Credit Derivatives, Disintermediation and Investment Decisions

Alan D. Morrison*

Merton College and Saïd Business School,

University of Oxford

First Version: August, 2000

Revised: May, 2001

*Merton College, Oxford OX1 4JD, U.K. or alan.morrison@sbs.ox.ac.uk. This paper is a revised version of a chapter in my doctoral thesis. I am grateful to my supervisors, Colin Mayer and Hyun Shin, for their support and encouragement. I am also grateful to Xavier Freixas, William Wilhelm, Clara Raposa and to seminar participants in Oxford for comments and discussion.

Credit Derivatives, Disintermediation and Investment Decisions

The credit derivatives market provides a liquid but opaque forum for secondary market trading of banking assets. I show that when entrepreneurs rely upon the certification value of bank debt to obtain cheap bond market finance, the existence of a credit derivatives market may cause them to issue sub-investment grade bonds instead, and to engage in second-best behaviour. Credit derivatives can therefore *cause* disintermediation and thus reduce welfare. I argue that this effect can be most effectively countered by the introduction of reporting requirements for credit derivatives.

KEY WORDS: Credit derivative, monitoring, junk bonds, debt finance, capital structure.

JEL CLASSIFICATION: G24, G28, G34

CREDIT DERIVATIVES, DISINTERMEDIATION AND INVESTMENT

This paper examines the consequences for the real sector of disintermediation in the debt markets. The specific phenomenon which I study is the market for *credit derivatives*. A credit derivative is a trade in which one party, the *protection buyer*, makes periodic payments to another party, the *protection seller*, in exchange for which the protection seller indemnifies the protection buyer against any losses which he experiences as a consequence of the default of some credit-risky *reference asset*[1]. Banks are thus able to pass the default risk associated with their assets on to third parties whilst simultaneously retaining legal title to the assets. The market for these derivatives has expanded very rapidly from about $180 billion in 1997 to $893 billion in 2000 (British Bankers Association, 2000).

When discussing credit derivatives, practitioners typically highlight two characteristics which differentiate them from other secondary loan markets. Firstly, bankers stress that the ease with which credit derivatives may be traded allows them to manage concentration risk in their portfolios:

> The use of credit derivatives by banks has been motivated by the desire to improve portfolio diversification (synthetically) and to improve the management of credit portfolios. (Das, 1998, p.10)

As a consequence, bank-originated loans are emerging as an asset class which is actively traded, and many bank-originated loans are now held by non-banks (Masters, 1999). Currently, only 47% of the protection sellers in the credit derivatives market are banks (British Bankers Association, 2000).

The second important feature of credit derivatives trades is that borrowers are not typically informed that their loan is the reference asset for a transaction:

> [...] there is no reason why the reference entity or any third party should become aware of the existence of the trade. For this reason, OTC contracts frequently require the fact that the trade has been entered into be kept confidential. (Jakeways, 1999, p. 58)

Bankers justify this secrecy by saying that it is necessary to protect their relationship rents:

> [...] borrowers typically are unwilling to have their debt sold. Banks fear that if they sell a loan, they may lose the opportunity for future business with the borrower. (Caouette, Altman and Narayanan, 1998, p. 305)

I examine in this paper the consequences of this market for funding and investment decisions in the real sector. I consider an economy in which entrepreneurs raise debt finance to run one of two projects and I show that in the absence of credit derivatives, some borrowers will employ bank debt to signal their intention to run a first best project. I argue that banks whose assets are highly concentrated in a particular sector will exhibit risk aversion and hence may trade with a less concentrated counterparty in the credit derivatives market in order to diversify their portfolios, as above. When a bank is sufficiently risk-averse towards a particular asset, it will entirely cover its exposure to that asset. For the issuer of such an asset, the credit derivatives market will destroy the signalling value of bank debt and he will instead issue junk bonds and run a second-best project. Although *trades* in the secondary market for bank debt will be welfare-increasing the *existence* of the market will, in that it alters the decisions of corporations and reduces the volume of bank debt, be welfare-reducing.

The paper's arguments are developed in three stages as follows.

Firstly, I provide a model for credit derivatives trade. Much of the initial activity in the secondary market for bank debt was in response to inconsistencies in the regulatory framework for bank capital allocation. This paper is concerned solely with the use of credit derivatives to accomplish *risk sharing* by a bank which is concerned about illiquid and concentrated counterparty risks in its loan portflolio. To model risk sharing, I assume that the bank has a concave utility function for wealth: theoretical justification for my assumption is provided by

Froot and Stein (1998), who argue that banks are capital constrained as a result of informational problems and consequently that they will act to conserve capital so as to be able to profit from future investment opportunities.

The bank has special skills in that it can reduce the probability of asset failure by making a non-divisible investment in monitoring. The bank can buy protection from dispersed and risk-neutral traders against the failure of a proportion of its assets. I demonstrate that some trade will always occur. The bank's incentive to continue monitoring after purchasing protection is decreasing in the proportion of its holding which it protects. When the cost of monitoring is sufficiently high the bank will protect its entire position and will cease to monitor.

Difficulties associated with unenforceable monitoring in the wake of loan sales have been previously examined by Gorton and Pennacchi (1995) in a model in which loan sales occur because they are a cheaper form of funding than deposit taking: a risk-sharing motivation does not arise and so loan sales may be impeded by monitoring incentive compatibility problems. In my model loan sales can proceed even in the presence of such problems. Gorton and Pennacchi suggest that the selling institution may overcome the incentive compatibility problems either by issuing an implicit guarantee against default or by restricting its loan sale to a portion of its total holding of the asset. The former suggestion relies upon mis-pricing of either the guarantee or the sale as a consequence of risk-insensitive reserve requirements and does not arise in the context of my risk-sharing model. I endogenise the restriction upon the size of the sale in this paper by extending its scope to include the corporate's funding decision. Bank debt will be employed only by those corporates for whom the banks will optimally choose to perform partial loan sales.

The second part of the paper builds a model for corporate financing which rests upon the value which insider bank-held debt creates for the dispersed holders of publicly quoted securities. This approach was first suggested by Fama (1985): the model of this paper is similar to Holmström and Tirole (1997), augmented to allow for risk averse bankers and variable project quality. I consider cash-constrained entrepreneurs who use debt to finance one of two positive net present value projects. One project has a higher NPV, while the other yields non-transferable private benefits to the entrepreneur. By monitoring their borrowers, bankers can ensure that they select the first best project. This skill is denied to the dispersed holders of bonds[2].

Banks exhibit risk aversion and bond holders do not, so bank debt will *ceteris paribus* be more expensive than bond debt. Bank finance will only be selected by entrepreneurs when a verbal *ex ante* commitment to make a first best *ex post* trading decision is not credible.

With no secondary market for credit derivatives borrowers in this model are stratified in a way which accords with recent empirical work by Cantillo and Wright (2000)[3]. First best project selection is incentive compatible for the highest quality borrowers and they therefore issue investment grade bonds. The *ex ante* optimal financing for intermediate borrowers would involve pure bond financing with a commitment to first best behaviour. For these borrowers such a commitment is not *ex post* optimal and they therefore employ mixed financing: the presence of a bank as a guarantor of first best behaviour will attract cheap bond market funds. Mixed financing is not optimal for the weakest borrowers and they therefore rely upon junk bond finance.

This intermediation model builds upon insights from the delegated monitoring literature (Campbell and Kracaw, 1980; Diamond, 1984; Mayer, 1988; Hellwig, 1991; Boot and Greenbaum, 1993). Holmström and Tirole (1997) discuss certification in the context of a discussion of capitalisation and Besanko and Kanatas (1993) examine cross-monitoring when bank monitoring effort is unverifiable and use this to determine an optimal bank to public debt ratio. The deliterious effects of bank asset liquidity have been examined in a different context by Myers and Rajan (1998). Empirical papers by James (1987), Lummer and McConnel (1989) and Datta, Iskandar-Datta and Patel (1999) support the suggestion that bank cross-monitoring creates value for dispersed claim-holders.

The third part of the paper examines the way in which financing decisions will be affected by the introduction of a credit derivatives market which may diminish the signalling value of bank debt. Entrepreneurs will only employ mixed funding in the presence of a secondary market for bank debt when it is incentive compatible for their bankers to retain a portion of the risk associated with the debt and to continue to monitor it. When this is not the case they will instead issue sub-investment grade bonds and will run second best projects. The opacity of the credit derivatives market prevents bankers from committing to retain a significant part of the assets which they originate. It will therefore reduce the number of first-best projects which are run and hence will be welfare-reducing.

The paper is organized as follows. In section 1 I describe the financing procedure, the project variables, the activities of the bank and the preferences of the bank and the bond holders. Section 2 describes how project selection is performed. In section 3 I examine the operation of the credit derivative market and derive conditions for the bank to continue monitoring in the wake of a credit derivatives trade. Section 4 describes the intermediation model and examines the effects of the credit derivatives market upon corporate financing decisions and upon project selection. Section 5 contains a discussion of my results and concludes. The appendix contains the proofs.

1 The Model

Consider an entrepreneur who wishes to invest in a project of size \$2. The project will return a verifiable cashflow of 0 if it fails or $R > 0$ if it succeeds. There are two types of projects, G (good) and B (bad), which succeed with respective probabilities p_H and $p_L \equiv p_H - \Delta p < p_H$. Type B projects generate a non-verifiable private benefit $B > 0$ for the entrepreneur; there are no private benefits associated with type G projects. I assume that type G projects are superior to type B projects and that both projects have positive net present value:

$$p_H R > p_L R + B > 2. \tag{1}$$

The assumption of positive NPV is made to facilitate the examination of the choice between bank and bond market financing in the presence of moral hazard. It may be interpreted as a statement about the relative merits of two projects for which finance may be raised: other investment opportunities are ignored.

Suppose that the entrepreneur is wealth-constrained so that he needs to raise the funds for investment by issuing debt securities. There are two sources of debt finance: a bank and a market for bonds.

Two features distinguish the bank from the bondholders. Firstly, bank debt carries tough covenants which are designed to give the bank leverage over the borrower. Such leverage is not available to the holders of securitized debt, partly because the covenants on this debt are less restrictive and partly due to coordination and free-rider problems. I use the term *monitoring* to describe the bank's use of its strong bargaining position. The bank's monitoring activities are unverifiable and hence uncontractible - they are performed solely to increase the utility which the bank derives from extending credit. When the bank monitors a project, it can ensure that it is of type G at a fixed non-divisible cost to the bank of M.

The second differentiating feature of the bank is its risk aversion: this assumption is discussed in the introduction. I wish to examine the risk-sharing motivation for credit derivatives and so I assume that the dispersed investors in bonds and credit derivatives have no concentration problems and are risk-neutral. For a given project this will render the costs of bank loans higher than those of bonds.

I make the simplifying assumption that the bank extends credit in units of 1. The bank's one-period investment decisions are selected so as to maximise the expected value of a separable utility function

$$V(z,\rho) = u(z) - \rho \tag{2}$$

where $u(.)$ is strictly increasing, twice continuously differentiable and concave, z is the income which the project generates and ρ is the cost of monitoring effort. $u(.)$ is normalised so that $u(0) = 0$. The dispersed investors in bonds derive utility z from a time 1 expected cashflow of z.

The funding activities and project management process are ordered according to figure 1.

[Figure 1]

At time t_0, E approaches the fund providers and offers them a contract which promises them a fixed payment at t_3 in exchange for a t_0 investment of 1. The project type is non-verifiable and hence does not appear in the contract. Bond market investors know when the bank has extended a credit line to E. An entrepreneur who borrows money from the bank is willingly and visibly subjecting himself to the monitoring process.

At time t_1, the bank has a single opportunity to buy protection against the risk of default by E, using a credit derivative.

At time t_2, the entrepreneur selects the project type which he will run. Although bank monitoring is not provable in a court it affects the entrepreneur's behaviour. If he monitored he will select the type G project. His selection will otherwise be governed by the funding costs to which he is subject.

At time t_3 the project terminates in state 0, 1 or 2 and the returns are apportioned between the various claimholders.

I will shortly examine the solution of the game in the following fashion. I firstly examine the t_2 project selection decision of the entrepreneur. I then examine the t_1 trades which will occur in the credit derivatives market. I show that the bank will elect either to sell a fixed proportion of its position and to continue to monitor the project or to sell its entire position and cease to monitor.

I then derive the t_0 financing decision of the entrepreneur. As a consequence of the bank's risk aversion, bank financing is *ceteris paribus* more expensive than bond financing so that bank financing will be employed only as a precommitment to first best project selection. If investors rationally anticipate loan sales and a consequential cessation of monitoring by banks the signalling value of bank debt will be destroyed and a sub-optimal project will be selected.

2 Project Selection

At time t_2 the entrepreneur decides whether to select a good project or a bad one. If mixed financing between the bank and the bond market was originally arranged the entrepreneur would prefer to select a bad project. If the bank is still monitoring the entrepreneur then a good project will be selected. If the bank has sold its entire position through the credit derivatives market then a bad project will be selected. If non-mixed financing was originally selected then the lender rationally anticipated the entrepreneur's decision: it will depend upon the specifics of the project as detailed below.

3 The Credit Derivatives Market for Mixed Financings

I consider the behaviour of a bank which is holding a loan which has been created as part of a mixed financing package. The loan cost \$1, has redemption value $\$R > \$1$ and will yield 0 if it fails. It follows from my earlier observations that in the absence of monitoring the entrepreneur will select a bad project.

Suppose that it is possible for the bank to pay a fee ϕ to a counterparty (the protection seller, or PS) in exchange for which the counterparty will indemnify the bank against any losses experienced on a proportion π of the loan, or reference asset, in the event of bankruptcy. The bank retains legal ownership of the loan and in particular has exclusive rights to perform monitoring and to enforce loan covenants. In this section I examine the effect of this type of trade upon the bank's monitoring decision.

3.1 Conditions for Trade

By assumption, the monitoring effort which the banker exerts is non-divisible and he will therefore decide either to continue with all of his monitoring effort or to stop altogether. To determine which situation obtains, write $f(\pi, \phi)$ and $g(\pi, \phi)$ respectively for the banker's utility after paying ϕ for protection on a proportion π of his position in the reference asset in the cases where he continues to and does not continue to monitor. Then:

$$f(\pi, \phi) = p_H u(R - \phi) + (1 - p_H) u(\pi R - \phi) - M$$
$$g(\pi, \phi) = p_L u(R - \phi) + (1 - p_L) u(\pi R - \phi).$$

Monitoring is worthwhile if and only if $f(\pi, \phi) \geq g(\pi, \phi)$.

Let $\phi_m(\pi) \equiv (1 - p_H) \pi R$ be the minimum cost at which trade can occur on a proportion π of the loan when monitoring is performed by the banker and let $\phi_{nm}(\pi) \equiv (1 - p_L) \pi R$ be the corresponding minimum cost when monitoring is not performed by the banker. Assume that $g(0, \phi_m(0)) < f(0, \phi_m(0))$, equivalently that $u(R) > \frac{M}{\Delta p}$: in the absence of credit derivatives this is a necessary condition for the bank to monitor and hence for mixed financing to be adopted.

Proposition 1 *There exist π_m, π_{nm} such that*

1. *If trade occurs at $\phi_m(\pi)$ then the banker will elect to continue to monitor precisely when $\pi \leq \pi_m$;*

2. *If trade occurs at $\phi_{nm}(\pi)$ then the banker will elect to continue to monitor precisely when $\pi \leq \pi_{nm}$;*

3. $\pi_{nm} > \pi_m$.

Assume that the credit market is competitive and that the banker is able to make credible take it or leave it offers when bargaining over price. Then trade will always occur at the minimum price which is acceptable to the PS: in other words, at $\phi_m(\pi)$ with monitoring and $\phi_{nm}(\pi)$ without monitoring. Since the banker's monitoring effort is unverifiable the PS will assume that monitoring occurs only when $f > g$. Proposition 2 describes the conditions under which monitoring will then occur.

Proposition 2 *The banker will protect a proportion* π_m *of his position if*

$$f(\pi_m, \phi_m(\pi_m)) \geq g(1, \phi_{nm}(1)).$$

In this case, he will continue to monitor and the survival prospects for the reference asset will be unaffected. If $f(\pi_m, \phi_m(\pi_m)) < g(1, \phi_{nm}(1))$ *then the banker will purchase protection upon his entire holding of the reference asset and will cease monitoring.*

Note that trade in both cases Pareto-dominates the no-trade situation so that some trade will inevitably occur: the consequential increase in the expected utilities of both counterparties is the "risk-sharing" effect which is usually cited as justification for the credit derivatives market. I demonstrate below that trade in the entire asset will be anticipated by the entrepreneur who will not then borrow from the bank, with the socially undesirable consequence of lower expected production levels.

Illustrations of these effects appear in figures 2 and 3, in which the utility $v(\pi)$ which the banker obtains from trade in a proportion π of his position in the reference asset is plotted in the special case where $u(z) = 1 - e^{-1.5z}$, $M = 0.01$, $R = 1.3$ and $p = 0.05$. In the former, we can see that the banker extracts a higher utility from trading at π_m than at 1. In the latter, the banker will elect to hedge his entire position and the entrepreneur will select the second best project. Note that in the case where monitoring continues, the drop in v which occurs at π_m is so substantial as to render v negative and trade impossible in a right neighborhood of that point.

[Figure 2]

[Figure 3]

4 A Precommitment Model for Corporate Financing Decisions

In this section I develop a model for corporate debt financing decisions which balances the precommitment value of bank debt against its higher costs. I then examine the consequences for this model of a market for credit derivatives.

4.1 No Credit Derivatives Trade Possible

Assume firstly that there will be no time t_1 opportunity for debt sales. In this case, the entrepreneur can use bank financing to precommit to good project selection provided the rate R which he offers to the bank satisfies two criteria:

1. *The monitoring constraint.* The banker will elect to monitor if $p_H u(R) - M \geq p_L u(R)$: equivalently, if
$$R \geq R_{mc} \equiv u^{-1}\left(\frac{M}{\Delta p}\right);$$
2. *The participation constraint.* The banker will lend to a type G project provided $p_H u(R) - M \geq u(1)$: equivalently, if
$$R \geq R_{pm} \equiv u^{-1}\left(\frac{u(1)+M}{p_H}\right).$$

The entrepreneur will therefore pay $R_m \equiv \max(R_{mc}, R_{pm})$ to achieve precommitment. Note that $R_m = R_{mc}$ iff $M \geq \frac{\Delta p u(1)}{p_L}$. It is convenient and does not materially affect our results to assume that $R > R_m + \frac{1}{p_H}$. The main result on financing is the following:

Proposition 3 *In the absence of a credit derivatives market, the entrepreneur will make the following financing and project selection decisions:*

1. *If $R \geq \bar{R} \equiv \frac{B}{\Delta p} + \frac{2}{p_H}$ then the entrepreneur will employ exlusively bond market finance at a price of $\frac{1}{p_H}$ and will run a good project;*
2. *If $\bar{R} > R \geq \underline{R} \equiv \frac{B}{\Delta p} + \frac{R_m p_H - 1}{\Delta p}$ then the entrepreneur will employ mixed financing. A good project will be selected, bond market financing costs will be $\frac{1}{p_H}$ and bank borrowing costs will be R_m;*
3. *If $R < \underline{R}$ then the entrepreneur will select pure bond market finance at rate $\frac{1}{p_L}$ and will run a bad project.*

Proof: Firstly, note that *ceteris paribus*, bank finance will be more expensive than bond finance. Bank finance will therefore be employed only when it provides certification value. The cost of finance from the risk neutral bond market investors for a good project will be $\frac{1}{p_H}$. Certification will not be required when good project selection is incentive compatible at this rate. This will be the case precisely when $p_H \left(R - \frac{2}{p_H}\right) \geq B + p_L \left(R - \frac{2}{p_H}\right)$, or when $R \geq \bar{R}$, as required.

If $R < \bar{R}$ then good project selection is not incentive compatible and pure bond market financing at $\frac{1}{p_H}$ will be impossible. The entrepreneur can however obtain issue bonds at this rate provided he does so as part of a mixed financing package with bank debt at R_m which will provide a precommitment to good project selection. This choice will dominate the alternative of pure bond finance with a bad project provided $p_H \left(R - R_m - \frac{1}{p_H}\right) \geq B + p_L \left(R - R_m - \frac{1}{p_H}\right)$, or $R \geq \underline{R}$, as required.

Finally, if $R < \underline{R}$ then mixed finance is dominated for the entrepreneur by management of a bad project with pure bond financing at $\frac{1}{p_L}$. Q.E.D.

Proposition 3 is compatible with observed financing patterns. The highest quality borrowers are those for whom R exceeds $\bar{R}$. These borrowers are able to finance themselves by issuing only investment grade bonds, which have a low cost of funds ($\frac{1}{p_H}$). Lower quality borrowers ($\bar{R} > R \geq \underline{R}$) can still issue high grade bonds, but must also employ banks to certify the quality of their projects. We can regard their bonds as having a lower investment grade rating. Entrepreneurs with a poor project ($R < \underline{R}$) will not find it optimal to give up their private benefits B in exchange for the certification which a bank loan provides and will instead finance themselves using high yielding (junk) bonds.

[Figure 4]

The proposition is illustrated in figure 4. Note that the difference between $\bar{R}$ and $\underline{R}$ and hence their intersection point $\bar{M}$ is independent of the private benefit B which accrues to the entrepreneur when he manages a bad project. R_m is guaranteed to be below $\underline{R}$ for every value of M as shown provided $B > \frac{\Delta p}{p_H}$. Investment grade bond finance will be employed in the vertically shaded region; mixed finance will be employed in the horizontally shaded region bounded by the y axis, $\bar{R}$ and $\underline{R}$; in the region shaded with diagonal lines junk bond financing will occur. Note from the figure that junk bonds are used when either the cost of monitoring M is high or when the return R from a successful project is low.

4.2 Credit Derivatives Trade Possible

We saw in section 3 that credit derivatives will always trade in the wake of mixed financings. If they do not cause a cessation of monitoring then they will increase the utility of both the bank and of the dispersed bond holders and are thus unambiguously welfare-increasing.

If continued monitoring is not incentive compatible for banks in the presence of a credit derivatives market then intermediate quality borrowers will cease to use bank debt to pre-commit to good project and so no risk-sharing opportunities will exist. To investigate the circumstances in which this will occur, consider the general case in which the bank lends at a rate R. If credit derivatives are possible then to ensure that bank debt retains its certification value, we require $f(\pi_m, \phi_m(\pi_m)) \geq g(1, \phi_{nm}(1))$, or equivalently:

$$M \leq h(R, M) \equiv p_H u(R\{1 - \pi_m(1 - p_H)\}) + (1 - p_H) u(R\pi_m p_H) - u(Rp_L). \quad (3)$$

In other words, bank debt has no certification value when $M > h(R, M)$. I demonstrate in this section that this will be the case throughout the mixed finance region whenever the bank is sufficiently risk averse. I require the following result:

Lemma 4 *If the bank's relative risk aversion* $-x\frac{u''(x)}{u'(x)}$ *exceeds* 1 *then* $\frac{\partial h}{\partial R} < 0$ *whenever* $\pi_m > \frac{p_L}{p_H}$.

Note that $\pi_m = 1 > \frac{p_L}{p_H}$ when $M = 0$ so it follows from lemma 4 that $\frac{\partial h}{\partial R}(R, 0) < 0$. It follows that when $M = 0$, $h(R, M) < M$. I prove in the appendix that $\frac{\partial h}{\partial M} < 0$. Since $h(0, M) \equiv 0$, it follows that when the relative risk aversion of the bank exceeds 1, equation 3 is violated throughout the mixed finance region. In other words, we have the following result:

Proposition 5 *When the relative risk aversion of the bank exceeds* 1*, the banker will always prefer to use the credit derivatives market to purchase protection against loan default rather than to retain his loan and to continue to monitor. In consequence, bank loans will have no certification value in the presence of an opaque credit derivatives market. Intermediate quality borrowers will issue junk bonds and will engage in second best projects.*

5 Discussion and Conclusion

In this section I review my argument, discuss its implications and finally make a policy recommendation.

The market for credit derivatives is often justified on the basis that it enables risk-sharing. In section 3 we saw that this effect can be wealth-increasing for both counterparties. The difficulty with this rationale is that it ignores the wider role of bank debt as a bonding device for lower quality credits. We saw in section 4 that some borrowers will use some bank funding to signal quality of project to the bond market and hence to secure a lower cost of funds. This will ensure that they make a first-best investment decision.

The introduction of credit derivatives affects this process by taking from bond investors the benefits associated with bank monitoring. Compelling the bank to offer the debt which it sells firstly to the bond holders as in a rights issue will not mitigate this effect. When a bank ceases to monitor a wealth *destruction* occurs as its counterparties in the debt sales will not be able to replicate its monitoring effort. Proposition 5 demonstrates that such a wealth destruction is inevitable whenever the lender is sufficiently risk averse. Bond investors will anticipate this destruction and bank debt will lose its certification value. In consequence, entrepreneurs will react to the credit derivatives market by substituting junk bond finance for mixed finance, and reducing the quality of their projects.

Why when bank certification fails can a market intermediated certification service not act as a substitute? Such a service is provided by the ratings agencies, who provide a monitoring service which is paid for by borrowers[4]. The importance of ratings has increased in recent years, particularly in continental Europe where monitoring has traditionally been provided by banks. This is in line with a reduction in the validity of bank certification, as predicted by our model. However, I argue that for three reasons, ratings agencies can provide only a partial substitute for bank monitoring. The guarantee of confidentiality which a bank provides may encourage its clients to reveal more information to it (Bhattacharya and Chiesa, 1995); if the information revealed through monitoring is too detailed to contract upon then the delegation of decision-making to the lender is optimal (Boot, Greenbaum and Thakor, 1993); banks are better able to perform Pareto-improving renegotiation than dispersed bond-holders (Berlin and Mester, 1992; Gorton and Kahn, 2000). Although disintermediation will result in an increased role for the ratings agencies, a reduction in the quality of projects which intermediate quality borrowers perform can therefore still be anticipated. Some evidence exists which is consistent with my findings: a significant increase in the volume of credit derivatives trades in Europe has coincided with a tenfold increase in junk bond issuance[5].

As discussed in the introduction, *de facto* risk aversion is often cited as a rationale for credit derivatives trade and it has an important role to play in our model. When banks are performing credit derivatives for reasons other than a desire to share risk (for example, to take advantage of inconsistencies in capital adequacy regulations), the problems which we discuss will not arise. In fact Gorton and Pennacchi (1995) demonstrate that in this case, secondary market trades in debt are consistent with a continued certification role. An assumption of bank risk aversion is not however unreasonable. Banks acquire information and hence the ability to monitor as a consequence of long-term relationships. When lending is relationship-driven, banks suffer from concentration of risks and in consequence display risk aversion towards the assets of the counterpart.

My funding model is closely related to that of Holmström and Tirole (1997), in which borrowers are stratified not by the quality of their projects, but by their capital endowment. Holström and Tirole demonstrate that firms with low levels of capital will rely upon mixed finance to obtain funds. One can envision a simple extension of my model in which firms are further distinguished by their capital allocation. In this case, a sufficiently high capital endowment would insulate a firm from the effects which I have described. A possible consequence of financial disintermediation might therefore be improved capitalisation of the real sector.

Other authors have explained the choice between bank and bond finance without regard to cross-monitoring. I conclude my discussion with a brief consideration of the consequences of an opaque credit derivatives market for some of their models. Diamond (1991) shows how bank monitoring can substitute for firm reputation. My argument suggests that a credit derivatives market might render such a substitution impossible and hence might render reputation acquisition harder. Boot and Thakor (1997) argue that market mechanisms are better for resolving informational problems relating to project quality, while banking relationships are most appropriate when the informational problem relates primarily to moral hazard. I have shown that the latter role for banks is eroded when credit derivative purchase dominates monitoring. Bolton and Freixas (2000) provide a model in which banks are better able to renegotiate loans when borrowers are financially fragile, but are also more expensive, as a consequence of costly capital adequacy requirements. Weaker borrowers will use bank finance. A simple extension of my argument implies that bankers who elect to purchase protection on loans will have no incentive to expend resources on renegotiation in the wake of a default and hence that the credit derivatives market will again lead to reduced levels of bank-originated debt.

The value destruction which I have identified is a consequence of the banker's inability to precommit *ex ante* to retain assets when it is not *ex post* incentive compatible to do so. This is a result of the opacity of the credit derivatives market, just as the entrepreneur's commitment problems are a consequence of information asymmetries which exist between himself and his investors.

An obvious policy suggestion arises. If bankers were required to report all credit derivatives trades then they would be able to commit to the provision of monitoring services so that the risk-sharing benefits of the market could be combined with effective mixed financing packages. Market players respond to this suggestion by arguing that disclosure would cause unnecessary damage to borrower relationships and hence might prevent risk-sharing from occurring atall. I have demonstrated that borrowers have a valid claim to be informed of the actions of their bankers and that communication failures are themselves eroding relationships.

Proofs

Proof of Proposition 1

1. By assumption, $g(0,\phi_m) < f(0,\phi_m)$ and $f(1,\phi_m(1)) = u(Rp_H) - M < u(Rp_H) = g(1,\phi_m(1))$. Differentiating the expressions for f and g,

   $$\frac{d}{d\pi}(f-g)(\pi,\phi_m(\pi)) = Rp_H\Delta p\{u'(R(1-\pi(1-p_H))) - u'(R\pi p_H)\} < 0,$$

   and the result follows.

2. It suffices to observe that

   $$\frac{d}{d\pi}(f-g)(\pi,\phi_{nm}(\pi)) = Rp_H\Delta p\{u'(R(1-\pi(1-p_L))) - u'(R\pi p_L)\} < 0.$$

3. Holding π fixed,

   $$\frac{\partial}{\partial\phi}(f-g)(\pi,\phi) = \mu[u'(\pi R-\phi) - u'(R-\phi)] > 0.$$

   Since $\phi_{nm} > \phi_m$, $(f-g)(\pi_m,\phi_{nm}(\pi_{nm})) > 0$, so that as required, $f(\pi,\phi_{nm}(\pi))$ and $g(\pi,\phi_{nm}(\pi))$ have not crossed over at $\pi = \pi_m$.

Proof of Proposition 2

The banker will elect to sell the proportion π of his position which will maximise his expected utility from trade. This is given by Lemma 6:

Lemma 6 *The banker's expected utility function from trade in a proportion π of his position in the reference asset is given by*

$$v(\pi) = \begin{cases} f(\pi,\phi_m(\pi)), & 0 \le \pi \le \pi_m \\ f(\pi,\phi_{nm}(\pi)), & \pi_m < \pi < \pi_{nm} \\ g(\pi,\phi_{nm}(\pi)), & \pi_{nm} \le \pi \le 1 \end{cases}$$

Proof: If $\pi \in [0, \pi_m]$ the PS can be sure that monitoring will be performed so that trade will occur at $\phi_m(\pi)$.

If $\pi \in (\pi_m, \pi_{nm})$ then if the PS sells protection at $\phi_m(\pi)$, monitoring will not be performed and he will have negative expected utility: trade cannot occur on this basis. Restricting attention to pure strategies, the PS will sell protection at $\phi_{nm}(\pi)$. For $\pi < \pi_{nm}$, $f(\pi, \phi_{nm}(\pi)) > g(\pi, \phi_{nm}(\pi))$, so in this range the banker will continue to monitor and will extract an expected utility of $f(\pi, \phi_{nm}(\pi))$. Since the banker monitors in this range, he will experience a drop in expected utility at π_m caused by the jump in the cost of protection and equal to $u(\phi_{nm}(\pi_m)) - u(\phi_m(\pi_m))$. Note that because he is not paying for the monitoring which occurs in this range, the PS will have a positive expected utility of $\pi\Delta pR$.

If $\pi \in [\pi_{nm}, 1]$ the PS can be sure that monitoring will not occur. He will charge $\phi_{nm}(\pi)$ for protection and will extract an expected utility of zero from the trade. There is no discontinuity in the expected utility of the banker as π increases through π_{nm}; his expected utility from the trade is now $g(\pi, \phi_{nm}(\pi))$. Q.E.D.

$$\frac{d}{d\pi}f(\phi, \phi_m(\pi)) = Rp_H(1 - p_H)\{u'(\pi Rp_H) - u'(R(1 - \pi(1 - p_H)))\} > 0,$$

so $v(.)$ is increasing between 0 and π_m. Similarly,

$$\frac{d}{d\pi}g(\pi, \phi_{nm}(\pi)) = p_L R\{p_L u'(R(1 - \pi(1 - p_L))) + (1 - p_L)u'(Rp_L)\} > 0,$$

so $v(.)$ is increasing for $\pi \in [\pi_{nm}, 1]$. The only discontinuity in v occurs at π_m, where $\lim_{\pi \uparrow \pi_n} v(\pi) > \lim_{\pi \downarrow \pi_n} v(\pi)$. The result is therefore immediate.

Proof of Lemma 4

Assume that $-x\frac{u''(x)}{u'(x)} > 1$.

$$\begin{aligned}\frac{\partial \pi_m}{\partial R} &= \frac{\{1-\pi_m(1-p_H)\}u'(R(1-\pi_m(1-p_H))) - p_H\pi_m u'(\pi_m R p_H)}{(1-p_H)Ru'(R(1-\pi_m(1-p_H))) + p_H R u'(\pi_m R p_H)} \\ &< 0, \text{ since by assumption, } xu'(x) \text{ is decreasing in } x.\end{aligned}$$

$$\begin{aligned}\frac{\partial h}{\partial R} &= \frac{\partial \pi_m}{\partial R} R p_H (1-p_H)\left[u'(Rp_H\pi_m) - u'(R\{1-\pi_m(1-p_H)\})\right] \\ &\quad + p_H\{1-\pi_m(1-p_H)\}u'(R\{1-\pi_m(1-p_H)\}) \\ &\quad + (1-p_H)p_H\pi_m u'(R\pi_m p_H) - p_L u'(Rp_L) \\ &< p_H\{1-\pi_m(1-p_H)\}u'(R\{1-\pi_m(1-p_H)\}) \\ &\quad + (1-p_H)p_H\pi_m u'(R\pi_m p_H) - p_L u'(Rp_L)\end{aligned}$$

Observe that since $xu'(x)$ is decreasing in x,

$$(1-\pi_m(1-p_H))u'(R(1-\pi_m(1-p_H))) < \pi_m p_H u'(R\pi_m p_H),$$

so

$$\begin{aligned}\frac{\partial h}{\partial R} &< \pi_m p_H u'(R\pi_m p_H) - p_L u'(Rp_L) \\ &< 0 \text{ if } \pi_m > \frac{p_L}{p_H},\end{aligned}$$

which concludes the proof.

Proof that $\frac{\partial h}{\partial M} < 0$.

Direct differentiation yields

$$\frac{\partial h}{\partial M} = \frac{p_H(1-p_H)}{\Delta p}\frac{u'(R(1-\pi_m(1-p_H))) - u'(R\pi_m p_H)}{(1-p_H)u'(R(1-\pi_m(1-p_H))) + p_H u'(R\pi_m p_H)},$$

so $\frac{\partial h}{\partial M} > 0$ if and only if

$$p_L(1-p_H)u'(R(1-\pi_m(1-p_H))) > p_H(1-p_L)u'(R\pi_m p_H).$$

Since $R(1-\pi_m(1-p_H)) > R\pi_m p_H$ and $p_L - p_L p_H < p_H - p_L p_H$, this is not the case and $\frac{\partial h}{\partial M} < 0$.

Notes

[1]The specific structure which we describe is a *Default Swap*. See Tavakoli (1998) for a detailed survey of credit derivative instruments and trades.

[2]Monitoring could be achieved by coalitions of bond-holders. We assume that as a consequence of coordination problems this can only occur when the members of the coalition have individually large holdings and thus exhibit risk aversion. In this case such coalitions will be indistinguishable from our banks.

[3]Cantillo and Wright demonstrate that firms operating in the safest markets tap bond markets while firms with poorer prospects typically rely upon intermediated finance. While they justify their empirical results in terms of the ability of banks to renegotiate after default they are also susceptible to explanation in terms of certification and monitoring.

[4]See Cantor and Packer (1994) for a survey of the operation of the ratings agencies.

[5]'Europe: A credit market in waiting', *International Financing Review* 1237, 1998.

References

Berlin, M., and L. Mester, 1992, "Debt Covenants and Renegotiation," *Journal of Financial Intermediation*, 2, 95 – 133.

Besanko, D., and G. Kanatas, 1993, "Credit Market Equilibrium with Bank Monitoring and Moral Hazard," *Review of Financial Studies*, 6, 213–232.

Bhattacharya, S., and G. Chiesa, 1995, "Proprietary Information, Financial Intermediation, and Research Incentives," *Journal of Financial Intermediation*, 4, 328 – 357.

Bolton, P., and X. Freixas, 2000, "Equity, Bonds and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information," *Journal of Political Economy*, 108, 324 – 351.

Boot, A. W. A., and A. V. Thakor, 1997, "Financial System Architecture," *Review of Financial Studies*, 10, 693 – 733.

Boot, A. W. A., and S. I. Greenbaum, 1993, "Bank Regulation, Reputation and Rents" in C.Mayer, and X.Vives (eds.), *Capital Markets and Financial Intermediation*, Cambridge University Press, Cambridge.

Boot, A. W. A., S. I. Greenbaum, and A. V. Thakor, 1993, "Reputation and Discretion in Financial Contracting," *American Economic Review*, 83, 1165 – 1183.

British Bankers' Association, 2000, *Credit Derivatives Report*, BBA, London.

Campbell, T. S., and W. A. Kracaw, 1980, "Information Production, Market Signalling and the Theory of Financial Intermediation," *Journal of Finance*, 35, 863–882.

Cantillo, M., and J. Wright, 2000, "How Do Firms Choose their Lenders? An Empirical Investigation," *Review of Financial Studies*, 13, 155 – 189.

Cantor, R., and F. Packer, 1994, "The Credit Rating Industry," *Federal Reserve Bank of New York Quarterly Review*, 19, 1 – 26.

Caouette, J. B., E. I. Altman, and P. Narayanan, 1998, *Managing Credit Risk*, Wiley Frontiers in Finance, John Wiley & Sons, Inc.

Das, S., 1998, "Credit Derivatives Instruments" in S.Das (ed.), *Credit Derivatives: Trading and Management of Credit and Default Risk*, John Wiley and Sons (Asia), Singapore, pp. 7–77.

Datta, S., M. Iskandar-Datta, and A. Patel, 1999, "Bank Monitoring and the Pricing of Corporate Debt," *Journal of Financial Economics*, 51, 435–449.

Diamond, D. W., 1984, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51, 393–414.

Diamond, D. W., 1991, "Monitoring and Reputation: The Choice Between Bank Loans and Directly Placed Debt," *Journal of Political Economy*, 99, 689–721.

Fama, E. F., 1985, "What's Different About Banks?" *Journal of Monetary Economics*, 15, 29–39.

Froot, K. A., and J. C. Stein, 1998, "Risk Management, Capital Budgeting, and Capital Structure Policy for Financial Institutions: An Integrated Approach," *Journal of Financial Economics*, 47, 55 – 82.

Gorton, G. B., and G. G. Pennacchi, 1995, "Banks and Loan Sales: Marketing Nonmarketable Assets," *Journal of Monetary Economics*, 35, 389–411.

Gorton, G., and J. Kahn, 2000, "The Design of Bank Loan Contracts," *Review of Financial Studies*, 13, 331 – 364.

Hellwig, M., 1991, "Banking, financial intermediation and corporate finance" in A.Giovanni, and C.Mayer (eds.), *European Financial Integration*, Cambridge University Press, Cambridge, U.K.

Holmström, B., and J. Tirole, 1997, "Financial Intermediation, Loanable Funds and the Real Sector," *Quarterly Journal of Economics*, 112, 663 – 691.

Jakeways, J., 1999, "The Legal Nature of Credit Derivatives" in A.Hudson (ed.), *Credit Derivatives: Law, Regulation and Accounting Issues*, Street & Maxwell, London, chapter The Legal Nature of Credit Derivatives, pp. 47 – 63.

James, C., 1987, "Some Evidence on the Uniqueness of Bank Loans," *Journal of Financial Economics*, 19, 217–235.

Lummer, S. L., and J. C. McConnel, 1989, "Further Evidence on the Bank Lending Process and the Capital Market Response to Bank Loan Agreements," *Journal of Financial Economics*, 25, 99–122.

Masters, B., 1999, "Credit Derivatives and Loan Portfolio Management" in J. C.Francis, J. A.Frost, and J. G.Whittaker (eds.), *The Handbook of Credit Derivatives*, McGraw-Hill, New York, pp. 43 – 86.

Mayer, C., 1988, "New Issues in Corporate Finance," *European Economic Review*, 32, 1167–88.

Myers, S. C., and R. G. Rajan, 1998, "The Paradox of Liquidity," *Quarterly Journal of Economics*, 113, 733 – 771.

Tavakoli, J. M., 1998, *Credit Derivatives: A Guide to Instruments and Applications*, Wiley Series in Financial Engineering, John Wiley & Sons, Inc.

Figure Legends

Figure 1: Project time line.

Figure 2: Utility when no wealth transfers occur. The figure shows the utility which the banks derives from trading when $u(z) = 1 - e^{-1.5z}$, $M = 0.01$, $p = 0.05$, $R = 1.3$ and $\mu = 0.04$. In this case the greatest utility is derived when the bank protects a proportion ϕ_m of his holding in the reference asset and continues to monitor. Risk sharing occurs without undesirable side-effects.

Figure 3: Utility when wealth transfers occur. The figure shows the utility which the bank derives from trading when $u(z) = 1 - e^{-1.5z}$, $M = 0.01$, $p = 0.05$, $R = 1.3$ and $\mu = 0.03$. In this case the bank will elect to protect all of its holdings of the reference asset and will stop monitoring. Risk sharing is achieved but will lead to sub-optimal project selection.

Figure 4: Funding decisions in the absence of credit derivatives. When the return R is sufficiently high unmonitored entrepreneurs can issue investment grade bonds. For lower R, unmonitored entrepreneurs will not select the first best projects and must rely upon bank certification to issue investment grade bonds. M is sufficiently low to persuade them to do so in the horizontally shaded region. In the diagonally shaded region entrepreneurs will instead elect to issue junk bonds and to manage a second best project.

Figure 1

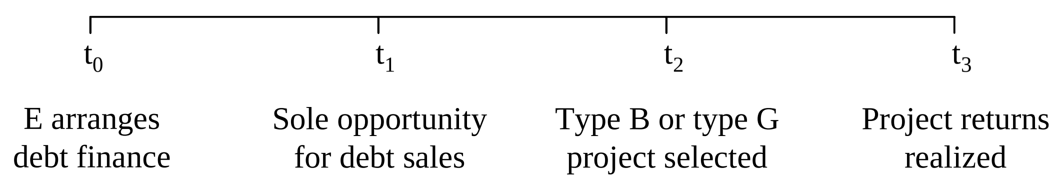
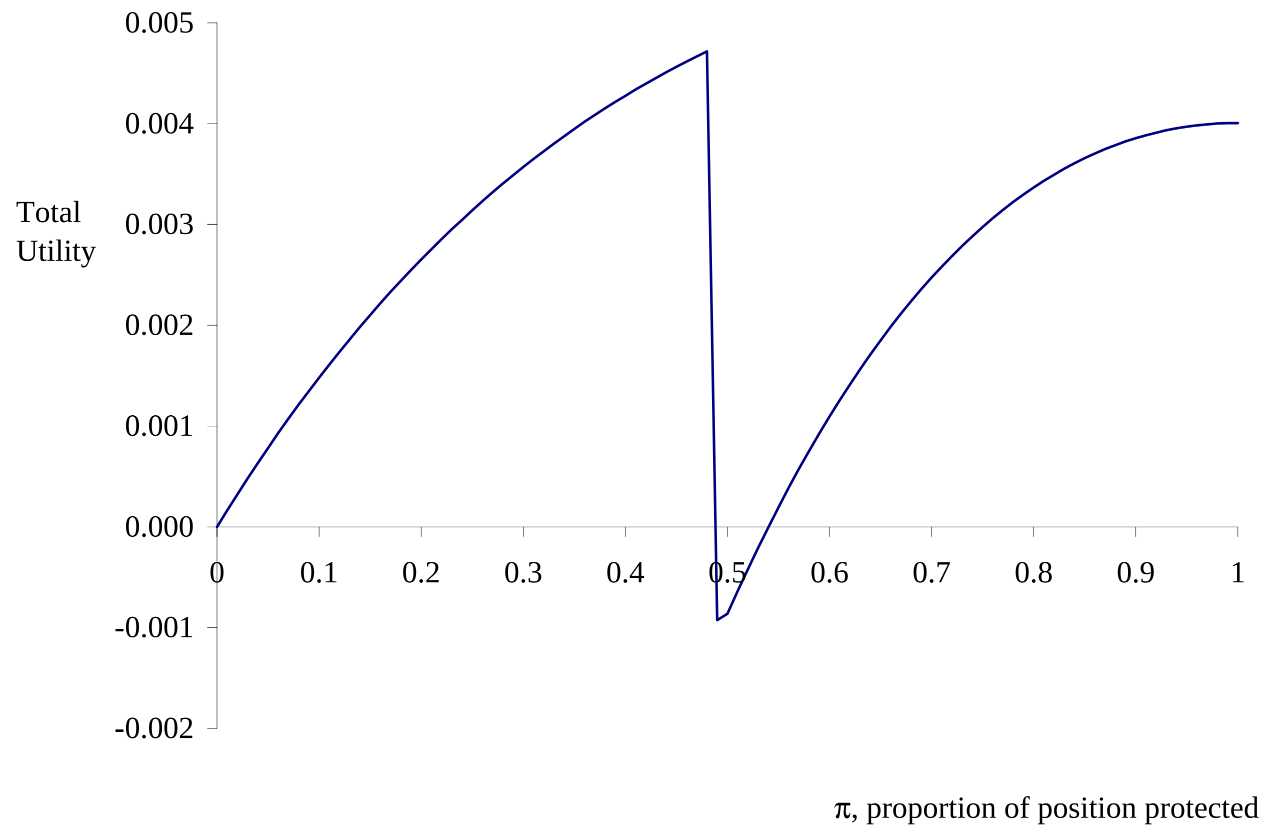

t0
t1
t2
t3
E arranges debt finance
Sole opportunity for debt sales
Type B or type G project selected
Project returns realized

Figure 2



Total
Utility
0.005
0.004
0.003
0.002
0.001
0.000
-0.001
-0.002
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
π, proportion of position protected

Figure 3

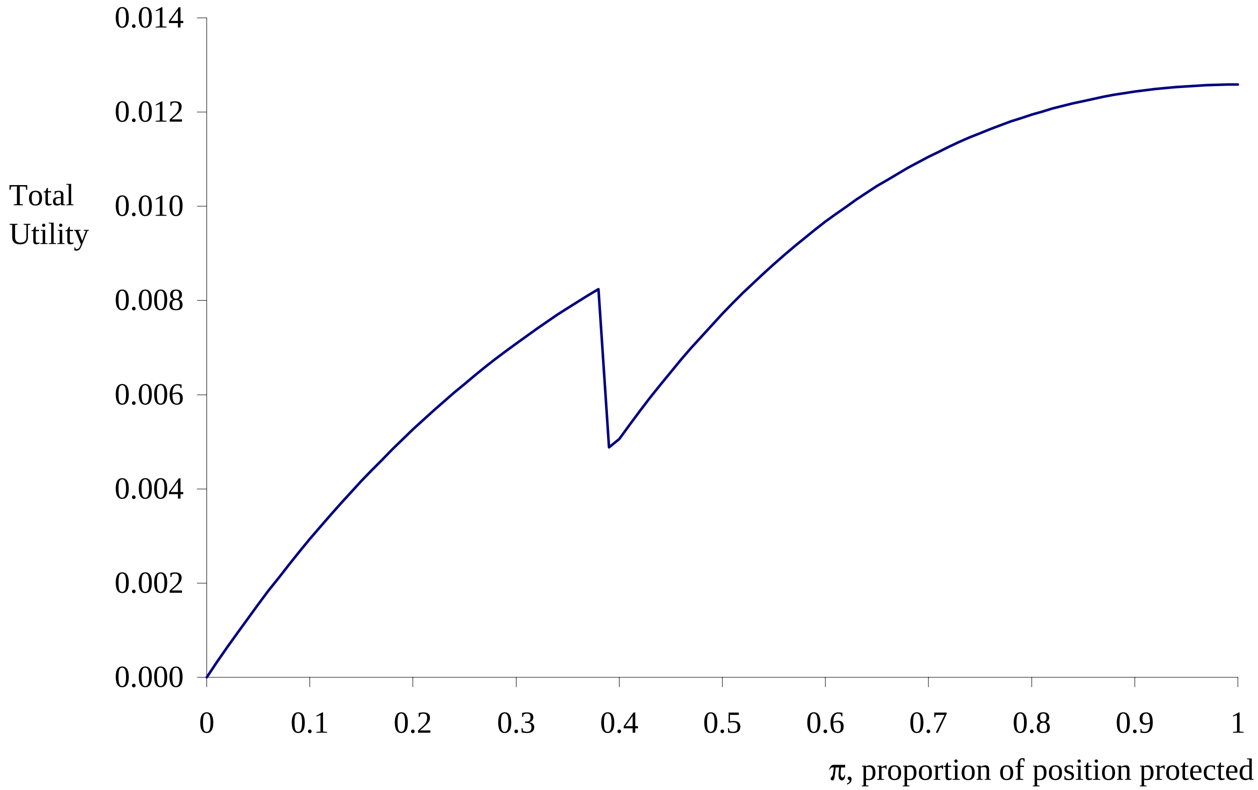
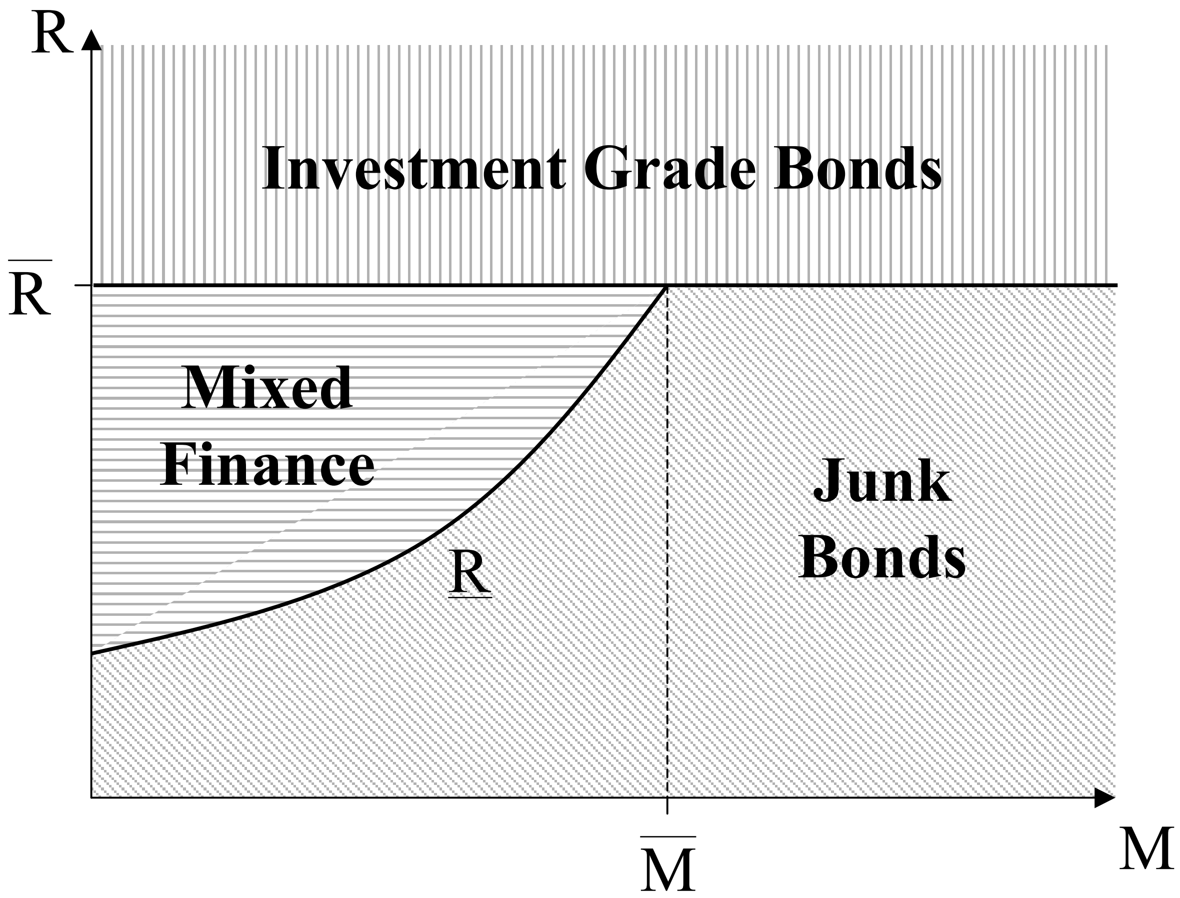

Total
Utility
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
π, proportion of position protected

Figure 4


R
Investment Grade Bonds
$\overline{R}$
Mixed
Finance
$\underline{R}$
Junk
Bonds
$\overline{M}$
M