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A Competitive Model of Credit Intermediation

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1. Introduction

Financial markets are usually held to exhibit fundamental informational asymmetries. Agents typically have private information on asset qualities and try to exploit it to their own advantage. The competitive mechanism fails to induce traders to reveal this information, and affects their willingness to acquire it at a cost (Grossman and Stiglitz, 1976, 1980). Moral hazard and adverse selection are generally expected to bear heavily on the nature if not the existence of equilibrium.

Financial markets also exhibit the widespread presence of intermediaries, specialized agents who sell liabilities in order to acquire assets. The latter are typically either equities or more often debt contracts issued by firms. Until recently, the intermediation literature had focussed primarily on scale economies in transaction. Firms and investors are matched together at lower costs when intermediaries manage bundles of transactions[1].

These peculiarities of financial markets – pervasive informational asymmetries and widespread intermediation – have been recently cast in a common theoretical framework, within which financial intermediaries act as information producers. Their existence is thus systematically connected to the informational imperfections which are likely to affect the direct market interaction between firms and investors[2]. The main theme running through this literature has been how informational problems can create nonconvexities in the intermediaries' "production set". This is the case e.g.with monitoring costs (Diamond, 1984) or reliability costs (Ramakhrisnan and Thakor, 1984).

The present paper considers an economy where an intermediary sector can arise in the presence of informational imperfections on capital markets. Here, a nonconvexity is assumed at the beginning, and the focus is on the effects of the cost structure on the emergence of an intermediary sector. Accordingly, no attempt is made at deriving optimal contract forms, nor at modeling the interaction between contract optimality and the prevailing form of financial intermediation.

In our model, debt is the only asset and entrepreneurs choose to sell debt obligations to either a competitive bond market or an intermediary. Firms are endowed with different technologies – which cannot be observed by other traders – and do not necessarily pay back their loan. Traders can choose to use a costly screening technology, thus becoming intermediaries who then perfectly discriminate across firms. Otherwise, they are given the option of either entrusting their wealth with an existing intermediary or investing directly in an unrecognizable firm.

As a first step, credit demand by firms is derived, whereby entrepreneurs choose whether or not to be perfectly discriminated. Secondly, the supply side is analyzed. Traders, who know the existing demand for credit, pick up either one of the above mentioned available alternatives. A credit equilibrium is then defined as a situation where demand equals supply on both the bond and the intermediary credit markets.

The main result of the paper is that there exists an equilibrium, at which some – although not necessarily all – firms receive intermediary credit. This is so in spite of all traders being identical: intermediation does not depend on the intermediaries' relative efficiency in information production. Rather, it is due to the entrepreneurs' willingness to accept being perfectly discriminated. The results obtained confirm the important role played by nonconvexities.

In our paper, we assume away reliability problems, an important limitation in our analysis which needs to be made clear from the outset. Such problems, as is well known, play a significant role in the theory of financial intermediation. If information production is the intermediaries' main function, the market would entrust its resources with them only when that information is taken as reliable.

The paper is organized as follows. In the next section the basic model is presented. In Section 3 we examine the agents' choices. Section 4 is devoted to the definition and existence of equilibrium, with and without intermediation. The problem of reliability is discussed in Section 5 and, finally, Section 6 offers some concluding remarks. All proofs are gathered in Appendix.

2. The basic model

We consider a simple two period economy, where one perishable commodity is used as input in the first period and consumed in the second. There is a continuum of agents, entrepreneurs (firms) and traders, who live both periods. They are divided into two sets which are taken equal to the unit interval.

Entrepreneurs have no initial endowment. Each of them is identified by a technology, and needs one unit of the commodity in the first period to implement it. This unit can be acquired by issuing a debt obligation, either directly on the bond market or to an existing intermediary. Not all entrepreneurs honour this debt. Some of them are dishonest and in the second period consume the whole output. Honest entrepreneurs consume their output net of loan repayment.

Traders have a unit initial endowment. Each trader can invest his endowment either in purchasing a unit bond on the bond market, or in acquiring the right to use a screening technology, or else in a deposit managed by an intermediary. In the first case, he faces an informational asymmetry, being unable to observe the entrepreneurs' technology and honesty. In the second case, the screening technology allows him to perfectly discriminate entrepreneurs with respect to both. A depositor faces no direct informational problem.

We now specify a more detailed description of the economy.

2.1 Entrepreneurs

Each entrepreneur $u \in [0,1]$ is either honest or dishonest. There is a set $H \subset [0,1]$ of honest entrepreneurs. We denote by h, $0 \leq h \leq 1$, the Lebesgue measure of H, i.e. $h = \lambda(H)$. Without loss of generality, we take $H = [1-h,1]$. The function $y: H \rightarrow \mathbb{R}_{++}$ associates to any honest entrepreneur the corresponding output he can produce with one unit of input. We denote by z, $z \geq 0$, the entrepreneurs' "reservation profit". It is such that production is not carried out if profit falls below z. The function $y(.)$ is assumed to satisfy the following assumption:

A.1 $y(.)$ is strictly decreasing on H and such that $y(1) > z$

This implies $y(u) > z$ for all $u \in H$. For later reference, we define $y(1-h) = y_M$ and $y(1) = y_m$.

Entrepreneurs have to borrow in order to implement their technologies. They can do so by applying for a unit loan at an intermediary or by selling a unit bond on the market. Dishonest entrepreneurs will always turn to the bond market, since no intermediary is going to serve them. Honest entrepreneurs however face an actual choice, which will be explicitly formalized in Section 3.

2.2. Traders

Every trader $t \in [0,1]$ is endowed with a unit of the commodity in the first period, and consumption takes place only in the second period. He invests his unit of wealth in whatever activity yields the highest return to him. A trader can choose to invest his wealth on the bond market where he is a price taker, unable to distinguish between firms. Alternatively, a trader can choose to become an intermediary by implementing a costly screening technology. Finally, a trader can also entrust his wealth with an existing intermediary, a possibility which obviously depends on some other traders choosing to be intermediaries.

Clearly, all intermediaries have an informational advantage. Thus, they do not finance dishonest entrepreneurs, while charge each honest applicant with his "reservation rate", $y(u) - z$. The screening technology is described by the a cost function $K(x)$, which depends on the number x of firms screened. It is assumed to be given by:

A.2 $$K(x) = \alpha + kx$$

where $\alpha \in [0,1]$ and $k \geq 0$ are given parameters. We therefore allow for the existence of a fixed cost which introduces a nonconvexity in the "information production set".

3. The agents' choices

3.1 The demand for credit

We now take up the first building block of our model, the derivation of the demand for both direct and intermediary credit. Under this respect, we recall that all dishonest entrepreneurs demand credit directly on the bond market.

Honest entrepreneurs can turn to either an intermediary or the market. In the former case, the profit is simply z, while in the latter it is $y(u) - R_b$, where $R_b \geq 0$ is the amount due as loan repayment[3]. The choice for $u \in H$ is therefore the bond market if $y(u) - R_b \geq 0$ and to an intermediary otherwise. The proportions of firm applying to the bond market is given by:

$$(1) \qquad \mu(R_b) = \lambda(\{u \in H \mid y(u) - R_b \geq z\}) + (1 - h)$$

which defines the supply of bonds. The proportion of firms applying to intermediaries is then given by $1 - \mu(R_b)$. When R_b satisfies $y_m - z \leq R_b \leq y_M - z$, $e = \mu(R_b)$ is the solution to the following equation:

$$(2) \qquad y(e) = R_b + z$$

as described in Figure 1. We notice that, for any R_b, $\mu(R_b) \in H$.

3.2. The supply of credit

As we know, each agent $t \in [0,1]$ faces three options (bondholding, intermediation, deposit) and chooses the one which grants the highest return. To model this choice, it is assumed that traders know the amount of credit demanded. Like firms, traders are price takers on the market and take as given the going deposit rate at which intermediaries accept deposits. The triplet $\omega = (R_b, R_d, e)$ is therefore taken as given throughout the present section, where e denotes the demand for credit, and R_d the deposit rate.

By definition, the return associated with deposit is R_d. We are now going to evaluate the return from intermediation and the return from bondholding, starting with the latter.

In order to evaluate the return from bondholding, we define the set $B \subset [0,1]$ of bondholders, whose measure is $b = \lambda(\mathrm{B})$. Each lender $t \in \mathrm{B}$ is willing to purchase one unit bond issued by any firm at the going market rate. Assume now that firms are uniformly spread on the bond market. The probability that a bond will be redeemed is then given by

$$(3) \qquad q(e) = 1 - \frac{1-h}{e}$$

Recalling that $(1-h) \leq e \leq 1$, we have $q(1-h) = 0$ and $q(1) = h \leq 1$. Thus, for any given ω the expected return from bondholding is equal to $q(e)R_{\mathrm{b}}$.

We now consider the return from intermediation. To do so, let $\mathrm{I} \subset [0,1]$ be the set of intermediaries, $\mathrm{B} \cap \mathrm{I} = \emptyset$. Any $t \in \mathrm{I}$ is then able to discriminate perfectly across entrepreneurs. For later reference, we define $i = \lambda(\mathrm{I})$ as the measure of this set. Given ω, assume that entrepreneurs are uniformly spread across intermediaries and that higher output firms are served first. For given (d, i, R_{d}), the screening activity yields an average return for the intermediary sector is

$$(4) \qquad \pi(s) = \left[d + i + \int_e^{e+s} [\, y(u) - z\,]\, du\right] - \left[s + sk + \alpha i + dR_{\mathrm{d}}\right].$$

It is defined for $s \in [0,1-e]$ as a function of s, the number of screened firms[4]. Intermediaries are assumed to use first their endowment in financing entrepreneurs, which allows to simplify the algebra a great deal. The positive term in large brackets represents therefore the revenue, i.e. deposits (including the intermediaries' own endowment) plus the revenue from screening. The negative term represents costs, i.e. actual lending (s) plus information costs $(sk + \alpha i)$ and deposit costs (dR_{d}). This function is strictly concave in s. The number of firms screened coincides with the amount of resources intermediaries need to finance them. The demand for resources will therefore be the solution to the following programme:

$$\begin{aligned} &Max\, \pi(s) \\ &s.t.\ s \in [0,1-e] \end{aligned}$$

where the constraint imposes that no more firms can be served than available for screening. The solution to this programme yields a demand function for deposits, $s = s(e) : H \rightarrow [0,1-e]$ which is continuous and depends only on e. Under the assumption that $y_{\mathrm{m}} < 1+k+z < y_{\mathrm{M}}$ it satisfies

$$y(e+s(e)) = 1+k+z$$

as illustrated in Figure 1. One can check that, whenever $y(e) > 1+k+z$, the same assumption implies that $s(e) > 0$ and that $s(.)$ is strictly decreasing for $e \in (1-h,1)$. Moreover $s(1) = 0$ and $s(1-h)$ is some constant between 0 and h. For $y(e) \leq 1+k+z$, we have $s(e) = 0$. It is useful to note that

$$1+k+z \geq y_M \Rightarrow s(e) = 0, \forall e$$
$$1+k+z \leq y_m \Rightarrow s(e) = 1-e$$

We have now evaluated the returns associated with the different credit supplying activites. Such returns, together with the entrepreneurs' demand, enable us to consider the definition and the existence of equilibrium in the model.

4. Equilibria and credit intermediation

4.1. Definitions and existence

A credit equilibrium is a vector $(R_b^*, R_d^*) \geq 0$ *and a distribution* $(b^*, d^*, i^*) > 0$*, such that*

(*i*) $b^* + d^* + i^* = 1$

(*ii*) $b^* = \mu(R_b^*)$

(*iii*) $d^* + (1-\alpha)i^* = s(b^*)$

(*iv*) $b^* > 0 \Rightarrow q(b^*)R_b^* \geq Max[R_d^*, \pi_i^*]$

(*v*) $d^* > 0 \Rightarrow R_d^* \geq Max[q(b^*)R_b^*, \pi_i^*]$

(*vi*) $i^* > 0 \Rightarrow \pi_i^* \geq Max[q(b^*)R_b^*, R_d^*]$

where $\pi_i^* = \dfrac{\pi(s(b^*))}{i^*}$ *is defined for* $i^* > 0$ *and given by:*

$$\pi_i^* = \left[\frac{1}{i^*}\int_{b^*}^{1-\alpha i^*} y(u)du\right] - \frac{1}{i^*}\left[[d^* + (1-\alpha i^*)]\,(k+z) + d^* R_d^*\right].$$

Condition (i) of the definition is actually an identity: each trader falls in either one of the three subsets: bondholders, depositors, intermediaries. Condition (ii) imposes that demand of bond credit equals the corresponding supply. Condition (iii) requires that the demand for deposits be equal to the corresponding supply, the latter including the intermediaries' own deposits, $(1-\alpha)i^*$. Conditions (iv) to (vi) impose that any given activity is chosen only if the corresponding expected payoff is not smaller than that granted by the other available activities. To evaluate the integral, we recall from (4) that $\pi(s) = \pi(s \mid e, d, i, R_d)$, which refers to the whole intermediary sector. We therefore divide by i to get per capita return.

The CE definition imposes a minimum consistency requirements on the agents' choices. It can be shown that, provided $h > 0$, there exists a pair of bond and deposit rates such that these requirements are met[5]. In fact, an equilibrium at which no screening is active and $b^* = 1$ is always granted by a low enough bond rate, such that all entrepreneurs choose to venture on the direct bond market. Since no positive return can be reaped from intermediation in such a case, neither intermediation nor deposit are profitable choices. All traders turn therefore to the bond market, which can be an equilibirum only if there is a positive probability of repayment (i.e., $h > 0$).

We now want to restrict our definition to a situation where intermediaries are active. Here follows therefore the definition of an ***equilibrium with credit intermediation*** (ECI).

An equilibrium with credit intermediation is a credit equilibrium such that

(*I*) $d^* > 0$ *and* $i^* > 0$

(*II*) $q(b^*)R_b^* = \pi_i^* = R_d^* > 0$

In other words, at a credit equilibrium with intermediation, deposit and screening are chosen, and identical traders get the same (positive) expected return. Each of them is then indifferent between the three activities. We are now in a position to establish the existence of an ECI. This is done in the following

Proposition: *Under the additional assumptions*

A.3 $y_m < 1 + k + z < y_M$

A.4 $\alpha > \bar{\alpha}$, *where* $\bar{\alpha} = 1 - y^{-1}(1 + k + z)$

A.5 $0 < h < 1$

there exists an equilibrium with credit intermediation.

This proposition, which is proved in the Appendix, deserves some specific comments. The first one is about how the determination of an ECI. The bond market equilibrium condition (*ii*) implies $b = e = \mu(R_b)$. This being granted, we recall that, by (*i*), $b + i + d = 1$. and therefore $i + d = 1 - e$. This, together with the deposit market equilibrium condition (*iii*), determines (d, i) as functions of e and hence of R_b. Condition (II) then determines the equilibrium rate. By construction, this is such that $q(\mu(R_b))R_b = R_d$. Bondholders, intermediaries and depositors earn the same expected return.

Some further observations concern the additional assumptions of our proposition. The first one imposes the natural constraint that the unit information cost (allowing for the reservation profit) be low enough for it to be covered by the honest firms' highest output, and high enough for some traders to opt for deposit. The second assumption puts a lower bound on the fixed costs. That lower bound is such that intermediaries have to rely on external deposits.

Assumption A.5 is crucial. It requires that honest and dishonest entrepreneurs are both present in the economy. Only at this condition is it possible for intermediaries to make positive equilibrium profits. In fact, it implies that in equilibrium the marginal firm, which is indifferent between direct and indirect credit, yields the intermediary a revenue higher than the rate paid to depositors.

In the following subsection we are going to examine in more detail the role of the assumptions on parameters. We shall then characterize an ECI and discuss its properties.

4.2. Equilibrium, honesty and information costs

Consider the parameters relating to the proportion of honest borrowers (h) and the variable information cost (k). It is straightforward to check that the only existing equilibrium when dishonesty is ruled out ($h=1$) is that with no intermediation. The reason is natural. If there is no quality uncertainty the bond and the deposit rate must be equal in equilibrium. As a result, no intermediary can make positive profits, irrespective of the information cost structure. Similar reasoning applies to the case $h=0$, where however no equilibrium can occur. In fact, no uncertainty implies equality between rates, but here it also implies $q(.)=0$. All (dishonest) firms apply to the bondmarket, but no traders is going to earn a return

As to variable costs, the basic intermediation result is not altered by having them equal to zero, so long as A.3 holds. Technically speaking, this depends on the intermediaries' demand for deposits (s) being always well defined, which in turn depends on the related return (π) being always concave. That is due to the average output of screened firms being obviously a concave function when output itself is ordered as a decreasing function. At some point, this stops traders from using the screening technology, even when the (variable) information costs are negligible.

The third crucial parameter is the fixed cost. When it is positive, it implies a nonconvexity in the "information production set", the importance of which is confirmed by the equilibrium behaviour of the model. This should be contrasted with the role played by the variable component, whose zero value does not affect in itself the emergence of an intermediary sector. As a preliminary remark, notice that in a credit equilibrium α determines the way non bondholders split themselves as depositors or intermediaries. Secondly, $\alpha > 0$ entails rationing because the fixed cost drives away resources, making them insufficient to serve the existing demand for intermediary credit. Rationing does not depend on moral hazard or adverse selection on the intermediary credit market, although it does depend on intermediaries having to pay for screening.

4.3. Equilibrium with intermediation

Most of the literature on financial intermediation stresses the idea that intermediation allows Pareto improvements *vis* à *vis* direct market interaction. This is not necessarily so in the present case. The main feature of our setup is the market approach used to model credit supply, in contrast with the "optimal contract" approach used by most of the intermediation literature[6]. Although this rules away any issue of contract optimality, it allows to model explicitly an environment where all traders act as price takers and have a negligible weight. The following remark helps interpreting the existence result established in the previous proposition.

Remark: *If $\alpha > 0$ all ECI are such that $b^* > 0$, i.e. the bond market is active.*

This remark is proved in the Appendix. It says that, under the stated condition, there are limits to the size of the intermediary sector[7], so that both honest and dishonest entrepreneur are supplying bonds at an ECI. The condition of positive fixed cost ($\alpha > 0$) implies that not all applicant firms are served by existing intermediaries. Of course, assumption A.4 does entail that the bond market is active.

As we already noticed, the presence of both honest and dishonest entrepreneurs and the traders' asymmetric information about honesty open up a wedge between the "safe" deposit rate and the "risky" bond rate. This allows intermediaries to make a positive profit. We can therefore give the following interpretation of the equilibrium behaviour of our economy. Due to asymmetric information on the bond market, the equilibrium bond rate is such as to lead some honest firms to opt for being price discriminated by intermediaries, who channel to them the depositors' resources. Depositors themselves are granted an equilibrium return equal to that obtained from any other activity. Under this interpretation, we can now attempt a comparison with an equilibrium with no screening which, as we know, always exists.

Two observations are worth making. First, all firms are served at a CE with no intermediation, which is not the case with an ECI. This is actually not surprising, since our bond market is an ordinary competitive market. One might therefore draw the implication that an equilibrium with credit intermediation is Pareto dominated by an equilibrium with no screening. The second observation, however, is that the bond market is "riskier" when intermediaries are active, since the latter attract honest entrepreneurs. This should actually be a general feature of models where intermediation sorts out the "best" firms. Under this respect, risk neutrality may therefore prove a particularly heavy restriction. In a sense, greater riskiness of the bond market and rationing on the intermediated market – as typical of an ECI as opposed to no screening equilibria – can be seen as the price the economy pays for no risk at all on the deposit side. Intermediation in this model does not necessarily work "too well", contrary to the criticism on the intermediation literature raised by some (e.g., Gertler, 1988).

As a final remark to this section, notice that, in spite of all traders being equal, they choose differently when confronted with the same equilibrium market returns. This depends on a sort of externality implicit in this setup: the return accruing to any trader, whatever his choice, depends on what the other traders are doing. A Nash interpretation of the model can be suggested, where the equilibrium outcomes could be seen as sets of optimal replies taken by traders, given the other traders' options[8]. This externality may also account for there being "many" intermediaries in equilibrium, which *prima facie* should be ruled out by the assumed nonconvexity. One observation can help interpreting this feature.

Consider an ECI. We already remarked that α determines the way traders split themselves between intermediation and deposit. Actually, the equilibrium proportion of intermediaries depends negatively on α, as one would expect. It is easy to see that higher levels of α reduce the proportion of traders willing to implement the screening technology, and increases the proportion of deposits. A lower number of intermediaries is associated to higher per capita revenue, which allows to cover the cost of an higher number of deposits. At any given equilibrium the revenue from screening is high enough to guarantee the equilibrium return to "many" intermediaries. A monopolistic equilibrium (with "one" intermediary[9]) could not be sustained, as the monopolist would earn more than everyone else.

5. Some remarks on reliability

In the model previously considered, credit intermediation is a possible equilibrium feature of the economy, occurring even though all traders are equal. However, this result has been derived ruling out reliability problems, which usually do play a significant role in the existing literature[10]. Generally speaking, reliability should be treated within a specific signaling framework: potential intermediaries try and communicate to the market their reliability through appropriate signals, such as the amount of personal resources they are able or willing themselves to employ in the firms they want to finance. Depositors as well would thus be involved in an informational problem.

In the present framework, reliability might be introduced via the cost function described by A.2. Such function was the same for all traders. Accordingly, our results relied on – indeed, drew their peculiarity from – the absence of any asymmetry in the traders' positions. The fact that intermediaries are constrained to put up their own deposit is, in this sense, immaterial: the deposit is the same for all. Actually, reliability becomes an issue when it creates a (perhaps potential) asymmetry among traders. In this sense, it can be captured by introducing a difference among the fixed information cost. For example, one may suppose that a sunk cost be a measure of the amount of personal resources any trader is required to put up as a signal of reliability. To be sure, in this way reliability requirements would be imposed exogenously on the model. However, they would turn up as nonconvexities in the "information production set" – a description which is anyway appropriate in so far as reliability costs do not strictly depend on the number of intermediated firms. Under this convention, a noterworthy point is that reliability may act as a barrier to entry[11]. This can be seen by noting that the endowment distribution played no role in the model discussed so far. When the fixed component differs across traders, this is no longer so. In fact, assume that each trader has a screening cost function as follows:

A.2' $$K_t(x) = \alpha_t + kx$$

where α_t is interpreted as a reliability cost. Define then $\varphi = \{\varphi_t\}$, $t \in [0,1]$, $\varphi_t = (1-\alpha_t)$, where agent t's endowment is unity. Clearly, only those traders belonging to the set $F(\varphi) = \{t \in [0,1] \mid \varphi_t \geq 0\}$ can act as intermediaries, so that the set I^* of active intermediaries at an ECI must satisfy $I^* \subseteq F(\varphi) \subseteq [0,1]$, with at least one inclusion holding strictly. Consider now the right hand side inclusion relationship: we say that there are barriers to entry in the intermediation market whenever $F(\varphi) \subsetneq [0,1]$. The existence of such barriers obviously depends on the relative behaviour of the endowment and the reliability costs distributions, which are independent of one another in this simplified framework[12]. The crucial, albeit obvious, fact is that $F(\varphi)$ does not (in principle) depend on k, which may be taken as a measure of a trader's efficiency in processing information. Thus, even if all traders are equally efficient, reliability may introduce a relevant asymmetry affecting any trader's entry into any market, and therefore alter the competitive nature of our economy.

6. Concluding remarks

In this paper, the existence of a (very simple) form of credit intermediation has been shown to be possible in a model where all potential investors are identical. Such a result has been obtained within a competitive framework where all agents in the economy act as price takers and have a negligible weight. Two are the model's assumptions that seem to deserve some concluding comments.

First, investment decisions are not explicitly taken into consideration. On the one hand, firms are endowed with very simple technologies. On the other, all input requirements have been normalized to unity. In this way one important issue has been ruled out: how the existence of an intermediary sector (and its peculiar features) affects the firms' investment decisions and their realized output[13].

Second, we have limited financing to credit contracts: the type of intermediary is not linked to the type of asset issued by any firm. In other words, the optimal arrangement between fund suppliers and fund demanders is not endogenously derived, neither is it considered how this might affect each intermediary's structure[14].

Both these symplifying assumptions are somewhat coherent with the perfectly competitive environment of our economy, where agents have no way to modify their position but via leaving the market[15]. The equilibrium with credit intermediation derived under these assumption is one where intermediaries sort investment opportunities which leave depositors running no risk and bondholders running more risk. Under this respect, the welfare performance of information producing intermediaries may be judged only *vis à vis* the distribution of risk aversion in the economy – something which goes beyond the scope of this paper.

By way of conclusion, there seem to be two observations that may be drawn form our results. First, nonconvexities are indeed essential to the emergence of intermediation as such, but "fixed costs" should be higher than some lower bound. Second, insofar as the social function of intermediaries can be reduced to information production in a perfectly competitive environment, the welfare effects associated to information revealing[16] should be allowed for in appraising that function.

REFERENCES

BENSTON, G.J. and C.W. SMITH (1976): "A Transaction Cost Approach to the Theory of Financial Intermediation", Journal of Finance, Papers and Proceedings, 31, 215–231.

BOYD, J.H. and E.C. PRESCOTT (1986): "Financial Intermediary–Coalitions", Journal ofEconomic Theory, 38, 211–232.

CAMPBELL, T.S. and W.A. KRACAW (1980): "Information Production, Market Signalling and the Theory of Financial Intermediation", Journal of Finance, 35, 863–882.

CHAN, Y.S. (1983): "On the Positive Role of Financial Intermediation in the Allocation of Venture Capital in a Market with Imperfect Information", Journal of Finance, 38, 1543–1568.

DIAMOND, D.W. (1984): "Financial Intermediation and Delegated Monitoring", Review of Economic Studies, 51, 393–414.

DRAPER, D.W. and J.W. HOAG (1978): "Financial Intermediation and the Theory of Agency", Journal of Financial and Quantitative Economics, Papers and Proceedings, 13, 595–611.

GALE, D. (1982): Money: in Equilibrium, Cambridge University Press, Cambridge.

GALE, D. and M. HELLWIG (1985): "Incentive–Compatible Debt Contracts: the One Period Problem", Review of Economic Studies, 52, 647–664.

GERTLER, M (1988): "Financial Structure and Aggregate Economic Activity: An Overview", Journal of Money, Credit, and Banking, 20, 559–587.

GREENWALD, B.C. and J.E. STIGLITZ (1988): "Imperfect Information, Finance Constraints, and Business Fluctuations", in M.Kohn and S.C.Tsiang (eds.), Finance Constraints, Expectations, and Macroeconomics, Clarendon Press,Oxford, 103–140.

GROSSMAN, S. and J.E. STIGLITZ (1976): "Information and Competitive Price Systems", American Economic Review, Papers and Proceedings, 66, 246–253.

GROSSMAN, S. and J.E. STIGLITZ (1980): "On the Possibility of Informationally Efficient Markets", American Economic Review,70, 393–408.

HELLWIG,M. (1989): "Asymmetric Information, Financial Markets and Financial Institutions. Where Are We Currently Going?", European Economic Review, 33, 277–285.

KRAHNEN, J.P. (1986): "Debt Contracts and Financial Intermediation: an Agency Perspective", mimeo, Freie Universität Berlin.

KRASA, S. and J. KUBITSCHEK (1988): "Direct Financing, Intermediation and Credit Rationing", mimeo.

LELAND, H.E. and D.H. PYLE (1977): "Informational Asymmetries, Financial Structure and Financial Intermediation", Journal of Finance, Papers and Proceedings, 32, 371–387.

RAMAKRISHNAN, R.T.S. and A.V. THAKOR (1984): "Information Reliability and a Theory of Financial Intermediation", Review of Economic Studies, 51, 415–432.

WILLIAMSON, S.D. (1986): "Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing", Journal of Monetary Economics, 18, 159–179.

WILLIAMSON, S.D. (1987): "Financial Intermediation, Business Failures, and Real Business Cycles", Journal of Political Economy, 95, 1196–1216.

YANELLE, M.O. (1989): "The Strategic Analysis of Intermediation", European Economic Review, 33, 294–301.

APPENDIX

(1) Proof of the Proposition

Consider the definition of credit equilibrium. Condition (*iii*) requires that $e = \mu(R_b)$. Using conditions (*i*) and (*ii*), together with (II), we can rearrange (4) to define the following function:

$$(1.A) \qquad f(R) = \int_{\mu(R)}^{\mu(R)+s(\mu(R))} y(u)\,du \;-(z+k)s(\mu(R)) - [1-\mu(R)]\,q(\mu(R))R$$

where, for ease of notation, we take $R_b = R$. Then, a credit equilibrium at which (II) holds, is defined by R^* such that:

$$(2.A) \qquad f(R^*) = 0$$

Indeed, that equation embodies the conditions (*i*) to (*iii*) and (II). We require that there is one $R^* > 0$ satisfying it, such that condition (I) is also satisfied, and $R_d^* = q[\mu(R^*)]R^* = q(b^*)R^*$. It is straightforward to check the following

(a) $f(R) = 0$ for $0 \leq R \leq (y_m - z)$

(b) $f(R) = -[1-\mu(R)]\,q(\mu(R))R$ for $(y_m - z) < R \leq (1+k)$

(c) $f(R) = \int_{1-h}^{1-h+a} y(u)\,du - (z+k)a,$ for $R \geq y_M - z$

where a is defined by $y(a + 1 - h) = 1 + k + z$.

In the interval (a), we have $e = \mu(R) = 1$, and therefore, $s(e) = 0$ and $d = i = 0$. In interval (b), we have $1 > e = \mu(R) > 1-h$ and $y(e) = R + z \leq (1 + k + z)$. Hence, $s(e) = 0$ and, by A.5, $0 < q(e) < 1$. One can conclude that within this interval $f(R)$ is negative (and actually decreasing). In interval (c), we have $e = 1-h$, which implies $s(e) = a$, a positive constant. By definition, $q(e) = 0$. Hence, $f(R)$ is a constant. It is positive since $(1 + z + k) < y_M$ entails $(z + k) < y_M$, and $y(u)$ is strictly decreasing.

The function $f(R)$ is continuous and an example is illustrated in Figure 2. Since $f(R) < 0$ for $y_m - z < R \leq (1 + k)$ and $f(R) > 0$ for $R \geq (y_M - z)$, there surely exists one

$1+k < R^* < y_M - z$ such that $f(R^*)=0$. It remains to check that it defines an ECI. We surely have the following:

$$\mu(R^*) \in (1-h, 1)$$
$$s(\mu(R^*)) \in (0, 1-e)$$

This implies this inequality:

$$\text{(3.A)} \qquad \mu(R^*) + s(\mu(R^*)) < 1$$

Now, when (2.A) is satisfied, the following holds

$$i + d = 1 - \mu(R^*)$$
$$(1-\alpha)i + d = s(\mu(R^*))$$

which, together with (3.A), imply

$$\alpha i = 1 - \left[\mu(R^*) + s[\mu(R^*)]\right]$$
$$d = [1-\mu(R^*)][1-\frac{1}{\alpha}] + s(\mu(R^*))/\alpha$$

The former implies $i^* > 0$ whenever $\alpha > 0$. We now prove that $d^* > 0$. For this to hold, it must be that

$$\alpha > 1 - \frac{s}{1-e} = \frac{1-e-s}{1-e} = \frac{1-y^{-1}(1+k+z)}{1-e} > 1-y^{-1}(1+k+z)$$

an inequality which is covered by assumption (A.4).

(2) Proof of the Remark

By definition, an ECI is such that $d^* > 0$, $i^* > 0$ and $R_d^* > 0$. By definition of a credit equilibrium, this implies $s(b^*) > 0$, which in turn implies $b^* \geq 1-h$. The bond market is active if $b^* > 1-h$. Suppose that $b^* = 1-h$. Then either $s(b^*) = h$ or $s(b^*) = a < h$. The former cannot be an equilibrium when $\alpha > 0$, for conditions (i) and (ii) of the credit equilibrium definition would be inconsistent with each other. The latter cannot be an equilibrium either, since it entails $q(b^*) = R_d^* = 0$.

FOOTNOTES

[1] E.g. Benston and Smith (1976). Insofar as market incompleteness is due to transaction costs, intermediaries would partially overcome this incompleteness.

[2] Among these authors, Boyd and Prescott (1986), Campbell and Kracaw (1980), Chan(1983), Diamond (1984), Draper and Hoag (1978), Krahnen (1986), Leland and Pyle (1977), Ramakrishnan and Thakor (1984), Williamson (1986, 1987). Some use an adverse selection framework, but more recent works rely on moral hazard to generate financial intermediation. Hellwig (1989) and Yanelle(1989) provide a recent appraisal of this literature.

[3] A bond is defined as a promise to pay in the second period an amount $\bar{R}_b$, against one unit lent out in the first.

[4] Definition (4) amounts to replace x by s/i in the cost function defined in (A.2).

[5]This is an upshot of the proof to the proposition which is established in the sequel. See the Appendix.

[6] For a criticism of this approach, particularly with respect to its static nature, see Hellwig (1989).

[7] This feature is absent in some models, which however allow for asset diversification (e.g.,Williamson, 1987).

[8] Working with a noncooperative game theoretic model with a discrete number of traders has actually provided results which are similar to those we are discussing.

[9] Individual intermediaries have actually a measure zero in this context, where anyway the constraint $\alpha \leq 1$ prevents i from falling below a given level. A model where intermediaries could invest more might alter this result.

[10] Ramakrishnan and Thakor (1984) put forth a model where information producers form intermediary coalitions, as reliability costs decrease with group size. Reliability may play a "noncompetitive" role in our model: its competitive structure is modified once reliability is explicitly considered (see section 6).

[11] This was already suggested by Campbell and Kracaw (1980), although in a different and somewhat informal framework.

[12] An explicit signaling mechanism based on the agents' endowment would obviously create a link between the endowment and the fixed cost distributions.

[13] Thus, in credit rationing models with endogenous investment the latter results from an optimal agreement between lender and borrower: see Clemenz (1986), Bester (1985). Conversely, if "equity rationing" occurs (Greenwald and Stiglitz, 1988), the existence of equity intermediaries might prove influencial in determining the amount of equities a firm is able to issue.

[14] Thus, banks are credit intermediaries, while equity intermediation is less homogeneous: some intermediaries are pure brokers, some issue their own liabilities. Clearly, the optimal contract form between firmand investor (Gale and Hellwig, 1985) bears on this point. Williamson (1986) argues that monitoring costs and risk aversion make debt the optimal arrangement between lending institutions and borrowers. Krasa and Kubitschek (1988) reach the same result in a game theoretic model.

[15] In this context, leaving the market is the only way to choose quantities. Traders do not have the power to modify the given contract form.

[16] We refer to Gale (1982, Ch.2) for a discussion of ex–ante and ex–post optimality under asymmetric information.

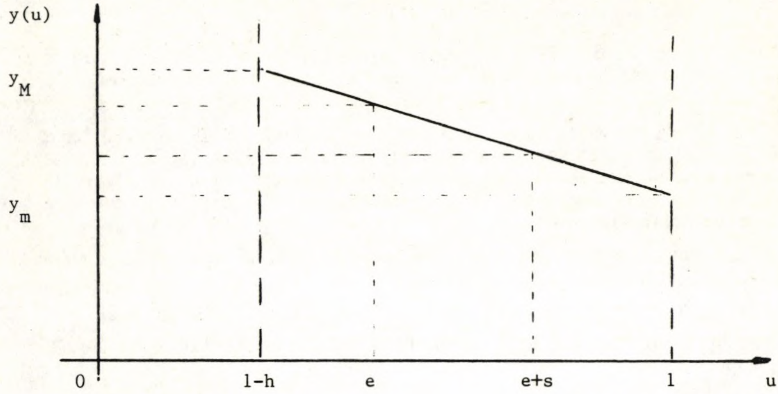

Figure 1

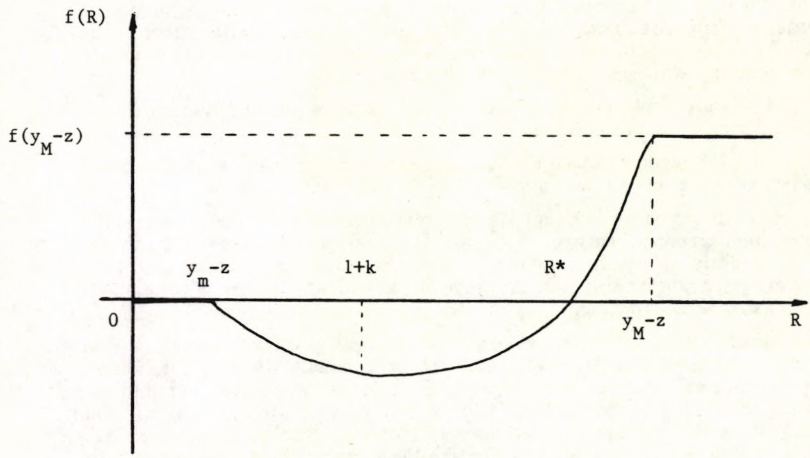

Figure 2

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