Christoph Kuhner

FINANCIAL RATING AGENCIES: ARE THEY CREDIBLE? - INSIGHTS INTO THE REPORTING INCENTIVES OF RATING AGENCIES IN TIMES OF ENHANCED SYSTEMIC RISK -

ABSTRACT

The paper asks if credit rating agencies have incentives to misrepresent their clients’ credit quality during an ongoing systemic crisis. Two important elements are essential for a systemic crisis: (1) Investors are not able to distinguish fundamentally healthy debtors from fundamentally unhealthy ones. (2) Investors tend to cumulatively withdraw their funds. Therefore, neither fundamentally healthy nor unhealthy debtors can be expected to survive a creditor’s exit. We model a signaling game that reflects these two assumptions and several others. The game focuses on the creditor’s financial pay-offs and the agency’s reputational pay-offs. We show that there are no separating equilibria in which agencies report observed credit quality truthfully and creditors make their withdrawal decision contingent on this report. Depending on the relevant parameters, four different equilibria emerge. In three of these equilibria, rating assignments are always ignored by the creditors. Only in one equilibrium, there is limited transmission of decision-useful information as both players will adopt mixed strategies. Pure strategy equilibria in which rating assignments reflect decision-useful information can develop for a certain scope of parameters if some of the above mentioned assumptions are relaxed, i.e. (1) if fundamentally healthy firms can survive cumulative creditor’s withdrawal with positive probability, or (2) if two rating agencies successively evaluate the debtor. The paper’s findings add to the understanding of self-fulfilling prophecy phenomena in financial markets.

JEL-Classification: D82, F34, G23.

1 INTRODUCTION

Rating agencies are independent third parties that are consulted in the course of a market transaction. Their goal is to overcome asymmetric information between both market sides by evaluating financial claims according to standardized quality categories. The activity of rating agencies is therefore part of the private certification industry¹.

¹ An overview concerning private certification business is provided in Yilmaz (1998).
The agencies’ most important job is the evaluation of fixed income securities. These include syndicated loans, bonds, commercial papers, bank deposits, and insurance claims. Normally, rating agencies focus their evaluation on the creditworthiness of a debtor. In most cases, agencies act on request of the evaluated firm; evaluation by one of the internationally recognized agencies serves as an entry ticket to many financial market segments. A rating mandate is valid for several years, during which the rating agency monitors the client firm and corrects the rating decision if there is any significant change in the client’s financial situation.

Although the rating decision is based on fixed, documented standards and procedures concerning, e.g., the use of public and non-public information or communication with management, rating agencies emphasize that their evaluation is, after all, their subjective opinion, which is not verifiable by courts. Also, damages due to obvious rating errors are not part of the rating contract and not currently enforceable by litigation. Therefore, the assignment of a certain issuer to a rating category constitutes non-verifiable, non-auditable, i.e., soft, information.

Since there are no legal mechanisms to mandate the quality of rating agencies’ evaluations, the informational value of a financial rating assignment depends entirely on the agencies’ incentive to build up and maintain a good reputation in the financial community. Under certain assumptions, this incentive will lead to a viable transmission of information. Certainly, we can regard the growth of rating agencies’ reputation in the last decades as strong evidence illustrating that reputational interests can provide adequate incentives for generating high quality financial information. Generally speaking, the rise of rating agencies is a classic example of the spontaneous evolution of institutions in the absence of state intervention.

Continuing criticism of the performance of credit rating agencies does not deny their role as economic institutions. Instead, it focuses on the idiosyncrasies of the financial ratings market, especially on its highly concentrated, oligopolistic structure. Frequently mentioned critical arguments include:

2 The convention that the issuer and not the ultimate users of credit rating information pays the bill for the service of the agencies was established in the early 70s; see Cantor/Packer (1994) or The Economist, 15 July 1995. In recent years, agencies have begun to evaluate securities and disclose the corresponding ratings even without being mandated by the issuer. Thus, every fixed-income issue with a volume exceeding US$ 50 M which must be registered as public issue with the SEC is nowadays rated by Standard & Poor’s “(...) as a matter of policy”. Standard & Poor’s (1998), p. 11.
3 For a comprehensive description of methodology and procedures see Standard & Poor’s (1998).
4 See, e.g., Moody’s Investors Service: “Because it involves a look into the future, credit rating is by nature subjective. Moreover, because long-term credit judgments involve so many factors unique to particular industries, issuers, and countries, we believe that any attempt to reduce credit rating to a formulaic methodology would be misleading and would lead to serious mistakes.” Standard & Poor’s (1998): “A credit rating is Standard and Poor’s opinion of the general creditworthiness of an obligor; (...) based on relevant risk factors.”
5 Cantor/Packer report two cases where a class action suit against rating agencies was planned after the insolvency of highly rated debtors. Both cases were dropped; see Cantor/Packer (1994), p. 4.
6 For proof that reputational interest will, under certain circumstances, lead to viable informational intermediation see, e.g., Hax (1998), pp. 129 - 184, with reference to Kreps/Wilson (1982).
7 For a historical overview see Cantor/Packer (1994).
- Power without accountability: The role of rating agencies is not limited to the role of a passive observer. They exert a certain influence on management's decision making, e.g., by advising on the impact of alternative management strategies on the firm’s rating assignment. Rating agencies' influence on corporate management is further strengthened by the fact that in many countries, agency evaluations are part of financial market regulations, e.g., the requirements that restrict the investment policies of banks, funds, and insurance companies. However, a market player with huge, and in some respects semi-governmental, authority who is at the same time neither liable nor accountable to anybody must be regarded with a certain skepticism.

- Conformity bias: There is anecdotal evidence that the leading agencies only rarely assign divergent evaluations to the same debtors. This observation may raise the suspicion of colluding behavior, or at least conformity. Collusion or herding results in a loss of information. Moreover, debtors who for any reasons whatsoever think they have been inadequately evaluated by their agency have no opportunity to obtain a modification.

- Sociocultural bias: There is a widespread suspicion that evaluations by the leading Anglo-American agencies are subject to a sociocultural bias, that they discriminate against issuers that do not follow the Anglo-American ideals in their management and financial reporting practices.

- Punishment of 'disobedient' firms: As noted, agencies provide ratings even in absence of a specific mandate. They do so for several reasons. There is some evidence that in the past, rating agencies have discriminated against those issuers who did not request a rating and therefore did not pay for the service rendered.

- Procyclical bias: Especially in the aftermath of the Southeast Asian crisis in 1997/1998, agencies were blamed for behaving procyclically, i.e. for simply following the majority opinion of market participants. According to many observers, the agencies did not give any warning signals until after the turbulence in the Asian markets had begun. However, when the crisis was actually spreading, the agencies reacted by cumulatively downgrading issuers invested in the Southeast-Asian markets without taking in account individual portfolio quality.

9 For the corresponding US regulations see Cantor/Packer (1994), pp. 5–6.
10 See, e.g., The Economist, 13 December 1997; for empirical evidence that does not support this criticism, see Cantor/Packer/Cole (1997), Morgan (1998). For a short explanation, see Merton/Bodie (1992), p. 93.
11 This argument is mentioned frequently in the ongoing discussion about the foundation of continental European rating agencies, see e.g. Monro-Davies (1996), p. 179f.
12 This suspicion gave rise to a legal procedure against Moody's. See The Economist, 1 June 1996.
14 In Germany, there was considerable public attention to this criticism, which was raised by the president of the German bankers association, who was at the time leader of one of the biggest German banks, see, e.g., von Gersdorff (1998).
In this paper, I focus on the last point; the suspicion, that agencies do not communicate observed information adequately in the presence of enhanced systemic risk, i.e., when a whole market segment is threatened by the cumulative exit of investors. I also analyze incentives of agencies for conformity in such an environment.

2 EMERGENCE AND RELEASE OF SYSTEMIC RISK: THE ASYMMETRIC INFORMATION FRAMEWORK

Systemic risk is the danger that a certain ‘shock’ event will trigger a series of successive losses along a chain of institutions or markets comprising a system. The shock event may be a sudden monetary contraction that causes a substantial shift of the yield curve, or a cumulative correction of expectations in response to disastrous incidents, like the breakdown of an important market player or the bursting of a speculative bubble.

There are several theories that explain the emergence and growth of systemic crises. One of them emphasizes the role of asymmetric information: In the aftermath of the shock event, the growing informational asymmetries concerning the creditworthiness of financial market players will lead to a homogeneously negative perception of credit quality, in response to which creditors will withdraw their funds. Thus, dramatic losses can be directly caused by the exit of investors or creditors who suspect that the financial position of their debtors is significantly affected. Systemic risk can spread through interrelated financing chains, a phenomenon known as contagion. The end of the story may be the breakdown of a whole financial market segment, with far-reaching impacts on macroeconomic aggregates. Thus, a systemic crisis can be characterized as an adverse selection phenomenon.

The explanatory power of the asymmetric information framework depends crucially on whether it can provide a convincing answer to the question of why common mechanisms, which have been developed to overcome informational asymmetries, should fail if a shock event occurs: In an economy’s normal state, debtors have the incentive to signal their credit quality e.g. by the disclosure of market and credit risk information or by balance sheet ratios like debt/equity. Based on these informations, creditors are able to discriminate between different levels of credit quality. If there is enhanced systemic risk, what should be different about such signaling mechanisms?

17 The asymmetric information theory of financial crises was framed by Mishkin (1991). For an exposition see also Mishkin (1992) or Mishkin (1997).
18 A more sophisticated framework is developed in Litan (1997), pp. 260–267, where three sources of systemic risk are highlighted: cascades, contagion and asset implosions.
20 For a discussion of different signaling mechanisms see, e.g., Burghof/Kuhner (1998).
Proponents of the asymmetric information framework answer this question by emphasizing that in financial markets, information acquisition and processing is subject to free rider problems, which can be aggravated in the wake of a shock event. However, rating agencies are institutions whose development was based on the need to overcome such free rider problems. Their ultimate responsibility is to release both early warnings and all-clear-signals so that investors can make rational exit decisions.

The following analysis takes as given rating agencies’ ability to (imperfectly) discriminate between high and low credit quality even in times of enhanced systemic risk. The question is whether agencies have adequate incentives to behave in a mitigating manner.

3 The Model

I construct a one-period-model with two players, the agency and the creditor. The debtor himself is not represented as an active player, since he is nothing more than the object of the agency’s observation and the target of the creditor’s withdrawal decision.

The agency’s evaluation technology is represented as a signal observed exclusively by the agency, which reveals credit quality imperfectly: If there is high fundamental credit quality, this signal will be observed with probability \( q > 0.5 \). If credit quality is poor, it will be observed with probability \( q' < 0.5 \). Both \( q \) and \( q' \) characterize the precision of the evaluating technology: \( (1 - q) \) equals the probability of an \( \alpha \)-error: bad quality is observed, but the debtor is fundamentally solid. \( q' \) equals the probability of the corresponding \( \beta \)-error: good quality observed, but the debtor is fundamentally unhealthy. In the long run, agencies will invest resources to increase the precision \( q \) and \( (1 - q') \) of their rating technology, thus enhancing their reputation. In the short run (and my model is a short-run model), \( q \) and \( (1 - q') \) are assumed to be fixed. Given a positive trade-off between \( q' \) and \( (1 - q) \), the precision of different evaluating technologies can be ranked ordinally.

In the following analysis, I set \( q' = (1 - q) \) to represent the evaluating precision in a single term. This assumption is without loss of generality.

After observing fundamental credit quality, the agency discloses its rating assignment to the public, investment grade or speculative grade. The creditors then decide whether to withdraw or continue. The consequences of withdrawal will be insolvency of the debtor with probability 1, which means: irrespective of the debtor’s fundamental credit quality type. If creditors continue with a debtor, fundamentally solid firms will survive, but those that are unhealthy will break down. The costs of insolvency that creditors bear are greater for continuing than if they withdraw, an assumption which is in line with common experience. The creditor’s payoffs are:

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22 See Kroszner (1997) and (1999) with a historical overview.
The payoffs of the agency are represented by reputational gains and losses, depending on whether a rating assignment is observed ex post as “true” or “false” by the financial market public. The agency will succeed in maintaining its reputation if firms rated investment grade survive, or if firms rated speculative grade fail. If a speculative-grade debtor survives, the agency’s reputational losses are at a comparatively low level. The agency’s reputation will be damaged to a greater extent if an investment-grade debtor defaults.

Several arguments can be made in favor of the assumed ordinal ranking of reputational effects. Arguably, the ultimate users of rating information, i.e., the creditors, will attach higher value to precision in investment-grade rating assignments than they will to precision in speculative-grade assignments, at least if we assume risk aversion. Moreover, a debtor’s insolvency is usually an event that will attract much more public attention than his unexpected survival. Finally, prediction errors are generally easier to avoid for debtors of apparently strong financial condition: Not only will low-quality creditors trade in an environment of enhanced volatility, they will also have incentives to increase their earnings’ volatility by adopting gambling-for-resurrection-strategies. For all these reasons, the public will be less inclined to forgive if highly rated creditors fail.

In my model, agency reputation depends on the perception of the financial market public. By assumption, the public is not able to observe the ultimate reason of an insolvency. Therefore, if an investor-grade debtor defaults, the agency will incur reputational losses even if insolvency is triggered by cumulative withdrawal for no material reason. The agency’s payoffs are summarized as follows:

Table 2: Agency’s payoffs.

<table>
<thead>
<tr>
<th>final node</th>
<th>payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>debtor firm survives</td>
<td>A</td>
</tr>
<tr>
<td>debtor firm breaks down after withdrawal</td>
<td>B</td>
</tr>
<tr>
<td>debtor firm breaks down after prolongation</td>
<td>0, A &gt; B &gt; 0</td>
</tr>
</tbody>
</table>

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<table>
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<tr>
<th>final node</th>
<th>(reputational) payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>firms rated investor grade survive</td>
<td>0</td>
</tr>
<tr>
<td>firms rated speculative grade fail</td>
<td>0</td>
</tr>
<tr>
<td>firms rated speculative grade survive</td>
<td>E</td>
</tr>
<tr>
<td>firms rated investment grade fail</td>
<td>F; 0 &gt; E &gt; F</td>
</tr>
</tbody>
</table>

Guesses about reputation are speculative in nature. The assumptions presented here are intended to provide a simple reasoning, in line with common sense. A certain confirmation of this viewpoint might be that, in their advertising publica-
tions, rating agencies emphasize the significance of the trade-off between rating grade and default risk\textsuperscript{23}.

Thus, the model reflects the two key characteristics of a systemic crisis, homogeneity of credit quality perceptions by the financiers (only the agency is able to discriminate imperfectly between different categories of creditworthiness) and withdrawal as an action that threatens the existence of both fundamentally healthy and unhealthy firms. This latter aspect reflects the intuition that in times of enhanced systemic risk, creditors are inclined to act cumulatively: If significant withdrawal should take place, virtually all creditors will exit, thus forcing the debtor firm into immediate insolvency.

However, my model does not capture the intuition that there is an irrational element inherent in the phenomenon of cumulative withdrawal: On the contrary, aggregate creditors’ behavior is modeled in the fashion of one single Bayesian player. This admittedly strong assumption is in line with viewpoints that describe cumulative withdrawal as a phenomenon of ‘rational herding’ on the information of Bayesian ‘front-runners’\textsuperscript{24}. The emerging pattern of the comprehensive game and the extensive form are:

Table 3:

<table>
<thead>
<tr>
<th>Node 1</th>
<th>Creditworthiness of a debtor firm is determined: good credit quality (G) is realized with probability p, bad credit quality is realized with probability (1 – p). p is common knowledge.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 2</td>
<td>Signal S indicating imperfectly the fundamental credit quality type is observed by the agency with probability ( P(S) = pq + (1 - p)(1 - p) ): ( P(S</td>
</tr>
<tr>
<td>Node 3</td>
<td>The agency discloses the debtor’s rating: investment grade (I) or alternatively speculative grade (nI).</td>
</tr>
<tr>
<td>Node 4</td>
<td>The creditor observes the rating and decides to run (R) or not to run (nR).</td>
</tr>
<tr>
<td>Node 5</td>
<td>In case of withdrawal the debtor will go bankrupt immediately (K). If the financier keeps quiet, debtors of fundamentally high credit quality will survive (nK), debtors of fundamentally low credit quality will fail (K).</td>
</tr>
</tbody>
</table>


\textsuperscript{24} For a general description of informational cascades and the role of frontrunners, see Bikhchandani/Hirshleifer/Welch (1992). Chen (1994) presents a respective bank run model.
The underlying solution concept of the setting is Bayes/Nash-equilibrium. Among the different types of equilibria are most prominently:

4 Equilibria

Information sets are represented by arcs.
(i) Separating equilibria: In separating equilibria, rating agencies will assign an investment-grade rating (I) contingent on the observation of good credit quality (S), and a speculative-grade rating (nI) contingent on the observation of bad credit quality (nS). Decision-useful information will be communicated if the response strategy of the creditor is prolongation (nR) in the former case (I) or withdrawal (R) in the latter case (nI).

(ii) Pooling-equilibria: In pooling equilibria, the agency will always assign the same rating (I or nI), regardless of observed credit quality. Creditors will ignore the rating assignment in their withdrawal decision.

(iii) Mixed strategy equilibria: Here, at least one actor will adopt a random draw strategy with fixed probabilities. Let \( \phi = [\phi(I|S), \phi(I|nS)] \) be the agency’s strategy vector and \( \pi = [\pi(R|I), \pi(R|nI)] \) be the creditor’s strategy vector. Then, a mixed strategy equilibrium implies that \( 0 \leq \phi \leq 1, 0 \leq \pi \leq 1 \). At least one of the inequalities will hold strictly.

I first address the question of whether decision-useful information is transmitted by rating assignments.

Lemma: A separating equilibrium, in which decision-useful information is transmitted, does not exist.

Proof:

(a) Conditions for a separating equilibrium of this type are:

- **Creditor:**
  1. \( \text{EU}(nR|I) \geq \text{EU}(R|I) \)
  2. \( \text{EU}(R|nI) \geq \text{EU}(nR|nI) \)

- **Agency:**
  3. \( \text{EU}(I|S) \geq \text{EU}(nI|S) \)
  4. \( \text{EU}(nI|nS) \geq \text{EU}(I|nS) \)

Condition (iii) will be never matched:

\( \text{EU}(I|S) \geq \text{EU}(nI|S) \)

\( P(nG|S) F \geq 0, \) is never fulfilled, because of \( F < 0 \).

The intuition behind the nonexistence of a separating equilibrium with communication of decision-useful information is straightforward: In a separating equilibrium of this type, a speculative grade rating will always trigger creditor withdrawal and, consequently, debtor insolvency. Therefore, the agency will always have an incentive to signal bad credit quality in order to minimize reputational losses, regardless of its observations.
The emerging equilibria are summarized in the following two propositions:

Proposition I: [Equilibria in pure strategies]

Dependent on the parameters $A$, $B$, $E$, $F$, $p$, $q$, three different equilibria in pure strategies emerge:

(i) $[\text{nI}; \text{R}]$ if $\frac{B}{A} \geq p$,
(ii) $[\text{nI}; \text{nR}]$ if $\frac{B}{A} \leq p$, and $\frac{F}{E} \leq \frac{(1-p)(1-q)}{pq}$
(iii) $[\text{nI}; \text{nS}, \text{nS}; \text{nR}]$ if $0 \leq \frac{B}{A} \leq \frac{p(1-q)}{1-pq-(1-p)(1-q)}$
\[ \text{and } \frac{(1-p)(1-q)}{pq} \leq \frac{E}{F} \leq 1 \]

Proof: See Appendix I.

Proposition II [Equilibria in mutually mixed strategies]

For $\frac{p(1-q)}{1-pq-(1-p)(1-q)} \leq \frac{B}{A} \leq p$
\[ \text{and } \frac{(1-p)(1-q)}{pq} \leq \frac{E}{F} \]

There exists an equilibrium in mutually mixed strategies with:

$[\text{nI}; \text{nS}]; 0 < \phi (\text{nI}; \text{nS}) < 1$ being the strategy of the agency, and
$[\text{nR}; \text{I}]; 0 < \pi (\text{R}; \text{nI}) < 1$ being the strategy of the creditor, where:

\[ \phi(nS) = \frac{B - pA - pq(A-B) - (1-p)(1-q)B}{pq(A-B) - (1-p)(1-q)B}, \]
\[ \text{and } \pi(R; nI) = 1 - \left[ \frac{(1-p)(1-q)F}{pqE} \right]. \]

Proof: See Appendix II.

The following figure illustrates the outlined equilibria for probabilities $p = 0.6$ and $q = 0.8$. 
Type (ii) pooling equilibria in which an issuer is rated speculative grade regardless of the agency’s credit quality observation, and the creditor always opts for prolongation, emerge for $B/A \leq 0.6$ and $E/F \leq 0.166$; type (i) pooling equilibria emerge for $B/A \geq 0.6$. For $0.214 \leq B/A \leq 0.6$ and $E/F \geq 0.166$, equilibria exist in which the creditor and the agency play mutually mixed strategies. For $B/A \leq 0.214$ and $E/F \geq 0.166$ a type (iii) equilibrium persists in which the agency always reveals observed credit quality correctly, but does not influence creditor’s behavior: The creditor always opts for prolongation.

For each combination of $(A/B, E/F, p, q)$, there is at best one single equilibrium in pure strategies. From a technical viewpoint, a possible explanation might be that compared to some well-known textbook examples of signaling games\textsuperscript{25}, our model reveals a more uncomplex structure: Remember that for $F < E$ and $p(G | nS) < 0.5$, the agency will never assign an investment grade rating. Because the agency’s strategy $(I | nS)$ is dominated, a large number of equilibrium candidates can be eliminated.

\textsuperscript{25} Celebrated textbook examples include Kreps’s beer-quiche-game, see, e.g., van Damme (1987), pp. 273–275. Patterns of games resembling the present type are discussed, e.g., in Dutta (1999), pp. 313–318.
One of the central findings in the elementary setting is that in pure strategy equilibria, the agency never generates decision-useful information: Even if assigned ratings reflect fundamental credit quality truthfully, as in equilibrium (iii), these disclosures will be ignored by creditors. Creditors will then act according to their a priori expectation.

Equilibrium (i) may be of particular interest: Here, creditors’ a priori expected payoff in case of withdrawal is greater than in case of prolongation. Therefore they will always vote for exit. Consequently, the “pathological” pooling equilibrium (i) will emerge. This situation appears to match the intuition of a self-fulfilling prophecy: Creditors withdraw their funds “in response” to low rating assignments, thus triggering insolvency in a seemingly deterministic manner. However, creditors do not act contingent on rating assignments; instead, they anticipate correctly that the agency’s reports have no informational value. Therefore, there is no causality relating the agency’s announcement and the creditor’s withdrawal decision: The agency’s equilibrium strategy may be best described as an opportunistic, jumping-on-the-bandwagon, behavior, by which the agency avoids reputational losses. Such a ruinous equilibrium of cumulative withdrawal emerges if the proportion of the creditor’s expected payoffs $B$ and $pA$ are above a certain threshold level. The precision $q$ of the agency’s creditworthiness observation has no influence on this equilibrium.

Limited transmission of decision-useful information happens in equilibria with mutually mixed strategies: Observation of low credit quality always leads to low credit ratings. If high credit quality is observed, the agency is assigning an investment-grade rating with probability $(1 - \varphi)$ and a speculative-grade rating with probability $\varphi$. Consequently, investment-grade rating assignments provide useful information for creditors, and creditors will opt for prolongation when they observe an investment-grade rating. However, speculative-grade rating assignments are of no use for decision makers: The expected pay-offs from a run strategy exactly equal those from a prolongation strategy.

Equilibria in mutually mixed strategies emerge if the agency is indifferent between its pure strategies $I$ and $nI$ when observing $S$, and if the creditor is indifferent between his pure strategies $R$ and $nR$ when observing $nI$. Indifference of both the agency and the creditor is achieved, because the opposing players fine-tune their randomizing probabilities $\varphi$ and $\pi$ which are common knowledge.

Note that in this setting, mixed strategies will never be adopted through a conscious decision of both players to fine-tune their randomizing probabilities. An incentive to randomize in order to ‘bluff’ the opponent would only exist if both players’ moves belonged to the same information set. However, because the creditor is the last to move, he does not have any strategic advantage in randomizing, and neither does the agency. Therefore, partly revealing information transmission in the scope of mixed strategy equilibria will be of very doubtful reliability.

The majority of the outlined equilibria – types (i), (ii) and (iii) – share a common property: In these equilibria, low credit quality ratings are assigned even to firms that appear to have good creditworthiness. This ‘downgrading bias’ matches the above-mentioned anecdotal evidence of financial rating agencies’ behavior during systemic crises.

5 Modifications

The assumptions of the elementary setting represent an extreme scenario of asymmetric information and debtors’ vulnerability: Agencies are in a quasi-monopolistic position, i.e., they are able to force debtors into bankruptcy whenever their recommendations are followed. Ironically, this kind of potential market power will lead to an equilibrium in which rating assignments are always or partly ignored by the audience.27

But what happens if the restrictive assumptions concerning the agencies’ market power are relaxed? Several modifications are arguable:

(i) A fundamentally healthy issuer survives a creditor’s withdrawal with a certain probability ($r$).

(ii) An additional signal concerning creditworthiness is observed. This signal is either common knowledge or it is observed by the creditors exclusively.

(iii) The issuer is evaluated sequentially by two different agencies (5.2).

In the following, I examine modifications (i) and (iii).

I do not consider here the modification that the public is able to observe the ultimate cause of debtor’s insolvency (cumulative withdrawal or fundamental weakness in case of prolongation), because per assumption the public cannot discriminate between different causes of insolvency.

5.1 Positive Probability for Fundamentally Healthy Debtors to Survive Withdrawal

I assume that fundamentally healthy debtors will survive the withdrawal of funds with positive probability $r$. The following figure shows modifications of the extensive form:

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27 Morgenstern (1928), pp. 93–108, outlines a similar result in macroeconomic forecasting.
Figure 3:

<table>
<thead>
<tr>
<th>node 1</th>
<th>node 2</th>
<th>node 3</th>
<th>node 4</th>
<th>final node</th>
<th>payoffs (Ag./Cred.)</th>
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</thead>
<tbody>
<tr>
<td>nature</td>
<td>nature</td>
<td>agency</td>
<td>financier</td>
<td>nature</td>
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Applying the conditions outlined in Lemma 1 leads to the following proposition:

**Proposition III**

All else equal, let $0 < r < 1$ be the probability that fundamentally healthy firms will survive creditor's withdrawal. Then, a range of separating equilibria in which useful decision information is transmitted will emerge

$$
\text{if } \frac{(1-r)p(1-q)}{(1-p)q - p(1-q)(1-r)} \leq \frac{B}{A} \leq \frac{(1-r)pq}{(1-p)(1-q) + pq(1-r)},
$$

and

$$
\frac{(1-p)(1-q)}{pqr} \leq \frac{E}{F} \leq 1.
$$

For probabilities $p = 0.6, q = 0.8$ and $r = 0.4$ e.g., a significant range of separating equilibria with communication of decision-useful information emerges: $0.78 \geq B/A \geq 0.29$ and $E/F > 0.42$.

**Figure 4:**

\[\text{Diagram showing the ranges of } B/A, E/F, \text{ and the regions for mixed strategy equilibria, separating equilibria, and fully revealing reports.}\]

The intuition behind this finding is straightforward: If debtors of high creditworthiness are likely to survive withdrawal with a certain probability, the public could
at least partly falsify the agency’s downgrading evaluation, even in case of withdrawal. Therefore, truthful reporting is induced if \( E/F \) approaches unity.

### 5.2 Rating by Two Agencies Successively

Finally, I analyze what happens if the creditor is evaluated by two agencies, successively. In this scenario, a second agency announces an assignment after having observed the assignment of the first agency. I assume that the evaluation technology of both agencies is identical and that they both rely on the same information. Therefore, they will never observe divergent credit quality (S, nS).

For both agencies, I assume the same reputational payoffs as in the elementary setting, although it would be possible to take into account more sophisticated reputational effects.\(^{28}\) The extensive form is modified in Figure 5.

(i) Sequentially stable separating equilibria with transmission of decision-useful information

In a separating equilibrium of this type, both agencies will report observed credit quality truthfully, and the creditor will take his withdrawal decision contingent on their report. The following inequalities must hold:

**Creditor:**

\[
\begin{align*}
\text{EU}(\text{nR}| I_1, I_2) & \geq \text{EU}(\text{R}| I_1, I_2) \\
\frac{B}{A} & \leq \frac{pq}{pq + (1 - p)(1 - q)} \\
\text{EU}(\text{R}| \text{nI}_1, \text{nI}_2) & \geq \text{EU}(\text{nR}| \text{nI}_1, \text{nI}_2) \\
\frac{B}{A} & \geq \frac{(1 - p)(1 - q)}{pq + (1 - p)(1 - q)} \\
\end{align*}
\]

**Agency II:**

\[
\begin{align*}
\text{EU}(I_2 | I_1, S) & \geq \text{EU}(\text{nI}_2 | I_1, S) \\
\frac{E}{F} & \geq \frac{(1 - p)(1 - q)}{pq} \\
\text{EU}(\text{nI}_2 | \text{nI}_1, nS) & \geq \text{EU}(I_2 | \text{nI}_1, nS) \\
\frac{E}{F} & \leq \frac{pq}{(1 - p)(1 - q)} \\
\end{align*}
\]

**Agency I:**

\[
\begin{align*}
\text{EU}(I_1 | S) & \geq \text{EU}(\text{nI}_1 | S) \\
\text{EU}(\text{nI}_1 | nS) & \geq \text{EU}(I_1 | nS) \\
\frac{E}{F} & \geq \frac{(1 - p)(1 - q)}{pq} \\
\end{align*}
\]

Bayes/Nash testing thus provides a large range of separating equilibria. However, in the presence of three active players, Bayes/Nash equilibrium is not a strong solution concept. In this setting, sequential stability is appropriate. As the following proposition states, analysis of sequential stability provides a region of sequen-

\[\text{See, e.g., Merton/Bodie (1993), p. 93: "(...) the incentives of the rating agencies can be such that it may be more important to them to produce essentially the same forecasts (ratings) as their competitors than to be accurate in their forecasts. Under conditions where customers can only observe noisy signals of raters' forecasting skills, a rating agency that produces a correct prediction when its competitors are wrong may stand to gain less than it stands to lose by producing an incorrect prediction when its competitors are right."}\]
Figure 5:

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ially stable separating equilibria in which agencies communicate decision-useful information. The scope of these equilibria is identical with the region of mixed strategy equilibria in the elementary setting:

Proposition IV:

All else equal, suppose that the creditor is rated sequentially by two agencies that both observe the same signal. Then, sequentially stable separating equilibria in which decision-useful information is transmitted will emerge if the following inequalities hold:

\[(1 - p)(1 - q)/pq \leq E/F \leq 1\]
\[[(1 - p)(1 - q)]/[((1 - p)(1 - q) + pq)] \leq B/A \leq p\]

Proof: See Appendix 3.

(ii) Sequentially stable pooling equilibria

In the presence of two agencies, pooling equilibria that are sequentially stable emerge for the same values of parameters p, q, A, B, E, F as in the elementary setting. The proof is in an analogy to (i). For p = 0.6, q = 0.8 the ranges of sequentially stable equilibria are shown in the following figure:

Figure 6:
The finding that competition between rating agencies may induce truthful reporting for a significant range of parameters is intuitively appealing. This particular result might be interpreted as good news for protagonists of regulatory and central banks' abstinence during periods of enhanced systemic risk. However, the “pathological” equilibrium \((nI, R)\) will persist even under the assumption of perfect competitiveness.

6 DISCUSSION AND CONCLUSION

The paper offers an explanation for arbitrary and cumulative downgrading by rating agencies during periods of enhanced systemic risk. From a conceptual viewpoint, the paper adds to the understanding of phenomena that might be perceived as self-fulfilling prophecies. The “pathological” pooling-equilibrium \((nI, R)\) is a case in point: Creditors withdraw their funds in response to low rating assignments, thus triggering insolvency in a seemingly deterministic manner. However, the agency’s report is only apparently self-fulfilling: Creditors do not act contingent on rating assignments. Instead, they anticipate that the agency’s reports have no informational value. Therefore, there is no causality relating the agency’s announcement to the creditor’s withdrawal decision.

In the elementary setting, agencies are in a quasi-monopolistic position, i.e., creditors are able to force debtors into bankruptcy whenever their recommendations are followed. It is precisely because of their role as monopolistic suppliers of information that the audience will attach no credibility or only limited credibility to creditors’ announcements.

Only if the restrictive assumptions concerning the agencies’ market power are relaxed will there be transmission of decision-useful information in pure strategy equilibria. Such equilibria emerge if there is a significant probability that fundamentally healthy debtors (rather than fundamentally unhealthy debtors) will survive creditors’ withdrawal, or if a debtor is evaluated by more than one agency.

The paper adds several points to the discussion about the emergence and prevention of systemic crises. Its central argument is that in an environment of enhanced systemic risk, informational intermediaries such as rating agencies cannot be expected to act as stabilizing institutions, providing reliable early warning signals or all-clear information. Therefore, the arguments put forward here underline the notion that systemic crises are essentially market failure phenomena. Thus, viewpoints that favor the release of regulatory and lender-of-last-resort functions, and using strengthened market discipline as their substitute\(^{29}\), might be questioned on the grounds of this paper's findings.

My model reflects the extraordinary scenario of a systemic crisis for which two aspects are essential: i.e. the inability of investors to discriminate between different levels of asset quality, and the immediate insolvency of both fundamentally healthy and unhealthy creditors if creditor withdrawal does take place. Only if these

\(^{29}\) See, e.g., Kaufman (1996).
assumptions are relaxed, separating equilibria, in which decision-useful information is transmitted, emerge. In the normal state of the economy, in which creditors form their opinion based on numerous observations and firms survive creditor’s withdrawal with a significant probability, separating equilibria will persist on a large range of parameters p, q, A, B, E, F. In these equilibria, agencies will release truthful reports and thus will be able to build up and maintain their reputation over the long term. My model instead takes a situation of enhanced systemic risk as given. It does not provide an explanation of how this situation emerges.

Under the restrictive assumptions, the findings raise considerable skepticism about the role of rating agencies when there is enhanced systemic risk. Thus, the findings may be regarded as arguments in support of the asymmetric information theory of financial crises.

Appendix I: Proof of proposition I: Equilibria in pure strategies

(i) [nI; R] is sustained if the following inequalities hold:
   Creditor: \[ EU(R|nI) \geq EU(nR|nI) \]
   \[ \frac{B}{A} \geq p \]
   Agency: \[ EU(nI|R) \geq EU(I|R) \]
   \[ 0 \geq F, \text{ always holds.} \]

(ii) [nI; nR] is sustained if the following inequalities hold:
   Creditor: \[ EU(nR|nI) \geq EU(R|nI) \]
   \[ \frac{B}{A} \leq p \]
   Agency: \[ EU(nI|nR, S) \geq EU(I|nR, S) \]
   \[ \frac{E}{F} \leq \frac{(1-p)(1-q)}{pq} \]
   \[ EU(nI|nR, nS) \geq EU(I|nR, nS), \text{ always holds.} \]

(iii) [(I|S; nI|nS); nR] along the same lines.

Appendix II: Proof of proposition II: Equilibria in mutually mixed strategies

The equilibrium \[ [(nI|nS); 0 < \phi(nI|S) < 1; (nR|I); 0 < \pi(R|nI) < 1) \] is sustained if the following six inequalities hold:

Creditor: (i) \[ EU(nR|I) \geq EU(R|I) \]
   \[ \frac{pq}{pq + (1-p)(1-q)} \leq \frac{B}{A} \]

   (ii) \[ EU([0 < \pi (R| nI) < 1]| nI) \geq EU(nR| nI) \]
   \[ \frac{B}{A} \leq \frac{\phi pq + p(1-q)}{1 - (1-\phi)(pq + (1-p)(1-q))} \]
(iii) \( EU([0 < \tau (R|nI) < 1]) nI \geq EU(R|nI) \)
\[
\frac{B}{A} \geq \frac{\varphi pq + p(1-q)}{1-(1-\varphi)[pq + (1-p)(1-q)]}
\]

It follows that inequalities (ii) and (iii) must hold strictly. Therefore:

\[
\varphi (nI|S) = \frac{B - pA + pq(A - B) - (1-p)(1-q)B}{pq(A - B) - (1-p)(1-q)B}
\]

\( \varphi (nI|S) = 1 \) for \( B/A = p \), and \( \varphi (nI|S) = 0 \) for

\[
\frac{B}{A} = \frac{p(1-q)}{1-pq - (1-p)(1-q)}
\]

Agency: (iv) \( EU(nI|nS) \geq EU(I|nS) \)
\[
(1-\pi) \frac{(1-q)(1-p)}{q(1-p)} \leq \frac{F}{E}
\]

(v) \( EU([0 < \tau (nI|S) < 1]) S \geq EU(I|S) \)
\[
(1-\pi) \frac{pq}{(1-p)(1-q)} \geq \frac{F}{E}
\]

(vi) \( EU([0 < \tau (nI|S) < 1]) S \geq EU(nI|S) \)
\[
(1-\pi) \frac{pq}{(1-p)(1-q)} \leq \frac{F}{E}
\]

from (v) and (vi) follows: \( \tau(R|nI) = 1 - \left[ \frac{(1-p)(1-q)F}{pq E} \right] \)

\( \tau(R|nI) = 0 \) for \( E/F = (1-p)(1-q)/pq \).

**Appendix III: Proof of proposition IV: Sequentially stable separating equilibria with communication of decision-useful information by two successively reporting agencies**

To compute sequentially stable separating equilibria in which both agencies report truthfully and the creditor acts contingent on this information, I define in a first step strategies for all information sets of the creditor which support the equilibrium path\(^{30}\):

\(^{30}\) For the computation of sequential equilibria in the Kreps/Wilson-fashion see, e.g., Eichberger (1994), p. 171 - 177.
Only if the creditor behaves according to these strategies if ever a node not being element of the equilibrium path is reached will a separating equilibrium of this type emerge. Because the creditor cannot commit herself to these strategies, she will adopt them only if they provide optimal expected payoffs. The creditor’s expected payoffs are determined by probabilities \( P(S|I_1, I_2), P(S|nI_1, I_2), P(S|nI_1, I_2), P(S|I_1, nI_2), P(S|nI_1, nI_2) \).

Information set 1 \( \{S, I_1, I_2\}; \{nS, I_1, I_2\} \):

\[
P(\|S_1, I_2 \|= \frac{\Omega P(I_2, I_1, S)P(I_1, S)}{\Omega P(I_2, I_1, S)P(I_1, S) + (1-\Omega)P(I_2, I_1, nS)P(I_1, nS)}
\]

Information set 2 \( \{S, nI_1, I_2\}; \{nS, G, nI_1, I_2\} \):

\[
P(\|S_1, nI_2 \|= \frac{\Omega[1-P(I_2, I_1, S)]P(I_1, S)}{\Omega[1-P(I_2, I_1, S)]P(I_1, S) + (1-\Omega)[1-P(I_2, I_1, nS)]P(I_1, nS)}
\]

Information set 3 \( \{S, I_1, nI_2\}; \{nS, I_1, nI_2\} \):

\[
P(\|S_1, nI_2 \|= \frac{\Omega P(I_2, nI_1, S)P(I_1, S)}{\Omega P(I_2, nI_1, S)P(I_1, S) + (1-\Omega)P(I_2, nI_1, nS)(1-P(I_1, nS))}
\]

Information set 4 \( \{S, nI_1, I_2\}; \{nS, nI_1, nI_2\} \):

\[
P(\|S_1, nI_2 \|= \frac{\Omega[1-P(I_2, nI_1, S)]P(I_1, S)}{\Omega[1-P(I_2, nI_1, S)]P(I_1, S) + (1-\Omega)[1-P(I_2, nI_1, nS)]P(I_1, nS)} = 0
\]

with \( \Omega = P(S) = pq + (1-p)(1-q) \)

In a separating equilibrium, \( P(S|I_1, I_2) = 1 \) and \( P(S|nI_1, nI_2) = 0 \) must hold. The remaining a posteriori beliefs must sustain the separating equilibrium (let \( P(S|nI_1, I_2) = \alpha, P(S|nI_1, I_2) = \beta, P(I_2| I_1, S) = \gamma, P(I_1| S) = \delta, P(I_2| I_1, nS) = \epsilon, P(I_1| nS) = \phi, P(I_2| nI_1, S) = \eta, P(I_2| nI_1, nS) = \theta, P(I_2| nI_1, nS) = \chi) \):

\[
(nI_1, I_2) \rightarrow nR, EU(nR| nI_1, I_2) \geq EU (R| nI_1, I_2):
\]

\[
\left[\alpha \frac{pq}{pq + (1-p)(1-q)} + (1-\alpha)\frac{p(1-q)}{p(1-q) + (1-p)q}\right] A \geq B
\]
\( \alpha \) is identified by:

\[
\lim_{\gamma, \delta \to 1, \epsilon, \phi \to 0} \alpha = \frac{\Omega(1 - \gamma)\delta}{\Omega(1 - \gamma)\delta + (1 - \Omega)(1 - \epsilon)\phi} = \Omega
\]

Consequently:

\[ B/A \geq p \]

\( (nI_1, I_2) \to nR \) leads to identical findings. Therefore, sequential stability persists for:

\[
\frac{[(1 - p)(1 - q)]\sqrt{pq + (1 - p)(1 - q)}}{pq/[(1 - p)(1 - q)]} \leq B/A \leq \frac{p}{E/F} \leq \frac{[(1 - p)(1 - q)]}{pq}
\]

Sequential stability of the pooling equilibria \((nI, R)\), \((nI, nR)\) is proved along the same lines.

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Morgenstern, Oskar (1928), Wirtschaftsprognose - eine Untersuchung ihrer Voraussetzungen und Möglichkeiten.
Standard & Poor's (1998), Corporate Ratings Criteria, ed. by Donald Shoultz et al.
Table of Notation

- **G, (nG)** - debtor of fundamentally good credit quality (bad credit quality)
- **S, (nS)** - good credit quality observed by the agency (bad credit quality observed)
- **I, (nI)** - agency attributes investment-grade rating (speculative grade rating)
- **R, (nR)** - creditor withdraws her funds (creditor keeps quiet)
- **K, (nK)** - debtor goes in default (debtor survives)
- **I₁, (nI₁)** - agency 1 attributes investment-grade rating (attributes speculative grade rating).
- **I₂, (nI₂)** - agency 2 attributes investment-grade rating (attributes speculative grade rating).
- **p, (1 – p)** - probability of fundamentally good credit quality (… of fundamentally bad credit quality)
- **q** - Prob \( S|G \)
- **q’ = (1 – q)** - Prob \( S|nG \)
- **r** - Probability that fundamentally good firms will survive creditor’s withdrawal (5.1)
- **A** - Creditor’s financial payoff if debtor firm survives
- **B** - Creditor’s financial payoff if debtor firm collapses as consequence of withdrawal
- **E** - Agency’s reputational payoff if debtor rated speculative-grade firm survives
- **F** - agency’s reputational payoff if debtor rated investment-grade firm collapses
- **ϕ (I|S)** - agency’s strategic probability to assign investment-grade rating when good quality observed (0 or 1 in case of pure strategies).
- **π (R|I)** - creditor’s strategic probability to withdraw in case of investment-grade ratings (0 or 1, if pure strategies are played.)
- **Ω** - \( P(S) = pq + (1 – p)(1 – q) \)
- **EU** - Expected payoff of agency or creditor, respectively.