investors if an inflated bad project defaults. For good projects, the CRA reports a good rating, which is finally published by the issuer. For such projects, the CRA receives the full reputation fee by all investors.
- Sophisticated investors always invest in good projects with good ratings and pay the reputation fee to the CRA. Even if an investor has an incentive to intentionally finance an inflated project, he cannot do so. There are no inflated ratings in the market.
- Trusting investors invest in all projects with a good rating. Because the CRA does not inflate the rating, financed projects do not default. The trusting investor pays the reputation fee to the CRA.
- Investors have no losses from defaults. Consequently, there are no damage claims.
- The expected profit for the issuer is
$$\theta = \lambda[R - (1+r)I - \phi] + (1-\lambda)0.$$
- The profit for the CRA is
$$\pi_H = \lambda\phi + \lambda\alpha\tau + \lambda(1-\alpha)\sigma.$$
- The profit for a trusting investor is
$$U_T^A = (1+r)I.$$
- The profit for a sophisticated investor is
$$U_S^A = (1+r)I.$$

6.3.5 Discussion

Compared to the previous regulations, the evaluation under increased accountability for CRAs is less straight forward. The outcome of the model is dependent on the relation between the rating fee and the reimbursement parameter. In general, the expected profit for the CRA from an inflated rating regime decreases due to the reimbursement costs of bad-project defaults. Therefore, the condition for an inflating CRA is stricter than in

previous models. By interpretation, we get that the introduction of accountability decreases the probability of inflating by the CRA. Even if the CRA still has an incentive to inflate credit ratings, the losses for investors are mitigated by the right to claim damages due to inflated ratings.

Before analyzing the detailed condition for rating inflation by the CRA, one should evaluate *Lemma 4* ($(1-p)(1+r)I > \epsilon p$), the condition under which a sophisticated investor intentionally invests in bad projects with an inflated rating. *Lemma 4* gives that a sophisticated investor finances a bad project if the possible profit due to a non-defaulting project (probability $1-p$) is higher than the loss in case of a default (probability p). The profit for a good project equals investment plus the interest rate ($(1+r)I$) whereas the loss is the forgone investment (I) minus the expected reimbursement (η). The higher the probability of default, the lower the interest rate and the higher the expected reimbursement, the lower is the probability that the condition for a sophisticated investor holds. As previously explained, the parameter of expected reimbursement η also involves the possibility of a successful claim for damages, costs of court proceedings, value of time, etc. In reality, documenting evidence is a cost-intensive and long-winded process. Thus, the actual loss of I is probably not close to the expected reimbursement η. Therefore, one may argue that it is less likely that sophisticated investors intentionally invest in inflated ratings. If sophisticated investors invest in inflated ratings, a regulator may face a new problem in the market of credit ratings. Good ratings are connected to lower reserve capital requirement, and thus, the systematical risk may increase. However, the threat that all investors raise claims of reimbursement probably prevent inflated ratings at all.

When sophisticated investors do not intentionally invest in a bad project with a good rating, the condition for the CRA inflating ratings is provided in *Lemma 5B* ($\phi - \alpha\tau(p-1) - \alpha p\eta > 0$). For a value of $\eta < \frac{1}{p}(\frac{\phi}{\alpha} + \tau(1-p))$, the CRA has the incentive to inflate a rating. As in the benchmark model, higher values of ϕ and τ are connected to a higher probability that the condition holds: the probability of rating inflation increases. For a higher default probability p, the inflation probability decreases because of two aspects. First, the probability of receiving the reputation fee from trusting investors, who invest in a bad project with a good rating, decreases. Second, the probability of damage claims increases. However, only trusting investors are investing in inflated ratings, and only these can get reimbursed. This leads to a new interpretation of the parameter α. On one side, a higher fraction of trusting investors increases the possibility for the CRA to receive the reputation fee from trusting investors. On the other side, a higher fraction of investors have the right to claim damages in case of a default. From a theoretical viewpoint, it can be said that the higher the proportion of trusting investors (boom periods), the higher is the incentive to rate honestly to avoid reimbursements if the reimbursement in case of default is higher than the reputation in case of non default . The main determinant for the likelihood of a CRA inflating ratings is the reimbursement parameter η. I have argued previously that η probably deviates from the actual investment. However, assuming large investments by investors (for example in governmental bonds), it is reasonable to assume that the possible damage claims from investors are much higher than a rating fee. Following this idea, the probability of an inflated rating regime decreases substantially due to accountability.

By comparing *Lemma 5A* with *Lemma 5B*, one sees that the condition for an inflating CRA is stricter if sophisticated investors, too, finance projects with inflated ratings. The underlying intuition is that CRAs have higher expected reimbursement costs and it is therefore less profitable to inflate ratings. In contrast to an equilibrium in which only trusting investors invest in bad projects, the interpretation of α changes. Now, an increasing fraction of trusting investors is solely connected with higher profits due to the reputation fee, which is paid if a project does not default. Sophisticated investors know that the CRA inflates ratings and do not pay the reputation fee for bad projects, although they do invest.

Finally, the possibility of rating shopping by issuers is a persistent failure of the market for credit ratings and is not mitigated by the accountability of CRAs. Issuers do not have to pay an upfront fee and therefore it is rational for them to ask every CRA in the market for a rating.

6.3.6 Welfare Analysis

The regulator is only interested in the profit or the potential losses of investors. The main difference to the benchmark model is that an investor can claim damages in case of a loss due to inflated ratings. Therefore, the welfare always increases. However, one has to distinguish between a situation with inflating CRAs and a situation with honest CRAs. In an equilibrium where CRAs have no incentive to inflate ratings (caused by the accountability), there is no possibility of an issuer getting an inflated rating for a bad project. Issuers therefore do not publish any bad rating (no added value); only good ratings (for good projects) are published. The outcome is independent of the incentive for a sophisticated investor to invest in inflated ratings since there are no inflated ratings in the market. The welfare would be equal to the optimal output that I have shown in the regulation framework of a mandatory rating publication:

$$W^H = min(U_S, U_T)$$
$$W^H = min((1+r)I, (1+r)I)$$
$$W^H = (1+r)I > 0$$

In an equilibrium in which CRAs have the incentive to inflate ratings, the welfare calculation changes. Further, the welfare function is dependent on the incentive if a sophisticated investor invests intentionally in inflated ratings. If a sophisticated investor invests intentionally in inflated rating and the CRA has the incentive to inflate ratings, the welfare function is given by

$$W^{IA} = min(U_S, U_T)$$
$$W^{IA} = min[\lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon], \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon]]$$
$$W^{IA} = \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon > 0$$

The profit is the same for trusting and sophisticated investors. Since sophisticated investors intentionally invest in inflated ratings, the profit in case of a bad project is larger than zero. This holds for trusting investors as well. In case of a good project, the profit is always positive. Therefore, the welfare has to be larger than zero.
In the last equilibrium, while a CRA has the incentive to inflate ratings, sophisticated investors do not invest intentionally in a bad rating. The welfare function has the form

$$W^{IB} = min(U_S, U_T)$$
$$W^{IB} = min[\lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon], \lambda(1+r)I + (1-\lambda)0]$$
$$W^{IB} = \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I + p\epsilon]$$

Since sophisticated investors do not invest intentionally in an inflated rating, the profit from investing in a bad project has to be negative. Consequently, the profit for a sophisticated investor is higher than that for a trusting investor. The welfare value is dependent on the parameter ϵ. Therefore, it is possible that the welfare value is either positive or negative. However, the welfare under the regulation of an increased accountability is larger than the welfare in the benchmark model. The intuition is that generally, a trusting investor has the possibility to claim damages if a bad project defaults.

6.3.7 Policy Implications

The increasing accountability does not provide an optimized outcome of credit rating at all events. However, the new regulation lowers a CRA's incentive to inflate ratings. With sufficiently high reimbursement costs (see critical values of η), a CRA does not inflate ratings. The optimized outcome may be reached. Even if the reimbursement cost are that high that sophisticated investors invests intentional in inflated ratings the regulation is successful since CRAs have even lower incentive to inflate ratings. The threat of reimbursement costs works, at least if the reimbursement costs are sufficiently high. Although the honest rating regime is not an unambiguous result, the presented regulation mechanism by the European Commission is promising. A CRA faces the high potential damage claims of investors and is therefore more cautious in avoiding unjustified ratings. In comparison to a mandatory rating publication, an increased accountability is a feasible instrument. A regulator does not need to intervene in the market and control actors directly; it is sufficient to offer investors the potential right for reimbursement. The actual value of a damage claim is subject to a civil legal process between investors and CRAs. A possible point of critique is that an investor has to be able to evaluate a project's characteristic ex-post, which is a crucial assumption of the model. In addition, the regulation does not prevent issuers from shopping for ratings. A connection of this regulation mechanism with an upfront fee may mitigate this failure.

6.4 Random Allocation of a Single CRA

Another regulation implemented by the European Commission (2013) is a rotation principle. For some specific and difficult financial products, an issuer-CRA relationship relationship should be non-stable.

"The Regulation introduces a mandatory rotation rule forcing issuers of structured finance products with underlying re-securitised assets, who pay CRAs for their ratings ("issuer pays model"), to switch to a different agency every four years. An outgoing CRA would not be allowed to rate re-securitised products of the same issuer for a period equal to the duration of the expired contract, though not exceeding four years. But mandatory rotation will not apply to small CRAs, or to issuers employing at least four CRAs each rating more than 10% of the total number of outstanding rated structured finance instruments. A review clause provides the possibility for mandatory rotation to be extended to other instruments in the future." (European Commission, 2013)

Freytag and Zenker (2012) try to evaluate this regulation mechanism by assuming a random allocation of a CRA to an issuer. This approximation is reasonable since the change in CRA after a time period is indeed like a random allocation of a CRA to an issuer. A random allocation prevents a relationship between an issuer and a CRA and is therefore equal to the direct proposal of rotation implemented by the European Commission. However, the regulation described in Freytag and Zenker (2012) does not only involve a random allocation. In addition Freytag and Zenker (2012) mention that "[. . .] the rating report is issued definitely, the CRA receives the fee-payment certainly." (p. 10). With this assumption, Freytag and Zenker (2012) implicitly assume a mandatory rating publication. However, the random allocation does not necessary has to involve a mandatory rating or an upfront fee. An issuer should still have the possibility to withhold a publication of a bad rating and avoid payment of a rating fee. In connection with the previously described fact that Freytag and Zenker (2012) assume that a CRA may publish a bad rating for a good project (negligent behavior), the validity of the evaluation is questionable.

Indeed the random allocation of an issuer does not avoid all failures in the credit rating industry. In my model background, the CRA has the same incentive to inflate a rating as in the benchmark model. Therefore, the analysis remains unchanged. The CRA inflates a rating certainly and issuers have the possibility to take advantage of trusting investors. Trusting investors suffer from losses and just stay in the market since they are naive. The only improvement of a random allocation is that an issuer has no more possibility to shop for a

rating since the issuer is allocated to a random CRA. Further improvements that are not implemented in my model need to be discussed. In addition, one may think that an intense relation between the issuer and the CRA increase the conflict of interest for the CRA and the incentive to inflate ratings.

To conclude, the random allocation of an issuer to a CRA does not mitigate the conflict of interest for the CRA in my model. The main improvement is that issuers have no more possibility to shop for a favorable rating. A regulation that solely relies on the random allocation of a CRA to an issuer is not promising.

6.5 Reduce the Overreliance of Investors on Credit Ratings

The European Commission tries to motivate investors to strengthen their own risk management to decrease the percentage of totally naive investors.

"In line with our G20 commitments, the new rules will reduce reliance on external ratings, requiring financial institutions to strengthen their own credit risk assessment and not to rely solely and mechanistically on external credit ratings. European Supervisory Authorities should also avoid references to external credit ratings and will be required to review their rules and guidelines and where appropriate, remove credit ratings where they have the potential to create mechanistic effects." (European Commission, 2013).

In a theoretical framework model, this regulation is easy to implement. If the attempt by the European Commission is successful, more investors would evaluate the characteristic of a project before investing. A higher fraction of investors observe if the CRA has inflated a rating. Therefore, the fraction of trusting investors (α) decreases whereas the fraction of sophisticated investors ($1 - \alpha$) increases. As shown in the analysis of the benchmark model, a decreasing α decreases the profitability of the inflated rating regime. Consequently, a CRA has less incentives to inflate ratings. The reasoning is that the less trusting investors are in the market, the lower the profit due to a reputation payment. Only trusting investors would pay the reputation fee if a bad project does not default. Furthermore, the profit for an issuer with a bad project decreases. Issuers, who order an inflated rating solely receive financing by trusting investors. Given a lower share of trusting investors, the profit for an issuer with a bad project decreases. If *Assumption 4* does not hold anymore, only issuers with a good project order a rating.

In conclusion, reduced over reliance of investors decreases the probability of rating inflation from two sides. First, an issuer with a bad project has profits because only trusting investors would invest in a bad project with an inflated rating. Second, an inflate CRA has lower revenues because of lower reputation from trusting investors. However, as long at is is profitable for an issuer to order an inflated rating (because a high enough share of trusting investors still exists, that is, *Assumption 4* holds), CRAs still have an incentive to inflate ratings because of a higher revenue from the rating fee. In connection with an upfront fee, a reduction in the over reliance on credit ratings is a very promising approach.

6.6 Public Certification Institution

A final possible regulation is the foundation of a public certification institution, which should act as a reference institution for investors. Such an institution was been widely discussed in the European media but has not been implemented so far. In the following, I present the possible structure of a PCI and how one may address the economic criticism of such an institution. I further try to simplify possible drawbacks and risks of CRA in the model. The PCI has thus far been a theoretical idea and there is no competitive PCI on the European or U.S. American market. Although I gather some ideas from academic articles (e.g., Lynch, 2010 or Noh, 2014) the structure of a European PCI is based on my ideas and presents a legitimate basis for debate. Further, I describe how the incentives of other actors (private CRAs, issuers, investors) in the market of credit ratings change through the founding of a PCI. Finally, a discussion is provided.

6.6.1 Structure of a PCI

The first essential question is how a PCI should be financed. One possibility is to introduce an issuer-pay model like for private CRAs. The main risk of such financing is that a PCI experiences the same conflict of interest as a private CRA. In contrast, Lynch (2010) recommends that a CRA be financed by a tax-paying public. The recent political discussion has shown that there is high political resistance to finance a PCI directly by the government budget. I present a PCI, which is financed by a lump sum tax of all investing sophisticated investors.[65] The idea is that large financial institutions (e.g., investment banks, investment funds, reinsurance institutions etc.), which are frequently investing in the capital market with be committed to financing the PCI. This taxation is not fair, since sophisticated investors are not in the need for a PCI (they usually have an own good-working risk management). Further, a taxation for sophisticated investors may have negative spillover effects (movements in other financial markets, lower liquidity in the capital market, etc.) that are not taken into account. The advantage of such a financing is that the public does not have to finance a PCI; instead, it is done by those market participants that always have positive profits under each regulation mechanism (according to the model prediction). I establish the financing structure to decrease the political resistance against the implementation of a PCI.

Several critiques argue that a PCI would have a bad market position and would not play an essential role. On one side, it is true that private CRAs would still play a dominant role in the credit rating industry. Therefore, I assume that sophisticated investors are still in the need for rating from a private CRA.[66] On the other side, I assume that a PCI is provided with special legal rights. In detail, an issuer that orders a rating is committed to informing the PCI and transfering all necessary information directly to the PCI. Afterwards, a PCI as well as a CRA simultaneously rate a project. The PCI publishes a rating irrespective of the outcome.

Before analyzing the model in detail, I incorporate one further point of criticism. Beck and Wienert (2010, p. 5) mention that it is reasonable to assume that a PCI is not able to work in the same accuracy as a private profit-maximizing CRA. One reason is that a PCI cannot compete in the competition of human talents. I further think that a PCI has less incentive to work accurately since the rating is not correlated with any revenue, so there may be a problem of moral hazard. Finally, the PCI may has less experience in the rating procedure. Consequently, the precision of a PCI rating is lower than that of a CRA's. To address this issue, I assume that a PCI cannot evaluate a credit rating as perfect as a private CRA. In the model, this means that the precision of a signal is not perfect but there is a chance e that a rating is wrong. The rating can be either unintentionally inflated (being good although the project is bad) or negligent (being bad for a good project). Both unintentional rating deviations occur with probability e. All agents in the model know about the imprecision of the PCI.

The new sequence of the credit rating game is as follows. (1) An issuer orders a rating from a CRA. Besides, an issuer is committed to report the ordering to the PCI. All information about the project is shared with the CRA as well as with the PCI. (2) The PCI publishes a rating irrespective of the outcome. The rating is based on own signal, which is imprecise; further, with probability e, the PCI publishes a wrong rating. An issuer still has the possibility to deny publication of a CRA's rating. Further, an issuer can shop for better ratings from other CRAs in the market.[67] (3) Trusting investors observe the information provided by the CRA and the PCI. They are usually totally trusting, but in case of different ratings from the PCI and the CRA, trusting investors get curious. They try to analyze the situation by considering an exogenous inflation probability (ω) and the imprecision of PCI's rating (e). If both ratings have the same outcome, trusting investors are still

[65] The idea of the lump sum tax is that possible substitution effects are lowered and prevent an excess burden. I do not provide any discussion about the structure of the tax, however, such an discussion would an interesting extension in the field of public economics.

[66] A possible reasoning is that sophisticated investors are actors in an international financial market. Therefore, it is essential that their assets are rated by big and global CRAs to provide a high trading possibility. Further, one may argue that sophisticated investors are situated in different (also non-European) countries and need the rating of globally certified CRAs for regulatory reasons.

[67] The shopping for ratings can be done in one step: an issuer directly orders several ratings since there is no upfront fee. Afterwards, the issuer decides to publish the best rating.

totally trusting. (4) Sophisticated investors are still able to evaluate the project. They need a rating from a private CRA because of regulatory reasons but they do not care about the rating from the PCI. For an honest rating, sophisticated investors pay the reputation to the CRA. Irrespective of own investment, sophisticated investors have to pay PCI by a lump sum tax (ψ). (5) The project is realized. (6) In case of a default but a good rating by the CRA, trusting investors withhold the reputation ex-post. The new structure of the credit rating industry is mapped in Figure 2.

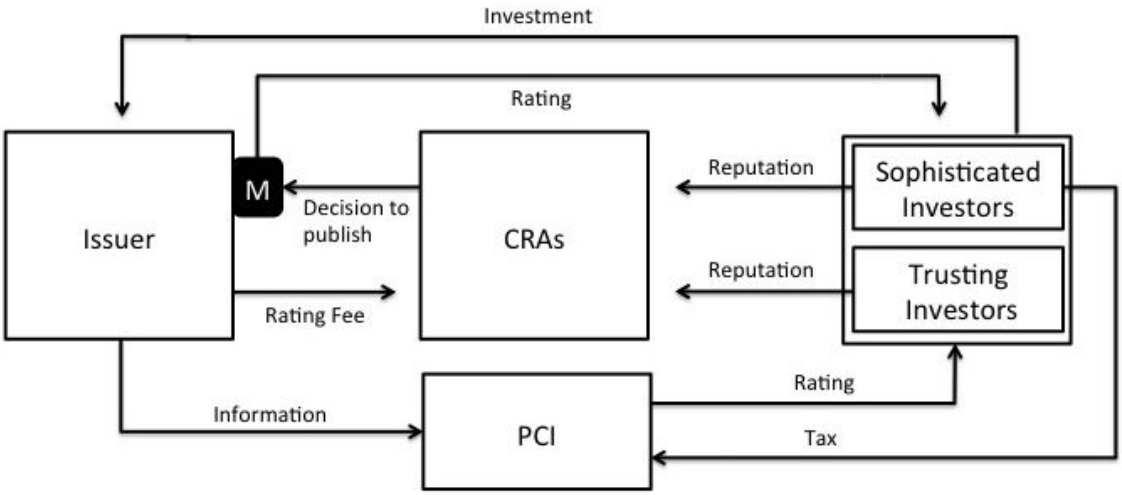


Figure 2: Structure of Credit Rating Market with a PCI

6.6.2 Investors

For sophisticated investors, the situation does not change significantly. Sophisticated investors evaluate the ratings and solely invest in good projects. They pay the reputation for good projects with a good rating to the CRA but withhold the reputation for bad projects with a good rating. Although sophisticated investors do not pay attention to the rating of the PCI, they have to finance the PCI by paying cost ψ.

For trusting investors, the game theoretical setting changes since they observe two different rating outcomes. For a complete analysis, one has to take a look on each possible situation: good rating by the CRA and good rating by the PCI, bad rating by the CRA and good rating by the PCI, good rating by the CRA and bad rating by the PCI, and bad rating by the CRA and bad rating by the PCI. Further, it may be possible that a CRA cannot publish a rating because an issuer does not authorize a publication. However, several situations can be out ruled directly. First, a trusting investor will never invest in a project that has a bad or no rating from the CRA. If the ratings by both the CRA and the PCI are bad, the trusting investor, being totally naive, does not invest. In contrast, the trusting investor is not naive if the CRA publishes no rating or a bad rating and the PCI publishes a good rating. As described previously, an investor is analyzing the incentives of the other actors. A trusting investor anticipates that the CRA always publishes a good rating for a good project and that the PCI's rating is caused by the imprecision of the PCI's rating method. Thus, a trusting investor does not invest if the CRA publishes a bad or no rating, irrespective of the PCI's rating. If both ratings are good, a trusting investor invests since he is totally naive. However, it is possible that the underlying project is bad, the CRA inflated the rating and the PCI rated wrongly.[68] Finally, a trusting investor may observe the outcome that the CRA reports a good rating whereas the PCI reports a bad rating. Because the ratings are different, a trusting

[68] Under the outcome of a good rating from the CRA and the PCI, the ex-ante expected profit with the exogenous probability of inflation ω and imprecision e is $\frac{\lambda(1-e)}{\lambda(1-e)+(1-\lambda)\omega e}[(1+r)I] + \frac{(1-\lambda)\omega e}{\lambda(1-e)+(1-\lambda)\omega e}[(1-p)(1+r)I - pI]$. See Appendix 9.12. for a calculation.

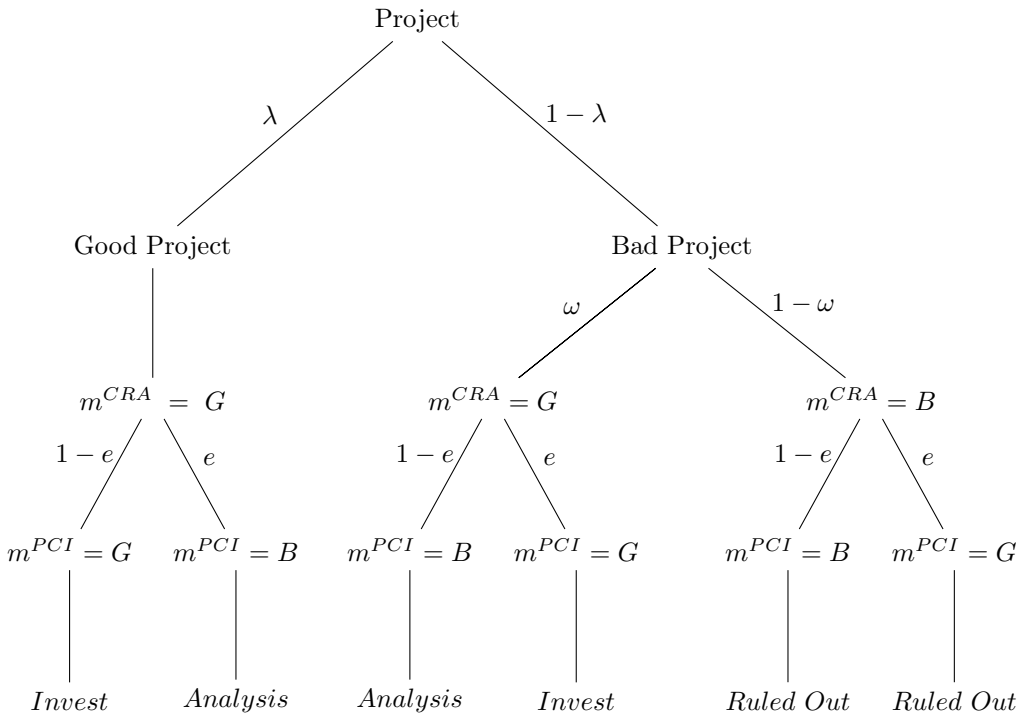


Figure 3: Decision of a Trusting Investor with a PCI

investor does not invest without analyzing the market situation. In contrast to a sophisticated investor, the trusting investor is not able to evaluate the project. However, a trusting investor knows about the exogenous inflation probability ω and the imprecision of the PCI's signal e. The probability of rating inflation according to the belief of a trusting investor is exogenously given, but one my argue that in a repeated setting of a credit rating game, ω is determined by the behavior of CRAs in past periods. A trusting investor calculates the probabilities of the two possible situations: (1) a good project receiving an honest rating by the CRA and a wrong rating by the PCI and (2) a bad project receiving an inflated rating by the CRA and a correct rating by the PCI. An overview of the actions in case of the different observations are showed in the following diagram:

Finally, an investor finances a project with a bad rating by the PCI and a good rating by the CRA if the expected profit is positive.

***Lemma 6**: It is profitable for a trusting investor to finance a project with a good rating by the CRA and a bad rating by the PCI if:*[69]

$$\lambda e[(1+r)I] + (1-\lambda)\omega(1-e)[(1-p)(1+r)I - pI] > 0.$$

Trusting investors solely pay reputation to the CRA if they have invested in a project, which does not default. A possible incorrect rating from the PCI has no effect on its profit.

6.6.3 CRAs

The introduction of the PCI as a new actor results in two equilibria on the investor's side: one in which trusting investors finance a project that has a good rating by the CRA and a bad rating by the PCI and the

[69] For the proof, see Appendix 9.12.

other in which trusting investors do not invest. The condition for an investing trusting investor is described in *Lemma 6*. The incentives for a sophisticated investor do not change, irrespective of the PCI's rating.
First, I analyze the equilibrium when trusting investors invest even if the rating from the PCI is bad. In such an equilibrium, the situation is the same as in the benchmark model. Trusting investors also invest in the inflated rating. Therefore, the profits for the CRA from an honest rating regime and from an inflated are

$$\pi_H^A = \lambda\phi + \lambda\alpha\tau + \lambda(1-\alpha)\sigma$$
$$\pi_I^A = \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma.$$

CRA inflates a rating if the condition in ***Lemma 1*** holds:

$$\phi - \alpha\tau(p-1) > 0.$$

In the second equilibrium, a trusting investor does not invest if the rating from the CRA is good but the rating from the PCI is bad. Since the PCI's rating is not as precise as the CRA's rating method, the honest rating regime may be less profitable for the CRA.
Honest rating regime: If a good project is rated good by the CRA but bad by the PCI, a trusting investor does not invest. For now, I assume that an issuer with a good project still has the incentive to order a rating.[70] Bad ratings are not published by the issuer, and the CRA does not gain any revenue then. For an honest rating regime, the CRA has the following profits for an allocation to a trusting or sophisticated investor:[71]

$$X_{HT} = \lambda\phi + \lambda(1-e)\tau$$
$$X_{HS} = \lambda\phi + \lambda\sigma.$$

Thus, the expected payoff of an honest rating regime is

$$\pi_H^B = \lambda\phi + \lambda\alpha(1-e)\tau + \lambda(1-\alpha)\sigma.$$

Inflated rating regime: The profit of the inflated regime is dependent on the incentive of the issuer to publish an inflated rating. This condition is presented in the next section. If issuers with bad projects would not publish inflated ratings, CRAs have the same revenue in both the honest and inflated rating regimes, since they solely would have the possibility to publish good ratings for good projects. However, I first assume that issuers still have the incentive to publish inflated ratings. The profit of the CRA is dependent on the rating of the PCI. Thus, the profit for the CRA in case of allocation to a trusting or sophisticated investor is[72]

$$X_{IT} = \phi + \lambda(1-e)\tau + (1-\lambda)e(1-p)\tau$$
$$X_{IS} = \phi + \lambda\sigma.$$

[70] For a detailed analysis, see the analysis of the issuer.
[71] For the calculations, see Appendix.
[72] For calculations, see Appendix.

Thus, the expected payoff of an inflated rating regime is

$$\pi_I^B = \phi + \lambda\alpha(1-e)\tau + \alpha(1-\lambda)e(1-p)\tau + \lambda(1-\alpha)\sigma.$$

Lemma 7:[73] *The CRA inflates the rating if the following condition holds:*

$$\phi - \alpha\tau e(p-1) > 0.$$

Beside the rating fee, which still plays a crucial role, the CRA still has a higher expected profit in the inflated rating regime, caused by the imprecision in PCI's rating.

6.6.4 Issuers

The incentives of the issuer to publish a rating is dependent on the decision (*Lemma 6*) of the investor. In the the first equilibrium, in which trusting investors finance a project even if the PCI rating is bad, the situation is again equal to the benchmark model. Under *Assumption 3* and *Assumption 4*, the issuer has the incentive to order and publish a rating independent of the characteristic of a project.
In the second equilibrium, the incentives for an issuer are different from the incentives in the benchmark model. Although the CRA still has an incentive to inflate ratings (*Lemma 7*), it is possible that the project does not get financed. If *Lemma 6* does not hold, trusting investors do not finance a project with a good rating from the CRA and a bad rating from the PCI. If the issuer has a good project, he faces the risk that a PCI rates the project bad because of an imprecise rating. Thus, a rating would not get financed by a trusting investor. A sophisticated investor always finances the good project. An issuer with a good project only orders a rating if the following assumption holds:[74]

Assumption 6:

$$\phi < \alpha(1-e)[R-(1+r)I] + (1-\alpha)[R-(1+r)I].$$

Compared to *Assumption 4*, this assumption seems less strong. Therefore, it is reasonable to assume that issuers with a good rating order a rating, even though there is the risk that the PCI publishes a wrong rating. If the issuer has a bad project, the project gets solely financed if the CRA inflates a rating (CRA always inflates, *Lemma 7*), the PCI rates the project incorrectly, and the project is allocated to a trusting investor. Therefore, the issuer with a bad project only publishes an inflated rating if the following inequality holds.[75]

Lemma 8: *The issuer with a bad project, who knows that trusting investors do not invest in case of a bad rating by the PCI, has an incentive to publish an inflated rating:*

$$\phi < \alpha e(1-p)[R-(1+r)I].$$

[73] For calculations, see Appendix 9.13.
[74] For calculations, see Appendix 9.14.
[75] Proof in Appendix 9.15.

If this condition does not hold, the issuer with a bad rating will not publish a rating to avoid losses. Only good projects are in the market.
In both equilibria, the issuer still has the possibility to shop for a better rating.

6.6.5 Outcome

The outcome is mainly determined by the decision of the trusting investor to finance a project with a good rating from the CRA and a bad rating from the PCI (*Lemma6*). The precision of PCI's rating and the belief of rating inflation play a crucial role for the decision of a trusting investor. For high values of ω (high probability of rating inflation) and low values of e (high precision of PCI's rating), a trusting investor is less likely to invest in such a project. If a trusting investor is still investing in such a project, the model implies the same outcome as in the benchmark model. However, the profits of sophisticated investors decrease because they have to finance the PCI. If trusting investors do not invest in such a project, the outcome is different. The CRA still has an incentive to inflate a rating (*Lemma 7*). Further, one has to distinguish again between an equilibrium, in which issuers with bad projects have an incentive to order a rating, and an equilibrium, in which it is not profitable for issuers of a bad rating to order an inflated rating. All three equilibria are shortly described in the following overview:

1. Equilibrium: $\lambda(1-\omega)e[(1+r)I]+(1-\lambda)\omega(1-e)[(1-p)(1+r)I-pI]>0$ *(Lemma 6), trusting investors finance a project with a bad rating from the CRA and a good rating from the PCI.*

- Given *Assumption 3* and *Assumption 4*, issuers order a rating from the CRA. The CRA chooses an inflated rating regime (*Lemma 1*). Further, the issuer can shop for a better rating.
- Sophisticated investors only invest in good projects and pay the reputation fee for good projects directly. Further, sophisticated investors have to pay lump sum tax ψ for the PCI.
- Trusting investors invest in all projects with a good rating, irrespective of the PCI's rating. If the CRA rates a project as good and the PCI as bad, trusting investors analyze the situation under consideration of the inflation probability and the imprecision of the PCI's rating. They expect that the profit for an investment is still positive and therefore invest in such a project. Finally, a trusting investor pays the reputation premium if the project does not fail.
- The expected profit for the issuer is
$$\theta=\lambda[R-(1+r)I-\phi]+(1-\lambda)[\alpha(1-p)(R-(1+r)I)-\phi].$$
- The profit for the CRA is
$$\pi_I^A=\phi+\alpha(1-p+\lambda p)\tau+(1-\alpha)\lambda\sigma.$$
- The profit for a sophisticated investor is
$$U_S=\lambda(1+r)I-\psi.$$
- The profit for a trusting investor is
$$U_T=\lambda(1+r)I+(1-\lambda)[p(-I)+(1-p)(1+r)I].$$
- Indeed, the profit of a trusting investor is negative. In the long run, the expectation of inflating CRAs change and the economy may move to another equilibrium.

2. Equilibrium: $\lambda(1-\omega)e[(1+r)I]+(1-\lambda)\omega(1-e)[(1-p)(1+r)I-pI]<0$ *(Lemma 6), trusting investors do not finance a project with a good rating from the CRA and a bad rating from the PCI. Further,* $\phi<\alpha e(1-p)[R-(1+r)I]$ *(Lemma 8), issuers with a bad publish order an inflated rating of a CRA.*

- Given *Assumption 6* and the holding condition in *Lemma 8*, issuers always order a rating. The CRA chooses an inflated rating regime (*Lemma 7*). The issuer still has the possibility to shop for ratings.
- Sophisticated investors only invest in good projects and pay the reputation fee for good projects directly. Further, sophisticated investors have to pay lump sum tax ψ to the PCI.
- Trusting investors only invest in projects where the ratings of both the CRA and the PCI are good. Because of the imprecision of the PCI, some bad projects are financed and some good projects are not financed. A trusting investor pays the reputation premium if the project does not fail.
- The expected profit for the issuer is
$$\theta = \lambda(1-e)[R-(1+r)I] + (1-\lambda)\alpha e(1-p)(R-(1+r)I) - \phi.$$
- The profit for the CRA is
$$\pi_I^B = \phi + \lambda\alpha(1-e)\tau + \alpha(1-\lambda)e(1-p)\tau + \lambda(1-\alpha)\sigma.$$
- The profit for a sophisticated investor is
$$U_S = \lambda(1+r)I - \psi.$$
- The profit for a trusting investor is
$$U_T = \lambda(1-e)(1+r)I + (1-\lambda)e[p(-I) + (1-p)(1+r)I].$$

3. Equilibrium: $\lambda(1-\omega)e[(1+r)I] + (1-\lambda)\omega(1-e)[(1-p)(1+r)I - pI] < 0$ *(Lemma 6), trusting investors do not finance a project with a good rating from the CRA and a bad rating from the PCI. Further,* $\phi > \alpha e(1-p)[R-(1+r)I]$ *(Lemma 8), issuers with a bad project do not order a rating.*

- The condition in *Lemma 8* does not hold. Given *Assumption 6*, only issuers with a good project order a rating. The CRA publishes a good rating. Only good ratings are in the market.
- Sophisticated investors in all projects in the market pay the reputation premium. Further, sophisticated investors have to pay lump sum tax ψ for the PCI.
- Trusting investors only invest in projects where the ratings of both the CRA and the PCI are good. Because of the imprecision of the PCI, some bad projects are financed and some good projects are not financed. A trusting investor pays the reputation premium with certainty since all projects in the market are good.
- The expected profit for the issuer is
$$\theta = \lambda(1-e)[R-(1+r)I] + \lambda\phi.$$
- The profit for the CRA is
$$\pi_H^B = \phi + \alpha(1-e)\tau + (1-\alpha)\sigma.$$
- The profit for a sophisticated investor is
$$U_S = (1+r)I - \psi.$$
- The profit for a trusting investor is
$$U_T = (1-e)(1+r)I.$$

6.6.6 Discussion

The outcome in the credit rating industry after the implementation of the PCI is not as promising as expected. First, it may happen that the outcome is equivalent to the outcome in the benchmark model, namely when trusting investors still do not pay attention to PCI's rating. The reason is that trusting investors believe in the honest behavior of CRAs and know about the imprecise rating methods of PCIs. In this equilibrium, the PCI does not protect investors, and the reference institution does not work. Further, the profit of sophisticated investors decreases because they have to finance the PCI. To conclude, even the benchmark model without any regulation is Pareto efficient. However, the belief of rating inflation may be variable. Thus, it is possible that the persistent inflation behavior of CRAs increases the belief of investing in an inflated rating. After a certain point of time, trusting investors do not invest anymore in projects for which the CRA reports a good rating but the PCI, a bad rating. So, the market moves to a new equilibrium.

In an equilibrium in which trusting investors do not invest in projects that a PCI rates badly, there still is an incentive for a CRA to inflate ratings. The reasons for the profitability of an inflated rating regime are as follows: (1) the issuer would receive a fee even for a bad rating and (2) CRA can receive the reputation fee for bad projects from trusting investors. The CRA receives the reputation fee if the PCI incorrectly rated a bad project as good and the project does not default. The final outcome is determined if the issuer with a bad project is still interested in an inflated rating. An inflated rating would only get financing if the project is allocated to a trusting investor and the PCI rates it incorrectly. For lower values of α (fraction of trusting investors) and e (higher precision of PCI's rating method), the profit decreases. If the possible profit is lower than the rating fee, the issuer with a bad rating does not publish the inflated rating. In an equilibrium in which issuers do not publish inflated ratings, the market for bad ratings dies. The profits for the CRA and for both trusting and sophisticated investors increase. Regardless of whether or not the issuer publishes an inflated rating, the outcome has a drawback. Some good projects get a bad rating from the PCI because of the imprecision of the rating method. Therefore, some good projects that are allocated to trusting investors do not get financing. Further, sophisticated investors still have to pay the lump sum tax and their profits decrease.

All in all, even the the most efficient equilibrium in the market with the PCI is less efficient than the outcome under a mandatory publication regulation or high accountability for CRAs (best and highly probable equilibrium). The PCI does not work as a perfect reference institution since the technology of evaluation is imprecise. Further, the PCI does not prevent the issuers from shopping for a better rating.

6.6.7 Welfare Analysis

The model has three equilibria and therefore three different welfare values. In the first equilibrium, trusting investors finance projects with a good rating from the CRA, independent of PCI's rating:

$$W = min(U_S, U_T)$$
$$W = min(\lambda(1+r)I - \psi, \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I])$$
$$W = \lambda(1+r)I + (1-\lambda)[p(-I) + (1-p)(1+r)I] < 0.$$

Welfare is negative and equal to the welfare in the benchmark model. In the second equilibrium, trusting investors do not finance projects that have a bad rating from the PCI but issuers still have an incentive to publish an inflated rating. The welfare value is

$$W = min(U_S, U_T)$$
$$W = min(\lambda(1+r)I - \psi, \lambda(1-e)(1+r)I + (1-\lambda)e[p(-I) + (1-p)(1+r)I]).$$

A trusting investor faces the risk of financing a bad project that was inflated and also received a good (incorrect) rating by the PCI. However, for low values of e (low imprecision of PCI's rating), it is likely that welfare is positive. For low values of e and high values of ψ, one could also consider a situation in which the profit of a sophisticated investor is lower than the profit of a trusting investor. The overall welfare value is ambiguous. For low values of λ (more bad projects in the market) and higher values of e (higher imprecision of PCI's rating method), the profit of a trusting investor may be negative. In the third equilibrium, trusting investors do not finance a rating that receives a bad rating from the CRA and issuers do not publish an inflated rating for bad projects. Welfare is then given as

$$W = min(U_S, U_T)$$
$$W = min((1+r)I - \psi, (1-e)(1+r)I) \geq 0.$$

The profit of a trusting investor is lower compared to mandatory publication regulation since he does not invest in all good projects (some receive a wrong rating from the PCI and the issuer does not invest). A sophisticated investor still has to pay a tax for financing the PCI. Dependent on ψ and e, the profits of both sophisticated and trusting investors are higher. Therefore, welfare is dependent on those values as well. However, the overall welfare value is non-negative. First, the profit of trusting investors is larger than or equal to zero, since $e \in [0, 1]$. Second, a sophisticated investor would only stay in the market if his profit is non-negative.

6.6.8 Policy Implications

All presented critiques of the PCI mitigate the success of the PCI as a reference institution. First, the establishment of the PCI is connected to high costs, especially if one requires that the PCI should not work under profit maximizing. One or more actors in the market have to finance the PCI. This financing results not only in political resistance by the actors but also in inefficiency due to additional costs. Second, the PCI does not necessarily change the market equilibrium because of an unimportant market position. It may be possible to improve the market position of the PCI by increasing PCI's rights significantly. However, the model shows that even under the PCI with almost perfect information, the outcome may be the same as in the benchmark model. Investors still believe in the system of private CRAs or need ratings of big private CRAs for international regulatory proposes. The PCI as a reference institution is thus not accepted. Third, Becker and Wienert (2010) mention that the PCI has a disadvantage in the rating procedure due to its lesser knowledge/experience. The model showed that the imprecision of ratings by PCIs is a crucial problem. Even if investors accept the PCI as a reference institution, the imprecision of the PCI decreases the efficiency of the market. To conclude, though the PCI seems to be an interesting idea of a governmental intervention in the market for credit ratings, its success is ambiguous and costly.

7 Final Comparison of Regulations

I have presented several regulation mechanisms, each with a unique impact and a distinct level of success to protect the credit rating industry from well-known failures. *Table 1* shows each rating mechanism, the decision of each actor, and the welfare impact. First, there are some regulations, which mainly work on the investor side by either increasing the knowledge of or reducing the fraction of trusting investors. Examples of those regulations are the implementation of a PCI or strengthening to reduce the over reliance of investors on ratings. Indeed, those regulations may be successful because issuers cab only take advantage of a totally trusting investor. If trusting investors have some additional information (PCI) or they become sophisticated (e.g., by strengthening the internal risk management), issuers have a lower probability that even inflated bad projects are financed. If the rating fee is higher than the probability of being allocated to a financing investor multiplied by the connected expected profit, an issuer does not publish an inflated rating for a bad project. However, the incentive for a CRA to inflate ratings is reduced but still persistent. In both regulation mechanisms, the issuer has the decision over a publication, and thus, a CRA anticipates that a bad rating is not published. Without any upfront fee, a CRA has zero incentive to rate a bad project honestly. In contrast, an inflated rating is connected to a rating fee and a possible further profit because some bad rating does not default and some trusting investors pay the reputation fee. As long as there is a marginal fraction of trusting investors in the market, the CRA has an incentive to inflate ratings.

In contrast, some regulation mechanisms target the profitability for a CRA to inflate ratings directly. First, an upfront fee decreases the incentive to inflate ratings since CRAs now receive a payment even if a rating is not published. Although bad rating incurs an additional payment, it is still profitable for a CRA to report an inflated rating instead of a bad rating for a bad project. Again, the reasoning is that CRAs anticipate that bad ratings are not published (no additional value for an issuer) and non-published ratings do not provide any further profits. With an inflated rating, the CRA has the possibility to receive reputation from trusting investors, who invest in bad projects that does not default. More promising is the regulation approach of the European Union, which increases the accountability of CRAs. The intuition is that the possibility of damage claims from the investors decrease the profitability of an inflating rating regime. In an optimized outcome, the profit from an inflating regime is lower than from an honest rating regime. The interesting fact of this regulation is that the CRA therefore commits to an honest rating regime. Issuers are not able to receive inflated ratings and investors are solely allocated to good projects. Their profits increase significantly. The most successful approach, which reduces the conflict of interest of CRAs entirely is the regulation of a mandatory rating publication. Further, the CRA has no more disadvantage in publishing an honest rating because bad ratings are connected to the reputation of all investors and involve a rating fee. However, the feasibility of such a regulation is questionable.

Finally, the mandatory rating publication also prevents the phenomena of issuer shopping. The random allocation of a single CRA to an issuer is targeting the same failure of the credit rating industry. In both regulation mechanisms, the issuer does not have a chance to observe several ratings before the publication of one preferred rating. In contrast, an upfront fee may decrease the probability of rating shopping but does not prevent it entirely.

As shown, each regulation has a different working mechanism and further has its advantages as well as disadvantages. However, it is crucial to emphasize that one should not only analyze each regulation individual but also see the connection between different regulations. The European Commission connects several rules, namely the increased accountability for CRAs, the random allocation of a CRA to an issuer, and the reduction of over reliance of investors on credit ratings. According to the theoretical evaluation of the model, this connection of regulations is promising. The reduction of over reliance decreases the fraction of trusting investors, the random allocation reduces the possibility of issuer shopping, and the increasing accountability for CRAs mitigates their conflict of interest. To conclude, the implementation of new rules by the European Commission seems like a successful approach.

Regulation			Issuer	CRA	Investor	Welfare	Final Evaluation
Absence of Regulation		One EQ	All good ratings are published Shop for ratings	Inflate ratings	Sophisticated investors: Positive profits Trusting investors: Negative profits	Negative	conflict of Interest Rating inflation Issuer shopping Cyclical ratings
Traditional Approach	Upfront Fee	One EQ	All good ratings are published Less shopping	Inflate ratings Decreased incentive to inflate ratings	Sophisticated investors: Positive profits Trusting investors: Negative profits	Negative	Lower conflict of interest Rating inflation persistant but lower incentive Less issuer shoping Cyclical ratings
Perfect Regulation	Mandatory Rating Publication	One EQ	Only orders ratings for good projects Cannot withhold publication No shopping possibility	Honest ratings	Sophisticated investors: Positive profits Trusting investors: Positive profits All investors: higher profits than in benchmark	Positive	No conflict of interest No rating inflation No issuer shopping No cyclical ratings
European Commission	Accountability of CRAs	1. EQ	All good ratings are published Shop for ratings	Inflate ratings Decreased incentive to inflate ratings EQ only stable for high tau	Sophisticated investors: Positive profits Trusting investors: Positive profits All investors finance bad projects All investors: higher profits than in benchmark	Positive	conflict of interest Rating inflation Issuer shopping Cyclical ratings
		2. EQ	All good ratings are published Shop for ratings	Inflate ratings Decreased incentive to inflate ratings	Sophisticated investors: Positive profits Trusting investors: Negative profits	Ambiguous: Dependent on epsilon Higher welfare than in benchmark	Conflict of interest Rating inflation Issuer shopping Cyclical ratings: Unsure
		3. EQ	All good ratings are published Shop for ratings	Honest ratings Inflated ratings would be connected to losses	Sophisticated investors: Positive profits Trusting investors: Positive profits	Positive	No conflict of interest No rating inflation Issuer shopping No cyclical ratings
	Random	One EQ	All good ratings are published No shopping	Inflate ratings	Sophisticated investors: Positive profits Trusting investors: Negative profits	Negative	conflict of interest Rating inflation No shopping Cyclical ratings
	Overreliance	One EQ	All good ratings are published Shop for ratings	Inflate ratings Decreased incentive to inflate	Sophisticated investors: Positive profits Trusting investors: Negative profits	Negative	conflict of interest Rating inflation Issuer shopping No cyclical ratings
New Approach	PCI	2. EQ	All good ratings are published Shop for ratings	Inflate ratings	Sophisticated investors: Positive profits Trusting investors: Negative profits Sophisticated investors finance PCI Investors do not pay attention to PCI	Negative	Conflict of interest Rating inflation Issuer shopping Cyclical ratings
		2. EQ	All good ratings are published Lower profits Incentive to publish an inflated rating decrease Shop for ratings	Inflate ratings	Sophisticated investors: Positive profits Trusting investors: Ambiguous Sophisticated investors finance PCI Trusting investors pay attention to PCI	Positive Higher than in benchmark	Conflict of interest and rating inflation Issuer shopping Cyclical rating Inefficiency since good projects not always financed
		3. EQ	Only ratings for good projects are published Shop for ratings	Would inflate ratings Only good ratings in the market	Sophisticated investors: Positive profits All investors: higher profits than in benchmark	Positive Higher than in benchmark	Conflict of interest No rating inflation No issuer shopping No cyclical rating

Table 1: Overview of Regulations

8 Conclusion

In the absence of any regulation, the credit rating industry is marked by a significant inequality between investors. CRAs are in a conflict of interest and inflate ratings, while issuers have the possibility to take advantage of trusting investors. Therefore, trusting investors suffer from a significant loss. Regulation reforms are able to decrease the inefficiency in the market for credit ratings. I have explained that it is reasonable that regulators are mainly interested in decreasing the losses from investors, and therefore, I evaluated each regulation possibility with a specific welfare function from the regulator's perspective. The regulation of a mandatory rating publication is the most promising but an unfeasible option. An upfront fee, which is strongly related to the Cuomo plan, is easy to implement but does not mitigate the main efficiency of the market, that is, the rating inflation. The approach of the European Commission, namely the connection of an increasing accountability to CRA, a random allocation from issuers to CRAs for specific financial products, and the reduction of over reliance of investors on credit ratings are a successful attempt to substantially decrease the efficiency in the credit rating industry. CRAs would have less incentive to publish inflated ratings, issuer shopping would be avoided, and the anti cyclical behavior of credit ratings would be decreased. All failures of the market are attacked directly and the welfare from a regulator's perspective increases. The implementation of a PCI in the market is an interesting and new idea. However, the financial needs of such an institution and the lower competitiveness on a complex global financial market lead to the conclusion that a PCI is not the most successful regulation mechanism for a regulation authority.

The model can be extended in several ways. First one may include the pricing sub game about the rating fee between issuers and investors in the model. Besides it needs to be noted that projects cannot be strictly classified into good or bad; further, even good projects may also have a probability of default, especially in cycles of economic downturn. Moreover, ratings are not strictly good or bad but more differentiated, and the rating mechanism of a CRA can be non-perfect. In addition, it is possible to allow issuers to publish multiple ratings. With all these extensions, the efficiency of the market and the regulation mechanisms can be modeled in greater detail. Another interesting extension would be to involve a dynamic framework so that even trusting investors update their beliefs about the probability of rating inflation and therefore do not remain totally trusting anymore. As shown in the discussion on the regulation of a PCI, it is likely that the economy moves in a more efficient equilibrium.

9 Appendix

9.1 Assumption 1

Assumption 1 can be be written as

$$\begin{aligned} & p(-I) + (1-p)(1+r)I < 0 \\ \Leftrightarrow\ & (1 + r - 2p - rp) < 0 \\ \Leftrightarrow\ & r < \frac{2p-1}{1-p} \end{aligned}$$

The assumption is important since r is an exogenous value. If we assume that the default risk of a bad investment is smaller than 0.5 ($p < \frac{1}{2}$) and that $r > 0$, the assumption would not hold.

9.2 Assumption 2

Assumption 2 can be be written as

$$\begin{aligned} & \lambda(1+r)I + (1-\lambda)[(1-p)(1+r)I - pI] < 0 \\ \Leftrightarrow\ & \lambda[1 + r - (1+p)(1+r) + p] < p - (1-p)(1+r) \\ \Leftrightarrow\ & \lambda(1 + r - 1 + p - r + rp + p) < p - 1 - r + p + pr \\ \Leftrightarrow\ & \lambda < \frac{2p - r + rp - 1}{p(2+r)} \end{aligned}$$

This assumption is important for the analysis of the equilibrium. For example, if $p = 0.8$ and $r = 0.1$, (assumption 1 is fulfilled) $\lambda < 0.34$.

9.3 Assumption 1 and Assumption 2

Assumption 1:

$$r < \frac{2p-1}{1-p}$$

Assumption 2:

$$\lambda < \frac{2p - r + rp - 1}{p(2+r)}$$

By inserting *Assumption 1* in *Assumption 2*, we get

$$\begin{aligned} \lambda &< \frac{2p - (\frac{2p-1}{2-p}) + (\frac{2p-1}{1-p})p - 1}{p(2 + \frac{2p-1}{1-p})} \\ \Leftrightarrow \lambda &< \frac{\frac{1-2p^2}{1-p} + \frac{2p^2-p}{1-p} - 1}{2p + \frac{2p^2-p}{1-p}} \\ \Leftrightarrow \lambda &< 1 \end{aligned}$$

9.4 Trusting investor's expected profit with exogenous rating inflation probability

A project can be either good or bad. The probability for a good project is λ, whereas the probability for a bad project is $(1 - \lambda)$. Good projects are always rated good because the signal is perfect. Independent of

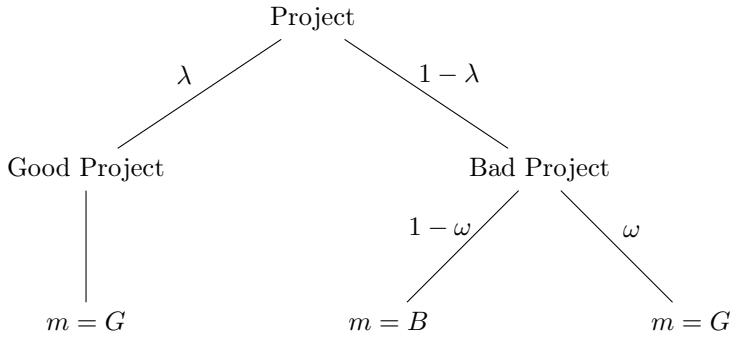


Figure 4: Decision of a Trusting Investor

the probability of rating inflation, a CRA reports a good project as good ($m = G$ according to signal $s = g$). Bad projects can be either inflated or not. The probability of inflation is ω, and thus, the project gets a good rating with probability ω ($m = G$, although $s = b$). A CRA does not inflate with probability $1-\omega$ and reports a rating of $m = B$ in accordance to the signal $s = b$. Since one is interested in all outcomes, it is not necessary to normalize, and the probabilities are

$$P[m = G, Project = G] = \lambda$$
$$P[m = B, Project = B] = (1 - \lambda)(1 - \omega)$$
$$P[m = G, Project = B] = (1 - \lambda)\omega$$

The profit for an investor in case of a good project with a good rating is $I(1 + r)$, and the negative profit in case of investing in an inflated rating (bad project)is $p(-I) + (1 - p)(1 + r)I$. Finally, if a bad project is rated bad, the trusting investor does not invest and has zero profits. Therefore, the expected outcome dependent on ω and λ is

$$U_T = \lambda I(1 + r) + (1 - \lambda)\omega[p(-I) + (1 - p)(1 + r)I] + (1 - \lambda)(1 - \omega)0$$

9.5 Lemma 1

Lemma 1:
The CRA inflates the rating if $\pi_I > \pi_H$, which can be written as

$$\begin{aligned}
&\pi_I > \pi_H \\
\Leftrightarrow\ &\phi + \alpha(1 - p + \lambda p)\tau + (1 - \alpha)\lambda\sigma > \lambda\phi + \lambda(\alpha\tau + (1 - \alpha)\sigma) \\
\Leftrightarrow\ &\phi + \alpha(1 - p + \lambda p)\tau > \lambda\phi + \lambda\alpha\tau \\
\Leftrightarrow\ &\phi - \lambda\phi > \alpha\tau(\lambda - 1 + p - \lambda p) \\
\Leftrightarrow\ &\phi(1 - \lambda) > \alpha\tau(\lambda - 1 + p - \lambda p) \\
\Leftrightarrow\ &\phi > \frac{\alpha\tau(\lambda - 1 + p - \lambda p)}{1 - \lambda} \\
\Leftrightarrow\ &\phi - \frac{\alpha\tau(\lambda - 1 + p - \lambda p)}{1 - \lambda} > 0 \\
\Leftrightarrow\ &\phi - \frac{\alpha\tau(p - 1)(1 - \lambda)}{1 - \lambda} > 0 \\
\Leftrightarrow\ &\phi - \alpha\tau(p - 1)
\end{aligned}$$

9.6 Lemma 2

Lemma 2:

The CRA inflates the rating if $\pi_I > \pi_H$, which can be written as

$$\begin{aligned}
&\pi_I > \pi_H \\
\Leftrightarrow\ &\phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma > \phi + \lambda(\alpha\tau + (1-\alpha)\sigma) \\
\Leftrightarrow\ &\alpha\tau(1-p+\lambda p) - \alpha\tau\lambda > 0 \\
\Leftrightarrow\ &\alpha\tau(1-p+\lambda p-\lambda) > 0 \\
\Leftrightarrow\ &\alpha\tau(p-1)(1-\lambda) < 0
\end{aligned}$$

9.7 Lemma 3

Lemma 3:

The CRA inflates the rating if $\pi_I > \pi_H$, which can be written as

$$\begin{aligned}
&\pi_I > \pi_H \\
\Leftrightarrow\ &\phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma > \phi + \alpha\tau + (1-\alpha)\sigma \\
\Leftrightarrow\ &\alpha\tau(1-p+\lambda p) + (1-\alpha)\lambda\sigma > (1-\alpha)\sigma \\
\Leftrightarrow\ &(1-\alpha)\sigma + \alpha\tau(p-\lambda p) - (1-\alpha)\lambda\sigma < 0 \\
\Leftrightarrow\ &\sigma(1-\lambda) + \frac{\alpha}{1-\alpha}\tau(p-\lambda p) < 0 \\
\Leftrightarrow\ &\sigma(1-\lambda) + \frac{\alpha}{1-\alpha}\tau p(1-\lambda) < 0 \\
\Leftrightarrow\ &\sigma + \frac{\alpha}{1-\alpha}\tau < 0
\end{aligned}$$

9.8 Lemma 4

Lemma 4:

A sophisticated investor is able to evaluate the characteristic of a project ex-ante. Thus, in case of a bad project with a good rating, a sophisticated investor can decide to either invest in the project or deny the investment. The bad project continues to have the possibility of non-default $(1-p)$ and a resulting profit for the investor of $(1+r)I$. If an investment defaults, the sophisticated investor first has a loss of $-I$ but has the right to claim the damage ex-post since the project had an inflated rating. The expected return of the damage claim is η, and therefore, the expected return is $(-I+\eta)$. I have introduced the difference between the investment and the expected reimbursement before as ϵ $(I-\eta=\epsilon)$, with *Assumption 5* $(I>\eta)$ in which the sophisticated investor still faces a loss in case of default of the project (profit of $-\eta$). The condition for an intentionally investing sophisticated investor is

$$\begin{aligned}
&(1-p)(1+r)I + p(-I+\eta) > 0 \\
\Leftrightarrow\ &(1-p)(1+r)I + p(-\epsilon) > 0 \\
\Leftrightarrow\ &(1-p)(1+r)I > p\epsilon
\end{aligned}$$

9.9 Lemma 5A

Lemma 5A:

The CRA inflates a rating if $\pi_I > \pi_H$, which can be written as

$$\begin{gathered}\pi_I > \pi_H \\ \Leftrightarrow \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma - (1-\lambda)p\eta > \lambda\phi + \alpha\lambda\tau + (1-\alpha)\lambda\sigma \\ \Leftrightarrow (1-\lambda)\phi + \alpha\tau(1-p+\lambda p) - \alpha\lambda\tau - (1-\lambda)p\eta > 0 \\ \Leftrightarrow (1-\lambda)\phi + \alpha\tau(1-p+\lambda p - \lambda - (1-\lambda)p\eta > 0 \\ \Leftrightarrow (1-\lambda)\phi - \alpha\tau(p-1)(1-\lambda) - (1-\lambda)p\eta > 0 \\ \Leftrightarrow \phi - \alpha\tau(p-1) - p\eta > 0\end{gathered}$$

9.10 Lemma 5B

Lemma 5B:

The CRA inflates a rating if $\pi_I > \pi_H$, which can be written as

$$\begin{gathered}\pi_I > \pi_H \\ \Leftrightarrow \phi + \alpha(1-p+\lambda p)\tau + (1-\alpha)\lambda\sigma - (1-\lambda)\alpha p\eta > \lambda\phi + \alpha\lambda\tau + (1-\alpha)\lambda\sigma \\ \Leftrightarrow (1-\lambda)\phi + \alpha\tau(1-p+\lambda p) - \alpha\lambda\tau - (1-\lambda)\alpha p\eta > 0 \\ \Leftrightarrow (1-\lambda)\phi + \alpha\tau(1-p+\lambda p - \lambda - (1-\lambda)\alpha p\eta > 0 \\ \Leftrightarrow (1-\lambda)\phi - \alpha\tau(p-1)(1-\lambda) - (1-\lambda)\alpha p\eta > 0 \\ \Leftrightarrow \phi - \alpha\tau(p-1) - \alpha p\eta > 0\end{gathered}$$

9.11 Critical values of η

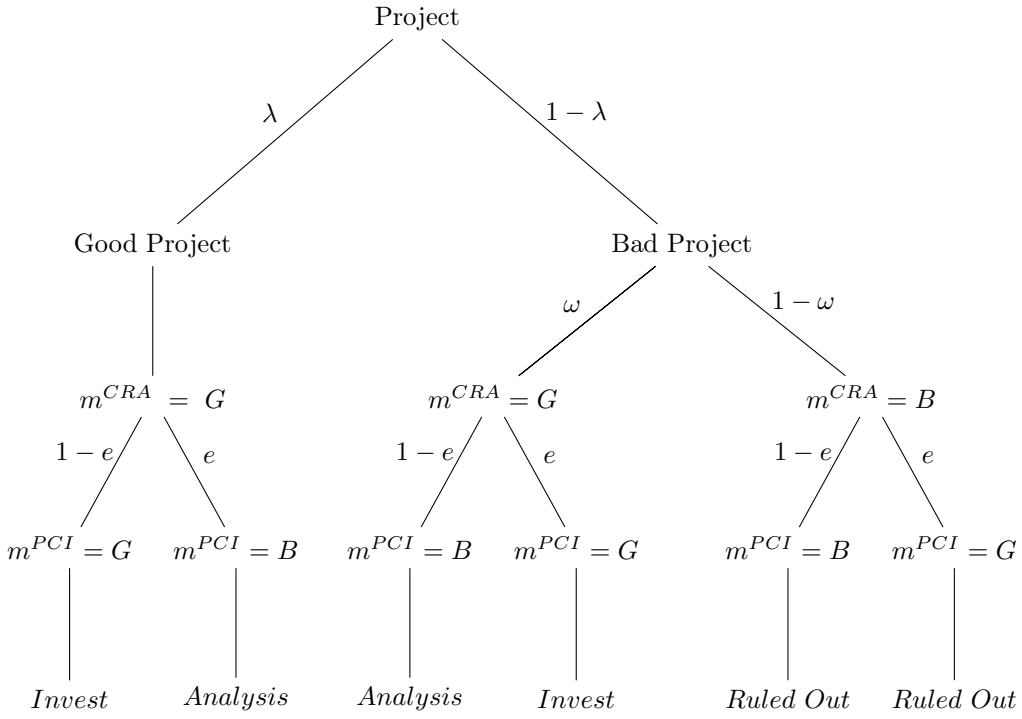
For calculation of the critical values, one needs to simply rewrite *Lemma 5A* and *Lemma 5B*. For a value where a CRA is indifferent to inflate ratings or not, the profit has to be equal to zero.

$$\begin{gathered}\phi - \alpha\tau(p-1) - p\eta^A = 0 \\ \Leftrightarrow p\eta^A = \phi - \alpha\tau(p-1) \\ \Leftrightarrow \eta^A = \frac{1}{p}[\phi - \alpha\tau(p-1)]\end{gathered}$$

$$\begin{gathered}\phi - \alpha\tau(p-1) - \alpha p\eta^B = 0 \\ \Leftrightarrow \alpha p\eta^B = \phi - \alpha\tau(p-1) \\ \Leftrightarrow \eta^B = \frac{1}{\alpha p}[\phi - \alpha\tau(p-1)] \\ \Leftrightarrow \eta^B = \frac{1}{p}[\frac{\phi}{\alpha} + \tau(p-1)]\end{gathered}$$

9.12 Lemma 6

Lemma 6:



When a trusting investor observes a good rating from a CRA and a bad rating from a PCI, he analyzes the situation with regard to the exogenous parameters λ (probability of good projects), ω (probability of rating inflation), and e (imprecision of PCIs). There are two situations where a good rating of a CRA and a bad rating of a PCI are observable. First, there may be a good project and thus consequently a good rating (CRA always provides a good rating for a good project and the investor anticipates this) and a wrong rating by a PCI (caused by imprecision). Second, for a bad project, the CRA inflates the rating and the PCI provides a bad rating. As shown in the tree diagram, the probability of the former situation is λe, whereas that of the latter situation is $(1-\lambda)\omega(1-e)$. By including the profit for a good project ($(1+r)I$) as well as a bad project ($(1-p)(1+r)I-pI$) and by further normalizing the probability to one, we obtain the following expected profits on observing the described outcome:

$$U_T^{good} = \frac{\lambda e}{\lambda e + (1-\lambda)\omega(1-e)}[(1+r)I]$$

$$U_T^{bad} = \frac{1-\lambda)\omega(1-e)}{\lambda e + (1-\lambda)\omega(1-e)}[(1-p)(1+r)I - pI]$$

The trusting investor only invests if the expected payoff is positive; therefore,

$$U_T^{good} + U_T^{bad} > 0$$

$$\Leftrightarrow \frac{\lambda e}{\lambda e + (1-\lambda)\omega(1-e)}[(1+r)I] + \frac{(1-\lambda)\omega(1-e)}{\lambda e + (1-\lambda)\omega(1-e)}[(1-p)(1+r)I - pI] > 0$$

$$\Leftrightarrow \lambda e[(1+r)I] + (1-\lambda)\omega(1-e)[(1-p)(1+r)I - pI] > 0$$

One has to emphasize that this calculation already assumes the existence of the observations. If a PCI would have a perfect signal (imprecision $e = 0$) and a CRA never inflates a rating ($\omega = 0$), a trusting investor cannot observe a good rating by a CRA and a bad rating by a PCI because the situation simply does not exist.

9.13 Lemma 7

Lemma 7:

The CRA inflates a rating if $\pi_I > \pi_H$, which can be written as

$$\begin{aligned}
&\pi_I > \pi_H \\
\Leftrightarrow\ &\phi + \alpha\lambda(1-e)\tau + \alpha(1-\lambda)e(1-p)\tau + \lambda(1-\alpha)\sigma > \lambda\phi + \alpha\lambda(1-e)\tau + (1-\alpha)\lambda\sigma \\
\Leftrightarrow\ &\phi + \alpha(1-\lambda)e(1-p)\tau > \lambda\phi \\
\Leftrightarrow\ &(1-\lambda)\phi + \alpha(1-\lambda)e(1-p)\tau > 0 \\
\Leftrightarrow\ &\phi + \alpha e(1-p)\tau > 0
\end{aligned}$$

9.14 Assumption 6

Assumption 6:

The issuer with a good project knows that sophisticated investors invest in all good projects with a good rating. In contrast, in this equilibrium, trusting investors invest only if the CRA as well as the PCI rate the project as good. In case of an unintentional mistake in the rating method by the PCI (probability e), a good project is provided a bad rating. The expected profit for an issuer with a good project is

$$\theta_G = \alpha(1-e)[R-(1+r)I] + (1-\alpha)[R-(1+r)I] - \phi$$

The issuer publishes a rating only if $\theta_G > 0$, that is, just in the case where

$$\begin{aligned}
&\theta_G > 0 \\
\Leftrightarrow\ &\alpha(1-e)[R-(1+r)I] + (1-\alpha)[R-(1+r)I] - \phi > 0 \\
\Leftrightarrow\ &\phi < \alpha(1-e)[R-(1+r)I] + (1-\alpha)[R-(1+r)I]
\end{aligned}$$

Compared to *Assumption 4* ($\phi < \alpha(1-p)[R-(1+r)I]$), this assumption is less strong. One knows from *Assumption 1* that $p \in (\frac{1}{2}, 1)$ and by assuming that the imprecision is $e \leq \frac{1}{2}$, *Assumption 6* will hold with certainty. The value of e smaller or equal to $1/2$, implying that the rating has a higher probability to be right than wrong, which is comprehensible.

9.15 Lemma 8

Lemma 8:

An issuer with a bad project anticipates that a sophisticated investor never invests in a bad project, even with an inflated rating. In case of an allocation to a sophisticated investor, the profit is $-\phi$, since the issuer has paid the rating fee for the publication. A sophisticated investor only invests in a bad project if the rating is inflated and the PCI provides a good rating as well. A PCI solely provides a good rating by mistake, which occurs with probability e. After an investment by the trusting investor, the project either defaults or non-defaults. If a project defaults, the issuer bears the loss of the rating fee ($-\phi$). In contrast, if a project does not default, the issuer receives the profit of the return minus the investment plus the interest rate for the investor. Therefore, the expected profit for an issuer with a bad project (with an inflated rating) is

$$\theta_B = \alpha e[R-(1+r)I] + (1-\alpha)0 - \phi$$

An issuer solely publishes an inflated rating for a bad project if the expected profit is positive:

$$\theta_B > 0$$
$$\Leftrightarrow \alpha e[R - (1+r)I] + (1-\alpha)0 - \phi > 0$$
$$\Leftrightarrow \phi < \alpha e[R - (1+r)I]$$

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