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Perverse Effects of a Ratings-Related Capital Adequacy System

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Allowing banks to hold less capital against loans to borrowers who have received a favorable rating by an approved rating agency may result in a rating system that neither reveals risk information about borrowers nor protects the deposit insurance fund. Part of the problem is the very idea of basing portfolio risk evaluation on the sum of individual loan risks, but there are also important incentive issues.

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Summary findings

It has recently been proposed that banks be allowed to hold less capital against loans to borrowers who have received a favorable rating by an approved rating agency. But a plausible model of rating-agency behavior shows that this strategy could have perverse results, actually increasing the risk of deposit insurance outlays.

First, there is an issue of signaling, with low-ability borrowers possibly altering their behavior to secure a lower capital requirement for their borrowing.

Second, establishing a regulatory cut-off may actually reduce the amount of risk information made available by raters.

Besides, the credibility of rating agencies may not be damaged by neglect of the risk of unusual systemic shocks, although deposit insurers greatest outlays come chiefly at times of systemic crisis. And using agencies' individual ratings is unlikely to be an effective early-warning system for the risk of systemic failure, so use of the ratings could lull policymakers into a false sense of security.

It is important to harness market information to improve bank safety (for example, by increasing the role of large, well-informed, but uninsured claimants), but this particular approach could be counterproductive. Relying on ratings could induce borrowers to increase their exposure to systemic risk even if they reduce exposure to specific risk.

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1. Introduction

It has recently been proposed[1] that banks should be allowed to hold less capital against loans to borrowers who have received a favorable rating by an approved rating agency. The objective is an improved allocation of bank capital and risk, and lower exposure to bank failure.

But a plausible model of rating agency behavior shows that this strategy can have perverse results, actually increasing the risk of deposit insurance outlays.

A number of different critiques are relevant.[2] For instance, while capital is intended to cope with unexpected loan-losses, ratings are more strongly related to expected default rates, than to the standard deviation or risk of default (and of course they don't take account of correlations between different loans in the portfolio).[3]

There is also the question of how important it is for rating agencies to retain credibility by posting ratings for bank loans that will prove to be *ex post* accurate. After all, in contrast to the situation with rating tradable bonds (where rating agencies mediate the conflicting interests of investors and issuers), bank and borrower share an interest in reducing the burden of regulatory capital by securing a favorable rating for the borrower.

Furthermore, one may ask just how reliable the rating agencies would be, especially in developing countries where information costs are high and where the ratings profession is in its infancy if it exists at all. Will there be issues of market power and concentration?

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[1] In the June 1999 consultative document "A New Capital Adequacy Framework" of the Basel Committee on Banking Supervision.

[2] There have been a number of other recent critiques of the incentive structure facing rating agencies, cf. Kuhner (1999), Partnoy (1999). For an overview of the regulatory use of rating agencies, see Adams et al. (1999).

[3] While standard deviation of default percentages from B rated securities in the US is 3.8 times higher than those of AA rated securities; the mean default percentage of B rated securities is fully 11.7 times higher than that of the AA rated. Note also that the Basel proposal does not closely tie the differential capital requirements to varying default percentages. For example, lending to corporates rated A are shown in the proposal as requiring 5 times the capital required for those rated AA, whereas historical experience indicates a mean default rate only 75 per cent higher and a standard deviation only 60 per cent higher. Cf. Adams et al. (1999), Caprio and Honohan (2000).

But our purpose here is to abstract from most of these questions to focus on the incentive structure in a model of competitive banking and rating, with free entry and substantial access by market participants to information. We show that even here there can be perverse effects from the introduction of more liberal capital requirements for lending to firms that receive favorable ratings.

We outline a model of bank lending under uncertainty to borrowers of different abilities. Well-informed and competitive banks comply with minimum capital requirements. They have access to an infinitely elastic supply of deposits, and these deposits are insured by a public insurer, whose expected payout will be the focus of our attention.

The capital requirements are differentiated according to whether the borrower has been (favorably) rated or not. The expected default percentage of rated borrowers is set to satisfy a certain threshold by rating agencies. Borrowers of different abilities choose the risk profile of their projects based both on systemic and specific risk factors. Low ability borrowers may choose a safer profile in order to secure a rating.

Our model reveals three main underlying problems. First, an issue of signaling, whereby low-ability borrowers may alter their behavior in order to secure a favorable rating and hence a lower capital requirement for their borrowing, even though they continue to place banks, and the deposit insurer, at risk. Second, the establishment of a regulatory cut-off may actually reduce the amount of risk information made available by raters. Third, even though rating agency credibility may require the average default percentage of rated companies to correspond to understood thresholds in normal times, they will not normally have an incentive to factor-in the risk of unusual systemic shocks, but it is these that cause the major surges in fiscal (deposit insurance) outlays.

The paper is organized as follows. Section 2 presents the risk and return opportunities of different classes of borrower. Section 3 describes the debt contract and the assumptions regarding the rating agencies. Section 4 analyses the banks' decisions, explores the conditions under which banks may fail, defining the efficient capital requirement, i.e. the minimum requirement to avoid failure and deriving the competitive equilibrium interest rate. Section 5 explores the impact of ratings-related capital requirements on contracts and behavior. Section 6 provides two specific examples to confirm that perverse results can arise. Leaving the model, section 7 provides a brief intuitive discussion of the nature and source of the distortions. Section 8 concludes.

2.   Risk and return for the borrowers

Our model distinguishes between systemic risk - associated with the potential for bank failures, and specific risk. Systemic risk is modeled by assuming that there are two possible states of the world s, $s = 0$ is the good state and and $s = 1$ is the bad state. The probability of the bad state or systemic crash $Prob\{s = 1\} = \pi$. Each period is a one-shot event with no consequence for subsequent periods.

The entrepreneurs in the model are risk-neutral, and each entrepreneur k is endowed with a specific ability or type $a_k \, \varepsilon \, [a_0, a_1]$. Each can choose risk parameters $u_k \geq 0$ and v_k, with $-u_k < v_k$. The entrepreneur must invest \$1 in the project, which she does not have and so must borrow. (We need to have different abilities/types because otherwise all entrepreneurs will behave the same way and there will be no reason for rating and capital differentiation)

The gross return on the project to an entrepreneur of ability a and chosen risk parameters u, v is $aX(u,v,s)$ if the project succeeds, which happens with probability $p(u,v,s)$; otherwise the project fails and the return is 0. (Note the implication that $p_1<0$; $p_2<0$; $p_3<0$).

In what follows we assume that: $p(u,v,s) = 1 - u - sv$. Conditional on the good state, the mean failure rate is just the specific risk u. The unconditional mean failure rate is

$$\theta = u + \pi v.$$

The expected gross return on the project is then $E(u,v;a) = a \int p(u,v,s) X(u,v,s) ds$. We further simplify by taking $X(u,v,s) \equiv X(u,v)$. Therefore

$$E(u,v;a) = (1-\theta) \, aX(u,v) \qquad (1)$$

Following de Meza and Webb (1999), we take X to be increasing and convex in both risk arguments, and assume that the expected return E is a hump-shaped function of risk, at first increasing, but eventually decreasing in each risk parameter conditional on any value of the other.

3.   Ratings and the debt contract

A rating agency can discover, at cost c, enough information about the value of a, u and v to compute the mean failure rate. It may assign a public rating z, $0 < z < 1$ to the entrepreneur such that the mean failure rate of all entrepreneurs with rating z is no greater than z. Borrowers can pay for the rating, and competition between raters will drive the price to c. With free entry, there must be some similar regulatory procedure or incentive structure for ensuring that the implicit default rate in the bank loan ratings prepared for the purpose of determining capital requirements is not systematically biased (though we leave it open as to whether the agency rates for specific risk only, or for unconditional risk). Thus we assume that the mean default rate of rated firms is no greater than an externally targeted rate θ_0.

The debt contract offered by banks is such that D is repaid unless the project fails, in which case nothing is paid. We can think of D as one plus the lending interest rate. The entrepreneur of type a thus chooses u, v to maximize net return on the project,

$$(1-\theta) \, [aX(u,v) - D].$$

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If the borrower can alter the repayment D by varying risk u,v an interior solution $\{u(a,D), v(a,D)\}$ will satisfy the first order conditions (2): (where the dependence of D on u or v is only relevant if presented as a contractual schedule or menu to the entrepreneur).

$$\frac{aX_u - D_u}{aX - D} = 1 \qquad (2')$$

$$\frac{aX_v - D_v}{aX - D} = \pi \qquad (2'')$$

These conditions are similar to those in de Meza and Webb (1999) and have the same properties that an entrepreneur of higher ability a will choose less risky projects, and that, conditional on ability, a higher value of D induces higher risk.

4.   Bank behavior and bank failure.

The banker invests own resources and accepts deposits; the assets of the bank are just loans. Each bank has access to unlimited (insured) deposit funds which it is obliged to repay (we assume zero interest). If the bank is unable to pay, the deposit insurer pays out the net deficit to the depositors. The bank must hold regulatory capital ratio γ against loans. This regulatory capital γ means that, for every ($1 dollar) loan made, deposits do not exceed $1-\gamma$. (In section 5 below we introduce the idea that this capital ratio may be made conditional on a rating, but in this section we take it to be the same for all loans).

Our banks have much information: each can observe a, u, v and z. Therefore the repayment contract can depend on these variables $D=D(u,v;a,z)$.

Each bank maximizes its expected return by offering contracts to as many borrowers as possible. The expected return to the bank can be thought of as chiefly coming from the good state; in the bad state the bank may fail. In order to see this we begin with the case where there is only one type a, and an undifferentiated capital requirement γ. In equilibrium, the bank will offer the same contract to all. The bank's expected return here per dollar lent will be:

$$B = (1-\pi)[(1-u)D - (1-\gamma)] + \pi \, max\{0,[(1-u-v)D - (1-\gamma)]\} \quad (3)$$

In the bad state, the deposit insurer will have to make a payout unless the contractual payment (repayment plus interest) is sufficient to payoff all depositors from performing loans:

$$D \geq \frac{1-\gamma}{1-u-v}. \quad \text{(Condition } F) \qquad (4)$$

We distinguish three cases: first, the safe or "restrained" case where the regulatory capital γ is so high that F is satisfied with strict inequality; second the efficient case where F holds with equality; third the failure case where F is not satisfied.

If condition F is not satisfied, the payout made by the deposit insurer in the bad state is: $(1-\gamma)-(1-u-v)D$. Note that the payout is higher, the higher is v.

Assuming free entry of banks, competition between banks will drive the contractual repayment down to the point where the return B is just sufficient to remunerate the capital. If the regulatory capital minimum is binding, then this implies $B = \gamma$.

In the efficient or failure cases this no-profit condition implies:

$$D = \frac{1 - \pi(1-\gamma)}{(1-\pi)(1-u)} \qquad \text{(Condition } P) \qquad (5)$$

Combining equality in the safety condition F with the no-profit condition P allows us to determine the *efficient* capital requirement γ^* (i.e. the minimum capital that will avoid failure) as a function of the risk parameters:

$$1/\gamma^* = 1 + \frac{1-u}{uv - \pi(u+v)}. \qquad (6)$$

In the safe or "restrained" case where capital requirements are strictly in excess of γ^* bank failure is impossible. The equilibrium contract in that case is obtained from substituting the no profit condition $B = \gamma$ into (3) above, where the second term on the right hand side is now strictly positive, yielding:

$$D = \frac{1}{(1-u-\pi v)} \qquad (5')$$

Combining (5), (5') allows us to plot the equilibrium contract D, conditional on u, as a function of the minimum capital γ. (Figure 1).

(Of course it must be borne in mind here that the risk parameters are in turn determined by the repayment D, though (2). Since both (2) and (5) determine monotonically increasing relationships between u and D, the possibility of multiple equilibria arises. We assume that the return function X is such that the slope of the relationship from (2) is uniformly shallower, so that there is an unique equilibrium).

Like the condition for safety, the contractual payment determined by competition is increasing in the capital ratio (up to γ^*), and increasing in the risk of default in good times $(1-u)$. On the other hand it is also sensitive to the risk of the bad state occurring, but not to the loan-loss risk conditional on the bad state, i.e. v. Given that the expected deposit insurance payout is dependent on v, this dramatizes the conflict between social and private goals.

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5. The impact of ratings-related capital requirements on contracts and behavior

Suppose now that there are just two types of entrepreneur H and L, with abilities $a_H > a_L$. For a given repayment contract D, type H will choose lower risk: $u(a_H;D) < u(a_L;D)$ and $v(a_H;D) < v(a_L;D)$. Assuming that these abilities can be observed, the contracts will be differentiated and the no-profit condition will determine two contracts $D_H < D_L$.

We now introduce the concept of having capital requirements depend on ratings. Specifically, we postulate that the regulator sets the capital requirement in respect of a borrower who has received a favorable rating at a lower rate $\gamma_0 < \gamma_1$. Further, suppose that these regulatory capital requirements are the *efficient* levels corresponding to types H and L respectively, i.e. γ_0 (γ_1) is the rate determined by equation (6) above for the risk choices made by $H(L)$.

There may not be an exact correspondence between ability and rating. In particular, the prospect of a better loan contract may induce low ability borrowers to choose a risk profile so cautious that it secures them a favorable rating. The bank will not be fooled by this, but it too will take advantage of the lower capital requirement.

Thus we need to take account of four different contracts $D(a,\gamma)$ satisfying the (competitive) no-profit condition P; they correspond to the two levels of ability and the two capital requirements. We may ignore the high capital high ability contract, which only becomes relevant if the cost of rating is so high that even high ability borrowers choose not to be rated, in which case the rating agencies play no further role.

The other three contracts are $D(a_H,\gamma_0) < D(a_L,\gamma_0) < D(a_L,\gamma_1)$. The middle one is the interesting and problematic contract offered to low ability borrowers L who have obtained a rating. Since the loan can qualify for the lower capital requirement, the bank can break-even with a lower-interest contract than the no-profit equilibrium contract for low ability entrepreneurs and high capital. But use of this middle contract places the deposit insurer at risk.

Since $\gamma_0(\gamma_1)$ are the efficient capital requirements for ability level $H(L)$, the system is no longer sure to satisfy the safety condition F *unless* the L borrowers do not find it desirable to obtain a rating. If they do get a rating, and borrow at the middle contract $D(a_L,\gamma_0)$, the lower capital γ_0 will be insufficient in the bad state to protect any bank which has lent to them.[4]

Here is where the role of the rating agencies comes to the fore. Recall that they can acquire information about the borrowers at cost c. Will this cost be sufficiently small, from the L borrower's point of view, to be worth paying in terms of the lower repayment?

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[4] The entrepreneur will respond to the lower interest rate by lowering risk, but not by enough to avoid violating the safety condition F. Furthermore, we can see from (2) above that the cost c incurred by the borrower in obtaining the rating will tend to increase the risk level chosen by the borrower.

From the assumption (made above) that the rater's reputation requires unbiased default probabilities for rated borrowers, the mean[5] default rate of rated firms will be no greater than the externally targeted rate $\theta_0 \geq \theta_H$. Denoting the proportion of low-ability firms by λ, and the choice of default rate of high ability firms by θ_H then the low ability firms can be rated provided their default rate θ_L satisfies $(1-\lambda)\theta_H + \lambda\theta_L \leq \theta_0$; i.e. if

$$\theta_L < \theta_1 = \frac{\theta_0 - (1-\lambda)\theta_H}{\lambda} \geq \theta_0 \qquad (7)$$

Thus, provided the high ability borrowers are choosing a default rate strictly lower than the target rate θ_0, the low ability borrowers will in practice be set a more lenient target $\theta_1 > \theta_0$.

However, lending to the low ability borrowers with *low* capital will be an equilibrium only if the best contract satisfying the no-profit condition gives the low ability borrower a better return (net of the costs of achieving a rating, and taking account of the impact on gross return of the risk choices made to secure the rating) than does the best high capital contract. We now examine the conditions under which this will be the case.

To get a rating, the low ability entrepreneurs will have to choose risk parameter values satisfying either (8a) or (8b), depending on whether ratings are based on specific risk alone (good state) or on unconditional risk:

$$1 - u \leq \theta_1 \qquad (8a).$$

$$1 - u - \pi v \leq \theta_1 \qquad (8b).$$

Subject to this, the borrower will choose the most favorable balance between specific and systemic risk u and v. For example, at an interior solution from a continuous range, the chosen u,v will satisfy a first-order condition corresponding to (2):

$$X_v - D_v = \pi(X_u - D_u) \qquad (8')$$

Writing the choice of u and v satisfying the rating-constrained contract (8a or b), (8') as $u(a_L, D(a_L, \gamma_0), \theta_1)$, $v(a_L, D(a_L, \gamma_0), \theta_1)$, the condition for the low ability entrepreneur to opt for a rating is:

$$\{1 - \theta_1\}\{a_L X[u(a_L, D(a_L, \gamma_0), \theta_1), v(a_L, D(a_L, \gamma_0), \theta_1)] - D(a_L, \gamma_0) - c\}$$

$$\geq \{1 - \theta(a_L, D(a_L, \gamma_1))\}\{a_L X[u(a_L, D(a_L, \gamma_1)), v(a_L, D(a_L, \gamma_1)] - D(a_L, \gamma_1)\} \qquad (9)$$

Evidently, this depends sensitively on the pay-off function X as well as on the loan contract terms. In two special cases discussed in the next section, we see that the low ability borrower L may opt for rating, and how this can work out to the disadvantage of the deposit insurance fund.

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[5] As discussed below, this may be either the unconditional default rate, or the default rate conditional on the good state.

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6.   Two specific examples

In order to provide a more precise and explicit illustration of what can go wrong when lending to rated firms requires less capital, this section examines two special cases for the return function $X(u,v)$, still where there are just two ability types $a_L < a_H$, (and where, for simplicity, the resource cost c of lending is negligible).

Both examples exploit the fact that, unless the capital requirements are high enough to avoid bank failure in the bad state, the choice of higher v entails higher expected deposit insurance outlay, without having any effect on the bank's return.

Special case (i)

First suppose that $X(u,v)$ only depends on the default probability $\theta = u + \pi v$, and that there are just two possible choices of θ: $\theta_0 < \theta_1$, (though firms can freely choose u, with v deduced along the corresponding trade-off). In this special case we also assume that, as discussed above, the rating agency rates firms based only on their "good state" default probability u.

Provided the safe choice θ_0 gives the better expected gross return (i.e. before repayment to the banks), there will then exist a range of values for D such that L will choose high risk θ_1 and H will choose low risk θ_0. (This can be seen from Figure 1 which plots the net return $\theta_i(X(\theta_i) - D/a)$ against D/a for each of the two values of i). The crossover point defines the critical value d^*. Then for values of D such that:

$$\frac{d^*}{a_L} < D < \frac{d^*}{a_H},$$

the low ability borrower will continue to choose high risk, while the high ability borrower chooses low risk. By equation (5') above a restrained (high capital) banking system will not, therefore offer the same contract to both types. But a bank which is allowed to maintain low capital against a rated borrower will be happy to offer a low D, based on a low u, even if that borrower retains high risk by shifting between u and v retaining the overall default rate θ while increasing the size of the deposit insurer's loss in the bad state.

Special case (ii)

Alternatively, suppose there are two possible values for each risk parameter $u_0 < u_1$ and $v_0 < v_1$, giving four alternative risk choices. Suppose that any risk choice other than (u_1,v_1) qualifies a borrower for a rating.

The potential social impact, of a lighter capital requirement being allowed for rated borrowers depends on whether the ligher capital requirement induces low ability borrowers to switch to v_1. If a low ability borrower chooses u_0 in order to get a lower D offered by the bank, as a result of the no-profit condition (5), can this result in the

borrower switching from v_0 to v_1, thereby increasing the expected outlay of the deposit insurer? The answer is yes.

Figure 3 indicates the different configurations that are possible. Writing $X(u_i, v_j)$ as X_{ij}, etc., it plots the expected return $\theta_{ij}(X_{ij}-D)$ to the borrower, depending on the risk choices and the terms of the lending contract D. For any given D, the borrower chooses the highest value - the outer envelope. The solid lines thus show the choices involving high systemic risk. The plots in both panels satisfy

$$X_{11} > X_{10} > X_{01} > X_{00}$$

and

$$\theta_{11} > \theta_{10} > \theta_{01} > \theta_{00}.$$

In the upper panel, the borrower's preferred choice of systemic risk is always v_1 and does not depend on D. (This will happen, for example, if the probability π of the bad state is very low). But, as illustrated by the lower panel of Figure 3, there can be a range of values of D which induce low systemic risk v_0 whereas for lower values of D high systemic risk v_1 is chosen.[6] What is happening here is that, if the gain in return for higher systemic risk v is sufficiently higher when specific risk u is lower, then a more favorable loan contract (low value of D) could induce the low ability firm to opt for higher systemic risk v_1, while still retaining its rating by switching to the low value of specific risk u_0.[7]

Thus, in this example, by lowering the competitive repayment contract D offered by banks to rated borrowers, the introduction of ratings-related capital requirements actually increases the systemic risk v and hence the expected outlay of the deposit insurer.

7.   Discussion: distortions from the rating system

We now see the nature of the costs potentially introduced by the rating system. First is the fiscal (deposit insurance fund) cost incurred in the bad state when banks fail because they offered the low-ability borrowers the contract based on low capital $D(a_L, y_0)$. This contract may have been good for the bank *ex ante*, but embodies too little capital for the bank to survive in the bad state. The level of capital y_0 is the efficient capital requirement for firms of type H, and is not enough to protect the bank from failure if it lends to firms of type L, even if those firms have adjusted their risk levels to satisfy the target failure rate.

Second, we note that the establishment of a regulatory cut-off may actually reduce the amount of risk information made available by the raters. The rater could announce the precise value of u and v for each borrower, but doing so will reduce the number of borrowers who can get a favorable rating in the sense that we have used it, i.e. falling within a group whose average risk of default is no greater than the regulatory threshold.

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[6] The highest values of D induce high systemic risk also, but for these values the borrower remains unrated.
[7] Incidentally, the lower specific risk will also help lower the value of D, according to (5) above.

Third, there is the consideration of the real economic resources c employed in the rating. Not only is this a direct social cost, but it also induces riskier behavior by *all* borrowers who pay it, regardless of ability.

A fourth possible bias arises if the rating agency bases the ratings on specific risk only. It is clear that this might be relevant when we consider that neither the bank nor the firm has any interest in ensuring that the rating agency is actually giving an accurate rating. Rather the contrary, as both stand to gain from a favorable rating. The situation here is different to that in bond market ratings, where the rating agency mediates the conflicting interest of issuers and investors, and thus the agency's credibility depends on their ratings having predictive power.

To be sure, we have assumed that some such credibility factor remains relevant for rating agencies in the banking sphere, perhaps because they need to retain their regulatory approval. Therefore we assumed that ratings are not systematically biased. But rare systemic crises (the "bad" state) may not be taken into account in this attempt to avoid being systematically biased. In particular, the agency could choose to ignore risk choices v and to give a rating to firms with $u < \theta_1 < u + \pi v$, i.e. firms whose default probability conditional on the good state is adequate, but whose *unconditional* default probability is below the regulatory threshold. The average default rate of such firms will not exceed u except and until the bad state is realized – at which date there will be a banking crisis anyway. If the rating agency's franchise extends only to the next banking crisis anyway it has nothing to lose by awarding ratings to the less demanding standard.

8.   Conclusion

Allowing banks to lower capital backing for loans made to highly-rated borrowers may result in a rating system that neither reveals risk information concerning borrowers, nor protects the deposit insurance fund. Part of the problem is the whole idea of basing portfolio risk-evaluation on the sum of individual loan risks, but there are also important incentive issues involved.

Our model formalizes the idea that the largest outlays of deposit insurers are chiefly in times of systemic crisis, and gives reasons why use of agencies' individual ratings is unlikely to be an effective early-warning system for the risk of systemic failure. As such, the use of ratings is likely to lull policymakers into a false sense of security.

While harnessing market information for improving bank safety is an important and valuable concept (for example, by increasing the role of large, well-informed but uninsured claimants), this particular approach could be counterproductive.

Reliance on ratings could induce borrowers to increase their exposure to systemic risk even if they reduce exposure to specific risk. This danger highlights the hidden dangers of allowing banks to hold less capital against rated borrowers.

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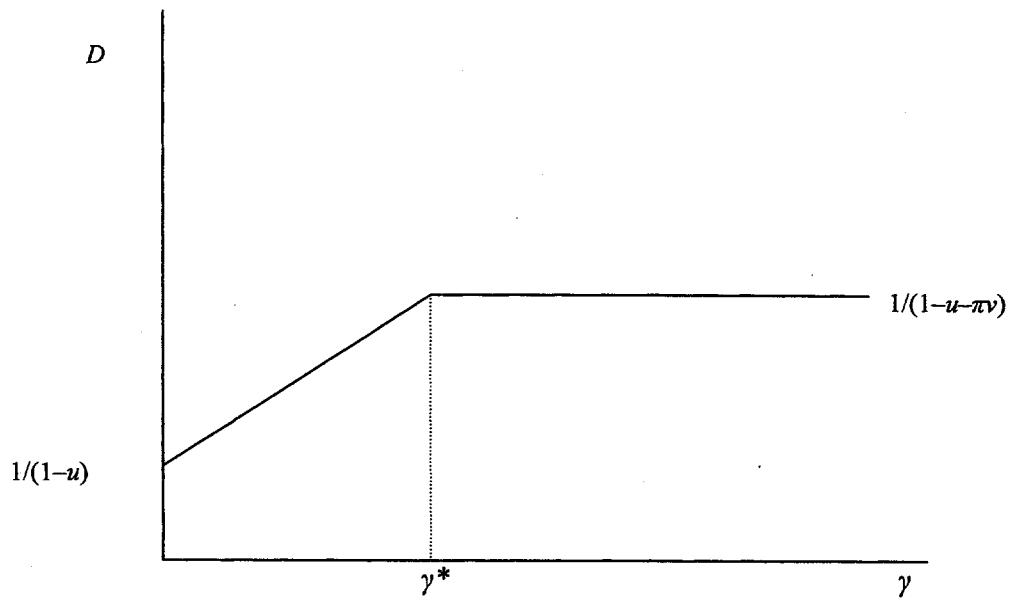
Figure 1: *Equilibrium interest contract for loans of risk level* u,v, *as a function of capital requirements* γ.
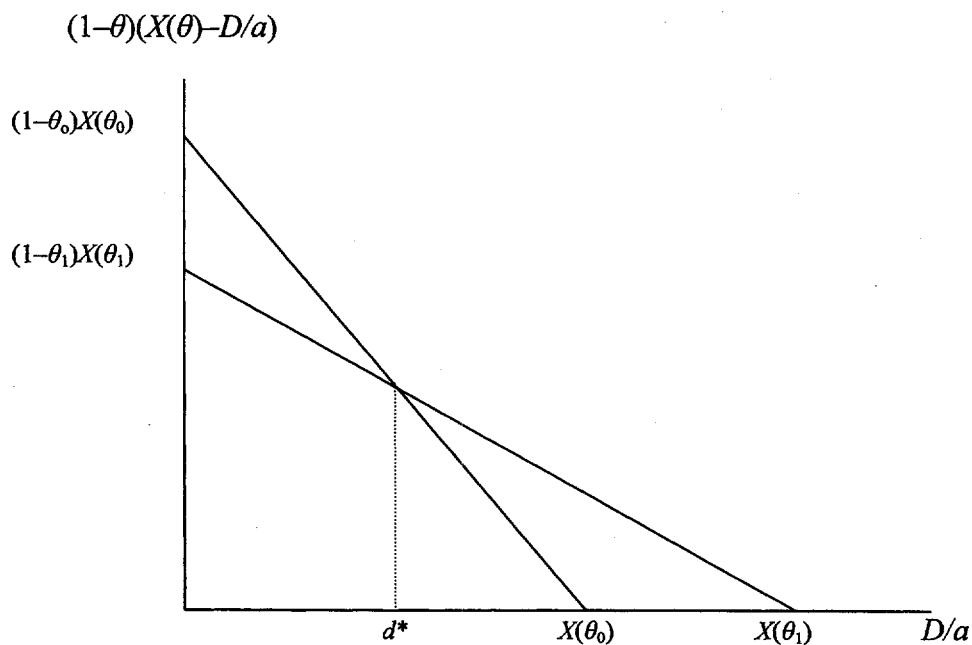

Figure 2: *Special case (i) -- Choice of risk level where only overall default risk matters.* Only for low values of D/a will firms choose safety; therefore at a given value of D, only sufficiently high ability firms will choose safety.
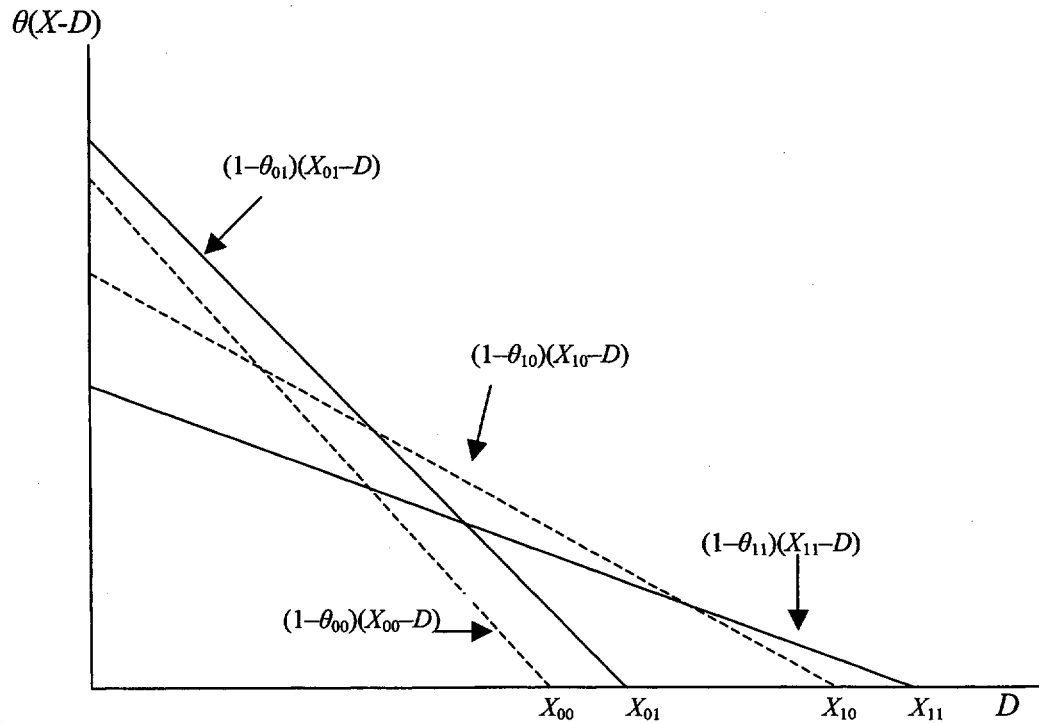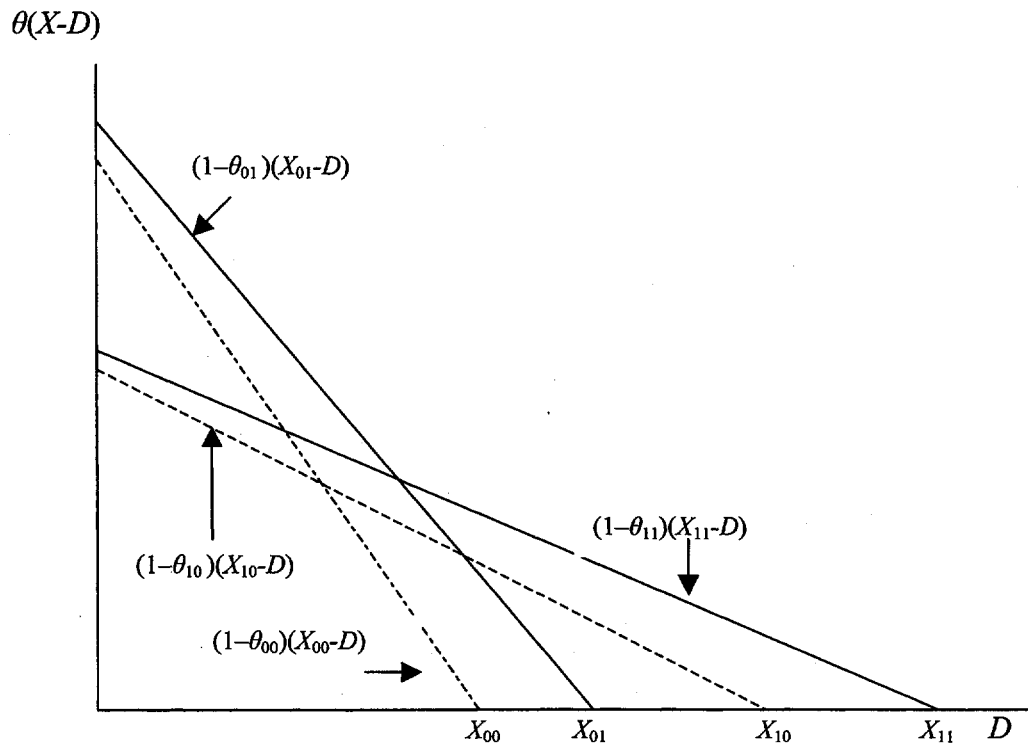
Figure 3: *Special case (ii) -- Choice of specific and systemic risk as* D *varies.*
Lower panel illustrates possible switch from low risk v_0 to high risk v_1 as D declines.

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