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Screening vs. Rationing in Credit Markets with Imperfect Information

By HELMUT BESTER*

Will credit be rationed in markets with imperfect information? Credit rationing is said to occur when some borrowers receive a loan and others do not, although the latter would accept even higher interest payments or an increase in the collateral.¹ In their 1981 article, Joseph Stiglitz and Andrew Weiss argued that banks may prefer to reject some borrowers because of negative adverse selection and incentive effects: for a given collateral, an increase in the rate of interest causes adverse selection, since only borrowers with riskier investments will apply for a loan at a higher interest rate. Similarly, higher interest payments create an incentive for investors to choose projects with a higher probability of bankruptcy. On the other hand, for a fixed rate of interest, an increase in collateral requirements may result in a decline of a bank's profits as well. Stiglitz and Weiss show that this happens if the more risk-averse borrowers, who choose relatively safe investment projects, drop out of the market. Hildegard Wette (1983) has shown that increasing collateral requirements may result in adverse selection even with risk-neutral investors.

The purpose of this paper is to show that no credit rationing will occur in equilibrium if banks compete by choosing collateral requirements and the rate of interest to screen investors' riskiness. This argument relies on

the assumption that banks decide upon the rate of interest and the collateral of their credit offers simultaneously rather than separately. Therefore, it becomes possible to use different contracts as a self-selection mechanism.² It is shown that investors with a low probability of bankruptcy are more inclined to accept an increase in collateral requirements for a certain reduction in the rate of interest than those with a high probability of failure.

Credit market equilibrium under imperfect information about investors' riskiness is analyzed in Section II. It is shown that, in equilibrium, no borrower is denied credit. The intuition is as follows. If some investor with a low probability of repayment does not receive the loan he prefers, then he will apply also for those contracts that are chosen by less risky borrowers. Therefore, a credit rationing equilibrium always pools good and bad risks. However, pooling of different risks at one contract is not viable against competition whenever self-selection mechanisms are available. If pooling occurs, then there exists another credit offer that is profitable because it attracts only the good risks from the pooling contract. An equilibrium is characterized by separation of borrowers of different risk. Borrowers with high probability of default choose a contract with a higher interest rate and a lower collateral than borrowers with low probability of default.

I. The Model

Consider a credit market with two types of entrepreneurs or firms, $i = a, b$. Each en-

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¹This is, of course, a different notion of rationing than, for example, Dwight Jaffee and Thomas Russell's: "Credit rationing occurs when lenders quote an interest rate on loans and then proceed to supply a smaller loan size than demanded by the borrowers" (1976, p. 651).

²A similar argument can be developed if investors can choose among a variety of projects with different riskiness. Collateral requirements can serve as an incentive mechanism because a higher collateral enforces a selection of less risky projects (see my 1984a paper).

entrepreneur has the opportunity to undertake a project which requires a fixed amount of investment I .³ The return to firm i 's project is given by a random variable $0 \leq \tilde{R}_i \leq \bar{R}_i$ with distribution function $F_i(R)$. As in Stiglitz and Weiss, it will be assumed that \tilde{R}_b corresponds to greater risk than \tilde{R}_a in the sense of a mean-preserving spread,⁴ such that

$$(1) \quad E\{\tilde{R}_a\} = E\{\tilde{R}_b\},$$

$$\int_0^y [F_b(R) - F_a(R)] dR \geq 0,$$

for all $y \geq 0$. Furthermore, let $F_i(R) > 0$ for all $R > 0$,⁵ $i = a, b$. There are N_i entrepreneurs of type i .

Entrepreneurs have an initial wealth endowment of $W < I$. They finance their projects by borrowing the amount $B = I - W$. Given the loan size B , a credit contract $\gamma = (r, C)$ is specified by the rate of interest r and the collateral C charged by the bank. Entrepreneurs may face costs to collateralization. For simplicity, these costs will be assumed to be proportional to the amount of collateral by a factor $k \geq 0$. Firm i is said to be bankrupt if $C + R_i < (1 + r)B$. If this happens, the bank becomes the owner of the investment project and its returns. Therefore, the expected profits of firm i by undertaking the project under a credit contract γ are given by

$$(2) \quad \Pi_i(\gamma) = E\{\max[\tilde{R}_i - (1 + r)B - kC, -(1 + k)C]\}.$$

On a loan γ to firm i the bank receives the expected rate of return

$$(3) \quad \rho_i(\gamma) = E\{\min[(1 + r)B, \tilde{R}_i + C] - B\} / B.$$

³Since the amount of investment is taken to be fixed, it cannot be used to convey information about a borrower's default risk. For models in which the level of investment is used as a signal for the repayment probability of borrowers, see my 1984b paper, and Hellmuth Milde and John Riley (1984).

⁴See Michael Rothschild and Stiglitz (1970).

⁵This condition ensures that there is a positive probability of default whenever the interest payments of a credit contract exceed the collateral.

Only contracts with $C \leq (1 + r)B$ will be considered.⁶ Banks finance their credit offers by funds from depositors. If π is the interest rate paid on deposits, then the bank's net profits on a loan γ to firm i are given by $[\rho_i(\gamma) - \pi]B$. The supply of loanable funds to the banking system will be described by a function $L^s(\cdot)$ of π . Let L^s be continuous, strictly increasing and let $L^s(0) = 0$.

Banks are unable to distinguish borrowers of different risk directly. They can do so only by offering a pair $(\gamma_\alpha, \gamma_\beta)$ of different credit contracts that act as a self-selection mechanism. The pair $(\gamma_\alpha, \gamma_\beta)$ is said to be *incentive compatible* if

$$(4) \quad \Pi_a(\gamma_\alpha) \geq \Pi_a(\gamma_\beta); \Pi_b(\gamma_\beta) \geq \Pi_b(\gamma_\alpha).$$

It is assumed that banks act as perfect competitors, that is, each bank takes the rate of interest π on deposits and the set of credit offers by competing banks as given and as independent of its own actions.

Entrepreneur i will invest only if he receives a loan γ such that $\Pi_i(\gamma) \geq (1 + \pi)W$. Whenever a pair $(\gamma_\alpha, \gamma_\beta)$ of contracts is offered, he prefers the contract which maximizes his expected profits.⁷ Hence, given the number of investors of each type and their decision rule, the demand for credit depends upon the set of available loan offers $\{\gamma_\alpha, \gamma_\beta\}$ and may be written as $L^d(\gamma_\alpha, \gamma_\beta)$.

II. Credit Market Equilibrium

Whether a particular entrepreneur is willing to undertake a project or not depends on the set of credit contracts offered by the banking system. Figure 1 shows the indifference curves⁸ of each type i of firms for all contracts γ such that $\Pi_i(\gamma) = (1 + \pi)W$. Below b, b' , all b investors wish to obtain a loan while type a firms do so below a, a' . As

⁶If $C > (1 + r)B$, then a firm would never admit to being bankrupt. Hence, it is assumed that bankruptcy becomes observable only after a firm declares to be bankrupt.

⁷The case of risk-averse entrepreneurs is studied in my 1984a paper.

⁸Notice that investors' indifference curves will in general not be concave.

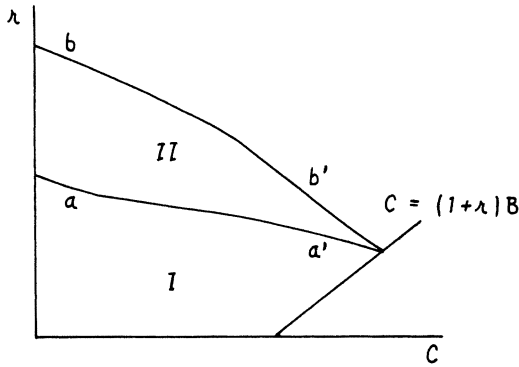


FIGURE 1

shown in Figure 1, one has

$$(5) \quad \Pi_b(\gamma) > \Pi_a(\gamma) \quad \text{if} \quad C < (1+r)B,$$

because firm i 's profits are a convex function of \tilde{R}_i . As was observed by Stiglitz and Weiss, an increase in the rate of interest or an increase in the collateral that entails a shift from region I to region II will result in investors of type a dropping out of the market. However, the less-risky borrowers are more profitable for the bank. Since the bank's rate of return on a loan to entrepreneur i is a concave function of \tilde{R}_i , one obtains

$$(6) \quad \rho_a(\gamma) > \rho_b(\gamma) \quad \text{if} \quad C < (1+r)B.$$

Hence, even when there is an excess demand for loans it may not be profitable for a bank to enter the market by raising the rate of interest r , or the collateral requirements C . The reason is that only the less-profitable borrowers of type b might find this offer attractive. Therefore, Stiglitz and Weiss argue that credit may be rationed in a competitive equilibrium.

In the following, it will be assumed that investor i will first apply for his preferred contract if he faces a pair $(\gamma_\alpha, \gamma_\beta)$ of credit offers. But, should he be denied credit, he may apply also for the other contract. Therefore, the bank's total profits on, say, contract γ_α depend also upon the fraction of borrowers who are rationed at γ_β . The fraction of firms that receive credit under the terms of

γ_j when applying for it will be denoted by λ_j , where $0 < \lambda_j \leq 1$.

The tuple $\{(\gamma_\alpha^*, \gamma_\beta^*), (\lambda_\alpha^*, \lambda_\beta^*), \pi^*\}$ is called a *credit market equilibrium* if, when borrowers choose among contracts to maximize expected profits: (i) each contract γ_α^* and γ_β^* yields zero profits to the bank; (ii) any additional credit offer γ will make no profits; and (iii) there is no excess supply of funds.

By requirement (iii) of this definition, it is assumed that competition among depositors will lower the deposit interest rate π as long as $L^s(\pi) > L^d(\gamma_\alpha, \gamma_\beta)$. Note that this does not preclude the possibility of an excess demand for loans. *Credit rationing* is said to occur if some entrepreneur i faces a positive probability of being rejected at each contract γ_j^* which maximizes his expected profits and, at the same time, $\Pi_i(\gamma_j^*) > (1 + \pi^*)W$.

An equilibrium will not exhibit rationing if entrepreneurs can provide collateral at no cost. Indeed, if collateral requirements cause no loss in welfare, then lenders can avoid any risk associated with a loan by offering contracts that lie on the $C = (1+r)B$ line in Figure 1. The default rate for these loans is zero and, therefore, no adverse selection occurs. Banks can profitably exploit any excess demand for credit by raising r and C simultaneously along $C = (1+r)B$ and rationing disappears in equilibrium. This shows that a credit market equilibrium with $\gamma^* = \gamma_\alpha^* = \gamma_\beta^*$ may always be found on the $C = (1+r)B$ line if $k = 0$. It satisfies $\rho_a(\gamma^*) = \rho_b(\gamma^*) = \pi^*$, and there is no rationing.

This solution to overcome the problem of adverse selection will not be efficient if the use of collateral implies costs. Banks may, however, use contracts with different collateral requirements as a self-selection mechanism. This is possible if the preferences of investors depend systematically upon their type.⁹ Entrepreneur i 's marginal rate of substitution between r and C at contract γ is given by

$$(7) \quad \sigma_i(\gamma) = - \frac{F_i((1+r)B - C) + k}{[1 - F_i((1+r)B - C)]B}.$$

⁹See, for example, Michael Spence (1973) and Riley (1979).

By second-order stochastic dominance, one must have $F_b(R) > F_a(R)$ for R sufficiently low. Hence, if $F_b(R) - F_a(R)$ does not change sign over $[0, (1+r)B - C]$, entrepreneurs of type a will exhibit a higher marginal rate of substitution at γ than entrepreneurs of type b . This means that they are inclined to accept a higher increase in collateral for a given reduction in interest payments than entrepreneurs of type b . Therefore, the collateral can be used to reveal the riskiness of an entrepreneur's project. In the following, it will be assumed that $F_b(R) - F_a(R)$ is positive over $(0, \bar{R}_a - W)$. This condition ensures that¹⁰ $\sigma_a(\gamma) > \sigma_b(\gamma)$ everywhere in region I of Figure 1, because entrepreneur a will not undertake a project if $(1+r)B - C > \bar{R}_a - W$.

The fact that the indifference curve of investor b is steeper than investor a 's at any contract γ enables banks to offer a pair of different, incentive compatible contracts as,¹¹ for example, $(\gamma_\alpha^*, \gamma_\beta^*)$ in Figure 2. Moreover, it implies that competition between banks will not be restricted to separate variations of either the rate of interest or the collateral. For this reason, credit rationing will turn out not to be viable against competition. In addition to the entrepreneurs' indifference curves a, a' and b, b' , Figure 2 depicts the bank's iso-rate of expected return schedule for loans to each type of borrower as α, α' and β, β' , respectively. Hence, for example, $\rho_a(\gamma)$ remains constant along α, α' . The bank's indifference curve for loans to type- i investors has a slope of

$$(8) \quad \mu_i(\gamma) = -F_i((1+r)B - C) / [1 - F_i((1+r)B - C)] B$$

at contract γ in (r, C) space. For $k > 0$ it is less steep than investor i 's indifference curve at γ . In Figure 2, contract γ_α^* and γ_β^* are

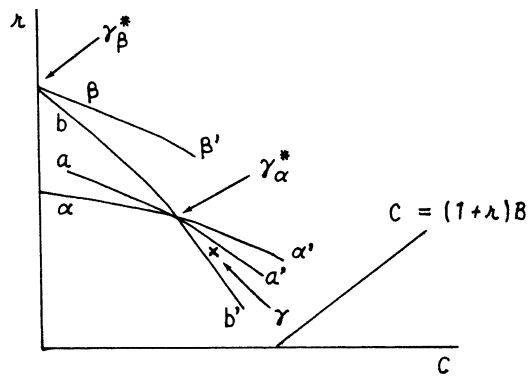


FIGURE 2

depicted so as to satisfy the conditions of the following theorem.¹²

THEOREM 1: Let $\{(\gamma_\alpha^*, \gamma_\beta^*), (\lambda_\alpha^*, \lambda_\beta^*), \pi^*\}$ be a credit market equilibrium and let both contracts γ_α^* and γ_β^* be demanded by entrepreneurs. Then there is no rationing at γ_α^* or at γ_β^* , and both contracts are incentive compatible. Moreover, $\pi^* = \rho_a(\gamma_\alpha^*) = \rho_b(\gamma_\beta^*)$. If $k > 0$, then $C_\alpha^* > C_\beta^* = 0$.

A simple argument establishes that there cannot be rationing at γ_α^* or γ_β^* in Figure 2. A type- a borrower feels rationed at γ_α^* only if $\lambda_\alpha^* < 1$ and $\Pi_a(\gamma_\alpha^*) > (1 + \pi^*)W$. However, in such a situation, a competing bank could enter the market and raise r_α^* by a small amount. All borrowers who are denied credit at γ_α^* would apply for this new offer. Since it yields higher returns to the lender than γ_α^* , market entry would be profitable, a contradiction to requirement (ii) of an equilibrium. This proves that entrepreneurs of type a are never rationed in equilibrium.

Suppose that some investors of type b are rejected at γ_β^* . Since these borrowers will apply also for γ_α^* , there must be pooling of different entrepreneurs at γ_α^* . Now, consider contract γ in Figure 2 being offered in ad-

¹⁰Notice that this condition is already implied by (1) in the case of two-outcome projects, i.e., if \bar{R}_a and \bar{R}_b are discrete random variables with only two possible realizations. Moreover, the condition would always be satisfied if, instead of mean-preserving spreads, the case of first-order stochastic dominance is considered.

¹¹Of course, an identical argument can be developed for n different types of borrowers.

¹²As shown by Rothschild and Stiglitz (1976) and Charles Wilson (1977), a competitive equilibrium may not exist. My Theorem 1, however, may be extended to Riley's "Reactive Equilibrium," or to Wilson's "Anticipatory Equilibrium" (see my 1984a paper).

dition to γ_α^* and γ_β^* . This offer will attract all firms of type a , but only those of type b who are rejected both at γ_β^* and γ_α^* . Therefore, the relative number of type- a to type- b loan applicants will be higher at γ than at γ_α^* . According to (6), entrepreneurs of type a are more profitable for the lender than those of type b . Hence, if γ_α^* yields zero profits, contract γ can be chosen to make a positive profit for the bank, contradicting the definition of equilibrium. This proves that there can be no rationing or pooling if γ_α^* and γ_β^* in Figure 2 constitute an equilibrium. The zero-profit condition, therefore, implies $\pi^* = \rho_a(\gamma_\alpha^*) = \rho_b(\gamma_\beta^*)$.

It remains to show that the set $\{\gamma_\alpha^*, \gamma_\beta^*\}$ is in fact the only possible equilibrium. Among all contracts satisfying $\rho_b(\gamma) = \pi^*$, γ_β^* is the most preferred by type b investors. There is also no contract that could make entrepreneurs of type a better off than γ_α^* without either rendering losses to the bank or attracting high risks from γ_β^* . Therefore, any other configuration of loan offers, which yields zero profits to the lender, is either dominated by $(\gamma_\alpha^*, \gamma_\beta^*)$ or it involves pooling of different investors at some contract. Since, according to the above argument, pooling is never viable against competition, any equilibrium must satisfy the conditions of Theorem 1.

Theorem 1 explains the widespread use of collateral requirements in debt contracts. Since collateral in general is costly, its use is inefficient under perfect information. However, collateral requirements can be explained as a response to imperfect information. They may serve to reveal information about the default risk of loan applicants. High-risk borrowers can be identified because they prefer loan contracts with lower collateral and a higher interest rate. In an equilibrium, the level of collateralization is negatively related to the riskiness of the borrower's investment project.

III. Conclusions

Problems of adverse selection cast serious doubts on the appropriateness of the Walrasian equilibrium concept in markets with imperfect information. If the average quality of supplied goods is positively related to the

market price, then buyers have an incentive to fix the price above the market-clearing level. In this situation, sellers become rationed because buyers prefer to pay a higher price in exchange for higher quality. As another response to adverse selection, a signalling convention may emerge. Sellers of high-quality goods invest in observable characteristics to distinguish their products from those of lower quality. In this case, the simple Walrasian auction market is replaced by a more complicated market for contracts. Typically, the price at which goods are exchanged is only one among several other characteristics of such contracts. This paper has investigated the question how the market reacts if both signalling and rationing are a priori feasible alternatives. In the framework of credit markets under imperfect information, it has been established that no borrower will be denied credit if banks use the collateral requirements of their loan contracts as a signalling mechanism. Signalling mechanisms eliminate demand rationing in competitive equilibrium. This suggests that theories which attempt to explain rationing by adverse selection effects also have to provide an explanation why screening devices cannot be adopted.

In this paper, the applicability of self-selection mechanisms has been established under assumptions which are stronger than those of Stiglitz and Weiss. First, a signalling equilibrium in the credit market necessitates a monotone relationship between the riskiness and the preferences of different borrowers. It has been shown that this condition is satisfied under an additional assumption on the probability distribution of returns on investment projects. Second, low-risk entrepreneurs have been assumed to be able to raise a sufficient amount of collateral to distinguish themselves from high risk ones. This is important because, obviously, perfect sorting in a credit market equilibrium may be impossible if some low-risk firms face a binding constraint on the amount of collateral they can provide.¹³ Thus, only partial screen-

¹³ The results of Section II remain valid, however, if the maximum amount of collateral is determined by the assumption that the marginal costs of a higher collateral are increasing and tend to infinity at some level \bar{C} .

ing may be possible and adverse selection could still arise, if the necessary conditions for market signalling are not fulfilled.

REFERENCES

- Bester, Helmut**, (1984a) "Screening versus Rationing in Credit Markets with Imperfect Information," Discussion Paper No. 136, University of Bonn, February 1984.
- _____, (1984b) "The Level of Investment in Credit Markets with Imperfect Information," Discussion Paper No. 150, University of Bonn, August 1984.
- Jaffee, Dwight M. and Russell, Thomas**, "Imperfect Information, Uncertainty, and Credit Rationing," *Quarterly Journal of Economics*, November 1976, 90, 651–66.
- Milde, Hellmuth and Riley, John G.**, "Signalling in Credit Markets," Working Paper No. 334, University of California-Los Angeles, July 1984.
- Riley, John G.**, "Informational Equilibrium," *Econometrica*, March 1979, 47, 331–59.
- Rothschild, Michael and Stiglitz, Joseph**, "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information," *Quarterly Journal of Economics*, November 1976, 90, 630–49.
- _____, and _____, "Increasing Risk: I, A Definition," *Journal of Economic Theory*, September 1970, 2, 225–43.
- Spence, Michael**, *Market Signalling: Information Transfer in Hiring and Related Processes*, Cambridge: Harvard University Press, 1973.
- Stiglitz, Joseph and Weiss, Andrew**, "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, June 1981, 71, 393–410.
- Wette, Hildegard C.**, "Collateral in Credit Rationing in Markets with Imperfect Information: Note," *American Economic Review*, June 1983, 73, 442–45.
- Wilson, Charles**, "A Model of Insurance Markets with Incomplete Information," *Journal of Economic Theory*, December 1977, 16, 167–207.