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Strategic Role of Credit Rating Agencies on Financial Markets

Bakalářská práce

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Abstrakt

Práce se zabývá rolí ratingových agentur na finančních trzích. Zatímco v letech před finanční krizí byly ratingy považovány za důvěryhodná ohodnocení rizikovosti investice, krize poukázala na mylnost takového předpokladu. Otázka, proč ratingová hodnocení selhala – zda to bylo z důvodu nepřesných modelů nebo zda v tom hrál roli i úmysl – je proto klíčová pro nastavení vhodné regulace. Tato práce naznačuje, že jedním z důvodů byl konflikt zájmů vyplývající z jejich obchodního modelu, který byl navíc umocněn využíváním ratingových hodnocení pro regulatorní účely jako je například kapitálová přiměřenost. Z tohoto důvodu byla řada investorů nucena volit investice především na základě ratingových hodnocení, což na straně ratingových agentur vytvořilo příležitost, jak vydělávat na systematickém nadhodnocování jejich kvality.

Abstract

The thesis deals with the role of credit rating agencies (CRAs) on financial markets. While in years prior to the financial crisis credit ratings were considered to be trustworthy as evaluations of investment risks, the crisis has proved this premise wrong. The reason for the credit ratings failure – whether it was due to inaccurate models and/or an intention – is therefore crucial for setting up appropriate regulations. This thesis suggests that one of the reasons was the conflict of interest arising from the CRAs business model that was additionally enhanced by the use of credit ratings for regulatory purposes, such as capital adequacy. Many investors thus had to choose investments primarily on the credit rating basis, which created the incentives for the CRAs to systematically overestimate the investments' quality.

Klíčová slova: Ratingové agentury, rating, reputační cena

Keywords: Credit rating agencies, credit ratings, reputation cost

Rozsah práce: 70 975 znaků

Prohlášení

Prohlašuji, že jsem bakalářskou práci vypracoval samostatně, použil pouze uvedené prameny a literaturu a tuto práci jsem sepsal výhradně za účelem získání bakalářského titulu na IES FSV UK. Souhlasím s jejím zpřístupněním pro studijní a výzkumné účely.

V Praze dne 20.5.2011 Tomáš Matyska

Poděkování

Na tomto místě bych rád poděkoval vedoucímu své práce za cenné rady a připomínky, které mi při konzultacích poskytl.

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Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

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Strategické efekty tvorby ratingu na finančních trzích

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

Jedná se o aktuální téma související se současnou finanční krizí. Základem práce by měl být článek The Credit Rating Game autorů Boltona, Freixase a Shapira. Práce si klade za cíl s využitím teorie her dále rozvinout jejich výsledky.

Struktura BP:

Abstrakt

V první části popíšu úlohu ratingových agentur na finančních trzích, jejich roli v současné krizi a příčiny, proč docházelo k chybným ohodnocením finančních instrumentů. Ve druhé části se pak pokusím pomocí teorie her vytvořit model popisující chování ratingových agentur na trhu. Ve třetí části budu zkoumat, jak se v tomto modelu projeví navrhovaná regulační opatření.

Osnova

1. Úloha ratingových agentur na finančních trzích
2. Rozbor základních podnětů vedoucích k chybným hodnocením některých finančních derivátů
3. Vytvoření modelu popisujícího chování ratingových agentur a vzájemné interakce mezi jednotlivými subjekty
4. Vliv navrhovaných regulačních opatření na trh s ratingovým hodnocením
5. Závěrečné hodnocení jednotlivých opatření

Seznam základních pramenů a odborné literatury:

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List of Abbreviations

ABS	Asset-Backed Securities
BCBS	Basel Committee on Banking Supervision
CDO	Collateralized Debt Obligations
CRA(s)	Credit Ratting Agency(ies)
ECAI(s)	External Credit Assessment Institution(s)
HHI	Herfindahl-Hirschman Index
IMF	International Monetary Fund
NRSRO(s)	Nationally Recognized Statistical Rating Organization(s)
(R)MBS	(Residential) Mortgage-Backed Securities
S&P	Standard & Poor's Ratings Services
SEC	United States Securities and Exchange Commission

Introduction

> *"Credit rating agencies are central to capital formation, investor confidence, and the efficient performance of the United States economy."*
>
> - Dodd-Frank Wall Street Reform and Consumer Protection Act

The quote from the Dodd-Frank Act clearly demonstrates the importance of the credit rating agencies (CRAs) on the markets. Nevertheless, the financial crisis has showed, that unreserved confidence in their opinions was wrong. High quality ratings of the structured products in the years prior to the crisis and their massive downgrades since the second half of 2007 belonged to the key triggers that made the crisis so severe.

In this thesis I examine the incentives a CRA may have to provide inaccurate estimations of the products. I extend the model made by Bolton, Freixas and Shapiro (2009), who work with reputation costs and assume two groups of investors on the market—sophisticated ones who are fully rational, and absolutely naive ones. In the extension I have replaced the assumption of total naivety of one group of investors with bounded rationality and I have found out that boundedly rational investors create higher incentives for the CRA's systemic rating inflation than absolutely naive investors. On the other hand, this bounded rationality decreases a loss from shopping for rating.

The thesis is organized as follows: In section 1 I describe the development of the credit rating industry in the United States since its beginning, raising

importance of the rating agencies and finally the regulatory uses of their ratings that made them one of the key players on financial markets. In section 2 I discuss the role of the rating agencies in the financial crisis and different business models, which the CRAs use. In sections 3 I present the Bolton et al. (2009) model and in section 4 I extend it by introducing bounded rationality to one part of investors. Finally, in section 5 I discuss some possible regulations.

1 Development of the Credit Rating Industry

1.1 CRAs' Role on the Markets

More than 100 years ago John Moody started publishing a book about railroad securities, using letter grades to assess their risk, and thus he founded the first credit rating agency—Moody's. During the 20$^{\text{th}}$ century, the credit rating industry has developed into one of the most substantial part of the financial markets.

A CRA can be, in principle, defined in two possible ways:

1. *General definition*:[1] A credit rating agency is a company that issues credit ratings for certain type of instruments. It provides investors with evaluations of an investment's credit risk. The issuer of an instrument being rated usually pays credit rating agencies to receive the credit rating.

[1] Andrlíková (2010)

2. *Legal definition*:[2,3] The term credit rating agency means any person–

   (a) engaged in the business of issuing credit ratings on the Internet or through another readily accessible means, for free or for a reasonable fee, but does not include a commercial credit reporting company;

   (b) employing either a quantitative or qualitative model, or both, to determine credit ratings; and

   (c) receiving fees from either issuers, investors, or other market participants, or a combination thereof.

According to the IMF (2010), CRAs basically provides two services on the financial markets—"information services" and "monitoring services". Information services are, in fact, issuing credit rating that is defined as *an assessment the creditworthiness of an obligor as an entity or with respect to specific securities or money market instruments*[4]. Credit rating thus reduces information costs, increases the pool of potential investors and promotes liquid markets. Through the monitoring services CRAs influence issuers to take corrective actions to avert downgrades via "watch" procedures.[5]

The influence of CRAs on the US markets have increased significantly during the last century. According to SEC (2003) there are several reasons like an

[2] Section 3(a)(61) of the Credit Rating Agency Reform Act of 2006

[3] An interesting fact is mentioned in BCBS (2009): "The terms 'credit rating' and 'credit rating agency' are defined only by a minority of respondents, primarily in regulations (with the US SEC defining both terms in legislation). Several respondents noted that the definitions were 'implicit' in their regulations or that familiarity with the terms is understood.

[4] Section 3(a)(60) of the Credit Rating Agency Reform Act of 2006

[5] IMF (2010), p. 86

increase in the number of issuers and an advent of new and complex financial products such as asset-backed securities (ABS). Moreover, this was multiplied by the globalization of the financial markets so the CRAs have expanded outside the United States.

In addition, governments and regulators have incorporated the rating requirements in the legislation. As an example, SEC (2003) mentions that US Congress used the requirement on the quality of credit rating by at least one nationally recognized statistical rating organization (NRSRO) for definition of the term "mortgage related security" in the Exchange Act[6].

The banking regulation framework Basel II[7] could be another example. If banks compute the capital requirements using the standardized approach described in BCBS (2006), "they must use chosen external credit assessment institutions (ECAIs[8]) and their ratings consistently for each type of claim, for both risk weighting and risk management purposes. Banks will not be allowed to 'cherry-pick'[9] the assessments provided by different ECAIs."[10]

[6] 15 U.S.C. § 78c(a)(41), Section 3(a)(41)

[7] BCBS (2009) mentions in the conclusion that "the category of determining regulatory capital clearly displayed the broadest extent of the use of credit ratings in the legislation, regulations, and/or supervisory policies (LRSPs), both in numbers of LRSPs and in the number of jurisdictions in which they are used."

[8] Basel Committee on Banking Supervision (BCBS) specifies in paragraph 90 in BCBS (2006) that the national supervisors are responsible for determining whether an ECAI meets the criteria that are listed in the paragraph 91.

[9] To select (only what one considers to be best or most desirable, profitable, etc.) from a number of options (http://www.yourdictionary.com/cherry-pick)

[10] Paragraph 94 in BCBS (2006)

1.2 NRSRO Concept

According to the Senate Report accompanying the Credit Rating Agency Reform Act of 2006 "the United States Securities and Exchange Commission (SEC) originally adopted the term NRSRO in 1975 solely for determining capital charges on different grades of debt securities under the Net Capital Rule[11]. The Net Capital Rule requires broker-dealers, when computing net capital, to deduct from their net worth certain percentages of the market value of their proprietary securities positions. These 'haircuts' provide a margin of safety against losses that might be incurred by broker-dealers in those positions. The SEC determined that it was appropriate to apply a lower haircut to securities held by a broker-dealer that were rated investment grade by a nationally recognized rating agency because those securities typically were lower-risk investments. The requirement that the rating agency be 'nationally recognized' was designed to ensure that its ratings were credible and reasonably relied upon by the marketplace."[12] In addition, many other federal, state and foreign laws and regulations have adopted the NRSROs concept during the next decades.

Although there are approximately 150 CRAs[13] on the worldwide markets, only three of them have the global impact. These are: Moody's Investor Service (Moody's), Fitch, Inc. (Fitch) and the Standard and Poor's Rating Services (S&P). These three CRAs were the only NRSROs agencies until

[11] 17 CFR 240.15c3–1. Adoption of Uniform Net Capital Rule and an Alternative Net Capital Requirement for Certain Brokers and Dealers, Release No. 34–11497 (June 26, 1975), 40 FR 29795 (July 16, 1975).

[12] Senate Report accompanying the Credit Rating Agency Act of 2006, p. 4

[13] de Haan and Amtebrink (2011), p. 3

2007. Currently there are seven other CRAs that are nationally recognized. The share of the CRAs on the NRSRO's market is presented in Tab. 1.1.

Tab. 1.1: Outstanding Credit Ratings Reported by NRSROs on Form NRSRO by Rating Class

NRSRO	Financial Institutions	Insurance Companies	Corporate Issuers	Asset-Backed Securities	Government, Municipal & Sovereign	Total Ratings
A.M.Best	3	5,364	2,246	54	0	7,667
DBRS	16,630	120	5,350	8,430	12,400	42,930
EJR	82	45	853	14	13	1,007
Fitch	72,311	4,599	12,613	69,515	352,697	511,735
JCR	156	31	518	64	53	822
LACE	17,263	60	1,000	0	61	18,384
Moody's	76,801	5,455	31,008	106,337	862,240	1,081,841
R&I	100	30	543	186	123	982
Realpoint	0	0	0	8,856	0	8,856
S&P	52,500	8,600	41,400	124,600	1,004,500	1,231,600
Total	235,846	24,304	95,531	318,056	2,232,087	2,905,824
HHI	2,599	2,601	3,145	3,145	3,767	3,495
HHI Inverse	3.85	3.84	3.18	3.18	2.65	2.86

Source: SEC (2011)

Market concentration is measured by Herfindahl-Hirschman Index (HHI), which is constructed as follows:

$$\text{HHI} = \sum_{i=1}^{n} s_i^2,$$

where s_i is the percentage of the market share of the i-th firm. Therefore, the HHI can range from close to zero for a perfect competition to 10,000 for a monopoly market. According to the United States Department of Justice, markets in which the HHI is below 1,000 are considered to be competitive, those in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI exceeds 1,800 are consid-

ered to be concentrated.[14] The inverse of the HHI (HHI Inverse in Tab. 1.1) is a measure of the number of equally sized firms which would constitute a comparable level of concentration for a given HHI and is calculated by dividing 10,000 by the HHI.[15]

From the overall HHI we can say that the rating industry is highly concentrated in the US. The share of Fitch, Moody's and S&P on all NRSROs' ratings is approximately 97%. Moreover, the shares of two of them (Moody's and S&P, both have approximately 40% share) are significantly higher than the Fitch's share, which is approximately 17%. The Senate Report accompanying the Credit Rating Agency Reform Act of 2006 describes these two largest NRSROs as a "partner monopoly" and the industry as a whole as "oligopoly" and also as a "government-sponsored cartel".[16] Sylla (2001) mentions that the high level of concentration has been significant for the rating industry for most of its history. White (2001) concludes that regulatory use of credit ratings resulted into such a concentration due to the creation of barriers to entry.

[14] http://www.justice.gov/atr/public/testimony/hhi.htm
[15] SEC (2011)
[16] Senate Report accompanying the Credit Rating Agency Act of 2006, p. 5

2 CRAs' Role in the Financial Crisis

2.1 CRAs' Ratings Classification

As mentioned in Sec. 1 the credit ratings are expressed on a scale of letters following the first rating issued by John Moody. In addition, as IMF (2010) mentions, CRAs use modifiers to further distinguish and rank ratings within each classification. Fitch and S&P use pluses and minuses (e.g. A+, A, A-), Moody's uses numbers (e.g. A1, A2, A3). The rating classification of the three biggest CRAs is in Tab. 2.1. CRAs also provide their intention to consider the credit rating changes. They use, for example, a negative review to indicate that the downgrade is likely within the next quarter and negative outlook to indicate the possibility of a downgrade within the next two years.[17]

Tab. 2.1: Long-Term Senior Debt Rating Symbols

Investment grade		
Interpretation	Fitch and S&P	Moody's
Highest quality	AAA	Aaa
High quality	AA+	Aa1
	AA	Aa2
	AA-	Aa3
Strong payment capacity	A+	A1
	A	A2
	A-	A3
Adequate payment capacity	BBB+	Baa1
	BBB	Baa2
	BBB-	Baa3

Non-investment grade		
Interpretation	Fitch and S&P	Moody's
Likely to fulfill obligation, ongoing uncertainty	BB+	Ba1
	BB	Ba2
	BB-	Ba3
High-risk obligations	B+	B1
	B	B2
	B-	B3
Vulnerable to default	CCC+	Caa1
	CCC	Caa2
	CCC-	Caa3
Near or in bankruptcy or default	CC	Ca
	C	C
	D	D

Source: Author's compilation from Andrlíková (2010) and IMF (2010)

[17] IMF (2010)

The agencies slightly differ in the definition what their credit rating means (see Tab. 2.2). Briefly, while S&P and Moody's define the credit rating as a relative creditworthiness of issuers and obligations, Fitch defines it as an expression of a credit risk. Nevertheless, the grades look very similar among these companies.

Tab. 2.2: Rating Agency Statements on What Their Ratings Are Designed to Measure

Fitch	"Credit ratings express risk in relative rank order, which is to say they are ordinal measures of credit risk and are not predictive of a specific frequency of default or loss. Fitch Ratings' credit ratings do not directly address any risk other than credit risk, ratings do not deal with the risk of a market value loss on a rated security due to changes in interest rates, liquidity and other market considerations."
Moody's	"There is an expectation that ratings will, on average, relate to subsequent default frequency, although they typically are not defined as precise default rate estimates. Moody's ratings are therefore intended to convey opinions of the relative creditworthiness of issuers and obligations...Moody's ratings process also involves forming views about the likelihood of plausible scenarios, or outcomes—not forecasting them, but instead placing some weight on their likely occurrence and on the potential credit consequences. Normal fluctuations in economic activity are generally included in these scenarios, and by incorporating our views about the likelihood of such scenarios, we give our ratings relative stability over economic cycles and a sense of horizon."
S&P	"Standard & Poor's credit ratings are designed primarily to provide relative rankings among issuers and obligations of overall creditworthiness; the ratings are not measures of absolute default probability. Creditworthiness encompasses likelihood of default and also includes payment priority, recovery, and credit stability."

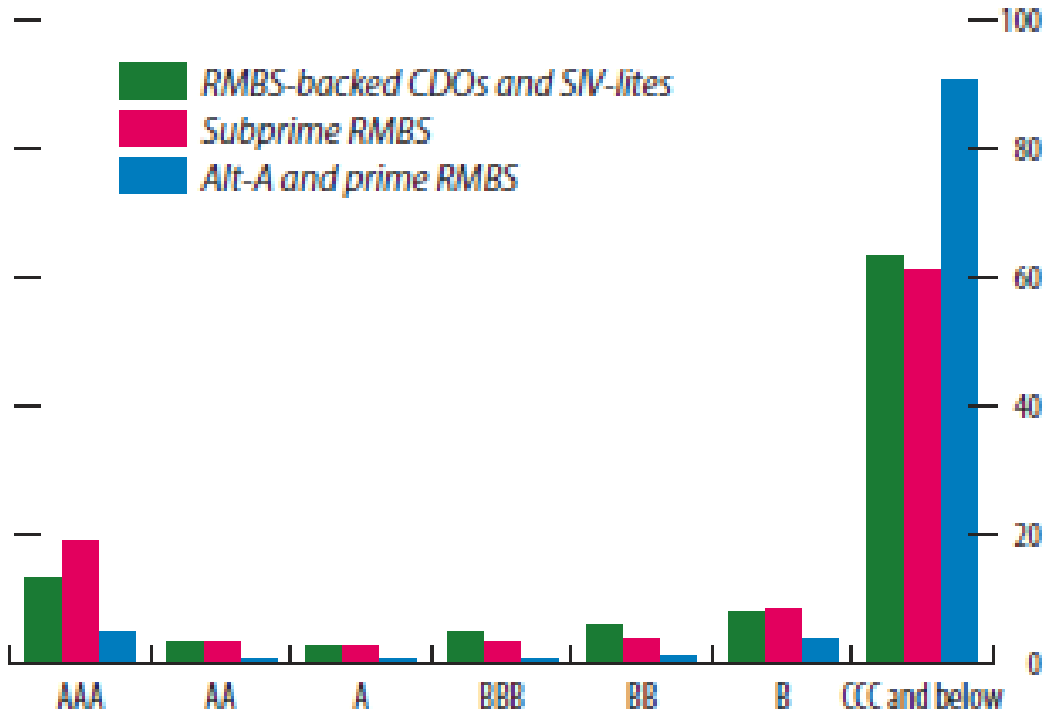
Source: IMF (2010)

2.2 Rating Downgrades During the Crisis

The recently passed financial crisis showed that either the CRAs were unable to predict the unprecedented failure of the specific securities or that their business models increased the conflict of interest and they systematically overestimated the ratings. Fig. 2.1 clearly demonstrates that the majority of residential mortgage-backed securities (RMBS) that were originally rated by S&P as highest quality investment is now below investment grade, mostly rated as near to default. Ashcraft et al. (2010) mention that originally it

was 80-95% of a typical subprime or Alt-A MBS deal with the highest rating and they also point out that while net rating revisions are small for earlier vintages, for MBS issued since 2005 it has been unprecedented downgrading by 3-10 rating notches on average. This could be also illustrated in Tab. 2.3. Moreover, Benmelech and Dlugosz (2009) find that tranches of ABS CDOs that had been rated by only one CRA were more likely to be downgraded and also that their downgrades were more severe.

Fig. 2.1: Ratings of AAA-Rated U.S. Mortgage-Related Securities
(In percent of S&P's originally rated 2005-07 issuance as of July 31, 2010)



Note: CDO = collateralized debt obligation; SIV = structured investment vehicle
Source: IMF (2010)

This massive rating downgrades of thousands of RMBS and CDO securities

Tab. 2.3: Percent of the Original AAA Securities Currently Rated Below Investment Grade

Vintage	Prime Fixed	Prime ARM	Alt-A Fixed	Alt-A ARM	Option ARM	Subprime
2004	3%	9%	10%	17%	50%	11%
2005	39%	58%	73%	81%	76%	53%
2006	81%	90%	96%	98%	97%	93%
2007	92%	90%	98%	96%	97%	91%

Source: Senate Report (2011) - BlackRock Solutions as of February 8, 2010

are mentioned in the Senate Report (2011) as one of the immediate triggers for the financial crisis.[18] This report also says that while at the beginning of July 2007 Moody's and S&P started with these unprecedented downgrades, in the first half of 2007 they issued hundreds highest ratings for RMBS and CDO securities, although there were signals and news about failing subprime lenders and increasing subprime mortgage default.

2.3 Conflict of Interest

The most important questions in these days are why this downgrading has happened and why the credit rating agencies has issued inaccurate ratings and, of course, how to prevent similar failures in the future. Many authors agreed on that one of the most important reasons is the conflict of interest inherent in the payment arrangement that is commonly used in rating industry.[19]

[18] See Senate Report (2011), p. 259
[19] See e.g. Senate Report (2011), p. 273

In the rating industry, there are basically two business models—the "issuer-pays model"[20] and the "investor-pays model"[21]. According to SEC (2011) *the issuer-pays model is to receive compensation from obligors for rating the obligor or securities issued by the obligor* and investors have access to all ratings under this model. By contrast, *in the investor-pays model investors and other market participants purchase the right to access the pool of credit ratings issued by the CRA*. The investors are not necessarily users of all credit ratings provided by a CRA under the investor-pays model..

The original model established by John Moody was the investor-pays model. White (2010) mentions that the CRAs converted to the issuer-pays model in the 1970s due to several reasons. One of the main reasons could have been the CRAs' fear of expansion of high-speed photocopy machines, which could have allowed the free-riding by the investors. This was in addition enhanced by bankruptcy of the Penn-Central Railroad, which shocked the bond markets and led issuers to pay for rating in order to convince investors that their investments are low risk.

2.3.1 Problems of the Issuer-pays Model

Seven out of ten NRSROs (including all three biggest) use primarily the issuer-pays model. The potential conflict of interest is evident in this model—a CRA has the incentives to overestimate the rating in order to gain fa-

[20] Other authors use different names for this model – for example, "issuer-initiated ratings system" (Skreta and Veldkamp, 2008)

[21] Other authors use different names for this model - for example, "subscriber-pays model" (SEC, 2011) or "investor-initiated ratings system" (Skreta and Veldkamp, 2008)

vor with the issuer. These incentives are multiplied by the usual payment method, where the CRA is paid only if the credit rating is issued.[22] Thus an investor may reject bad rating and try to get more positive rating without large financial costs. This is called rating shopping and according to the Nomura Fixed Income Research I define it as follows:[23]

> *Rating shopping occurs when an issuer chooses the rating agency that will assign the highest rating or that has the most lax criteria for achieving a desired rating. Rating shopping rarely involves corporate, sovereign, and municipal bonds. However, it is common for securitization issues.*
>
> *Rating shopping has a strong effect when one rating agency's criteria is much more lax than its competitor's criteria. Unless investors demand multiple ratings on deals, issuers will tend to use only ratings from the agency with the most lenient standards.*

The presence of the rating shopping on the financial markets could be demonstrated by Tom McGuire, former chief of Moody's:

> *"The banks pay only if Moody's* [or other CRA, author's note] *delivers the desired rating. ... If Moody's and a client bank do not see eye to eye, the bank can either tweak the numbers or try its luck with a competitor like S.&P., a process known as ratings shopping."*[24]

[22] SEC (2008), p. 9
[23] Nomura Fixed Income Research (2006), p. 1
[24] Quote from Lowenstein, R. (2008)

In addition, Skreta and Veldkamp (2008) point out that even if we assume the CRAs do not overestimate their ratings, the increase in the complexity of the securities lead to a systemic bias in disclosed ratings. This may also be an incentive for the issuer to make its assets even more complex.

This point of view could be supported by Mark Adelson, director of structured finance research at Nomura Securities:

> *"The complexity of a typical securitization is far above that of traditional bonds. It is above the level at which creation of the methodology can rely solely on mathematical manipulations. ... The inherent complexity of credit risk in many securitizations means that reasonable professionals starting with the same facts can reasonably reach the different conclusion."*[25]

Mathis et al. (2009) make stronger conclusions. They find out that if the fraction of income coming from ratings of complex products is large, then the opportunistic CRA always lies if its reputation is good enough.

Another problem is mentioned in SEC (2011). Briefly, under the issuer-pays model, hired CRAs have access to non-public information, which is the reason why it is difficult for other agencies to rate the same product. As a result, the products are frequently rated only one or two CRAs that are hired by

[25] Testimony of Mark Adelson before the Subcommittee on Capital Markets, Insurance and Government Sponsored Enterprises, Committee on Financial Services, U.S. House of Representatives; 27 September 2007;
http://financialservices.house.gov/hearing110/adelson.pdf

the issuer. In addition, investors may also tend to place greater weight on an opinion that is based on access to these private information.

As mentioned above, the higher competition among CRAs under the issuer-pays model could paradoxically result in the lower quality of ratings. Bolton et al. (2009) provide a theoretical explanation in their simple model[26], whilst Becker and Milbourn (2009) bring the empirical evidence. They examine credit rating industry data of the decade starting in the mid 1990s—the period when Fitch expanded its share on the market. In their paper they find out that higher competition leads to more issuer-friendly ratings, and that the ratings and bond yields are less correlated due to the competition. This "Drive for Market Share" is also mentioned in the Senate Report (2011): "In the years leading up to the financial crisis, gaining market share, increasing revenues, and pleasing investment bankers bringing business to the firm assumed a higher priority than issuing accurate RMBS and CDO credit ratings".[27]

Many authors say that under the issuer-pays model a monopoly might be most effective[28]. The idea behind it is very simple—if there is no competition among the CRAs the issuer has no possibility to shop for rating. If he needs credit rating of his product due to regulation he has to ask the only one CRA for it. The CRA would know this fact and thus it would have less incentives to inflate its ratings.[29] General problem is that the monopoly agency has

[26] The model will be discussed in detail in section 3.
[27] Senate Report at p. 273
[28] For example Skreta and Veldkamp (2008)
[29] As I will show in the model, the incentives are present on the monopoly market under the issuer-pays model.

less incentives to provide accurate information and to improve its ratings processes.

2.3.2 Problems of the Investor-pays Model

There are objections against investor-pays model, too. SEC (2011) mentions two possible problems. First, an investor who holds a security on long or short position may potentially be given an advantage by the fact that an CRA's upgrading or downgrading of the rating caused the desired change of a market value of the security. The argument against this objection is very simple—if one investor is on short position, the other one has to be on long and vice versa. Thus their interests on upgrading or downgrading the rating are in opposite and, therefore, the rating should stay unbiased.

The second SEC's objection is that an investor, who has in a portfolio security that is likely to be downgraded, may try avoid this downgrade in order to preserve its higher evaluation because of regulation requirements. Nevertheless, it is not probable that he would have sufficient power to avoid all rating agencies in this downgrade.

The last problem are the closed ratings in the investor-pays model; there could thus be less information on the markets, especially for small investors who do not have enough resources to buy the ratings. On the other hand, as Skreta and Veldkamp (2008) state out, the most complex financial products are mostly purchased by large institutional investors such as hedge funds or pension funds that have enough money to buy their own ratings. Nevertheless, Mathis et al. (2009) mention that a free-rider problem or information

leakage might occur under this model, but Pagano and Volpin (2010) mention, that the markets with other forms of financial information operate under the investor-pays model commonly. Hence, in these sectors with highly structured products, the investor-pays model may be a good choice.

3 Bolton's et al. (2009) Model

From the theoretical point of view, all the aforementioned problems with the systematical ratings inflation should be corrected by reputation costs paid by the CRAs. Nevertheless, Bolton et al. (2009) shows in their model that in boom times, there are more so-called naive investors and if their share on the markets exceeds some specific level, the profit from the inflation of rating is higher than the reputation costs paid for this inflation. Here, I demonstrate the main ideas of their analysis, which I use in the Sec. 4.

3.1 Model's Description

There are good and bad investments on the market; a bad one defaults with probability $p > 0$, and a good one with probability zero. Both of them yield the same return R in the case when an investment is not in default and a recovery amount r when it is in default. All agents (including issuers) believe ex-ante that the investment is good with probability $\frac{1}{2}$.

In this moment a CRA enters between an issuer and investors and uses its processes to assess whether the investment is good (g) or bad (b). The CRA

receives a signal $\theta \in \{g, b\}$, which has the following informational content about the true state of the world ω:

$$\mathrm{P}(\theta = g \mid \omega = g) = \mathrm{P}(\theta = b \mid \omega = b) = \epsilon \tag{3.1}$$

$$\mathrm{P}(\theta = g \mid \omega = b) = \mathrm{P}(\theta = b \mid \omega = g) = 1 - \epsilon \tag{3.2}$$

where ϵ measures the quality of the signal (or the quality of the rating process). Authors assume that the level of precision is known and comes from an interval $\left(\frac{1}{2}, 1\right)$.

The CRA also posts two fees for the rating before the signal is retrieved. An initial fee ϕ^I is paid before the start of the rating process, while a rating fee ϕ^R is paid when (and if) the rating is issued. Therefore, while the initial fee has to be paid upfront, the rating fee is paid only if the issuer is satisfied with the rating and wishes to publish it (hence, there is a possibility of shopping for rating in this model). The rating (or message) m is displayed in a form of a letter G in the case of the good rating and a form of letter B in the opposite case ($m \in \{G, B\}$).

Authors assume that if investors find out that the CRA lied, they will punish the CRA by ignoring its ratings in the future. However, they are not able to determine whether the rating is truthful or not at the time of its issuing. This means that they are not able to find out whether the rating m is equal to the signal θ. Nevertheless, in the case of default they are able to find out it ex-post (authors assume that the investors are able to identify perfectly whether the CRA lied or not). Naturally, there are only two possible situations. First, the CRA receives $\theta = g$ and reports $m = G$. In such case the investors will

not punish the CRA, because they see that the CRA acted in a "good faith". Second, the CRA receives $\theta = b$ and reports $m = G$, in this case the CRA will be punished by paying reputation costs ρ if the project failes. Reputation costs are assumed as exogenous.

Authors assume two types of investors. The first group are so-called *sophisticated* investors, who represent a fraction $1-\alpha$ of all investors. They do not know whether the investment is good or bad and they are not able to observe the signal of the CRA. Nevertheless, they observe the payoffs for both the CRA and the issuer, and therefore understand the CRA's potential conflict of interest. By contrast, *naive* investors do not understand the incentives the CRA may have and take the ratings at face value.

After the CRA rates the investment, the issuer decides whether to purchase the rating or not. In the case of satisfaction (the rating is $m = G$) he purchases it, in the opposite case he refuses it (proofs are in Lemmas 1 and 2 in Sec. 4). The refusal of a rating is a message for investors—sophisticated investors change their beliefs in a way consistent with the Perfect Bayesian Equilibrium, while naive investors use their ex-ante beliefs as if there were no rating procedure.

The investors are risk neutral and they can purchase one or two units of an investment[30]. Bolton et al. (2009) also assume that the investors require a return u on the first unit and a return U on the second unit ($U > u$). First

[30] This model thus enables more varied simulation than common models, where there are possible only two actions—"buy" and "not buy". In addition, in duopoly this model enables shopping for rating. If we use broader definition of shopping for rating, i.e. that the issuer could refuses the bad rating, the shopping for rating is possible in monopoly, too.

of all, authors define p^*, which is such the cutoff probability that an investor is indifferent between purchasing one or two units, i.e.:

$$(1 - p^*) R + p^* r = U.$$

Further, authors make three assumptions about these returns:

Assumption A1: Even if an investor knows that an investment is bad, he will be willing to purchase one unit. This condition can be written as

$$(1 - p) R + pr > u.$$

This inequality says that the probability of default is not high enough to discourage the investor from buying one unit of the investment.

Assumption A2: If an investor has reliable information that an investment is good, he purchases two units. This condition can be written as

$$(1 - \epsilon) p < p^*.$$

In other words, it says that if the investor trusts the rating agency, and if the rating agency issues report $m = G$ he will buy two units.

Assumption A3: If an investor has no information about an investment, he will be willing to purchase one unit. This condition can be written as

$$\frac{p}{2} > p^*.$$

It means that if there is no trustful information and thus if the investor uses its ex-ante beliefs, he will be willing to purchase only one unit.

These three assumptions imply that the issuer can sell two units to at least one fraction of investors only in the case, when the CRA reports $m = G$.

Last, authors use the following notation:

$$\begin{aligned} V^G &= (1 - (1 - \epsilon)\, p)\, R + (1 - \epsilon)\, p\, r \\ V^B &= (1 - \epsilon\, p)\, R + \epsilon\, p\, r \\ V^0 &= \left(1 - \frac{p}{2}\right) R + \frac{p}{2}\, r \end{aligned}$$

where V^G is the maximum value investors can have for an investment when monopoly CRA reports G truthfully[31], V^B is the minimum value[32] (the CRA reports B) and V^0 is the investors' ex-ante valuation of the investment. Since $\epsilon > \frac{1}{2}$ and $R > r$, it is clear that

$$V^B < V^G,$$

and

$$V^0 = \frac{1}{2}\left(V^G + V^B\right), \tag{3.3}$$

and thus

$$V^B < V^0 < V^G.$$

Finally, the issuer sets a price T for the investment. In general, he can

[31] i.e. $V^G = (1 - \mathrm{P}\,(\omega = b \mid \theta = g)\, p)\, R + \mathrm{P}\,(\omega = b \mid \theta = g)\, p\, r$
[32] i.e. $V^B = (1 - \mathrm{P}\,(\omega = b \mid \theta = b)\, p)\, R + \mathrm{P}\,(\omega = b \mid \theta = b)\, p\, r$

choose from a set $T \in \left\{V^B, V^0, V^G\right\}$. The investors observe the report (if there is any), and the price and they decide how much of the investment they are willing to purchase. If the price is higher than their evaluation of the investment, they do not purchase, not even one unit. If the investors believe that the investment is good, they are willing to purchase two units for price $T = V^G$. Last, if the investors do not have reliable information that the investment is good and if the price is equal to or lower than their evaluation, they purchase one unit.

Authors examined monopoly and duopoly market and their conclusions are discussed in the following subsection.

3.2 Conclusions

Authors find out that for both the monopoly and the duopoly, there exists cutoff level α^*[33] of naive investors. If the fraction of naive investors is higher than α^*, the CRAs take advantage of naive investors and always report $m = G$. In the opposite case, the CRAs always report the truth.

Moreover, they find out that if the fraction α of naive investors is too small, the duopoly is not sustainable, because for an issuer the value of the additional rating is small. He is thus willing to purchase only one rating.

Comparing the duopoly to the monopoly authors conclude, that with increasing fraction of naive investors there are larger incentives to inflate the rating for the monopolistic CRA than for the duopolistic CRAs.

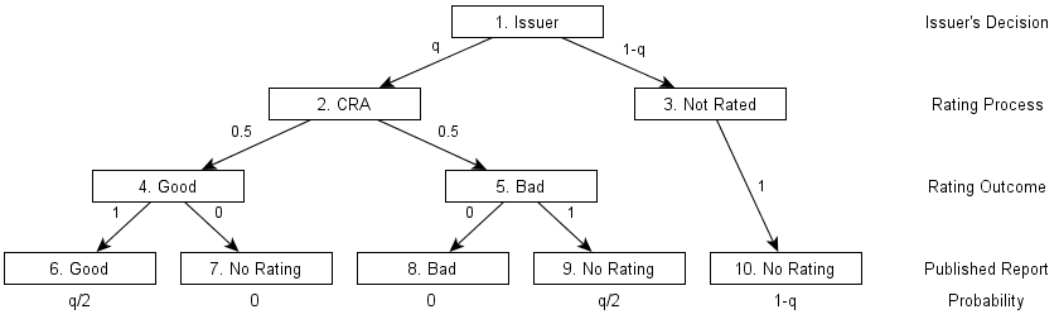
[33] The cutoff is different for monopoly and for duopoly.

4 Extension of Bolton et al. (2009)

4.1 Assumptions

I have one remark on the model described in Sec. 3. In my opinion, the assumptions about the behavior of naive investors are oversimplified. I think that a better way is to assume that naive investors are boundedly rational and that they have incomplete information. That means: naive investors understand the incentives that an issuer has for hiding a message $m = B$, but they do not understand the incentives that a CRA may have for a systemic rating inflation and thus they take its rating, if issued, at a face value (i.e., $m = G$ always results in V^G). A basic scheme of a game with a single CRA and naive investors is in Fig. 4.1.

Fig. 4.1: Evolution of beliefs of naive investors for a single CRA



Source: Author

In general, naive investors know that the first step is made by an issuer who decides whether to apply for a rating or not. They believe ex-ante that he applies with probability q and that he does not apply with complement probability $1 - q$. If the issuer applies for the rating, a CRA then observes a

signal θ and issues a report m. The naive investors use their ex-ante beliefs whether an investment is good or bad and thus they assume that the CRA marks the investment to be good with probability $\frac{1}{2}$ and to be bad with the same probability. Finally, the issuer decides whether to purchase and publish the rating or not. If the rating is good, he will always purchase it, in the opposite case he will always refuses it (see the Lemmas 1 and 2 thereinafter). Therefore, after the rating process proceeded (or not) there are only three feasible states. These are the nodes 6, 9 and 10 in Fig. 4.1. Their probabilities are easy to determine:

$$\begin{aligned} P(\text{G} \cap \text{Applied}) &= \frac{q}{2} \\ P(\text{No Rating} \cap \text{Applied}) &= \frac{q}{2} \\ P(\text{No Rating} \cap \text{Not Applied}) &= 1 - q \end{aligned}$$

Hence, it is reasonable to change the behavior of naive investors in the following way:

- In the case when a rating is announced they take the rating at a face value.
- In the case when there is not rating they use the Bayes' theorem to calculate the probabilities for each one of two possible states (nodes 9 and 10):

$$\begin{aligned} P(\text{Not Applied} \mid \text{No Rating}) &= \frac{2-2q}{2-q} \\ P(\text{Bad Rating} \mid \text{No Rating}) &= \frac{q}{2-q} \end{aligned}$$

– And therefore they change the evaluation of an investment in the case when there is no rating published in the following way:

$$V^{NR} = \frac{2-2q}{2-q}V^0 + \frac{q}{2-q}V^B$$

– It is obvious, that

$$V^B < V^{NR} < V^0.$$

By contrast, sophisticated investors are able to observe whether an issuer applied for rating or not, and so they are able to recognize whether the rating was bad and the issuer refused it (in this case they evaluate the investment V^B) or whether he did not applied for it (in this case they use their ex-ante evaluation V^0). Moreover, they observe the payoffs for the CRA, and thus they are able to identify the situation when the CRA overestimates the quality of the investment.

I summarize used symbols in the following box:

p	Probability of bad investment's default
$\theta \in \{g, b\}$	Signal received by a CRA
ϵ	Precision of the signal θ
$m \in \{G, B\}$	Message reported by a CRA
ϕ^I, ϕ^R	Fees paid by an issuer to a CRA
ρ	Reputation costs
V^G, V^B, V^0	Investor's valuation in case of good/bad rating and ex-ante
V^{NR}	Naive investors' valuation in case of no rating is published
α	Fraction of naive investors
q	Naive investors' beliefs that the investment was rated
R	Return of the investment if not in default
r	Recovery amount in the case the investment default
T	Price settled by an investor after the rating is issued or not
u, U	Opportunity costs

In the following two lemmas I will prove that the issuer is always willing to purchase a good rating and that he always refuses a report $m = B$.

Lemma 1: The issuer is always willing to purchase good rating.

Proof: Since the naive investors always take the rating at a face value, a good rating increases their evaluation of an investment. Moreover, there is not any regime in which a purchasing of G report could decrease sophisticated investors' evaluation:

1. If they observe that the CRA reports truthfully, they evaluate the investment V^G.
2. If they observe that the CRA inflates its rating, they remain with the ex-ante evaluation V^0.

Hence, the overall evaluation increases after a disclosure of the G rating and the issuer will be then always willing to purchase it.[34]

■

Lemma 2: The issuer always refuses bad rating.

Proof: In accordance with the assumptions, an announcement of B rating decreases an evaluation of naive and sophisticated investors from V^{NR} to V^B and from V^0 to V^B, respectively.

[34] In general, there is possibility that the issuer refuses the rating even if $m = G$. It could occur if the CRA sets higher rating fee ϕ^R than is the additional profit that the issuer gain for this rating. Nevertheless, I assume rational CRA that sets the fees up to the upper feasible limit and thus the issuer always purchases the report $m = G$.

Thus, if the B rating is announced, the overall evaluation decreases and the issuer will always refuse it.

■

4.2 Solutions of the Extended Model

4.2.1 Single CRA

To solve my extension I need the following lemma, which is expressed in Bolton et al. (2009). It determines when a CRA has incentives for the rating inflation.

Lemma 3: Given the fee ϕ^R, the CRA's reporting strategy is:

1. For $\phi^R > \epsilon\, p\, \rho$, always to report G.
2. For $0 < \phi^R < \epsilon\, p\, \rho$, to report the truth, transmitting its signal perfectly.

The idea behind it is simple: if the profits from rating inflation outweigh the expected reputation cost, the expected yield $\phi^R - \epsilon\, p\, \rho$ is thus higher than 0 and this creates an incentive for the CRA to inflate the rating.

To simplify notation, I adopt the following terms:

$$\begin{aligned} \pi^0_{issuer} &= \max\left[V^{NR},\, (1-\alpha)\, V^0\right] \\ \pi^B_{issuer} &= \max\left[\alpha V^{NR},\, V^B\right] \end{aligned}$$

The term π^0_{issuer} represents the value of the investment in the case, when the issuer does not apply for rating. While sophisticated investors observe it and thus they are willing to purchase one unit for $T \leq V^0$, the naive investors do not know whether he applied for rating or not and thus they are willing to purchase one unit for price $T \leq V^{NR}$. Hence, the issuer can choose whether he will sell the investment solely to sophisticated investors for price $T = V^0$ or to all investors for price $T = V^{NR}$. The term π^B_{issuer} represents the value of the investment in the case, when the issuer applies for rating and the message is $m = B$ (and therefore he does not purchase it).

Next step is to settle the fees that the CRA could charge the issuer with in both informational regimes.

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

1. If $\alpha 2V^G - \pi^0_{issuer} > \epsilon\, p\, \rho$, the CRA always reports G, sets
   $\phi^R \in \left(\epsilon\, p\, \rho,\, \alpha 2V^G - \pi^0_{issuer}\right]$, and
   $\phi^I = \alpha 2V^G - \pi^0_{issuer} - \phi^R$,
   and has profits $\alpha 2V^G - \pi^0_{issuer} + \left(1 - \frac{\epsilon p}{2}\right) \rho$.

2. If $\alpha 2V^G - \pi^0_{issuer} < \epsilon\, p\, \rho$, the CRA reports truthfully, sets
   $\phi^R \in \left[0,\, \min\left[2V^G + \pi^B_{issuer} - 2\pi^0_{issuer},\, \epsilon\, p\, \rho\right]\right]$, and
   $\phi^I = \frac{1}{2}\left(\min\left[2V^G + \pi^B_{issuer} - 2\pi^0_{issuer}\, \epsilon\, p\, \rho\right] - \phi^R\right)$,
   and has profits $\frac{1}{2}\min\left[2V^G + \pi^B_{issuer} - 2\pi^0_{issuer},\, \epsilon\, p\, \rho\right] + \rho$.

Proof: First, let us assume that the CRA always reports $m = G$. In this case, sophisticated investors use their ex-ante beliefs, because they recognize

the situation and know, that the report does not have any additional information about the true state of the world ω. This means that the issuer may obtain an additional profit solely from the naive investors. The total profit is equal to $\alpha 2V^G$, where α is the fraction of naive investors, V^G is their valuation of the investment under the good rating, and multiplication by 2 is due to the assumption A2. In order to obtain the additional profit that the issuer has from the inflated rating, it is necessary to subtract the profit π^0_{issuer}, which he could gain, if he did not apply for the rating.

Thus, the issuer is willing to purchase the report until the sum of ϕ^I and ϕ^R is not higher than

$$\alpha 2V^G - \pi^0_{issuer}.$$

This implies, that maximal feasible rating fee ϕ^R is as high as $\alpha 2V^G - \pi^0_{issuer}$. (There are not any restrictions on minimal level of initial fee, thus we can assume $\phi^I = 0$.)

Lemma 3 says, that always reporting G is possible if the CRA's profit from issuing inflated rating is higher than its expected reputation cost, i.e., if

$$\alpha 2V^G - \pi^0_{issuer} > \epsilon\, p\, \rho.$$

If this condition is fulfilled the CRA then sets the fees such that

$$\epsilon\, p\, \rho < \phi^R \leq \alpha 2V^G - \pi^0_{issuer},$$

and

$$\phi^R + \phi^I = \alpha 2V^G - \pi^0_{issuer}.$$

Its profit is then[35]

$$\pi^I_{CRA} = \alpha 2V^G - \pi^0_{issuer} + \left(1 - \frac{\epsilon\, p}{2}\right)\rho.$$

Second, let us assume that the CRA transmits the signal truthfully. In this case the report $m = G$ causes the highest evaluation V^G for both types of investors who will be then willing to purchase 2 units according to the assumption A2. The report $m = B$ leads to π^B_{issuer} overall evaluation. Therefore, the maximal feasible rating fee is:[36]

$$\phi^R = 2V^G - \pi^B_{issuer}.$$

Moreover, the rating fee must also satisfy, that the additional revenues, that the issuer has from contracting truthful CRA, are not lower than π^0_{issuer}, i.e.

$$\frac{1}{2}\left(2V^G - \phi^R + \pi^B_{issuer}\right) \geq \pi^0_{issuer}$$

[35] The term $\frac{\epsilon\, p}{2}$ in the bracket is because of the ex-ante beliefs that only one half of all investments is bad, thus the CRA lies only in one half of all reports.

[36] The CRA sets both the initial fee ϕ^I and the rating fee ϕ^R before the rating process, i.e., before the issuer applies for the rating, so it has to set their sum equal or lower than is the maximal value of the rating. Again, there is no restriction on the initial fee and thus we could assume $\phi^I = 0$

The maximal rating fee satisfying this condition is:

$$\phi^R = 2V^G + \pi^B_{issuer} - 2\pi^0_{issuer}$$

Since

$$2V^G - \pi^B_{issuer} > 2V^G + \pi^B_{issuer} - 2\pi^0_{issuer},$$

and since truthtelling equilibrium is feasible only if $\phi^R < \epsilon\, p\, \rho$ (Lemma 3), the rating fee for truthful reporting cannot exceed

$$\min\left[2V^G + \pi^B_{issuer} - 2\pi^0_{issuer},\, \epsilon\, p\, \rho\right].$$

Hence, CRA's profit from truthful transmitting of the signal is

$$\pi^T_{CRA} = \frac{1}{2}\min\left[2V^G + \pi^B_{issuer} - 2\pi^0_{issuer},\, \epsilon\, p\, \rho\right] + \rho$$

Finally, if both the rating inflation and the truthful transmition of the signal θ are feasible $\big($which is equal to $\alpha 2V^G - \pi^0_{issuer} > \epsilon\, p\, \rho\big)$, the CRA prefers to inflate the rating, because in this case

$$\pi^I_{CRA} > \left(1 + \frac{\epsilon\, p}{2}\right)\rho \geq \pi^T_{CRA}.$$

■

While the overall conclusions are very similar to the original model made by Bolton et al. (2009)—also the extended model shows that the rating inflation

can be an equilibrium outcome—, there is one important additional finding in this extension.

In the original model the cutoff level of α^*, which determines whether the CRA will inflate the rating or not, is equal to

$$\frac{\epsilon\, p\, \rho + V^0}{2V^G}.$$

If the α^* is larger than the cutoff the CRA will always inflate the rating, if it is lower, it will always report the truth.

In the extended model, the cutoff level $\hat{\alpha}$ is equal to

$$\frac{\epsilon\, p\, \rho + \pi^0_{issuer}}{2V^G}.$$

Since $\pi^0_{issuer} = \max\left[V^{NR},\, (1-\alpha)\, V^0\right] < V^0$, it is clear that ceteris paribus $\hat{\alpha} < \alpha^*$. Thus lower fraction of naive investors is enough to create the incentives for the CRA to inflate the rating. This fact is due to the newly introduced assumptions of bounded rationality and incomplete information of naive investors. It means that (i) they do not understand the incentives, which the CRA may have to rating inflation, (ii) they are not able to observe whether the issuer applied for rating or not, but (iii) they understand to the incentives that the issuer has to hide the bad rating. These are the reasons why they lower their ex-ante evaluation of an investment that has no rating. This decreased investors' overall ex-ante evaluation of the investment and due to this an additional profit created by a good rating is higher. It then causes that the fraction α of naive investors that is sufficient enough for

rating inflation decreases. Hence, boundedly rational naive investors create higher systemic bias than absolutely naive investors, who do not understand any incentive the issuer or the CRA may have.

It is also clear that higher reputation costs lowers the incentives for rating inflation[37], so increase of the reputation costs could be the way how to prevent CRAs from rating inflation.

Another important question is how the precision of the signal affects the incentives for rating inflation—whether the fraction α of naive investors, that is enough for rating inflation, decreases or increases with the increasing precision ϵ, when other parameters are fixed. We can rewrite the formula $\alpha 2V^G - \pi^0_{issuer} - \epsilon\, p\, \rho$ in the following ways:

1. $\max\left[V^{NR},\, (1-\alpha)\, V^0\right] = (1-\alpha)\, V^0$:

$$\alpha 2V^G - (1-\alpha)\, V^0 - \epsilon\, p\, \rho = \alpha 2\left((1-p)\, R + p\, r\right) - (1-\alpha)\, V^0 + \epsilon\, p\left(\alpha 2\left(R-r\right) - \rho\right)$$

2. $\max\left[V^{NR},\, (1-\alpha)\, V^0\right] = V^{NR}$:

$$\alpha 2V^G - V^{NR} - \epsilon\, p\, \rho = \alpha 2\left((1-p)\, R + p\, r\right) - \frac{2-2q}{2-q} V^0 - \frac{q}{2-q} R + \epsilon\, p\left[\left(\alpha 2 + \frac{q}{2-q}\right)\left(R-r\right) - \rho\right]$$

Therefore, it is unclear whether the incentives for rating inflation increase

[37] This is the same conclusion as in original model.

or decrease with respect to ϵ, but if $\rho > \left(\alpha 2 + \frac{q}{2-q}\right)(R-r)$, the incentives would be definitively decreasing in precision. Hence, if the reputation cost is large enough, the incentives to rating inflation are higher for more complex products like ABS, whose precision of signal ϵ is lower, than for simple products like sovereign bonds, whose precision is high. Similar conclusion make Mathis et al. (2009).

Investors' Surplus/Loss in Each Informational Regime

In this part I analyze how the rating procedure influences the investors' surplus in monopoly. I note that if there is no rating agency, all investors are willing to purchase one unit for price V^0. If the price is higher than their evaluation, they do not purchase even one unit. I also note, that

$$V^B < V^{NR} < V^0 < V^G.$$

Now, I will analyze all possible equilibria:

1. The CRA always reports $m = G$. In this case the fair value of an investment is V^0, because the report does not bring any information about true state of the world ω. Naive investors believe the CRA and purchase two units for price V^G, while their real return is V^0, and therefore their total loss is $\alpha\left(2V^0 - 2V^G\right)$. Sophisticated investors evaluate the investment V^0, but because of price V^G they do not purchase even one unit and thus their surplus is equal to zero. Hence, in this case naive investors incur a total loss $\alpha 2\left(V^0 - V^G\right)$.

2. The CRA reports truthfully $m = G$. In this case all investors buy two units of an investment for price V^G, the real return is the same and the total surplus of all investors is then equal to zero.

3. The CRA reports truthfully $m = B$, and

   (a) $\max\left[\alpha V^{NR}, V^B\right] = \alpha V^{NR}$, then the issuer takes advantage of naive investors and sell them one unit for price V^{NR}, while the real value is V^B. Therefore, naive investors incur a loss $\alpha\left(V^B - V^{NR}\right)$. Sophisticated investors evaluate the investment V^B, but because of price V^{NR} they act in the same way as in the case when the CRA always reports $m = G$ and they get a surplus equal to zero.

   (b) $\max\left[\alpha V^{NR}, V^B\right] = V^B$. In this case, even if issuer hides the bad rating, he has to set the price equal to V^B and thus all investors buy one unit for the real value and they have surplus equal to zero similarly as in the case 2.

Now, it is easy to calculate the total surplus for all investors in the situation when the CRA reports truthfully:

- If $\max\left[\alpha V^{NR}, V^B\right] = \alpha V^{NR}$, then the total loss is equal to

$$\frac{\alpha\left(V^B - V^{NR}\right)}{2}.$$

- If $\max\left[\alpha V^{NR}, V^B\right] = V^B$, it is clear that total total investors' surplus is equal to zero.

Comparing the case when the CRA always report $m = G$ with the case when an issuer takes advantage of naive investors, it is clear, that the loss is higher if the CRA always reports $m = G$.

Comparing the results with the original model I find that in the case, when an issuer takes advantage of naive investors, i.e. when he hides the bad rating and sells solely to naive investors, the loss of naive investors is lower in the extended model. In the original model it is equal to $\frac{\alpha\left(V^B - V^0\right)}{2}$. It is clear that

$$\frac{\alpha\left(V^B - V^0\right)}{2} < \frac{\alpha\left(V^B - V^{NR}\right)}{2} < 0.$$

Moreover, since $\frac{V^B}{V^{NR}} > \frac{V^B}{V^0}$, it is obvious, that minimal fraction α of naive investors, that is enough to create a possibility for an issuer to take an advantage of naive investors, is higher in the extended model.

Overall, the boundedly rational naive investors (i) create larger incentives for the CRA to inflate the ratings, (ii) incur lower loss in the case, when an issuer take the advantage of them, but (iii) lower the possibility that the issuer could do so.

4.2.2 Two CRAs

I will now examine the game with two competing rating agencies. The scheme of the game from the point of view of naive investors is presented in Fig. 4.2. Both CRAs are considered as ex-ante homogeneous, i.e., the precision of their signal is equal and thus each report has the same value.

First, I adopt the following notations from Bolton et al. (2009):

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

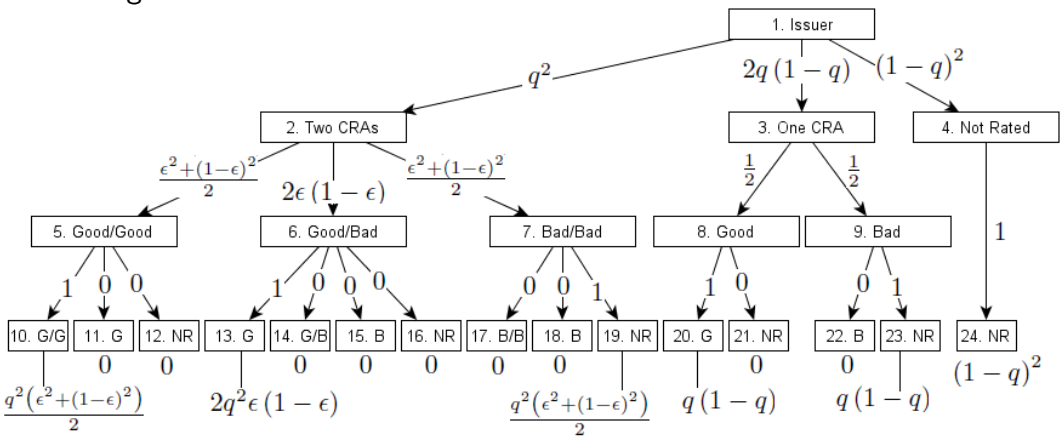
These terms represent the value for sophisticated investors only when both CRAs transmit their signals truthfully. For naive investors, the terms represent the value when both CRAs report $m = G$ or $m = B$, respectively, no matter whether truthfully or not. The value for all investors if one CRA reports $m = G$ and the second one reports $m = B$ is equal to V^0—naive investors consider each report at a face value thus $m = G$ implies V^G and $m = B$ implies V^B and their overall evaluation is equal to $\frac{1}{2}V^G + \frac{1}{2}V^B$, which is equal to V^0 (see Eq. 3.3). It is clear that

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

As shown in Fig. 4.2, there are, in general, three possibilities how an issuer could act. He can hire no, one or two CRAs. I assume, that naive investors believe ex-ante that the issuer hires the CRA k for $k = 1, 2$ with probability q and that they believe that the hiring of each CRA is independent. Hence

$$\begin{aligned} P\,(2 \text{ CRAs are hired}) &= q^2 \\ P\,(1 \text{ CRA is hired}) &= 2\,q\,(1-q) \\ P\,(0 \text{ CRA is hired}) &= (1-q)^2 \end{aligned}$$

Fig. 4.2: Evolution of beliefs of naive investors for two CRAs



Source: Author

Using the scheme and the Bayes' theorem I define the notations:

$$V_D^{NR} = \frac{2(1-q)^2}{q^2\left(\epsilon^2+(1-\epsilon)^2\right)-2q+2}V^0 + \frac{2q(1-q)}{q^2\left(\epsilon^2+(1-\epsilon)^2\right)-2q+2}V^B + \frac{q^2\left(\epsilon^2+(1-\epsilon)^2\right)}{q^2\left(\epsilon^2+(1-\epsilon)^2\right)-2q+2}V^{BB}$$

$$V_D^G = \frac{q(1-q)}{q(1-q)+2q^2\epsilon(1-\epsilon)}V^G + \frac{2q^2\epsilon(1-\epsilon)}{q(1-q)+2q^2\epsilon(1-\epsilon)}V^0$$

First term represents the value of an investment to naive investors when there is no rating published. The second term represents their valuation if only one report $m = G$ is available. Moreover, I assume that the parameter q satisfies

$$V_D^{NR} > V^B.$$

Again, I assume that sophisticated investors are able to observe issuer's de-

cisions and that they understand the CRAs' incentives.

I will also modify the assumption A2 in such a way that:

Assumption A2$_\mathbf{D}$:

$$\frac{q\left(1-\epsilon\right)\left(q\epsilon+1-q\right)}{q\left(1-q\right)+2q^{2}\epsilon\left(1-\epsilon\right)}p<p^{*}$$

This ensures that in the case, when only one G report is issued, naive investors would be willing to purchase 2 units for price V_D^G.

I will also use the following notations:

$$\begin{aligned}
\pi^{2} &= \frac{1}{2}\left(\left(1-\epsilon\right)^{2}+\epsilon^{2}\right)\left(2V^{GG}+\max\left[\alpha V_{D}^{NR},\, V^{BB}\right]\right)+2\epsilon\left(1-\epsilon\right)\alpha 2V_{D}^{G}\\
\pi^{1} &= \max\left[V_{D}^{G},\,\left(1-\alpha\right)V^{G}\right]+\frac{1}{2}\max\left[\alpha V_{D}^{NR},\, V^{B}\right]\\
\pi^{0} &= \max\left[V_{D}^{NR},\,\left(1-\alpha\right)V^{0}\right]
\end{aligned}$$

The first term defines the expected revenues the issuer has from contracting two truthful CRAs, the second term defines the expected revenues he has from contracting one truthful CRA, and the third term defines the value of an investment if he does not apply for rating.

Similarly to Bolton et al. (2009), I use these assumptions:

Assumption A4: Value of the first report $m = G$ for naive investors is larger than the value of the second report $m = G$ for all investors:

$$\alpha 2V_{D}^{G}-\pi^{0}>2\left(V^{GG}-\max\left[V_{D}^{G},\,\left(1-\alpha\right)V^{G}\right]\right)$$

This assumption also ensures that the issuer would be always willing to purchase one good report, if there are reports $m = B$ and $m = G$.

Assumption A5: A CRA cannot take unilaterally advantage of naive investors:

$$\alpha 2 V_D^G - \pi^0 - 2\left(\pi^2 - \pi^1\right) < \epsilon\, p\, \rho^D$$

This assumption thus guarantees an existence of the truthtelling equilibrium, ρ^D in this inequality stays for reputation costs for each CRA.

Again, I need the following lemma from Bolton et al. (2009) for solving my extension.

Lemma 4: Given the vector of fees $\left(\phi_1^R,\, \phi_2^R\right)$ for both CRAs, the CRA k's for $k = 1,\, 2$ reporting strategy is:

1. If $\phi_k^R > \epsilon\, p\, \rho^D$, always to report $m = G$.
2. If $0 \leq \phi_k^R < \epsilon\, p\, \rho^D$, to transmit the signal perfectly.

Now, I will find the equilibrium outcome in the fee setting game.

Proposition 2: The equilibrium of the fee setting game is:

1. If $\alpha 2\left(V^{GG} - V_D^G\right) > \epsilon\, p\, \rho^D$, both CRAs always report G, set $\phi_k^R \in \left(\epsilon\, p\, \rho^D,\, \alpha 2\left(V^{GG} - V_D^G\right)\right]$, and
   $\phi_k^I = \alpha 2\left(V^{GG} - V_D^G\right) - \phi_k^R$ for $k = 1,\, 2$
   and each CRA has then the profits $\alpha 2\left(V^{GG} - V_D^G\right) + \left(1 - \frac{\epsilon p}{2}\right)\rho^D$.

2. If $\alpha 2\left(V^{GG}-V_D^G\right) < \epsilon\, p\, \rho^D$, both CRAs report truthfully, set $\phi_k^R \leq \epsilon\, p\, \rho^D,\ k=1,\,2$, and

   (a) If $\alpha \in \left[\frac{\pi^0+\frac{1}{2}\max\left[\alpha V_D^{NR}, V^B\right]}{2V_D^G},\ 1\right]$

      i. and if

      $\pi^2 - \pi^0 - 2\left(\pi^2-\pi^1\right) \geq 0$, then any fees that satisfy $\frac{1}{2}\phi_k^R + \phi_k^I = \pi^2 - \pi^1,\ k=1,\,2$ are an equilibrium.

      ii. and if

      $\pi^2 - \pi^0 - 2\left(\pi^2-\pi^1\right) < 0$, then any fees that satisfy $\sum_{k=1}^{2} \frac{1}{2}\phi_k^R + \phi_k^I = \pi^2 - \pi^0$, and
      $\frac{1}{2}\phi_k^R + \phi_k^I \leq \pi^2 - \pi^1,\ k=1,\,2$ are an equilibrium.

   (b) If $\alpha \in \left[\frac{\pi^0}{2V_D^G},\ \frac{\pi^0+\frac{1}{2}\max\left[\alpha V_D^{NR}, V^B\right]}{2V_D^G}\right)$, the issuer only hires one CRA, and $\phi_k^R = \phi_k^I = 0,\ k=1,\,2$.

Proof: First, let us consider the case when an issuer have already paid ϕ_1^I and ϕ_2^I, and both CRAs always report $m=G$. Since sophisticated investors recognize the situation and use their ex-ante beliefs, the issuer and rating agency could profit only from naive investors. The issuer has basically three possibilities:

- He buys no report and has the profit:

$$\pi^0,$$

- He buys one report and has the profit:

$$\alpha 2 V_D^G - \min_{k=1,2} \left\{ \phi_k^R \right\}$$

- He buys two reports and has the profit:

$$\alpha 2 V^{GG} - \sum_{k=1}^{2} \phi_k^R$$

It is clear that the issuer prefers two G reports to one if

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

Thus if each CRA set its fee $\phi_k^R = \alpha 2 \left(V^{GG} - V_D^G \right)$, the issuer is willing to buy both G reports as long as

$$\alpha 2 V^{GG} - \sum_{k=1}^{2} \phi_k^R = \alpha 2 V^{GG} - \alpha 4 \left(V^{GG} - V_D^G \right) > \pi^0,$$

which is equal to

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

Now it is necessary to verify whether the assumption A4 holds, i.e., whether $2 \left(V^{GG} - \max \left[V_D^G, \, (1 - \alpha) V^G \right] \right) \geq \alpha 2 \left(V^{GG} - V_D^G \right)$:

- It is easy to verify that if $\max \left[V_D^G, \, (1 - \alpha) V^G \right] = V_D^G$, the assumption holds.

- Let us now assume that $\max\left[V_D^G,\,(1-\alpha)\,V^G\right] = (1-\alpha)\,V^G$, then

$$\begin{aligned} 2\left(V^{GG} - (1-\alpha)\,V^G\right) &\geq \alpha 2\left(V^{GG} - V_D^G\right) \\ (1-\alpha)\,V^{GG} &\geq (1-\alpha)\,V^G - \alpha V_D^G \end{aligned}$$

  and the assumption holds. □

Therefore, any rating fees $\phi_k^R \in \left(\epsilon\,p\,\rho,\,\alpha 2\left(V^{GG} - V_D^G\right)\right]$, $k = 1,\,2$ satisfy the assumption A4. Each CRA then set the initial fee ϕ_k^I equal to $\alpha 2\left(V^{GG} - V_D^G\right) - \phi_k^R$ and has profit

$$\alpha 2\left(V^{GG} - V_D^G\right) + \left(1 - \frac{\epsilon\,p}{2}\right)\rho^D.$$

Moreover, the assumption A4 together with the ex-ante CRAs' homogeneity guarantee that there cannot be an equilibrium, where both CRAs set higher fees up to $\alpha 2 V_D^G - \pi^0$ in which case the issuer would be willing to purchase only one G report. Due to homogeneity of both reports, each CRA would profit by lowering its fees. Hence, the CRAs would compete à la Bertrand and eliminate this possible equilibrium.

Let us now assume that both CRAs transmit their signals truthfully. If two G reports are available and since the assumption A4 the maximum feasible rating fee for each CRA is

$$\phi_k^R \leq \min\left[2\left(V^{GG} - \max\left[V_D^G,\,(1-\alpha)\,V^G\right]\right),\,\epsilon\,p\,\rho^D\right].$$

$2\left(V^{GG} - \max\left[V_D^G,\,(1-\alpha)\,V^G\right]\right)$ is the maximal feasible fee the issuer is will-

ing to pay for two reports, while $\epsilon\, p\, \rho^D$ is the upper cutoff for the truthtelling (Lemma 4). From the assumption A4 it is clear that the issuer prefers two reports to none and if one CRA reports $m = G$ and the second one reports $m = B$, he will buy only the G report.

Now, it is necessary to examine from an ex-ante perspective whether the issuer wants to deal with two, one or neither CRA. It is clear that $\pi^2 > \pi^0$, thus the condition for the issuer to prefer two CRAs to none is:

$$\pi^2 - \pi^0 \geq \sum_{k=1}^{2} \frac{1}{2}\phi_k^R + \phi_k^I, \tag{4.1}$$

and the condition for the issuer to prefer two CRAs to one is:

$$\pi^2 - \pi^1 \geq \min_{k=1,\,2} \left\{ \frac{1}{2}\phi_k^R + \phi_k^I \right\}, \tag{4.2}$$

If we want to find a cutoff, when the issuer has no incentives to hire two CRAs and thus he is willing to purchase only one rating, we are looking for a state when maximal additional revenue from the second rating is smaller than the π^0, i.e.

$$\alpha 2 V_D^G - \frac{1}{2} \max\left[\alpha V_D^{NR},\, V^B\right] < \pi^0.$$

It is thus clear that for α such that

$$\alpha < \frac{\pi^0 + \frac{1}{2}\max\left[\alpha V_D^{NR},\, V^B\right]}{2V_D^G},$$

the issuer has no incentive to hire 2 CRAs for any set of fees. Moreover, since $\pi^1 - \pi^0 > 0$, he will be willing to hire one CRA. Since the CRAs are

considered as ex-ante homogeneous, they will compete à la Bertrand and thus they will set $\phi_k^R = \phi_k^I = 0,\ k = 1, 2$. In addition, due to proposition A4 it is clear that

$$\alpha > \frac{\pi^0}{2V_D^G}$$

The issuer is thus willing to apply for two ratings for $\alpha \in \left[\frac{\pi^0 + \frac{1}{2}\max\left[\alpha V_D^{NR}, V^B\right]}{2V_D^G},\ 1\right]$. The CRAs will then set the fees. According to the condition 4.2 the maximal feasible fees for each CRA in the truthtelling equilibrium are

$$\frac{1}{2}\phi_k^R + \phi_k^I = \pi^2 - \pi^1,\ k = 1, 2.$$

This level of fees is possible if the condition 4.1 holds too, i.e. if

$$\pi^2 - \pi^0 - 2\left(\pi^2 - \pi^1\right) \geq 0$$

In the case, when the condition 4.1 does not hold, each CRA sets its fees such that this condition holds with equality and inequality 4.2 is fulfilled.

There is a possibility that one CRA will try to deviate the truthtelling, always report $m = G$ set its fees $\frac{1}{2}\phi_k^R + \phi_k^I$ equal to $\alpha 2V_D^G - \pi^0$ in order to gain in the situation, when the other CRA reports truthfully $m = B$. This possibility is excluded by the assumption A5.

Finally, if $\alpha 2\left(V^{GG} - V_D^G\right) > \epsilon\, p\, \rho^D$ then inflation of the rating by always reporting G is profitable for both CRAs. They set their fees $\phi_k^I + \phi_k^R$ equal to $\alpha 2\left(V^{GG} - V_D^G\right)$ for $k = 1, 2$. Moreover, in this case there cannot be an equilibrium where one CRA reports truthfully and the other always report

G. This would imply that without prejudice to generality $\phi_1^R > \epsilon\, p\, \rho^D$ and $\phi_2^R < \epsilon\, p\, \rho^D$. However, this creates an opportunity for second CRA to set its rating fee equal to $\phi_2^R = \phi_1^R - \varepsilon$, where $\varepsilon \in \left(0,\, \phi_k^R - \epsilon\, p\, \rho^D\right)$, and always report G.

■

The overall conclusions are again very similar to those made by Bolton et al. (2009) in their original model: there exist two possible equilibria—one where both CRAs inflate rating, in second both report truthfully, and there is also the possibility, that the duopoly is not sustainable. Nevertheless, I will focus only on the cases, when the duopoly is sustainable.

The difference between the extended model and the original model is again in the minimal level of naive investors that is enough for always reporting G, which is again lower in the extended model since $\alpha 2\left(V^{GG} - V_D^G\right) - \epsilon\, p\, \rho^D > \alpha 2\left(V^{GG} - V^G\right) - \epsilon\, p\, \rho^D$ always holds. The reasons are the same as in monopoly case—the naive investors do not know whether the issuer applied for one or two ratings in the case when only one good report is issued. Due to this uncertainty they lower their ex-ante valuation of one good report. This again leads to decrease of the minimal fraction α of naive investors that is enough for rating inflation. Hence, boundedly rational naive investors creates higher bias in both a monopoly and a duopoly.

Investors' Surplus/Loss in Each Informational Regime

Similarly to the case of monopoly CRA, I analyze how the rating procedure influences the investors' surplus in the sustainable duopoly. I remind that if

there is no rating agency, all investors are willing to purchase one unit for price V^0. If the price is higher than their evaluation, they do not purchase even one unit. I also note, that

$$V^{BB} < V^B < V_D^{NR} < V^{NR} < V^0 < V_D^G < V^G < V^{GG}$$

Now, I focus on surplus in each possible regime:

1. Both CRAs always report $m = G$. Similarly to the monopoly, when a CRA always report $m = G$, naive investors incur a loss $\alpha 2\left(V^0 - V^{GG}\right)$, while the sophisticated ones have surplus equal to zero.

2. Both CRAs report the truth, and

   (a) $m_1 = m_2 = G$. This case is similar to the truthtelling monopoly when $m = G$, the overall investors' surplus is equal to zero.

   (b) $m_k = G,\ m_{-k} = B,$ for $k = 1, 2$. In this case the real value is V^0, but an issuer purchases only the good report and he sells two units solely to naive investors for V_D^G. They thus incur a loss $\alpha 2\left(V^0 - V_D^G\right)$. Sophisticated investors observe the payoffs and do not purchase even one unit and therefore they have surplus equal to zero.

   (c) $m_1 = m_2 = B$, and

      i. $\max\left[\alpha V_D^{NR}, V^{BB}\right] = \alpha V_D^{NR}$. Similarly to the truthtelling monopoly we get, that naive investors' loss is equal to $\alpha\left(V^{BB} - V_D^{NR}\right)$ and the sophisticated investors get surplus equal to zero.

ii. $\max\left[\alpha V_D^{NR},\, V^{BB}\right] = V^{BB}$. Similarly to the truthtelling monopoly we get, that the overall investors' surplus is equal to zero.

- Now, it is easy to calculate the total investors' surplus in truthtelling duopoly:
  - if $\max\left[\alpha V_D^{NR},\, V^{BB}\right] = V^{BB}$, then the total investors' loss is equal to
  $$2\epsilon\left(1-\epsilon\right)\alpha 2\left(V^0 - V_D^G\right).$$
  - if $\max\left[\alpha V_D^{NR},\, V^{BB}\right] = \alpha V_D^{NR}$, then the total investors' loss is equal to
  $$2\epsilon\left(1-\epsilon\right)\alpha 2\left(V^0 - V_D^G\right) + \alpha\frac{1}{2}\left(\epsilon^2 + \left(1-\epsilon\right)^2\right)\left(V^{BB} - V_D^{NR}\right).$$

Hence, it is obvious, that misreporting CRAs create higher investors' loss than the issuer, who shops for rating. In addition, the possibility of shopping for rating causes, that in truthtelling duopoly, when both CRAs are hired, the naive investors get always negative surplus. This is the similar conclusion to Skreta and Veldkamp (2008), who find that even if the CRAs report the truth, the possibility of shopping for rating creates the systemic risk.

Comparing the results with the original model I find in the case when both CRAs report the truth, the total investors' loss is lower in the extended model, again. The reason is the same as in monopoly—naive investors lower their evaluation in the case when there are less than two reports and thus they do not overpay the investment as much as in the original model.

Therefore, while the bounded rationality creates higher incentives for the CRAs to inflate the ratings, it decreases the investors' loss in the case of truthtelling CRAs when the issuer shops for rating in a duopoly.

4.2.3 Comparison of Monopoly CRA and Duopoly CRAs

If we compare a monopoly and a duopoly in terms of shopping for rating, it is obvious that shopping is much likely on duopoly market. This conclusion does not depend on the definition of shopping—If we assume that shopping for rating occurs only when the issuer may choose better rating among two ratings (as it is defined in Sec. 2), its probability in monopoly is equal to zero, while in duopoly it is equal to $2\epsilon\left(1-\epsilon\right)$. If we use a broader definition that shopping for rating is the possibility to hide the bad rating, its probability is then equal to $\frac{1}{2}$ and $\frac{1}{2}+e\left(1-e\right)$ in monopoly and in duopoly, respectively. This is not surprising, because in duopoly the issuer has more possibilities how to choose the best option.

Comparing monopoly and duopoly in terms of eventual surplus and losses for investors, I found that lying duopoly CRAs creates higher losses to the investors than lying monopoly CRA. Moreover in truthtelling duopoly, the issuer can always take advantage of naive investors and shop for rating.

Finally, while it is unclear whether the incentives to rating inflation are higher in monopoly or in duopoly, it is clear that with increasing level of α, the

incentives increase faster in monopoly since

$$\frac{\partial\left(\alpha 2V^G - \pi^0_{issuer} - \epsilon\, p\, \rho\right)}{\partial\alpha} = \begin{cases} 2V^G + V^0 & \text{if } \max\left[V^{NR},\, (1-\alpha)\, V^0\right] = (1-\alpha)\, V^0 \\ 2V^G & \text{if } \max\left[V^{NR},\, (1-\alpha)\, V^0\right] = V^{NR} \end{cases},$$

and

$$\frac{\partial\left(\alpha 2\left(V^{GG} - V^G_D\right) - \epsilon\, p\, \rho^D\right)}{\partial\alpha} = 2\left(V^{GG} - V^G_D\right),$$

and the inequality $2V^G > 2\left(V^{GG} - V^G_D\right)$follows from the assumption A4.

5 Regulatory Proposals

It is clear from the extended model that there are basically two distortions—the first one is the possibility that the issuer could refuse bad rating and thus shop for rating, second one is the presence of naive investors on the market that creates an incentive for the credit rating agency to inflate its rating. In this part I discuss several possible solutions that could eliminate or at least decrease these incentives.

5.1 The Issuer

As shown in the extended model, under the issuer-pays condition the issuer can take an advantage of naive investors, because he can hide bad reports in monopoly and shop for rating in duopoly, i.e. he can hire two CRAs and choose the better report. There are basically two arrangements that could solve this problem.

The first one is a requirement for rating agencies to disclose all ratings they made. This would prevent the possibility of rating shopping by the issuer and thus it would create higher investors' surplus in the cases of truthtelling equilibria. Nevertheless, it might not solve the incentives that the CRAs have for ratings inflation. The cutoffs of naive investors would be equal to the one found by Bolton et al. (2009) in the original model, i.e. $\alpha 2V^G - V^0 - \epsilon\, p\, \rho$ and $\alpha 2\left(V^{GG} - V^G\right) - \epsilon\, p\, \rho^D$ in monopoly and duopoly, respectively. Hence, the obligatory disclosure of ratings lowers the incentives on CRAs' side but it would not eliminate them.

This can be solved by an upfront payment for the rating. Nevertheless, it does not exclude the possibility of shopping for rating. Especially, in duopoly the issuer could observe ex-ante the stringency of each CRA and choose the one with more lax criteria and thus the CRAs could tend to more lax evaluation.

The second possibility is to switch to an investor-pays model. As mentioned in the Sec. 1, the investor-pays model was the one that rating industry originally used. The problem is, however, that on the current technology level the possibility of free riding is highly probable in the case of direct trading between investors and rating agencies.[38] On the other hand, the markets with different financial information—like financial analysis—work on investor-pays basis very well.[39]

[38] See e.g. White (2010)
[39] See e.g. Pagano and Volpin (2010)

5.2 The Credit Rating Agency

The extended model shows that the decisive factor on the side of the CRA, which could eliminate, or at least lower the incentives for rating inflation, is its reputation cost. Regulation should therefore be aimed at increasing this cost.

This could be achieved by a possibility of losing a business in cases of high level of inaccurate ratings. That means that the regulator should control for whether the ratings are correct and precise enough and in the case they are highly inaccurate, he may punish the rating agency, or exclude it from the market.

5.3 The Investor

Finally, the incentives for the inflation of the rating could be mitigated by decreasing the fraction of naive investors that are on the market. This is a surprising suggestion because, at first sight, there is no possibility of excluding the naive investors from the market. However, the substantial players on the market are large institutional investors like pension funds and banks who have to take the rating at face value because of its regulatory use. Hence, even if they are able to observe the presence of shopping for rating, they have to primarily invest in accordance with the regulatory requirements, and due to this, large institutional investors could be very well identified with the boundedly rational naive investors from the extended model. Therefore, the limitation of regulatory use of the credit rating could be another way how

to make the rating agencies more truthful, because it would lead to decrease of "naivety" on the markets. Hence, the rating would be only supplemental criterion used for regulation, not the key one.

6 Conclusions

In this thesis I have examined the extension of the model introduced by Bolton et al. (2009). I have replaced their assumption of total naivety of a fraction of investors by the assumption of bounded rationality. I have found that due to this assumption the incentives for credit rating agencies (CRAs) to overestimate the quality of an investment increased. The reason is that the bounded rationality decreases the overall ex-ante evaluation of the investment in the case, if there is not any rating issued in monopoly, or if there is only one good rating in duopoly. Such a decrease of valuation creates an extra range, when the rating inflation is profitable. In both cases this results in a decrease of the minimal fraction of naive investors that is enough for CRAs to inflate their ratings. On the other hand, the bounded rationality reduces the losses that the investors suffer in the cases when the issuer shops for rating.

I have found that this deviation could be mitigated by an obligatory disclosure of all ratings that the CRA made. Nevertheless, the disclosure does not prevent the CRA from taking an advantage of naive investors, because there is still a cutoff when the rating inflation becomes profitable for the CRA. This implies that a presence of investors who take the rating at face value

creates systemic bias in the markets. Paradoxically, these could be large institutional investors like banks or pension funds, because they have to fulfill some regulation requirements on the quality of their portfolio, which is often measured by the ratings of the products.

Therefore, it is necessary to prevent the credit rating agencies from the rating inflation. As I showed, the key parameter on the CRA's side is the reputation cost paid for systematical ratings' overestimation. An enhancement of the reputation cost, that could be for example achieved by possibility of exclusion from the market, would lead to more precise ratings.

Finally, I have discussed an impact of limitation of regulatory use of credit rating and found that this could result in the decrease of fraction α of naive investors. This decrease would then lead to the rating agencies becoming more truthful.

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