Time Varying Adverse Selection in Credit Markets

Chris Yung*

November 10, 2004

Abstract

Although most market imperfections have been shown to be countercyclical in severity, adverse selection costs may be procyclical. On one hand, given a fixed set of borrowers, improvements in economic conditions raise creditworthiness, which lowers the interest rates demanded by competitive lenders. However, the quality of the borrower pool is not fixed: improved economic opportunities can draw in progressively lower quality firms, preventing higher quality firms from capturing the additional surplus in economic expansions.

*Assistant Professor of Finance, Leeds School of Business, University of Colorado. I would like to thank Kerry Back, Jeroen Swinkels and John Nachbar for comments on a chapter of my dissertation on which this article is based. I would like to thank Jaime Zender and Eric Hughson for additional comments.

Time Varying Adverse Selection in Credit Markets

Abstract

Although most market imperfections have been shown to be countercyclical in severity, adverse selection costs may be procyclical. On one hand, given a fixed set of borrowers, improvements in economic conditions raise creditworthiness, which lowers the interest rates demanded by competitive lenders. However, the quality of the borrower pool is not fixed: improved economic opportunities can draw in progressively lower quality firms, preventing higher quality firms from capturing the additional surplus in economic expansions.

Keywords: Adverse Selection, Debt, Business Fluctuations, Credit, Cycles.

JEL Classifications: E32, E44, E51, G21.

1 Introduction

High quality firms face an adverse selection problem when trying to sell securities to uninformed investors. Lower quality firms may mimic the offering terms, in which case the pooled securities are sold at a single price rather than the prices that would prevail in a full-information world.

The object of this paper is to show that the behavior of low-quality firms, and therefore severity of this adverse selection problem, depends upon the business cycle. Firms with very valuable projects find it profitable to issue securities under a wide range of economic conditions, because the value of the residual claim is so high. When economic conditions are relatively poor, weaker firms will not mimic this behavior; doing so risks the loss of collateral. Thus, in weak economic times, high-quality firms find that other firms generally do not imitate their behavior. Securities may be sold at or near their full value.

An exogenous, positive shock to economic opportunities makes it profitable for a new wave of weaker, marginal firms to enter the market. High-quality firms face more mispricing since they are forced to pool with more firms of lower quality. This provides a sense in which the adverse selection problem worsens in good times. Such an argument is broadly consistent with a widespread view that the motives of managers making new security issues are particularly suspect during boom periods. These viewpoints are often couched in terms of managers "timing the market" and occasionally couched in terms of irrational investors. This model describes issuance behavior which does have a "timing" aspect to it, although I assume that financial markets are aware of borrowers' incentives and respond accordingly.

The finding that a market imperfection can have procyclical severity contrasts with much of the literature. Greenwald, Stiglitz and Weiss (1984) argue that credit rationing is more severe in recessions since balance sheets weaken. In their model, all firms seek funding in all economic states. Their analysis therefore omits the endogenous relationship between business cycles and the identity of borrowers, a relationship which drives my results. Azariadas and Smith (1998) also find countercyclical credit rationing, but they show that causality can run in both directions. In addition to recession weakening balance sheets − which causes rationing − it is possible that the economy fluctuates between Walrasian and credit rationing equilibria. A regime-change to credit-rationing causes output to drop. Causality differences aside, both models highlight market imperfections with countercyclical severity.

Like credit rationing, several other market imperfections have been shown to be countercyclical in severity.[1] Rampini (2004) argues that, due to risk-aversion, agents in the economy are hesitant to engage in value-increasing entrepreneurial activity. Cyclical wealth declines exacerbate this cautiousness and reduce entrepreneurial activity. This moral hazard problem therefore acts as a "multiplier" effect, magnifying the severity of economic shocks. Williamson (1987) and Bernanke and Gertler (1989) study the costly state verification problem of lenders across the business cycle. Net worth tends to fall in downturns, which raises expected monitoring costs in recessions.

[1] Asset substitution may be the exception to this rule. Stiglitz and Weiss (1992) show that when managers can choose projects (rather than being exogenously assigned them, as in adverse selection models) imperfections may become either more or less severe in expansions. The direction of the result depends upon the cyclical movements in the relative attractiveness of risky and safe projects. Their theory provides no guidance on whether the risky projects are likely to become more attractive in good times or not, so the predictions are ambiguous.

2 The model

The basic structure and much of the notation is imported directly from Stiglitz and Weiss (1981), with two important changes. First, in their analysis the lender chooses the contract to maximize profits, under the maintained assumption that borrowers have no outside opportunities.[2] Instead, in my model borrowers choose the contract to maximize the value of the residual claim, subject to leaving the (competitive) financial markets with non-negative expected returns. Mechanically, this may make my model appropriate for a public debt issue, or a private debt issue if borrowers can engage potential lenders in ex-ante Bertrand competition.[3] This applicability is not the reason the model structure is chosen this way, however. Unlike Stiglitz and Weiss, I wish to focus on the surplus enjoyed by high-quality borrowers, and how this surplus co-varies with economic conditions. Doing so is impossible in a model in which the lender selects the contract and therefore retains all economic surplus.

The second change is that I allow firm types to be ordered by first-order stochastic dominance as well as by second-order stochastic dominance; Stiglitz and Weiss only consider the latter. This assumption turns out to be important. Stiglitz and Weiss show that raising the interest rates causes safe firms to exit the market before risky firms do. These differential exit incentives underly their core result, a trade-off for lenders: high interest rates extract more surplus from a given pool of borrowers, but tend to reduce the quality of the pool. In a model of first-order stochastic dominance, the opposite effect occurs. For a given debt contract, high-quality borrowers retain a more valuable residual claim. High interest rates now tend to force out low-quality borrowers first.

Since the results critically depend upon the nature of the stochastic dominance assumed, I present the results separately for each type of dominance.

[2]Throughout the analysis, I refer to the borrowers as *issuers* or *firms* interchangeably. Suppliers of capital are referred to as *lenders* or *investors.*

[3]As Stiglitz and Weiss point out, such competition is unlikely to be feasible if the borrower has a pre-existing relationship with the lender. Given undercutting by outsider investors, the current lender would have the opportunity match the rate. Outside lenders would only succeed in attracting away borrowers for which the existing lender was unwilling to match the rate, i.e., borrowers for which the lender has negative information. This adverse selection problem may limit lender competition. See Sharpe (1990) for formal models of this "captured borrower" problem.

2.1 Firms Types Ordered by SSD

The economy consists of two observationally equivalent firm types, S and R for 'safe' and 'risky' respectively. They each have collateral C and a project which requires capital investment B. Denoting Z to be the gross returns of the project and a parameter γ indicating the state of the economy, the probability densities $f_i(Z, \gamma)$ of gross returns by firm type satisfy

$$\int_0^\infty Z f_R(Z, \gamma) dZ = \int_0^\infty Z f_S(Z, \gamma) dZ \quad \forall \gamma \tag{1}$$

$$\int_0^y Z f_R(Z, \gamma) dZ \geq \int_0^y Z f_S(Z, \gamma) dZ \quad \forall \gamma, \; \forall y \tag{2}$$

$$F_i(Z, \gamma_2) \leq F_i(Z, \gamma_1) \quad \forall Z, \; \forall i \in \{R, S\}, \; \forall \gamma_2 > \gamma_1 \tag{3}$$

Conditions (1) and (2) indicate that, in each state of the economy, firm types R and S are ordered by second-order stochastic dominance. As is well-known, this is equivalent to assuming that the returns of the projects satisfy

$$\tilde{r}_R(\gamma) \stackrel{d}{=} \tilde{r}_S(\gamma) + \tilde{\epsilon} \tag{4}$$

for a random variable $\tilde{\epsilon}$ satisfying $E[\epsilon | \tilde{r}_S] = 0$. That is, the return of the risky project is equal (in distribution) to the return of the safe project with a noise term added.

Condition (3) is the assumption that economic improvements (as measured by increases in γ) reflect *first-order* stochastic improvements in the quality of all projects in the economy. This is equivalent to the assumption

$$\tilde{r}_i(\gamma_2) \stackrel{d}{=} \tilde{r}_i(\gamma_1) + \tilde{\alpha} \quad \forall i \in \{R, S\} \quad \forall \gamma_2 > \gamma_1 \tag{5}$$

for some nonnegative random variable $\tilde{\alpha}$.

Second-order stochastic dominance by firm type implies that

$$\int_0^\infty v(Z) f_R(Z, \gamma) dZ \leq \int_0^\infty v(Z) f_S(Z, \gamma) dZ \quad \forall \gamma \tag{6}$$

for all increasing, concave functions $v()$. This relation is often used, by interpreting $v()$ as the utility of wealth, to motivate the preference of monotonic, risk-averse individuals for safe investments. Instead, in this model, both lenders and borrowers are assumed to be risk-neutral. However, the nature of a debt contract is such that the borrower becomes the residual claimant of the project. If the interest rate on funds borrowed is $\hat{r}$ then default occurs when

$$C + R \leq B(1 + \hat{r}). \tag{7}$$

The net return to borrowers can be written

$$\pi(Z, \hat{r}) = max[Z - (1 + \hat{r})B \ , \ -C] \tag{8}$$

and the return to lenders is

$$\rho(Z, \hat{r}) = min[R + C \ , \ (1 + \hat{r})B]. \tag{9}$$

The borrower's return is therefore a convex function of the returns of the project whereas the lender's return is a concave function. Similarly, assumption (3) implies that

$$\int_0^\infty v(Z) f_i(Z, \gamma_1) dZ \leq \int_0^\infty v(Z) f_i(Z, \gamma_2) dZ \quad \forall \gamma_2 > \gamma_1, \ \forall i \in \{R, S\} \tag{10}$$

for all increasing functions $v()$. The following claims are then trivial.

Lemma 1 *Denoting expected borrower utility (by firm type) as*

$$U_i = \int_0^\infty \pi(Z, \hat{r}) f_i(Z, \gamma) dZ \tag{11}$$

and the expected utility of the lender from funding a firm of type i by

$$\overline{\rho}_i = \int_0^\infty \rho(Z, \hat{r}) f_i(Z, \gamma) dZ \tag{12}$$

it follows that

a) $U_R > U_S$ *for all interest rates $\hat{r}$ and in all economic conditions γ.*
b) $U_i(\gamma_2) > U_i(\gamma_1)$ *for all interest rates $\hat{r}$ and economic conditions $\gamma_2 > \gamma_1$.*
c) $\overline{\rho}_S > \overline{\rho}_R$ *for all interest rates $\hat{r}$ and in all economic conditions γ.*
d) $\overline{\rho}_i(\gamma_2) > \overline{\rho}_i(\gamma_1)$ *for all interest rates $\hat{r}$ and economic conditions $\gamma_2 > \gamma_1$.*

Proof: 1a) follows from convexity of $\pi(Z, \hat{r})$, 1b) follows from monotonicity of $\pi(Z, \hat{r})$, 1c) follows from concavity of $\rho(Z, \hat{r})$ and 1d) follows from monotonicity of $\rho(Z, \hat{r})$. $\square$

Comparison between Lemma 1a and Lemma 1c illustrates a divergence between the interests of borrowers and lenders. Borrowers are better off with risky projects (although this model does not allow project choice) whereas lenders prefer safe projects. Borrowers issue debt if and only if the expected residual claims from the project in solvent states exceed the expected loss of collateral in default states, that is, if $U_i(\hat{r}, \gamma) \geq 0$. Theorem 1 shows how these incentives depend upon firm type and interest rate.[4]

Theorem 1 *Fixing a given economic state γ, there exist critical values $\hat{r}_1$ and $\hat{r}_2 > \hat{r}_1$ such that*
a) *If $r < \hat{r}_1$ then both firms choose to borrow.*
b) *If $r \in [\hat{r}_1, \hat{r}_2)$ then only the risky firm chooses to borrow.*
c) *If $r \geq \hat{r}_2$ then no firms choose to borrow.*

Proof : The borrowers zero-profit condition is

$$\Pi(\hat{r}, \gamma, i) = \int_0^\infty Max[R - (\hat{r}+1)B; -C] \, dF_i(R, \gamma) \; = \; 0 \qquad (13)$$

Noting that $\frac{\partial \Pi}{\partial \hat{r}} < 0$, it follows that for each firm type i there exists some cutoff interest rate $\hat{r}_i$ such that the firm will issue if and only if $r < \hat{r}_i$. Lemma 1a implies that $\hat{r}_2 > \hat{r}_1$. □

Not surprisingly, high interest rates drive firms out of the market. The key fact which underlies Stiglitz and Weiss's results is the differential tolerance displayed by borrowers. As Lemma 1a shows, for a given contract high-risk borrowers enjoy higher utility and thus are more willing to remain in the market when rates are high.

Taken together, Lemma 1c and Theorem 1 illustrate a trade-off regarding the welfare impact on lenders of higher rates: in general, higher rates extract more surplus from a given firm but deteriorate the average quality of firms funded.

Thus, the lender's profit function is nonmonotonic in the interest rate, just as in Stiglitz and Weiss's analysis. For low interest rates, both firm types apply and increases in the interest increases the value of the lender's claim. When r exceeds $\hat{r}_1$ the safe firm drops out of the market. Because

[4]The analysis hereafter assumes that if a firm is indifferent between issuing a security and not, that firm does not issue. This assumption is not critical but avoids ambiguity in the following theorem and subsequent results as to whether intervals should be open or closed.

safe firms are more profitable to lenders, this exit entails a discrete drop in expected lender profits at $\hat{r}_1$. Beyond that point, increases in the interest rate again raise lender profits. The payoff profile is shown in Figure 1.

[Insert Fig 1 here]

Figure 1 is the same payoff function as Stiglitz and Weiss's Figure 3. What differs between the two models is the determinant of interest rates. Here the firm chooses the contract – it offers a bond to a competitive financial market. It chooses the lowest interest rate for which lenders earn nonnegative profit. Thus, surplus goes to the firm rather than to the financial markets. The expected return need only compensate lenders for their capital supply B.

The next result shows how the results of Theorem 1 change with shocks to economy.

Theorem 2 *The critical values $\hat{r}_i$ in Theorem 1 satisfy* $\frac{\partial \hat{r}_i}{\partial \hat{\gamma}} > 0$.

Proof : The borrower's zero profit condition is

$$\Pi(\hat{r}, \gamma, i) = \int_0^\infty Max[R - (\hat{r} + 1)B; -C] \, dF_i(R, \gamma) \; = \; 0 \tag{14}$$

From the implicit function theorem

$$\frac{\partial r}{\partial \gamma} = \frac{-\frac{\partial \Pi}{\partial \gamma}}{\frac{\partial \Pi}{\partial r}} > 0. \tag{15}$$

The inequality follows since both the numerator and denominator are negative (borrower expected profits decrease in the interest rate and increase in the economic state).□

As Theorem 1 indicates, the model has two equilibria, one in which only the risky firm issues debt and another in both firms are active. We now turn attention to the boundary between these two equilibria. Define a curve $R_{pool}(\gamma)$ to be the maximum interest rate for which safe firms will choose to issue debt, as a function of economic conditions. By Theorem 2, this curve slopes upward. Improving economic conditions make the safe firm able to bear higher interest rates before exiting the market.

Define the function $L_{RISKY}(\gamma)$ to be the lowest interest rate for which lenders earn nonnegative profits, assuming that (for now) it is exogenously specified that only risky firms are in the market. As an immediate application of Lemma 1b, $L_{RISKY}(\gamma)$ is a decreasing function of γ. Economic improvements are first-order stochastic improvements and so the lender is satisfied with a smaller face value in robust times. Define $L_{POOL}(\gamma)$ to be the analogous curve when it is exogenously specified that both firm types are active in the market. Since the safe firm is more profitable for the lender, the curve $L_{POOL}(\gamma)$ lies below the curve $L_{RISKY}(\gamma)$. Lenders demand a lower rate when the safe firm is present in the borrower pool.

The equilibrium interest rate schedule is shown in the heavy line[5] in Figure 2. Note that for economic states below γ^* the interest rate exceeds r_{POOL}, so that indeed the safe firm opts out of the market. As the economy improves beyond γ^*, $\hat{r}$ falls to the point where safe firms find it profitable to enter the market. That is, the interest rate is below the curve R_{POOL}. All else equal, such entry would entail a discrete jump in the lender's profit, since the safe firm is a more profitable customer. Hence the interest rate in this competitive market has a discrete drop to reflect the improved risk profile of the pool from the lender's perspective.

In general, Figure 2 illustrates that as economic conditions improve, the interest rate drops for two reasons. The direct effect is that each firm in the economy becomes more creditworthy; this is why the curves L_{POOL} and L_{RISKY} slope downward. An indirect effect is that economic improvements draw in marginal, safe firms whose projects are attractive to lenders. This effect is seen in the drop from the higher curve L_{RISKY} to the lower curve L_{POOL} at the point γ^*. This drop provides a sense in which adverse selection costs are countercyclical: given a positive shock to the economy, the interest rate for firms that were funded in the old regime falls by more than the amount justified by each firm's improved creditworthiness. As the next section shows, the opposite can be true when borrowers are ordered by first-order stochastic dominance.

[5] Curves are shown as linear for simplicity.

2.2 Firms Types Ordered by FSD

This section retains the assumption that shocks to the economy involve first-order stochastic dominance shifts. Here, however, I assume that firm types are also ordered by first-order stochastic dominance rather than the second-order stochastic dominance previously considered. To reflect this change, firms will be described as 'good' and 'bad' rather than 'safe' and 'risky.' First-order stochastic dominance implies

$$F_G(Z,\gamma) \leq F_B(Z,\gamma) \quad \forall Z, \;\; \forall \gamma \tag{16}$$

where G and B refer to the good and bad firm, respectively. This condition is equivalent to the assumption that the projects of the two firm have returns which satisfy

$$\tilde{r}_G(\gamma) \stackrel{d}{=} \tilde{r}_B(\gamma) + \tilde{\alpha} \tag{17}$$

for some nonnegative random variable $\tilde{\alpha}$.

Lemma 2 *Denoting expected borrower utility (by firm type) as*

$$U_i(\hat{r},\gamma) = \int_0^\infty \pi(Z,\hat{r}) f_i(Z,\gamma) dZ \tag{18}$$

and the expected utility of the lender from funding a firm of type i by

$$\overline{\rho}_i = \int_0^\infty \rho(Z,\hat{r}) f_i(Z,\gamma) dZ \tag{19}$$

it follows that

a) $U_G > U_B$ *for all interest rates* $\hat{r}$ *and all economic conditions* γ*.*
b) $U_i(\gamma_2) > U_i(\gamma_1)$ *for all interest rates* $\hat{r}$ *and economic conditions* $\gamma_2 > \gamma_1$*.*
c) $\overline{\rho}_G > \overline{\rho}_B$ *for all interest rates* $\hat{r}$ *and all economic conditions* γ*.*
d) $\overline{\rho}_i(\gamma_2) > \overline{\rho}_i(\gamma_1)$ *for all interest rates* $\hat{r}$ *and economic conditions* $\gamma_2 > \gamma_1$*.*

Proof: 1a) and 1b) follow from monotonicity of $\pi(Z,\hat{r})$. 1c) and 1d) follow from monotonicity of $\rho(Z,\hat{r})$. □

In this section, there is no conflict of interest analogous to that discussed after Lemma 1. Higher quality projects are preferred by both borrowers and lenders − contrast this result with last section, in which borrowers prefer risk and lenders prefer safety. High-quality borrower's more valuable residual claim makes them more prone to enter the market even when rates are high, as the following theorem shows.

Theorem 3 *Fixing a given economic state γ, there exist critical values $\hat{r}_1$ and $\hat{r}_2 > \hat{r}_1$ such that*
a) *If $r < \hat{r}_1$ then both firms choose to borrow.*
b) *If $r \in [\hat{r}_1, \hat{r}_2)$ then only the good firm chooses to borrow.*
c) *If $r \geq \hat{r}_2$ then no firms choose to borrow.*

Proof : The borrowers zero-profit condition is

$$\Pi(\hat{r}, \gamma, i) = \int_0^\infty Max[R - (\hat{r} + 1)B; -C] \, dF_i(R, \gamma) \ = \ 0 \qquad (20)$$

Noting that $\frac{\partial \Pi}{\partial \hat{r}} < 0$, it follows that for each firm type i there exists some cutoff interest rate $\hat{r}_i$ such that the firm will issue if and only if $r < \hat{r}_i$. Lemma 2a implies that $\hat{r}_2 > \hat{r}_1$. □

Again, high interest rates tend to force firms to exit the market. The differential tolerance of borrowers to high interest rates is reversed relative to that of last section. Had Stiglitz and Weiss admitted first-order stochastic dominance, their model would not have exhibited a trade-off. Higher interest rates extract more surplus from any given firm while simultaneously *raising* the quality of the borrower pool. The optimal interest rate in such a model would be the highest rate that any firm would be willing to bear. The lender's payoff profile is shown in Figure 3.

[Figure 3]

In contrast to Stiglitz and Weiss's analysis, the terms of the contract are set by issuers rather than by financial markets. Before turning attention to interest rates, however, I complete the analysis of incentives by showing how the entry/exit decisions depend upon the business cycle for exogenously specified interest rates.

Theorem 4 *The critical values $\hat{r}_i$ in Theorem 3 satisfy* $\frac{\partial \hat{r}_i}{\partial \hat{\gamma}} > 0$.

Proof : The borrower's zero profit condition is

$$\Pi(\hat{r}, \gamma, i) = \int_0^\infty Max[R - (\hat{r} + 1)B; -C] \, dF_i(R, \gamma) \ = \ 0 \qquad (21)$$

From the implicit function theorem

$$\frac{\partial r}{\partial \gamma} = \frac{-\frac{\partial \Pi}{\partial \gamma}}{\frac{\partial \Pi}{\partial r}} > 0 \tag{22}$$

The inequality follows since both the numerator and denominator are negative (borrower expected profits decrease in the interest rate and increase in the economic state).□

Theorem 4 is identical to Theorem 2, which indicates that this result is invariant to the nature of stochastic dominance assumed. However, because it is now the low-quality firm that exits the market first, we are interested in the boundary between pooling equilibria and equilibria in which only the high-quality firm issues debt. Define the curves $L_{POOL}(\gamma)$ and $L_{GOOD}(\gamma)$ to be the lowest interest rates for which lenders break even in these two scenarios. As in the last section, these curves slope downward since economic states are ordered by first-order stochastic dominance. Define the curve $R_{POOL}(\gamma)$ to be the lowest interest rate for which low-quality firms exit the market. By Theorem 4, this curve slopes upward.

Figure 4 plots equilibria as a function of economic state. Low γ correspond to economic conditions for which only the good firm issues bonds. For high γ all firms are active. The heavy line shows the equilibrium interest rate schedule, which accounts for the entry/exit decision of the bad firm.

[Figure 4]

Adverse selection costs are not necessarily procyclical. Consider a shock to the economy that moves the equilibrium from point C to point D. All firms become more creditworthy. This decrease is credit risk is met with a reduction in interest, just as would be expected. Similarly, consider the movement from point A to point B. Both equilibria involve only the good firm. Interest rates adjust to reflect reduced credit risk, just as in a full-information world.

Procyclical adverse selection costs can be seen in the movement from point B to point C. Consider a shock at point B that improves economic conditions slightly. Were interest rates to stay the same, or even fall, bad firms would now have the incentive to enter the market – they were indifferent at point B and this shock to γ increases the value of their residual claim. However, in such a case the lender would earn negative expected profits, given the discrete drop in the quality of the borrower pool.[6] Interest rates must rise in order to ensure that bad firms still opt out of the market. Effectively, the presence of bad firms − which are latent at point B − acts as a constraint to good firms that presents them from capturing the benefits of improved economic conditions.

The intuition is not limited to the two-type framework assumed here. The generalization of Figure 4 would involve a heavy line with multiple, smaller upward sloping line segments to reflect the entry of progressively lower quality firms as γ grows. The effect of this entry may partially, or completely, offset the benefit dues to improved creditworthiness of each firm in the economy which otherwise tends to reduce rates.

[6]For comparison, the point B' in figure 4 reflects the interest rate that lenders would demand were bad firms to enter the market at this point.

3 Discussion

This paper develops a model in which the entry of low quality firms in good times adversely affects high quality firms. Such entry partially offsets the direct, positive effect on good firms due to improved economic opportunities. Hence, adverse selection costs can be procyclical. This result is particularly surprising in light of the body of existing literature, which is almost unanimous in the conclusion that market imperfections are countercyclical in severity.

Time variation in adverse selection may be of independent interest, aside from its implications for debt markets. Adverse selection plays a key role in many areas, from labor markets and mergers to corporate governance and equity IPOs. These markets suffer from other imperfections, which also vary across the business cycle. In any such analysis, it would be useful to distinguish financial contracting provisions likely to be driven by asymmetric information but not by other imperfections.

The model admits only very simple one-period debt contracts, and thus does not touch on potentially important security design considerations. Hence the menu of "signaling" options is extremely limited. I do not allow firms to choose the maturity of their debt or the identity of their lenders (public versus private). These extensions might prove useful since different types of debt face different exposure to adverse selection.[7] Intertemporal variation in adverse selection could drive intertemporal substitutions between different forms of debt. Such an extension would need to involve a complete specification of the costs and benefits of each type of debt financing, which is beyond the scope of this paper.

[7]For example, short-term debt is one costly response to the adverse selection problem (Flannery 1986); bank financing is another (Diamond 1991, Rajan 1992).

References

[1] AZARIADAS, C., AND B. SMITH (1998), Financial Intermediation and Regime Switching in Business Cycles *American Economic Review*, 99, 516-536.

[2] BERNANKE, B., AND M. GERTLER (1989), Agency Costs, Net Worth, and Business Fluctuations *American Economic Review*, 79, 14-31.

[3] DIAMOND, D. (1991), Debt Maturity Structure and Liquidation Risk, *Quarterly Journal of Economics*, 106, 709-737.

[4] FLANNERY, M. (1986), Asymmetric Information and Risky Debt Maturity Choice, *Journal of Finance*, 41, 19-37.

[5] GREENWALD, B, STIGLITZ, J. AND A. WEISS (1984), Informational Imperfections in the Capital Market and Macroeconomic Fluctuations, *American Economic Review*, 74, 194-199.

[6] RAJAN, R. (1992), Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt, *Journal of Finance*, 47, 1367-2000.

[7] RAMPINI, A. (2004), Entrepreneurial Activity, Risk and the Business Cycle, *Journal of Monetary Economics*, 51, 555-573.

[8] SHARPE, S. (1990), Asymmetric Information, Bank Lending and Implicit Contracts: A Stylize Model of Customer Relationships, *Journal of Finance*, 45, 1069-1087.

[9] STIGLITZ, J. AND A. WEISS (1981), Credit Rationing in Markets with Imperfect Information, *American Economic Review*, 71, 393-410.

[10] STIGLITZ, J. AND A. WEISS (1992), Asymmetric Information in Credit Markets and Its Implications for Macro-Economics, *Oxford Economic Papers*, 44, 694-724.

[11] WILLIAMSON, S. (1987), Financial Intermediation, Business Failures, and Real Business Cycles, *Journal of Political Economy*, 95, 1196-1216.

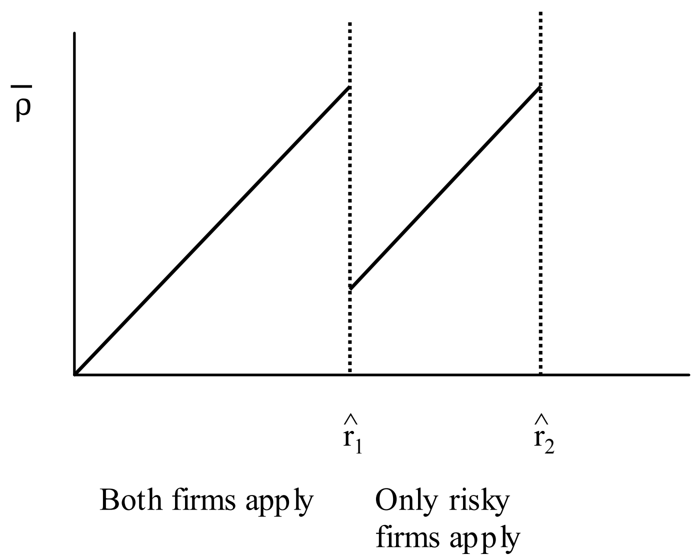

Figure 1

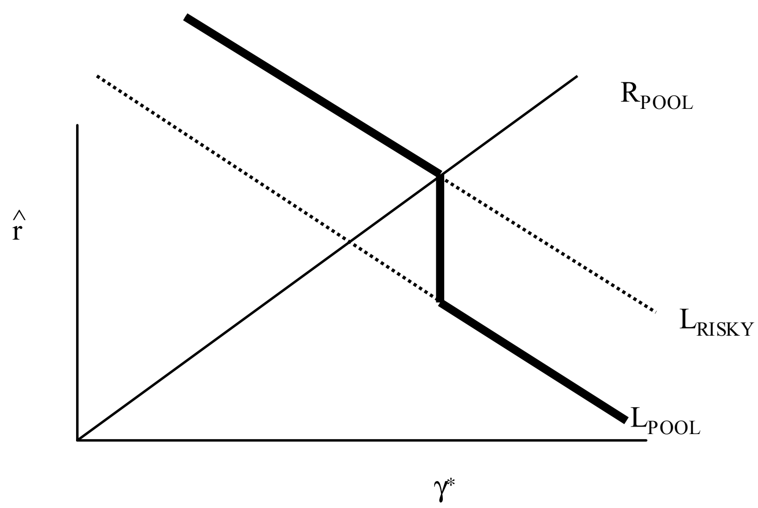

Figure 2

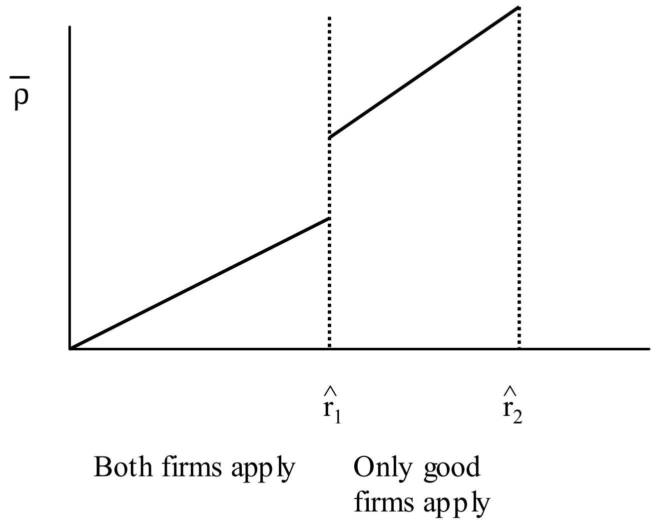

Figure 3

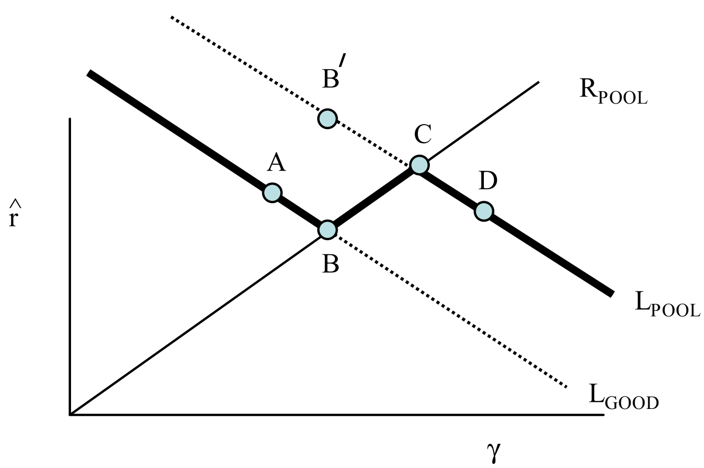

Figure 4