A Mix of Rationing and Restrictions in an Equilibrium Model of Investment Loans*

by

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Abstract

Banks supply loans for firms to enter an industry. They choose between credit restrictions, where firms' decisions are limited by contract, and credit rationing. These are both ways to avoid firms' moral hazard. Firms may vary in terms of collateral they can offer and banks may vary in terms of their ability to monitor and manage their borrowers' performance. An equilibrium is described where both restrictions and rationing are observed and the balance depends on the parameters of the system. Thus in some situations a contract rationed perhaps to those firms with the most collateral is most frequently observed while in others a credit restriction contract is the more prevalent. Extensions include the analysis of the case where temptations change endogenously and to an adverse selection variation.

Keywords: credit rationing, control, moral hazard
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1. Introduction

Asymmetric information in credit markets has encouraged the development of two literatures. In one, the focus is on the incompleteness of contracts and how this can be ameliorated (for example Hart and Moore (1998)); in the other, the focus is rather on the possibility of credit rationing to reduce the adverse selection or moral hazard problems from the outset (for example De Meza and Webb (2000)). This paper incorporates aspects of both literatures but has a specific approach emphasising both the equilibrium of a product market from the viewpoint of the borrowing firm seeking investment funds to enter that product market, as well as equilibrium from the point of view of banks and their loan decisions. Asymmetric information exists in the form of a moral hazard faced by borrowing firms. We attempt to identify types of contracts representing both literatures, and identify parameter values and changing circumstances which prompt a shift in the balance of contracts from one type towards another. Our contention is that widening the notion of equilibria to encompass different types of contract leads to a richer analysis of investment, by start-up firms in particular, and for external loan finance in general.

Thus our equilibrium will have “high quality” banks imposing restrictions on firms to stop their succumbing to moral hazard, while other banks, with less ability at designing and implementing restrictions, will offer contracts to those firms with sufficient collateral to separate themselves from temptation. The balance of contracts and the distribution of gains between banks and firms are the outcomes of interest. This balance reflects the extent of moral hazard, certainty-equivalent interest rates, and general commercial risks, and will be seen by carrying out a simple comparative static exercise. One of the more innovative elements of the modelling relates to the form of credit rationing. Our product market approach implies that the greater the number of firms financed, the lower the available

returns. Thus if fewer restaurants are set up in a city, more profits can be earned by successful restaurants. If more restaurants are set up then lower profits from more competition can trigger greater moral hazard or adverse selection problems. We thus use the number of firms financed as the rationing device, rather than the traditional approach (Stiglitz and Weiss (1981)[1]) of maintaining lower capital costs in the face of excess demand for finance. Collateral assists in maximising the number of firms that can be financed in this way by choosing an appropriate rather than a random sample. In contrast, if firms all have the same amount of collateral then a random sample of firms will be needed so that the total firms in the industry is constrained to permit sufficient profit to outweigh the moral hazard temptation.

The role of restrictions or "rules" to limit discretion of borrowers is not often considered in the control literature, although it is recognised that control can be exercised by concentrated equity holders or by banks (see Stiglitz, 1985), and this is a theme taken up by Grossman and Hart (1988) who emphasise voting structure. When banks have some control of the investment then it is important that they exercise this control well. Indeed, venture capitalists may be thought to be specialist institutions for just this purpose. [2] We seek to model a market equilibrium where, for different parameter values, we see either mostly credit rationing (some potential borrowers unable to find finance from which they could profit) or mostly credit restrictions (borrowers limited by contract to less than full control of their investment). An equilibrium exists when no bank, firm, or potential bank or firm, can increase expected profit by changing its actions. We characterise the two kinds of contract between banks and firms

[1] Further analysis is given by Clemenz (1986). De Meza and Webb (1987) contrast this under-supply of investment finance, compared with the full-information outcome, with the over-supply induced by pooling of different qualities of investment project. De Meza and Webb (2000) offer a model that has features of both arguments.

[2] See Kaplan and Stromberg (2000). Hart (2001) also considers the effect of reducing firm's discretion, but within a day-to-day management framework, rather than the technology choice issue that we focus on here.

as Credit Rationing or Credit Restrictions. We also find the effects of parameter changes on the nature of the equilibrium, including the balance of contracts in use. The analysis offers a simple approach to the monopoly gains available to a bank offering the highest quality of control. It also suggests how moral hazard problems can vary endogenously.

In the next section, the model is described. The equilibrium is stated and analysed in section 3 and a number of extensions are considered in section 4. These include a discussion of the likely form of restrictions, the return to banks that can design better restrictions, and a simple dynamic model of how the equilibrium might cycle endogenously. Conclusions are summarised in a final section.

2. **The Model**

We consider the following market for credit. There are an infinite number of potential firms within an industry, identical except that some potential firms have more collateral than other firms. Each firm needs to make an investment to enter the industry. This comprises a money-equivalent effort cost F and a capital investment normalised to 1. The capital has to be raised from a bank, and only standard loan contracts, incorporating any collateral available, are considered. If the firm borrows the capital and makes the effort, then the firm will produce one unit of output during the life of the investment. For any choice of capital investment, the cash flow from this single period of production is defined by a lottery $\{X, Y; q\}$ where X is a good outcome, Y is a bad outcome, and q is the probability of the good outcome while 1-q is the probability of the bad outcome. At the end of the period, the loan is repaid if funds are available (basically if the good outcome occurs) and the firm dissolves whichever outcome occurs (so only a single period is considered). There are a large number of banks competing

for the firms' business. Each bank has to repay $R>1$, to its depositors at the end of the period, for each unit loan it makes.

The contract for the loan is composed of two clauses.

(i) A clause stipulating observable investment decisions to be made by the firm and possibly further restrictions concerning the process of the project, and

(ii) a repayment amount D (determined by the contract and the competitive market for credit) to be repaid by the firm to the bank at the end of the period, unless the firm has no funds, and the collateral (to be forfeit to the bank if the firm has no funds).

Clause (i) can state the kind of investment to be undertaken and can detail its control by the firm and bank, possibly acting in concert. We will consider two such clauses. One is an empty clause that leaves all discretion to the firm; the other is a clause that sets specific rules for the nature and control of the project. We will refer to these as "discretion" and "rules" respectively. The analysis assumes that discretion dominates rules in the absence of issues of asymmetric information, and so the discretion clause will be denoted as G for good while the rules clause is denoted B for bad. The asymmetric information only involves G: here the firm can use its discretion to choose either an efficient project investment G_e or an inefficient one, G_i. For example the money borrowed can be used to buy a machine or it can be used to bet on horses or futures markets. Stipulating B in the contract implies a particular machine or policy which may not be the best available - that is it may not be G_e – but it is enforceable. Examples of possible contract restrictions are given in section 4. The investment choice is more clearly shown in Figure 1. We assume that G_e leads to the lottery $\{S(N), 0; g\}$; G_i leads to the lottery $\{S(N) + H, 0; h\}$; B leads to the lottery $\{S(N) - L, 0; g\}$. H is the moral hazard temptation which has extra risk (so that $h<g$); L is the cost of bank control or restrictions, and

the better the bank the lower the cost. We will assume that $H > 0$, $L > 0$. Reading across from the left-hand node, the bank offers a G or a B contract; the firm decides whether to adopt G_e or G_i if it has accepted G, and then the outcomes result.

Banks and firms are assumed to be risk neutral, and so collateral plays no role in B-type contracts and we will assume that there is no collateral in these contracts. In G contracts the moral hazard of choosing G_i rather than G_e is less the greater the collateral since there is less protection from financial loss in bankruptcy for the firms. In these G contracts bank "quality" is immaterial since the bank has no active role.

The good outcome X in the lottery $\{X, Y; q\}$ depends on the number N of firms receiving contracts since each such firm supplies one unit to the market and hence more firms means more product supply and lower product price, whether or not that firm is financially successful. The more units sent to the market (higher N), the lower the cash surplus S of successful firms. The schedule $S(N)$ thus has a negative slope as depicted in Figure 2.3. Firms that are not successful (the lottery awards the bad outcome Y) have production costs that exceed revenue and hence these firms have a zero cash surplus. These unsuccessful firms cannot repay any of their loan other than the posted collateral. In equilibrium all successful firms will make the required repayment to the bank and take back any posted collateral.

The firms have differing amounts of collateral, and the amount of collateral held by the firm with the N_G^{th} highest amount is $K(N_G)$: hence $K'(N_G) < 0$. The banks' cost of providing control to a firm is increasing in the number of firms so controlled. Thus $L(N_B)$ is the cost due to the control by banks of the N_B^{th} firm that is given a B-type contract: hence $L'(N_B) > 0$, depicting increasing costs of control as less expert bankers are employed. Since the banks are

assumed to have no economies of scope, it is irrelevant to the overall equilibrium whether the most expert bankers are employed by the same bank or if each bank has a sample of employees of different abilities.

The competitive equilibrium is a number of contracts N composed of N_G and N_B contracts of types G and B respectively, such that no change of contract, additional contract, or withdrawal of contract can lead to gains for either party to the contract. N_G and N_B are defined by (1) and (2) below.

$$g\,S(N_G + N_B) = gD + L(N_B) + F \quad \text{(Participation in } B\text{-type contracts)} \qquad (1)$$

where D is defined by $R=gD$ so that the capital loan plus interest is repaid on average, and the marginal banker just covers all costs. Also

$$g\,S(N_G + N_B) - gD - F - (1-g)\,K(N_G) = h\,S(N_G + N_B) + hH - hD - F - (1-h)\,K(N_G)$$

(incentive compatibility in G-type contract) (2)

where D is defined by $R=gD + (1-g)\,K(N_G)$, so that the banks cover their loan costs on average (with probability $1-g$ they only obtain the collateral), and all N_G firms able to provide $K(N_G)$ collateral have no incentive to choose G_i in preference to G_e. If $K(N_G)$ is a constant (even if it is equal to zero) then there can still be a solution for N_G and N_B from equations (1) and (2). This would be the case of homogeneous firms, and those firms lucky enough to obtain finance of type G would make more profit than excluded firms. In this case therefore a random selection of firms for type G contracts would bestow profit prizes on those chosen.

Our inclusion of a collateral criterion replaces the need for a random selection, but is not a necessary part of the model.

A *B*-type contract is expected to just cover its costs if $g\ S(\ N_G + N_B) = R + F + L$. This condition (1) is the case for the marginal contract. Better bankers earn a surplus for the N_i^{th} contract of $L(N_B) - L(N_i)$ where $N_i<N_B$. All *G*-type contracts must satisfy the incentive compatibility condition (2) but have no *L* cost and so $gS(\ N_G + N_B) > R + F$ for all these contracts. Given a standard required collateral of $K(N_G)$ there is no gain from higher collateral, and all these *G*-type contracts earn those firms able to provide the collateral all the surplus of $gS(\ N_G + N_B) - R - F$. On the basis that $K(N_G)$ and $L(N_B)$ are linear functions, the equilibrium is depicted in Figure 2. From (1), we have the equilibrium condition:

$$gS(N) = R + F + L(N_B) \qquad (3)$$

given in Figure 2.1, while from (2) we have

$$gS(N) = C - K(N_G) \qquad (4)$$

where $C = ghH/(g-h) + R$, and this is given in Figure 2.2. Figure 2.3 simply aggregates $N = N_B + N_G$.

To obtain existence of the mixed equilibrium, we need that *G*-type contracts can be introduced at a position where currently only *B*-type contracts are in place and vice-versa. This implies that the horizontal sum of the schedules $R+F+L(N_B)$ and $C-K(N_G)$ (the "supply"

of contracts) cuts $gS(N)$ (the "demand" for contracts) above both $R+F+L(0)$ and $C-K(0)$.[3] Since it is most efficient to use the firm's discretion, efficiently applied (i.e. G_e), and least efficient to use the firm's discretion, inefficiently applied (i.e. G_i), the full information equilibrium would be that collateral is unnecessary: only G-type contracts would be issued and each firm would be required to use technology G_e and the repayment for a successful firm would be $D_e = R/g$ leaving the lending banks with zero expected profit. In this case the equilibrium would involve N_G^* contracts solving $gS(N_G^*)=R+F$, and the moral hazard technology G_i rules this out provided $gS(N_G^*)=R+F < C-K(N_G^*)$. We will assume the latter holds so that the asymmetric information problem bites.

A mixed equilibrium may occur provided at least one of $K'(.)$ and $L'(.)$ is non-zero. If both are zero so that L and K are constants and there is no differentiation in either banks or firms then we would expect one of (3) or (4) to hold and not the other. Then all contracts would be of one type, and that type could change if parameter values changed. Thus all contracts would be of type G if $gS(N) = R + F + L > C - K$, and all would be of type B if $gS(N) = R + F + L < C - K$. It requires at least one of L and K to be variable for a mixed equilibrium to occur.

3.Analysis

In this section we will identify the surpluses earned in the mixed equilibrium and then carry out comparative static exercises. The banks' surpluses are given by the shaded area in Figure 2.1. Here the surpluses may be partly or wholly offset by any skill-related additional payments to staff. (In other words the banks may have to share their rents with the scarce resources that produce them.) Each firm with B-type contracts makes zero expected surplus

[3] See an earlier version of this paper (Ireland (2003)) for an analysis of homogeneous firms and banks where contracts are generally either all type G or all type B. Issues relating to different kinds of finance, including equity finance, in a similar model are discussed in Ireland (2004).

since there are many firms competing for the limited quality bank capacity, and the marginal contract offers no surplus to either bank or firm. On the other hand, the surpluses made by firms with sufficient collateral to separate themselves from the pool and remove the moral hazard risk from the contracts are independent of any higher collateral available. This reflects the fact that, in our risk-neutral model, higher collateral will only affect the outcome-contingent distribution of profits and losses, and not the overall expected outcomes of profits and losses. The fact that sufficient collateral will simply solve a problem and permit access to a better contract means that wealth is a key advantage for start-up firms.

We can write equations (3) and (4) in implicit form and, using N and N_B as endogenous variables ($N_G = N - N_B$), investigate how N, N_B and N_G change as H, h, g, F and R change exogenously. For example, a change in H results in adjustments defined by:

$$gS' \, dN - L' \, dN_B = 0 \qquad (5)$$

$$gS'dN + K' \, dN - K' \, dN_B = (gh/(g-h)) \, dH \qquad (6)$$

and given $S'<0$, $K'<0$ and $L'>0$ we have:

$$\frac{dN}{dH} < 0 \quad \text{and} \quad \frac{dN_B}{dH} > 0$$

and thus $\frac{dN_G}{dH} < 0$.

Thus if the moral hazard becomes more tempting then the number of contracts allowing discretion will be reduced since more collateral is required. This raises the profitability of marginal *B*-type contracts and hence N_B is increased, but not so far as to increase N in total.

Table 1 gives similar results for other exogenous changes. As would be expected, the effect of a change in h is similar to that of H. Higher F reduces the number of B-type contracts due to the impact on participation, while this increases the profit from G_e relative to G_i and hence increases G-type contracts to make up some of the difference. Higher costs of (certainty-equivalent) interest means that R is higher and reduces both types of contract since both participation and incentive compatibility constraints become harder to satisfy. Finally, an increase in g increases both the number of contracts and the number of G-type contracts, but the effect on the number of B-type contracts is ambiguous. This is because the G-type response due to lower collateral requirements might lead to a reduction in profitability of both types of contract.

Table 1: Comparative statics: effects of changes of exogenous parameters on number and composition of contracts.

	H	h	F	R	g
N	-	-	-	-	+
N_B	+	+	-	-	?
N_G	-	-	+	-	+

4. Extensions and Discussion

Type of restrictions

The formulation of restrictions on how the credit can be used may vary from a continuous monitoring process (such as membership of boards of directors) which would impose

particular views and concerns on the firm's decisions, to policies such as whether and how to source connected work from outside the firm. One example might be the requirement to spend the credit on particular products from firms which are known to be reliable, rather than on the "best deal" which might involve high risks. This might lead to requirements to deal with suppliers offering quality marks, or suppliers in particular countries less prone to corruption. A further restriction might require that supply is not organized “in-house”. Thus the requirement to out-source key inputs might be a safeguard against risky internal production plans. A feature of all kinds of restriction is that the credit would be used in a way that could be monitored by the bank or by the firm's auditors.

The use of restrictions to deny the firm the temptation to risk the bank's investment will inevitably reduce the profit possibilities as well as the loss possibilities. The quality of the restrictions in minimising the former for any given gain in risks of loss are obviously key. The development of venture capitalists[4] might be thought to be an institutional response to the need for providing both monitoring and restrictions on expenditure and experience and judgement in decision making.

Our model of credit rationing follows the (Blanchard and Fischer, 1989, p479) type 2 format since credit is rationed among firms, with some firms going without and thus being denied access to the product market. An alternative type 1 format would supply all firms with credit but at a lower level than they desire. This may be thought to be another form of credit restriction: a firm may only borrow up to a binding constraint. In the absence of other finance, the firm must then choose only smaller capital projects, and this may remove or reduce the moral hazard issue. In this case, the credit restriction versus credit rationing

[4] See for example Hellman and Puri (2000).

assessment becomes a type 1 or 2 credit rationing assessment.[5] Then the mixed equilibrium we have found is a mix of type 1 and type 2 credit rationing.

Evidence

There are a number of aspects of our analysis which invite the search for evidence. In this section we will pick the most obvious. First, the G_i technology with the higher rate of failure occurs only in disequilibrium. Increased moral hazard will lead to more collateral required or more restrictions only once it is recognised. In the interim, while adjustments in contracts are made, firms will fail. This points to firm failure being concentrated at particular times, and especially that large firms will only fail when they are given too much discretion. The reason for concentrating on large firms is that their liquidation is relatively rare while we would expect small firms to enter and exit trading due to numerous factors. In 2001 95 "big, publicly owned companies" filed under Chapter 11 protection in the USA, a large increase on previous experience. (Economist, Sept 7th 2002, p71.) Of the 23 largest bankruptcies in the US since 1980, 11 were filed in 2001-2, 10 in 1987-1992 while none were filed in the period 1993-2000 (BankruptcyData.com). Although other explanations are possible, the governance factors of discretion and restrictions considered here may have a role to play.

Endogenous Hazards

The comparative static results summarised in Table 1 indicate that the response of the market to a reduction in moral hazard (reduction in H or h) is that there would be an increase in G-type contracts and in the number of contracts overall, but some reduction is B-type contracts. Thus as the moral hazard becomes larger or smaller so the number and composition of loans

[5] A key motivation behind the type 1 credit rationing model is to make firms increase their own financial commitment to the project and hence be less prone to moral hazard and more likely to repay. Obviously our model does not explicitly include the option of an internal finance contribution as part of the financial contract, but the implication is clear.

changes. In this subsection we model in the simplest way how changes in moral hazard might arise as a response to the number and composition of contracts. By adding very simple first-order dynamics we obtain a result where a perturbation to the equilibrium leads the system to oscillate about the new equilibrium.

An argument that would support this kind of approach is the following. Suppose that moral hazard reflects opportunities that have been noted recently during the exercise of the *G*-type contract: that is, in using their discretion to maximise profit opportunities, entrepreneurs discover lotteries of the G_i type which are increasingly attractive (higher H or h). The more *G*-type contracts that exist, the more such discoveries are made. These therefore increase the available moral hazard in the next round. We can summarise this as $C_t = C + l\, n_{G\,t-1}$ where $\lambda > 0$ and $C_t = \frac{g\, h_t H_t}{g - h_t}$ and is increasing in h_t and H_t, and $n_{G\,t-1}$ is the difference between $N_{G\,t-1}$ and an equilibrium value of N_G. Linearising (3) and (4) gives the equations

$$\begin{aligned} & gS' n_t - L' n_{Bt} = 0 \\ & gS' n_t + K' n_t - K' n_{Bt} = C_t - C = l\, n_{G\,t-1} \\ & n_{G\,t} + n_{Bt} = n_t \end{aligned} \qquad (7)$$

where all the functions or derivatives of functions (S', K', and L') are evaluated at the equilibrium values of n, n_G or n_B respectively. Substituting out $n_{B\,t}$ and n_t leaves:

$$\left(\frac{g S' L'}{L' - gS'} + K'\right) n_{G\,t} = l\, n_{G\,t-1} \qquad (8)$$

where $\left(\frac{g S' L'}{L' - gS'} + K'\right) < 0$. The solution for the time path of $n_{G\,t}$ is

$$n_{Gt} = A\, x^t \qquad (9)$$

where A is determined as the initial (period zero) deviation from equilibrium and

$$x = \frac{l}{\frac{gS'L'}{L' - gS'} + K'} < 0$$

Providing the change in h_t and H_t, and thus C_t, as a function of $n_{G\,t-1}$, is not too large,

$$l < \left| \frac{gS'L'}{L' - gS'} + K' \right|$$

and $0 > x > -1$ and the system converges in an oscillatory way towards the equilibrium. The interesting points to note are that, using equations (7):

$$n_t = \left(\frac{L'}{L' - gS'}\right) n_{G\,t} \tag{10}$$

and

$$n_{B\,t} = n_t - n_{G\,t} = \frac{gS'}{L' - gS'} n_{G\,t} \tag{11}$$

so that when the system is out of equilibrium

$$\frac{n_t}{n_{G\,t}} > 0 \quad \textit{and} \quad \frac{n_{B\,t}}{n_{G\,t}} < 0.$$

This implies that as n_G oscillates above and below its equilibrium value, so total contracts oscillates with the same sign, while n_B oscillates with the opposite signs. During an adjustment to equilibrium, we would see the number of *G*-type contracts increase, but the number of *B*-type contracts decrease, when the total number of loan contracts increase. Clearly, with a more complex dynamic specification the outcome would be less simple. However, the main feature is likely to remain. When the moral hazard issue diminishes, the collateral necessary to secure a loan becomes less and easier to provide. As the supply of such loans increases, so loans based on monitoring and restrictions are reduced since there is a smaller operating surplus, via increased product supply and competition, to absorb the extra bank costs of *B*-type contracts.

The notion that moral hazard opportunities would expand as a result of firms' discretion to seek out profits may be of wider interest. During a period when *B*-type contracts are rare, one can think of a gradual reduction of banks' ability to monitor firms in broad terms as they rely increasingly on firms' own decision making. At the same time, the development of firms' skills at selecting profitable opportunities is likely to be mirrored by an increase in opportunities with moral hazard. Then the imposition of larger numbers of *B*-type contracts instead of *G*-type may mean that firms' knowledge about opportunities dissipates with the absence of incentives to renew and research restricted opportunities. At the end of the day, banks will come to accept that their control is against the interests of efficiency when temptations of firms are sufficiently small. Then a switch to relying on firms having profit incentives to avoid inefficient projects will occur, only to be gradually eroded as firms' discover additional temptations. So a cycle will evolve.

A number of formulations of firms' balance sheet effects on cyclical behaviour via financial markets include Greenwald and Stiglitz (1993). They are concerned with the ability of profits to create better hedges to avoid bankruptcies and hence higher investment. In our argument here, we are focussing on the (possibly complementary) propensity of the financial system to change mechanisms and hence create cycles of activity.[6]

Adverse Selection

It is straightforward to reinterpret the model as an adverse selection rather than moral hazard problem. In this case we assign G_e or G_i to all firms in a random allocation of types prior to contracts being signed, with the probability of G_e being assigned equal to q. We also assume

[6] See Arnold (2002) for a recent survey of business cycle models.

that a restriction to technology B supercedes this allocation. Thus contracts based on credit restrictions are unaffected. The adverse selection issue relates to the need to retain G_e – types as bank customers for contracts without restrictions. Then the competitive rate for repayments is D which solves

$$R = \lambda D + (1-\lambda)K \text{ where } \lambda = qg + (1-q)h \quad (12)$$

Thus we need

$$g(S(N) - D) - (1-g)K - F \geq 0$$

or

$$gS(N) - gR/\lambda - (1-g/\lambda)K(N_G) - F \geq 0 \quad (13)$$

Again we are assuming that collateral is available according to the schedule $K(.)$, and this schedule is independent of the type of firm. Competition to participate in profitable contracts will ensure that in equilibrium:

$$gS(N) - gR/\lambda - (1-g/\lambda)K(N_G) - F = 0 \quad (14)$$

We can combine (14) with the equilibrium condition for B-type contracts:

$$gS(N) - R - F - L(N_B) = 0 \quad (15)$$

In this equilibrium, firms without sufficient collateral, and not having a contract, cannot make profit from a *B*-type contract since there is no vacant "quality" bank, and cannot obtain a *G*-type contract since further such contracts would be seen as only attracting G_i-types (and

would also make all *G*-type contracts unprofitable to G_e-types (and hence loss making for the banks). In the analysis here we have assumed that *H* is large enough that all G_i-types would want a *G*-type contract when G_e-types would want one. Otherwise *H* plays no role in (14) and (15). The comparative statics of, *N*, N_G and N_B from exogenous shifts in *h*, *R*, *F*, *g* and *q* are as given in Table 2. Differences between Tables 1 and 2 reflect the substitution of an incentive compatibility condition (4) in the moral hazard case by a further participation condition (14) in the adverse selection case. Thus the effects of *h* are reversed since higher *h* reduces the cost of sharing G_i and G_e technologies within the G-type contracts. The same explanation is relevant for the effect of *q*. The effect of an increase in *F* is uniform and the ambiguous cases with *g* and *R* relate to the possibility that one of N_B or N_G responds very strongly.

Table 2: Comparative statics: effects of changes of exogenous parameters on number and composition of contracts – the adverse selection case.

	H	*h*	*F*	*R*	*g*	*q*
N	0	+	-	-	+	+
N_B	0	-	-	?	+	-
N_G	0	+	-	-	?	+

The dynamic adjustment of a perturbation of the equilibrium if *q* is decreasing in N_G again shows that oscillation around equilibrium of *N* and N_G are positively related, but that N_B oscillates in the opposite cycle. The same basic notion holds: if N_G is high then knowledge of alternative risky technologies will become more widespread leading to a smaller proportion of applicants for *G*-type loans being trustworthy. This will lead to higher finance costs for

these loans and thus a reduction in their number to maintain participation of trustworthy applicants. This reduction will lead to some increase in *B*-type contracts due to the extra profitability.

5. Conclusions

The characterisation of contracts in our model is very simple, and of course there may be many differences among markets and industries at any one time as well as changes in regime over time. Nevertheless, the analysis brings together two rather different literatures and sees their contributions as complementary.

The major argument we have made is that the equilibrium system of contracting loans may change in composition as well as size due to changes in opportunities and perceptions. A system which is based largely on contracts involving delegation and discretion may change in favour of monitoring and lender control and intervention when experience suggests an increase in moral hazard. Such changes in equilibrium may take some time to be implemented due to the lags in contract renewal. One factor in recent experience is that large and apparently diversified firms which were perhaps thought to be immune to moral hazard issues have been found to be as affected as smaller firms. Thus the importance of the contract mix discussed here has increased with their relevance. The equilibrium in our simple model may relate to a very rough and ready statement of equilibrium behaviour in reality. We point to banks evaluating an applicant firm's business plan and assessing whether there is sufficient profit (above zero by a sufficient margin) to keep the firm focussed on its (G_e type) investment. In less trusting times, banks more often seek to ensure that the business plan is one that can be monitored and that institutional arrangements are in place to control any renegade deviations, albeit that these same institutional arrangements also restrict the firm's

discretion to profit from opportunities that may arise. The choice between restrictions and rationing remains clear, despite the complex and varied outcomes that will be observed across industries and markets.

The specific nature of the loan contracts and their description in terms of success and failure are not likely to be fundamental to the broad nature of the analysis. However, a number of the factors considered may deserve further analysis. Other types of finance including equity holdings are topics that could be investigated within the framework presented here. In the presence of nominal rigidities the varying number of projects financed can clearly cause changes in employment, but a more extensive general equilibrium approach would be required to investigate that issue.

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Figure 1: Contract and choices: Bank contract offers one of *G, B*. Firm decides on G_e or G_i if contract states *G*. Outcomes are the lotteries {.,.; .}.

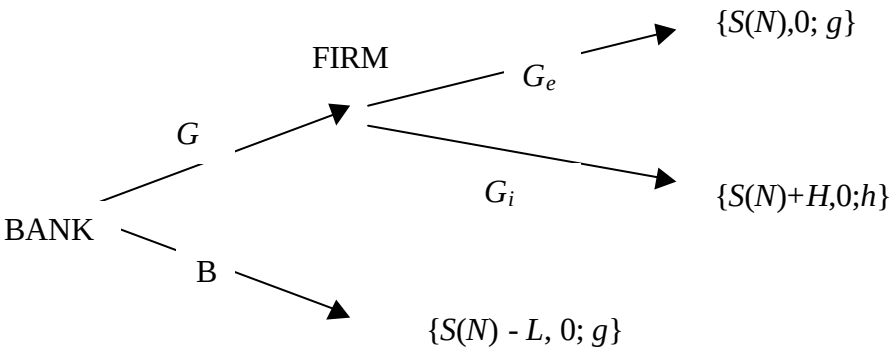


Figure 2: Mixed Equilibrium

Fig 2.1 Fig 2.2

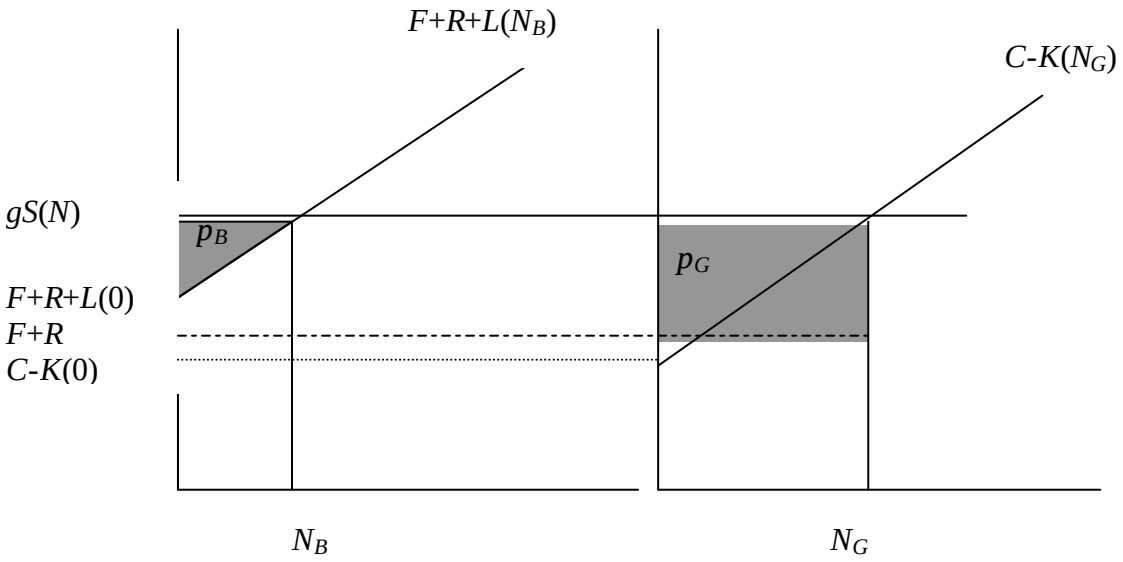
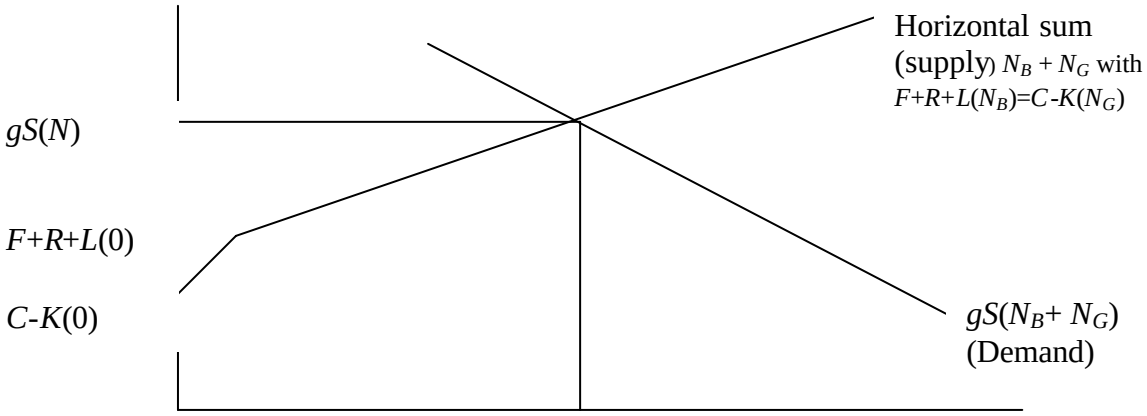


Fig 2.3



$N = N_B + N_G$