Credit Derivatives, Disintermediation and Investment Decisions

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Abstract

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

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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

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\(^1\)The specific structure which I describe is a Default Swap. See Tavakoli (1998) for a detailed survey of credit derivative instruments and trades.
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 as follows.

Firstly, I build 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.

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). 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.

I examine mixed financing in two cases. In the first case the contracts which the entrepreneur writes with the bank and with the bond market are unconstrained. The entrepreneur is then able to write contracts in which the risk neutral bond holders make additional payments in the wake of project failure which are used to compensate the risk-averse bankers. Such transfers may render bank certification cheaper. In practice, bond contracts of this type are not observed, possibly because of fears of fund expropriation by failed entrepreneurs who are contractually obliged to redistribute payments from bond holders to bankers. The second case which I examine therefore constrains the contracts which the entrepreneur writes with his financiers so that all ex post payments flow to the financiers. Certification in this case is possible, but it may be more costly.

This intermediation model builds upon insights from the delegated monitoring literature (Campbell and Kracaw, 1980; Diamond, 1984; Mayer, 1988; Hellwig, 1991; Boot and Green-
Credit Derivatives, Disintermediation and Investment Decisions


The second part of the paper considers the consequences of allowing trade in credit derivatives after financing has occurred. 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 portfolio. 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.

I again consider two cases, corresponding to the situations where the banker is able to commit ex ante to a specific credit derivatives strategy, and where he is not. In the former case credit derivatives facilitate the fund redistribution which the entrepreneur cannot perform in the wake of project failure. In other words, they have a purely risk-sharing role and they allow the first-best contract to be achieved in the constrained economy. As such they are unambiguously welfare-increasing.

In the second case, which corresponds to the current market situation, credit derivatives trades are not reported so the banker cannot make an ex ante commitment to a specific protection level. In this case the banker has two choices: he can either purchase partial protection upon his asset and continue to monitor it, or he can protect his entire position and cease to monitor. The first type of trade fulfills the risk-sharing role which is usually attributed to credit derivatives trade without impairing the certification value of bank debt. The second type of trade achieves risk-sharing, but in so doing destroys the certification value of debt. I show that the second type of trade will be preferred when either the private benefits associated with second best projects are high, or when the bank is particularly risk-averse.

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 paper is organized as follows. In section I I describe the financing procedure, the project variables, the activities of the bank and the preferences of the bank and the bond holders. Section II describes how project selection is performed. In section III I develop an intermediation model in which bank finance is used to certify quality to the bond market. Section IV examines the effect upon financing and project selection decisions of a market for credit derivatives. Section V contains a discussion of my results and concludes. Non-essential proofs are contained in the appendix.

I. The Model

Consider an entrepreneur who wishes to invest in a project of size $1. The project will return a verifiable cashflow of 0 if it fails or $R > 0 if it succeeds. There are two types of project: 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:

$$p_H R > p_L R + B > 1. \quad (1)$$

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.

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

At time $t_0$, the entrepreneur approaches the banker and the bond market for funds. The bank contract $(\lambda, I, J)$ stipulates the $t_0$ advance $\lambda$ from the bank to the entrepreneur and the
Credit Derivatives, Disintermediation and Investment Decisions

$t_0$ | $t_1$ | $t_2$ | $t_3$
---|---|---|---
Entrepreneur borrows from bond market and from bank. | Single opportunity for the bank to buy default protection | Entrepreneur selects project | Project ends and returns are apportioned

Figure 1: Funding and project management time line.

t_3 repayments I and J which the entrepreneur makes in case the project succeeds or fails. The bond market contract $(\beta, P, Q)$ stipulates the amount borrowed $\beta$ and the repayments $P$ and $Q$ in case the project succeeds or fails respectively. The project type is non-verifiable and does not appear in either contract. Note that, as the entrepreneur is wealth-constrained, any $t_3$ payments which occur after project failure must be financed from an initial surplus $(\lambda + \beta) - 1$.

I assume that the bank is risk averse: as discussed in the introduction, this assumption is motivated by concerns about future credit rationing. Specifically, I assume that the banker has an amount of capital $1$ to devote to projects of the type which the entrepreneur is running. Any uninvested capital is placed in a riskless storage technology whose returns are normalised to $0$. The bank’s one-period investment decisions are selected to maximise the expected value of a separable utility function

$$V(z, \rho) = u(z) - \rho$$

(2)

where $u(\cdot)$ is strictly increasing, twice continuously differentiable and concave, $z$ is end of period wealth, comprising returns from the project and uninvested bank capital, and $\rho \in \{0, M\}$ is the expenditure on monitoring. $u(\cdot)$ is normalised so that $u(0) = 0$. The dispersed investors in bonds derive utility $z$ from a time 1 expected cashflow of $z$.

At time $t_1$, the bank has a single opportunity to buy protection against the risk of default by the entrepreneur, using a credit derivative. The bank can commit at this stage to a specific level of protection. I consider in section IV credit derivatives trade both when the banker can commit at $t_0$ to a given credit derivative trading strategy, and when he cannot.

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 is monitored then 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 and the returns are apportioned between the various claimholders.

I analyse the game in the following fashion. I firstly examine the $t_2$ project selection decision of the entrepreneur. In section III I examine the funding and the project selection decisions of an entrepreneur when there is no credit derivatives market. I demonstrate that the highest quality borrowers can commit to run first best projects and will borrow using only bonds, which I interpret as investment grade securities. Other borrowers cannot make a credible commitment to run first best projects. The lowest quality borrowers will elect to issue low quality, or junk,
bonds and to run second best projects. Borrowers of intermediate quality will elect to fund themselves partly using bank finance and partly with bonds. In this case, the *monitoring equilibrium*, bank debt acts as a *certification device* and hence reduces the entrepreneur’s cost of funds.

In section IV I examine the consequences for project selection of a credit derivatives market. When such a market exists, risk averse banks will use credit derivatives to insure themselves against losses arising from entrepreneurial default. I show that banks will either sell a fixed proportion of their initial position and continue to monitor the residual, or that they will sell their entire position and cease to monitor.

I then determine the optimal $t_0$ 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 finance will only be employed in a certification device in a monitoring equilibrium. I demonstrate that for a class of entrepreneurs, no bank contract can sustain a monitoring equilibrium when there is a credit derivatives market. In this case investors will rationally anticipate loan sales and a consequential cessation of monitoring by banks. This will destroy the signalling value of bank debt so that a sub-optimal project will be selected.

II. 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.

III. 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 when there is no market for credit derivatives.

Banker risk aversion renders bank finance *ceteris paribus* more expensive than bond finance. The entrepreneur will therefore use bank finance only when it provides certification value. If he can make a credible commitment to first best behaviour then he will issue only bonds. The cost of finance from the risk neutral bond market 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: in other words, when $\left( R - \frac{1}{p_H} \right) p_H \geq \left( R - \frac{1}{p_H} \right) p_L + B$, or when

$$ B \leq B_m \equiv \left( R - \frac{1}{p_H} \right) \Delta p. $$

When $B > B_m$ a verbal commitment by the entrepreneur to select a first best project will not be credible. In this case, he may elect to use mixed bank and bond market finance to commit to first best behaviour. I examine two cases. In the first, the entrepreneur’s choice of
finance package is unconstrained. I examine this case in section III.A. In the second case, I constrain the entrepreneur’s financing choices. The constraints are motivated and examined in section III.B: they are in accord with observed financing patterns.

A. Unconstrained Entrepreneurial Financing

When there are no constraints upon the entrepreneur’s financing contracts, he writes respective contracts \((\lambda, I, J)\) and \((\beta, P, Q)\) with the bank and the bond market, as detailed in section I. His problem is to select these contracts to maximise the following expected payoff:

\[
p_H (R + \beta + \lambda - 1 - I - P) + (1 - p_H) (\beta + \lambda - 1 - J - Q),
\]

subject to the following constraints:

\[
\beta + \lambda \geq 1; \quad (4)
\]
\[
R + \beta + \lambda - 1 \geq I + P; \quad (5)
\]
\[
\beta + \lambda - 1 \geq J + Q; \quad (6)
\]
\[
u (I + 1 - \lambda) - u (J + 1 - \lambda) \geq \frac{M}{\Delta p}; \quad (7)
\]
\[
pu (I + 1 - \lambda) + (1 - p_H) u (J + 1 - \lambda) - M \geq u (1); \quad (8)
\]
\[
p_H P + (1 - p_H) Q \geq \beta. \quad (9)
\]

Equations 4, 5 and 6 are budget constraints which state respectively that the entrepreneur must have sufficient funds to cover the cost of the investment, and to cover his financing obligations after project success and failure. The entrepreneur will only select mixed financing when it dominates the strictly positive returns which he can obtain from pure bond finance and so at most one of equations 5 and 6 can bind.

Equation 7 is the banker’s monitoring incentive compatibility constraint: this must be satisfied if the bank loan is to have certification value. Equations 8 and 9 are the respective participation constraints for the banker and for the bond market: in both cases, the entrepreneur must offer an expected return which is at least as good as that provided by the storage technology.

To understand the optimal contract, note firstly that the entrepreneur will aim to finance himself at minimum cost. Since there are no constraints upon the bond market other than equation 9, this will certainly bind and we can use it to eliminate \(Q\) from the other constraints. The problem therefore reduces to the maximisation of the net income from bank finance:

\[
\lambda - Ip_H - J (1 - p_H),
\]

subject to constraints 4, 5, 7, 8, and equation 11:

\[
\lambda - \frac{p_H}{1 - p_H} \beta - 1 - J + \frac{p_H}{1 - p_H} P \geq 0. \quad (11)
\]

Let \(\mu_1, \mu_2, \mu_3, \mu_4, \mu_5\) be the Lagrangian multipliers for constraints 4, 5, 11, 7 and 8.
respectively. The optimisation problem yields the following first order conditions:

\[ 1 + \mu_1 + \mu_2 + \mu_3 - (\mu_4 + p_H \mu_5) u'(I + 1 - \lambda) + (\mu_4 - (1 - p_H) \mu_5) u'(J + 1 - \lambda) = 0; \quad (\text{foc}\lambda) \]
\[ \mu_1 + \mu_2 - \frac{p_H}{1 - p_H} \mu_3 = 0; \quad (\text{foc}\beta) \]
\[ -p_H \mu_2 + (\mu_4 + p_H \mu_5) u'(I + 1 - \lambda) = 0; \quad (\text{foc}\beta) \]
\[ -(1 - p_H) \mu_3 - (\mu_4 - (1 - p_H) \mu_5) u'(J + 1 - \lambda) = 0; \quad (\text{foc}\beta) \]
\[ -\mu_2 + \frac{p_H}{1 - p_H} \mu_3 = 0. \quad (\text{foc}P) \]

Conditions foc\beta and focP together imply that \( \mu_1 = 0 \). In other words, the shadow price of additional capital is zero. This is similar to the capital structure irrelevance result of Modigliani and Miller (1958) and follows in this model from the banker’s ability to resolve agency problems and from my assumption that all project returns are costlessly verifiable. With these assumptions the risk-neutral entrepreneur can borrow at a fair price as much as he wishes from the competitive risk-neutral bond market.

This argument suggests that the entrepreneur need borrow a total of no more than $1 at the start of the project. This is true for sufficiently high \( R \), because bond finance does not affect the banker’s objective (equation 10) or the monitoring and participation constraints. To see this, suppose that \( \{ (\bar{\lambda}, \bar{I}, \bar{J}), (\bar{\beta}, \bar{P}, \bar{Q}) \} \) solves the entrepreneur’s optimisation problem. Replace \((\bar{\beta}, \bar{P}, \bar{Q})\) by \((\beta', P', Q')\), where \( \beta' = 1 - \bar{\lambda}, Q' = -\bar{J} \) and \( P' = \frac{1 - \lambda + (1 - p_H) \bar{J}}{p_H} \). The objective function and equations 7 and 8 are unaffected by this change. Conditions 4 and 6 now bind and condition 9 continues to do so. It follows that \( \{ (\bar{\lambda}, \bar{I}, \bar{J}), (\beta', P', Q') \} \) is an optimal contract provided

\[ R \geq \bar{J} + \frac{1 - \bar{\lambda} + (1 - p_H) \bar{J}}{p_H}. \]

This is equivalent to a requirement that \( R \) is large enough to cover the costs of optimal financing.

It is convenient and does not materially affect the results to assume that this is the case:

**Assumption 1** The return \( R \) on a successful project satisfies equation 12 for some solution \( \{ (\bar{\lambda}, \bar{I}, \bar{J}), (\bar{\beta}, \bar{P}, \bar{Q}) \} \) to the entrepreneur’s optimisation problem. Consequentially, we can assume without loss of generality that the budget constraints 4 and 6 both bind.

I observe above that at most one of equations 5 and 6 can bind. It follows from focP that \( \mu_2 = \mu_3 = 0 \) and

\[ \mu_4 = p_H (1 - p_H) \left\{ \frac{1}{u'(I + 1 - \lambda)} - \frac{1}{u'(J + 1 - \lambda)} \right\} > 0; \]
\[ \mu_5 = \frac{p_H}{u'(I + 1 - \lambda)} + \frac{1 - p_H}{u'(J + 1 - \lambda)} > 0. \]

At the optimum the bank’s monitoring and participation constraints therefore bind. The unconstrained optimal mixed finance contract selects \( \lambda, I \) and \( J \) so as to minimise the cost of ensuring that this happens and uses bond market finance to accomplish this in the cheapest way. This may involve transfers between bond-holders and bankers when the project fails, so that for example bankers may receive a payment in the event of project failure.
B. Constrained Entrepreneurial Financing

In this section, I place restrictions upon contracts in which after project failure either bankers or bond-holders make an additional payment to the entrepreneur. As discussed above, such payments are intended to cross-subsidise other fund providers and hence to reduce the cost of bank certification. In the model of this section, they would have to be routed via the failed entrepreneur. Although I do not explicitly model the fund distribution process, it is reasonable to suppose that failed entrepreneurs will not perform distribution correctly and to assume that fund expropriation will occur.4 I therefore rule out distribution of this nature:

**Assumption 2.** *Further cash advances in the wake of project failure are not possible:*

\[ J, Q \geq 0. \]

When assumptions 1 and 2 are satisfied, equation 6 implies that

\[ J = Q = 0. \]  \hspace{1cm} (13)

The entrepreneur therefore borrows an amount \( \lambda \) from the bank and repays \( I \) after project success and 0 otherwise; he borrows \( 1 - \lambda \) from the bond market and repays \( \frac{1-\lambda}{p_H} \) if the project succeeds and nothing else. His objective of maximising equation 10 is then equivalent to selecting the contract \((\lambda, I)\) which minimises the following cost of funds expression:

\[ C(\lambda, I) \equiv I + \frac{1-\lambda}{p_H}, \]  \hspace{1cm} (CoF)

subject to the following monitoring incentive compatibility (MIC) and participation (IR) constraints:

\[
\begin{align*}
 u(I + 1 - \lambda) - u(1 - \lambda) & \geq \frac{M}{\Delta p}; \quad \text{(MIC)} \\
p_H u(I + 1 - \lambda) + (1 - p_H) u(1 - \lambda) & \geq u(1). \quad \text{(IR)}
\end{align*}
\]

These constraints are illustrated along with an iso-cost line in \((\lambda, I)\) space in figure 2. Both are satisfied in the region which lies above the lines labelled MIC and IR.

The entrepreneur will select a contract \((\lambda, I)\) which subjects him to bank monitoring only if his expected return from doing so exceeds that which he can obtain by financing himself with junk bonds and running a second best project: when \(p_H \left( R - I - \frac{1-\lambda}{p_H} \right) \geq p_L \left( R - \frac{1}{p_L} \right) + B\), or

\[ I \leq I(\lambda, B) \equiv \frac{R\Delta p + \lambda - B}{p_H}. \]

The points satisfying this requirement appear below the line labelled \(I(\lambda, B)\) in figure 2. Any contract in the shaded region will therefore both ensure that the good project is undertaken and will be incentive compatible for the entrepreneur. I will refer to this as the *certification region*. The most attractive contract in the certification region is the one which has lowest cost:

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4See Jensen (1986) for a discussion of the agency problems associated with free cash flows.
as in section III.A this falls at the intersection point \((\lambda^*, I^*)\) of MIC and IR. Solving equations IR and MIC when they bind yields the following values for \(\lambda^*\) and \(I^*\):

\[
\lambda^* = 1 - u^{-1} \left( u(1) - \frac{M p_L}{\Delta p} \right); \quad (14)
\]

\[
I^* = u^{-1} \left( u(1) + \frac{M(1 - p_L)}{\Delta p} \right) - u^{-1} \left( u(1) - \frac{M p_L}{\Delta p} \right). \quad (15)
\]

Figure 2: The certification region.

Note that \(I(\lambda, B)\) is decreasing in \(B\). When \(B\) is so high that \(I(\lambda, B)\) passes below \((\lambda^*, I^*)\) bank certification will not happen. The critical level \(B_M\) of private benefits below which this will not occur is illustrated in figure 2. \(B_M\) is the solution of \(I(\lambda^*, B_M) = I^*:\)

\[
B_M \equiv R \Delta p - I^* p_H + \lambda^* = R \Delta p + 1 - \left\{ p_H u^{-1} \left( u(1) + \frac{M(1 - p_L)}{\Delta p} \right) + (1 - p_H) u^{-1} \left( u(1) - \frac{M p_L}{\Delta p} \right) \right\}. \quad (16)
\]

Note that
difficult

\[
\frac{\partial B_M}{\partial \lambda} = \frac{-p_H (1 - p_L)}{\Delta p u \left\{ u^{-1} \left( u(1) + \frac{M(1 - p_L)}{\Delta p} \right) \right\} + \frac{(1 - p_H) p_L}{\Delta p u^{-1} \left( u(1) - \frac{M p_L}{\Delta p} \right) \right\}} < 0;
\]

\[
\frac{\partial B_M}{\partial \Delta p} = \Delta p > 0,
\]

so that the number of projects for which mixed finance will occur decreases as the cost of monitoring increases and increases as the return \(R\) from successful projects increases.

I summarise the discussion of optimal financing patterns below:

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5To prove this directly, let \(\mu_1\) and \(\mu_2\) be the respective Lagrangian multipliers for the IR and MIC constraints. The first order conditions for \(\lambda\) and \(I\) are

\[
-\frac{1}{p_H} + (p_H \mu_1 + \mu_2) u' (I + 1 - \lambda) + (\frac{1 - p_H}{\Delta p}) (\mu_1 - \mu_2) u' (I + 1 - \lambda) = 0; \quad (\text{foc}\lambda)
\]

\[
1 - (p_H \mu_1 + \mu_2) u' (I + 1 - \lambda) = 0. \quad (\text{foc}\ I)
\]

Then if \(\mu_1 = 0\), foc\(\lambda\) implies that \(\mu_2 < 0\), which is a contradiction. If \(\mu_2 = 0\) then foc\(\lambda\) and foc\(\ I\) together imply that \(I = 0\), which contradicts MIC. It follows that \(\mu_1, \mu_2 > 0\) and hence that both MIC and IR bind at the optimum.
Proposition 3 Suppose that there is no trade in credit derivatives and that entrepreneurs cannot contract to distribute funds between financiers after failure. Then entrepreneurial financing and investment decisions will depend upon the private benefits $B$ of the second best project as follows:

1. If $B < B_m$ the entrepreneur will be financed solely through investment grade bonds with yield $\frac{1}{p_H}$ and will select a good project;
2. If $B_m < B \leq B_M$ the entrepreneur will employ mixed bank and bond finance and will run a good project. He will borrow $\lambda^*$ from a bank and will repay $I^*$ if the project succeeds, and he will issue $(1 - \lambda^*)$ bonds at a rate $\frac{1}{p_H}$;
3. If $B > B_M$ the entrepreneur will issue only sub investment grade bonds at rate $\frac{1}{p_L}$ and will elect to run a bad project.

The dividing line $B_M$ between good and bad project selection is decreasing in the cost $M$ of monitoring and is increasing in the return $R$ from a successful project.

Proposition 3 is consistent with observed financing patterns. The highest quality borrowers are those for whom $B$ is less than $B_m$. These borrowers are able to finance themselves by issuing investment grade bonds, which have a low cost of funds. Lower quality borrowers ($B_m < B \leq B_M$) 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. I say that such entrepreneurs are in a monitoring equilibrium. Entrepreneurs for whom the temptation to expropriate funds is the highest ($B > B_M$) will not find it optimal to give up their private benefits in exchange for the certification which a bank loan provides and will instead finance themselves using high yielding, or junk bonds.

IV. Credit Derivatives and Monitoring Equilibria

I now consider the consequences of opening a time $t_1$ credit derivative market where the banker can buy default protection from a dispersed and risk neutral investor base. Note that such a market cannot increase welfare when the $t_0$ financing decisions of the entrepreneur are unconstrained, as he will obtain then the cheapest possible certification. I therefore confine my analysis to the case where both assumptions 1 and 2 obtain.

I adopt in this section the terminology of the credit derivatives market and refer to the banker’s counterpart in the credit derivative trade as the protection seller. Given a bank loan contract $(\lambda, I)$, a credit derivative contract $(r_u, r_d)$ requires the banker to pay a time $t_1$ fee $f$ in exchange for which he receives a time $t_3$ payment from the protection seller of $r_u$ if the entrepreneur succeeds and of $r_d$ if the entrepreneur fails.

I assume that the banker can commit at time $t_1$ to a particular level of protection. I examine two scenarios: when the banker can commit at $t_0$ to a particular credit derivative strategy, and when he cannot. Commitment is possible only when credit derivative trades are reported. As discussed in the introduction, this is not currently the case and the no precommitment case therefore describes the current market.
A. Time \( t_0 \) Commitment Possible

Suppose that the banker can commit at time \( t_0 \) to adopt a particular credit derivative strategy and let \( \mathcal{F} \equiv \{ (\bar{\lambda}, \bar{I}, \bar{J}), (\bar{\beta}, \bar{P}, \bar{Q}) \} \) be the unconstrained optimal \( t_0 \) financing strategy of section III.A. Recall from assumption 1 that \( \bar{J} + \bar{Q} = 0 \).

Consider the following series of trades:

1. The entrepreneur borrows \( \bar{\lambda} \) from the banker against a repayment of \( \bar{I} - \frac{\bar{Q}(1-p_H)}{p_H} \);
2. The entrepreneur borrows \( 1 - \bar{\lambda} \) from the bond market at the rate \( \frac{1}{p_H} \);
3. The banker commits to purchase at time \( t_1 \) a credit derivative which pays \( \bar{J} = -\bar{Q} \) if the project fails and \( \bar{Q} \frac{(1-p_H)}{p_H} \) if it succeeds.

The cost of the credit derivative in part (3) is 0 if monitoring occurs. With this fee the banker’s net cashflows are equal to those which he would obtain if the entrepreneur employed the financing package \( \mathcal{F} \). With these cashflows bank participation is individually rational and monitoring is incentive compatible and so the credit derivative will be costless.

The entrepreneur’s contracts with the bank and the bond market satisfy equation 13 and so are admissible in the constrained economy. The entrepreneur’s expected \( t_3 \) income from these contracts is

\[
p_H \left( R - \bar{I} + \frac{\bar{Q}(1-p_H)}{p_H} - \frac{1}{p_H} \right) = p_H \left( R - \bar{I} - \bar{P} \right),
\]

which is his expected income from \( \mathcal{F} \).

Trades 1, 2 and 3 therefore achieve the first best solution \( \mathcal{F} \) in the constrained economy. When the banker’s time \( t_1 \) credit derivative trades are ex ante contractible they perform the fund distribution role which cannot in the constrained economy be undertaken by the entrepreneur. They are therefore unambiguously welfare-increasing.

B. Time \( t_0 \) Commitment not Possible

In this section I assume that the banker cannot commit to a particular credit derivative trading strategy. When this is the case, I shall describe the credit derivatives market as opaque. As I show in the introduction, the existing market for credit derivatives is opaque. I find that the monitoring equilibria of proposition 3 typically cannot be sustained in the presence of an opaque credit derivatives market.

Let \( q \in \{ p_L, p_H \} \) be the probability of project success. Since bank finance is used only when the entrepreneur cannot commit to first best behaviour, \( q \) will be \( p_L \) whenever monitoring is no incentive compatible after credit derivative trade. The protection seller will therefore rationally anticipate \( q \) and the banker will pay a protection fee of \( f_q \equiv q r_u + (1-q) r_d \). The banker’s expected utility excluding monitoring costs will be

\[
V(q) \equiv qu (I + 1 - \lambda + r_u - f_q) + (1-q) u (1 - \lambda + r_d - f_q)
\]

\[
= qu (I + 1 - \lambda + (1-q) (r_u - r_d)) + (1-q) u (1 - \lambda - q (r_u - r_d)) \quad (16)
\]

Proposition 4 describes the banker’s optimal credit derivative contract and also his monitoring decision.
Proposition 4 Suppose that a banker has entered into a contract \((\lambda, I)\) with an entrepreneur and let \(r_d^*\) satisfy
\[
u(I + 1 - \lambda - (1 - p_H)r_d^*) - u(1 - \lambda + p_Hr_d^*) = \frac{M}{\Delta p}.
\] (17)
Let \((r_u, r_d)\) be the credit derivative contract which the banker selects. Without loss of generality, \(r_u = 0\). If
\[
p_Hu(I + 1 - \lambda - (1 - p_H)r_d^*) + (1 - p_H)u(1 - \lambda + p_Hr_d^*) - M \geq u(1 - \lambda + Ip_L)
\] (18)
then \(r_d = r_d^*\) and the banker will monitor the entrepreneur; otherwise, \(r_d = I\) and the banker will not monitor the entrepreneur.

The intuition behind this result is as follows. Note from equation 16 that \(r_u\) and \(r_d\) enter the banker’s objective function only as \((r_u - r_d)\) and we can therefore assume without loss of generality that the payment \(r_u\) which he receives after project success is zero. This is a feature of traded credit derivatives.

The banker’s ex post utility level is the same after project success and failure if he selects \(r_d = I\). He will therefore select the highest compensation level \(r_d \leq I\) which is consistent with a given monitoring decision. For continued monitoring, this is the payment \(r_d^*\) of equation 17 at which the monitoring incentive compatibility constraint binds. For no monitoring, this is \(I\).

When \(t_0\) commitment to a credit derivatives strategy is not possible an additional incentive compatibility constraint must be satisfied to ensure that monitoring occurs: this is equation 18, which states that the expected utility from a protection level of \(r_d^*\) with monitoring exceeds that from protection of \(I\) without monitoring.

I derived in section III.B the optimal bank contract when \(B_m < B \leq B_M\) and in the absence of a market for credit derivatives. It transpires that when there is a credit derivative market the banker will elect at time \(t_1\) to cover his entire exposure under this contract and to stop monitoring. In other words, the credit derivative market will destroy the certification value of the contract \((\lambda^*, I^*)\).

Proposition 5 The contract \((\lambda^*, I^*)\) violates equation 18 and hence will not induce bank monitoring in the presence of a credit derivatives market.

Proof. At \((\lambda^*, I^*)\), equation MIC binds and so \(r_d^* = 0\). Equation 18 reduces to
\[
p_Hu(I^* + 1 - \lambda^*) + (1 - p_H)u(1 - \lambda^*) - M \geq u(1 - \lambda + Ip_L).
\]
Since IR binds at \((\lambda^*, I^*)\), this reduces to
\[
I^*p_L - \lambda^* \geq 0.
\]
Substituting from equations 14 and 15, we obtain
\[
I^*p_L - \lambda^* &= p_Lu^{-1}\left(u(1) + \frac{M(1-p_L)}{\Delta p}\right) + (1-p_L)u^{-1}\left(u(1) - \frac{Mp_L}{\Delta p}\right) - 1 \\
&< u^{-1}\left(p_L\left[u(1) + \frac{M(1-p_L)}{\Delta p}\right] + (1-p_L)\left[u(1) - \frac{Mp_L}{\Delta p}\right]\right) - 1 \\
&= 0,
\]
where the second line follows from the concavity of \(u(.)\). Equation 18 is therefore violated, as required.

Proposition 5 demonstrates that when the credit derivatives market is opaque, the optimal contract of section III.B will never provide certification value. It will not therefore be used. First best behaviour is however still achievable in the presence of an opaque credit derivatives market if equation equation 18 is satisfied for some contract \((\lambda, I)\) in the certification region of figure 2.

Since equation 18 is violated at \((\lambda^*, I^*)\) it is violated in some neighbourhood of this point and hence there exists \(B'_M < B_M\) such that credit derivatives destroy certification value for projects with private benefits greater than \(B'_M\). To obtain an approximate condition (of second order accuracy) for the existence of entrepreneurs for whom banks continue to provide certification value in the presence of an opaque credit derivatives market, write

\[
p_H u(I + 1 - \lambda - (1 - p_H) r_d^*) + (1 - p_H) u(1 - \lambda + p_H r_d^*) - u(1 - \lambda + I P_L) - M
\]

\[
= p_H [u(I + 1 - \lambda - (1 - p_H) r_d^*) - u(1 - \lambda + I P_L)]
\]

\[
+ (1 - p_H) [u(1 - \lambda + p_H r_d^*) - u(1 - \lambda + I P_L)] - M,
\]

and perform a Taylor Series expansion of the square bracketted terms to second order to obtain the following expression:

\[
I \Delta p u' (1 - \lambda + I P_L) + \frac{I^2 \Delta p^2 + p_H (1 - p_H) (I - r_d^*)^2}{2} u'' (1 - \lambda + I P_L) - M. \quad (19)
\]

Condition 18 is satisfied if and only if equation 19 is positive. This is equivalent to the following bound on the bank’s absolute risk aversion \(R_A(.)\):

\[
R_A (1 - \lambda + I P_L) \equiv - \frac{u'' (1 - \lambda + I P_L)}{u' (1 - \lambda + I P_L)} < 2 \frac{I \Delta p - \frac{M}{u'(1 - \lambda + I P_L)}}{I^2 \Delta p^2 + p_H (1 - p_H) (I - r_d^*)^2}. \quad (20)
\]

Note that the right hand side of this expression is strictly below \(\frac{2}{I^2 \Delta p}\) in the shaded region.

I summarise this discussion in the following proposition:

**Proposition 6** The presence of an opaque credit derivatives market destroys the certification value of the optimal loan contract \((\lambda^*, I^*)\) of section III.B. Either of the following conditions is sufficient to ensure that no bank loan can provide certification value:

1. The private benefits \(B\) associated with a bad project are sufficiently close to \(B_M\);
2. The bank’s absolute risk aversion exceeds \(\frac{2}{I^2 \Delta p}\).

When either of these conditions is satisfied intermediate borrowers will not borrow from banks. They will instead issue junk bonds and will run second best projects.

**V. 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 ?? 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 ?? 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 ?? 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. 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.

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.

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6See Cantor and Packer (1994) for a survey of the operation of the ratings agencies.
Credit Derivatives, Disintermediation and Investment Decisions

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. Holmström 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 at all. 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.

References


Proof of Proposition 4

Given a credit derivative \((r_u, r_d)\), monitoring will be incentive compatible if and only if

\[ V(p_H) - M \geq V(p_L), \]

which reduces to the following condition:

\[ u(I + 1 - \lambda + (1 - p_H)(r_u - r_d)) - u(1 - \lambda - p_H(r_u - r_d)) \geq \frac{M}{\Delta p}. \] (21)

The Lagrangian for the banker’s problem with monitoring is therefore

\[ \mathcal{L} = V(p_H) - M + \mu \left( u(I + 1 - \lambda + (1 - p_H)(r_u - r_d)) - u(1 - \lambda - p_H(r_u - r_d)) - \frac{M}{\Delta p} \right), \]

which yields the following first order condition for both \(r_u\) and \(r_d\):

\[ p_H(1 - p_H) \left\{ u'(I + 1 - \lambda + (1 - p_H)(r_u - r_d)) - u'(1 - \lambda - p_H(r_u - r_d)) \right\} + \mu \left\{ (1 - p_H)u'(I + 1 - \lambda + (1 - p_H)(r_u - r_d)) + p_Hu'(1 - \lambda - p_H(r_u - r_d)) \right\} = 0. \] (focM)

Condition focM depends upon \(r_u\) and \(r_d\) only through \((r_u - r_d)\) so we may assume without loss of generality that \(r_u = 0\). Condition 21 then implies that \(r_d < I\), so that focM implies that \(\mu > 0\) and hence that 21 binds so that \(r_d\) is the solution \(r_d^*\) to equation 17.

If the banker elects not to monitor his elected utility after contracting will be \(V(p_L)\). Maximising \(V(p_L)\) leads to the following first order condition for both \(r_u\) and \(r_d\):

\[ u'(I + 1 - \lambda + (1 - p_L)(r_u - r_d)) = u'(1 - \lambda - p_L(r_u - r_d)), \] (focNM)

and again we can assume without loss of generality that \(r_u = 0\). focNM then implies that \(r_d = I\), as required.

Finally, note that the banker will elect to monitor if and only if \([V(p_H) - M]_{(r_d, r_u) = (r_d^*, 0)} \geq [V(p_L)]_{(r_d, r_u) = (r_d^*, 0)}\). This is equation 18.