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SOME CONSEQUENCES OF CREDIT RATIONING IN AN ENDOGENOUS GROWTH MODEL

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I. Introduction

It is widely accepted among students of economic development that savings behavior is an important determinant of equilibrium rates of real growth. It is also commonly argued that, in economies in the early stages of development, too much investment is "self–financed," or in other words, that too little investment is financed through the extension of credit. This is despite the fact that, in less–developed countries, working and fixed capital are often primarily financed through business loans. This suggests that an understanding of the credit allocation mechanism is central to an understanding of real economic growth, and that this is perhaps particularly the case in less–developed economies.[1]

It is also widely accepted that informational frictions are pervasive in the credit markets of less developed economies, with it being difficult to identify potential borrowers who have access to "high–return" investment projects. [On this point see, for instance, Diaz–Alejandro (1985), Khatkate (1982a; p. 691, 1982b; p. 830), Bhatt (1988), Carter (1988), and McKinnon (1973; p. 18).] Credit rationing is viewed as endemic in these markets.[2] Furthermore, the "imperfections of the credit market, which give rise to qualitative credit rationing," are often argued to provide a rationale for government interventions in these markets [Chandavarkar (1971; p. 71)]. It is even argued in some cases that the government is possessed of superior information, and that it should therefore manipulate interest rates in order to channel credit to its "best uses". [Khatkate (1982b; p. 830)]. However, such interventions have frequently been viewed as counterproductive after the fact. [Khatkate (1982b; p. 830), Bhatt (1988; p. 285)].

This paper examines the consequences of informational frictions that give rise to credit rationing for real rates of economic growth. In order to do so, a model is developed in which externalities of the type discussed by Romer (1986) and Prescott and Boyd (1987a,b) are present in the production technology. These externalities give rise to a production function displaying (social) increasing returns to scale.[3] In such models savings behavior will, in general, be an important determinant of real growth, as discussed by Prescott and Boyd incentives to ration credit. Section IV undertakes an analysis of some commonly used or proposed government programs designed to affect the allocation of credit. Throughout the model is kept simple and illustrative. However, many of the assumptions made in order to accomplish this do not do violence to reality. Comments on many of the assumptions made, as well as on some features of the equilibrium that is derived are collected in Section V. Section VI concludes.

II. The Model

A. The Environment

A discrete time economy is considered, with time indexed by $t = 1,2,...$. The economy is populated by a sequence of two period lived, overlapping generations, plus a set of initial old agents present at $t=1$. All generations are identical in size, and all young generations are identical in composition. Each generation contains a countable infinity of agents.

Young generations are divided into two groups, referred to as borrowers and lenders. These groups are of equal size, and differ as follows. All young agents have one unit of labor to allocate, which is supplied inelastically. (Old agents have no endowment of labor.) Young lenders at t can sell their labor to firms, earning the real wage rate w_t. The proceeds can either be consumed at t, or loaned to other agents. Letting c_j denote consumption of the single good at age j, lenders have the utility function $c_1 + c_2$. Finally, lenders have no endowment of the consumption good at either date.

Young borrowers at t also have one unit of labor to allocate. (They have no endowment of the consumption good at either date as well.) Their labor can either be sold to firms, in which case it earns the real wage rate w_t, or it can be used to operate an "investment project". Investment projects require one unit of labor to operate, and they (stochastically) convert this labor and inputs of the consumption good into capital.

$$(3) \qquad \theta\left[\frac{2-\lambda}{\lambda p_H}\right]^{1-\theta} > \frac{1+\beta_H}{Qp_H}.$$

It remains to describe the information available to agents in this economy. Each borrower knows his own type. Type is private information ex ante, however, producing an adverse selection problem in credit markets.

Finally, each initial old agent operating a firm is endowed with k_1 units of capital. The fraction of initial old agents operating firms is denoted by $f \in (0,1]$.

B. Behavior of Agents

As discussed above, both firms and workers behave competitively in labor markets, taking the wage rate w_t as given, and firms and capital owners behave competitively in rental markets, taking the rental rate ρ_t as given. In credit markets behavior is as follows. Lenders announce loan contracts at t consisting of a triple (R_t, q_t, π_t), where R_t is the gross real rate of interest, q_t is the loan quantity offered, and π_t is the probability that a borrower "applying for" these loan terms is granted credit. As will soon be apparent, the same argument employed by Rothschild and Stiglitz (1976) can be used to establish that any equilibrium must display self–selection of borrowers according to contracts accepted (applied for). Thus lenders can be viewed as announcing loan contracts $(R_{it}, q_{it}, \pi_{it})$ to be offered to type i borrowers at time t. Contract announcements are made taking the announcements of other lenders as given.

Credit markets are assumed to operate as follows. At the beginning of time t each potential borrower approaches a lender, who has announced a loan contract. With probability π_{it} a type i borrower is granted the loan. If so, he operates his investment project. All activity in the credit market is assumed to conclude before the labor market opens at t. It is also assumed that each potential borrower can apply to only one lender for a loan.[5] Then if a borrower is denied credit, he supplies his unit of labor to a firm, and earns the wage rate w_t. These earnings are then stored, providing old age consumption of $\beta_i w_t$ for a type i borrower.

It is now possible to define an equilibrium in the credit market.

Definition. A Nash equilibrium in credit markets is a sequence of contracts $\{(R_i,q_{it},\pi_i)\}_{t=1}^{\infty}$; $i = H,L$, satisfying (5) and (6) $\forall t$, and such that no lender has an incentive to offer an alternate contract at any date, taking the offers of other lenders and the sequence $\{\rho_t\}$ as given.

C. Equilibrium Contracts

The reasoning of Rothschild and Stiglitz (1976) implies that (a) any equilibrium must display self–selection; (b) that in equilibrium contracts earn zero expected profits, so that

(7) $$R_i = 1/p_i;\ i = H,L,$$

and (c) that the contracts received by type i borrowers must be maximal for them among the set of all contracts that satisfy (5)–(7), given the contracts received by type j ($\neq$i) borrowers.

Before proceeding to characterize (candidate) equilibrium loan contracts, it will be useful to describe what is required in order for the expression in (4) to be increasing in π_i. Using (7), this requires that

(8) $$p_i(Q\rho - R_i)q_{it} \geq \beta_i w_t,$$

where attention has now been restricted to equilibria with a constant value of ρ_t; $t \geq 2$.[7] Since $q_{it} \leq w_t$, (8) can clearly be satisfied only if $Q\rho > 1/p_i$ $\forall i$, and if

(8′) $$p_i Q\rho > 1 + \beta_i;\ i = H,L.$$

(8′) is henceforth assumed to hold.

subject to (10). But assumptions (1) and (8′) imply that the solution to this problem has (10) holding with equality, so

$$\text{(11)} \quad \pi_L = \frac{p_H Q\rho - 1 - \beta_H}{p_H Q\rho - (p_H/p_L) - \beta_H} < 1.$$

Then, from (9), $q_{Lt} = w_t$ in equilibrium. Finally, it is easy to verify that the contracts just described satisfy (6).

As in Rothschild–Stiglitz (1976) no equilibrium in pure strategies need exist. Existence issues are very much the same as in Rothschild–Stiglitz. In particular, by construction no lender has an incentive to offer any other contract that attracts only one type of borrower. Thus an equilibrium exists if no lender has an incentive to offer a pooling contract. However, the incentives to do so depend (partially) on the value ρ, which is endogenous. Therefore a further discussion of existence is deferred until the determination of ρ has been described.

D. Equilibrium

If an equilibrium (with constant values of ρ_t and π_{it})[8] exists, it has the contracts just described. However, the equilibrium value of π_L depends on ρ. Determination of ρ, π_L, and w_t in equilibrium is now taken up.

All agents behave competitively in both labor and capital markets. Letting the number of firms be equal to the number of borrowers with positive quantities of capital,[9] there are $\left(\frac{1}{2}\right)[\lambda p_H + (1-\lambda)\pi_L p_L]$ firms per capita $\forall\, t \geq 2$. This is because half of all agents are borrowers. Among borrowers, a fraction λ are of type H. All these agents receive credit, and a fraction p_H of them will have successful investment projects. Among the fraction $1-\lambda$ of borrowers of type L, a fraction π_L receive loans, and a fraction p_L of these operate successful projects. Similarly, the per capita supply of labor is $\left(\frac{1}{2}\right)[1 + (1-\lambda)(1-\pi_L)]$ $\forall\, t$. This is

Writing (14) as

$$L_t = (\rho/\theta)^{\frac{1}{1-\theta}};\ t \geq 2,$$

and substituting this into (16), gives the growth rate of the per firm capital stock[12]

$$(16') \qquad \frac{k_{t+1}}{k_t} = Q(1-\theta)(\rho/\theta)^{-\frac{\theta}{1-\theta}};\ t \geq 2.$$

Finally, let Y_t denote aggregate per capita output. Then $Y_t = (\frac{1}{2})[\lambda p_H + (1-\lambda)\pi_L p_L]y_t$; $t \geq 2$, and $Y_1 = (\frac{1}{2})fy_1$. Since $y_t = \bar{k}_t^{\delta} k_t^{\theta} L_t^{1-\theta}$, $Y_{t+1}/Y_t = y_{t+1}/y_t = k_{t+1}/k_t$ $\forall$ $t \geq 2$ in equilibrium. Then for $t \geq 2$, (16′) gives the equilibrium rate of growth of per capita output. Thus the determination of all "steady state" equilibrium quantities can be reduced to the determination of ρ and π_L. Henceforth all discussion will be concerned only with these "steady state" values (i.e., will focus only on $t \geq 2$).

The determination of ρ and π_L is depicted diagrammatically in Figure 1, which has π_L on the horizontal axis and ρ on the vertical axis. The locus defined by (11) intersects the vertical axis at $(1+\beta_H)/Qp_H$, and has a slope given by

$$(17) \qquad \left.\frac{\partial \rho}{\partial \pi_L}\right|_{(11)} = \frac{[p_H Q\rho - (p_H/p_L) - \beta_H]^2}{p_H Q[1-(p_H/p_L)]} > 0.$$

The locus defined by (15) intersects the vertical axis at $\rho = \theta[(2-\lambda)/\lambda p_H]^{1-\theta}$, and has a slope given by

$$(18) \qquad \left.\frac{\partial \rho}{\partial \pi_L}\right|_{(15)} = -\theta(1-\theta)L^{-\theta}\left\{\frac{1-\lambda}{\lambda p_H + (1-\lambda)\pi_L p_L} + \frac{(1-\lambda)p_L L}{\lambda p_H + (1-\lambda)\pi_L p_L}\right\} < 0.$$

Then (17), (18), and the assumption of equation (3) imply that the loci defined by (11) and (15) are as shown in Figure 1. Clearly there exists a unique solution for ρ and π_L satisfying $0 < \pi_L < 1$. Denote this solution by π_L^* and ρ^*. As is apparent, ρ^* satisfies $\rho^* > (1+\beta_H)/p_H Q$. Satisfaction of the other half of (8′) is not guaranteed, but $\rho^* > (1+\beta_L)/p_L Q$ will clearly hold if β_L/p_L is sufficiently close to β_H/p_H.

Assuming (8′) is satisfied by ρ^*, a candidate equilibrium has been derived in which type L borrowers face credit rationing. The existence of this rationing affects not just the level of output for this economy, but its equilibrium rate of growth as well. In particular, substituting (12) into (16) and rearranging terms implies that

$$\frac{k_{t+1}}{k_t} = Q(1-\theta)\left[\frac{1 + (1-\lambda)(1-\pi_L)}{\lambda p_H + (1-\lambda)\pi_L p_L}\right]^{-\theta} \text{; } t \geq 2.$$

Then

$$\frac{\partial \ln(k_{t+1}/k_t)}{\partial \pi_L} = \frac{\theta(1-\lambda)}{1+(1-\lambda)(1-\pi_L)} + \frac{\theta(1-\lambda)p_L}{\lambda p_H + (1-\lambda)\pi_L p_L} > 0.$$

Therefore policy actions that can reduce credit rationing (increase π_L) will have the effect of increasing real rates of growth. A consideration of some policies intended to have this effect is undertaken below.

E. <u>Existence of Equilibrium</u>

Assuming that the value of ρ^* derived above satisfies $\rho^* > (1+\beta_L)/p_L Q$, the only issue with respect to the existence of an equilibrium is whether lenders have an incentive to offer an alternative (pooling) contract in the presence of the contracts described previously. Let

Noting that ρ^* is a continuous function of λ, it is readily verified that (20′) is satisfied for $\lambda = 1$, and hence for all values of λ sufficiently close to one. Thus, just as in Rothschild and Stiglitz (1976), sufficiently large values of λ guarantee the existence of an equilibrium.

Example. Consider an economy that has $Q = 3.5$, $\lambda = .65$, $\theta = .5$, $p_H = .5$, $p_L = .7$, $\beta_H = .25$, and $\beta_L = .75$. For this economy $\rho^* = .8359$ and $\pi_L^* = .4269$. These values of ρ^* and π_L^* satisfy (8′) and (20′), so that this economy has an equilibrium.

III. Comparative Statics/Dynamics

It is easy to verify that ρ^* and π_L^* are differentiable functions of the parameters of the model: Q, p_L, p_H, β_L, β_H, λ, and θ. The effects of changes in some of these parameters, especially in terms of their effects on equilibrium rates of growth, are now briefly examined. Of particular interest are changes in Q, p_L, and p_H, since varying these parameters corresponds to "changing the technology" for producing capital. However, not all technological improvements are growth inducing.

A. Effects of Varying Q

The consequences of an increase in Q, which increases the ease of converting consumption goods into capital, are depicted in Figure 2.[14] As is apparent, the locus defined by (15) is not affected by changes in Q. However, increases in Q reduce the intercept of the locus defined by (11). The horizontal shift in that locus as a result of changing Q is given by

$$\left.\frac{\partial \pi_L}{\partial Q}\right|_{d\rho = 0} = \frac{p_H \rho[1 - (p_H/p_L)]}{[p_H Q\rho - (p_H/p_L) - \beta_H]^2} > 0.$$

Thus increasing Q shifts the locus (11) down and to the right in Figure 2. Therefore increases in Q increase π_L (reduce credit rationing) and reduce ρ. Moreover, as is apparent from (16′),

k_{t+1}/k_t will be increased. Then improvements in the technology for converting the consumption good into capital that affect all investment projects in the same way will lead to increased rates of growth. This need not be the case for technological improvements that affect different borrowers differently, however.

B. <u>Effects of Varying p_L</u>

Increases in p_L represent "technological" improvements in type L investment projects. The consequences of such an improvement are depicted in Figure 3. As is apparent, changes in p_L do not affect the intercept of either locus. The horizontal shift in the locus defined by (11) is given by

$$\left.\frac{\partial \pi_L}{\partial p_L}\right|_{d\rho = 0} = \frac{-(p_H Q\rho - 1 - \beta_H)(p_H/p_L^2)}{[p_H Q\rho - (p_H/p_L) - \beta_H]^2} \leq 0$$

while the vertical shift in (15) is given by

$$\left.\frac{\partial \rho}{\partial p_L}\right|_{d\pi_L = 0} = \frac{-\theta(1-\theta)(1-\lambda)\pi_L L^{1-\theta}}{\lambda p_H + (1-\lambda)\pi_L p_L} \leq 0.$$

Thus increases in p_L shift the locus defined by (11) up and to the left, while the locus defined by (15) shifts down and to the left. Then, as is apparent from the figure, π_L^* declines, while the effect on ρ^* is indeterminate.

It should not be surprising that increases in p_L increase the amount of credit rationing, since increases in p_L reduce R_L, and hence exacerbate the adverse selection problem giving rise to this rationing. What may be surprising, on the other hand, is that this same increase in

p_L can increase ρ^*, and hence from (16′), can reduce the growth rate of the economy. This possibility is now illustrated by example.

Example. As in the previous example, $Q = 3.5$, $\lambda = .65$, $\theta = .5$, $p_H = .5$, $\beta_H = .25$, and $\beta_L = .75$. The effects of varying p_L between .62 and .74 are shown in Table 1. (For all the parameter values reported equations (8′) and (20′) are satisfied, so the existence of an equilibrium is not at issue.) As can be seen, each increase in p_L increases ρ^*, and therefore by (16′), reduces the real growth rate of the economy. In short, for this combination of parameter values the increased credit rationing caused by increases in p_L is sufficient to more than offset the consequences of the "technological" improvement in terms of what happens to real growth.

C. Effects of varying p_H

It is easy to verify that changes in p_H induce the following horizontal shift in the locus defined by (11):

$$\left.\frac{\partial \pi_L}{\partial p_H}\right|_{d\rho=0} = \frac{Q\rho - \frac{1}{p_L} - \frac{\beta_H}{p_L}}{[p_H Q\rho - (p_H/p_L) - \beta_H]^2} > 0.$$

The horizontal shift in the locus defined by (15) is

$$\left.\frac{\partial \pi_L}{\partial p_H}\right|_{d\rho = 0} = \frac{-\theta(1-\theta)\lambda L^{1-\theta}}{\lambda p_H + (1-\lambda)\pi_L p_L} < 0.$$

Then the consequences of increasing p_H are as depicted in Figure 4. As is apparent, ρ^* declines, so from (16′), k_{t+1}/k_t increases. The effect on π_L^* is ambiguous.

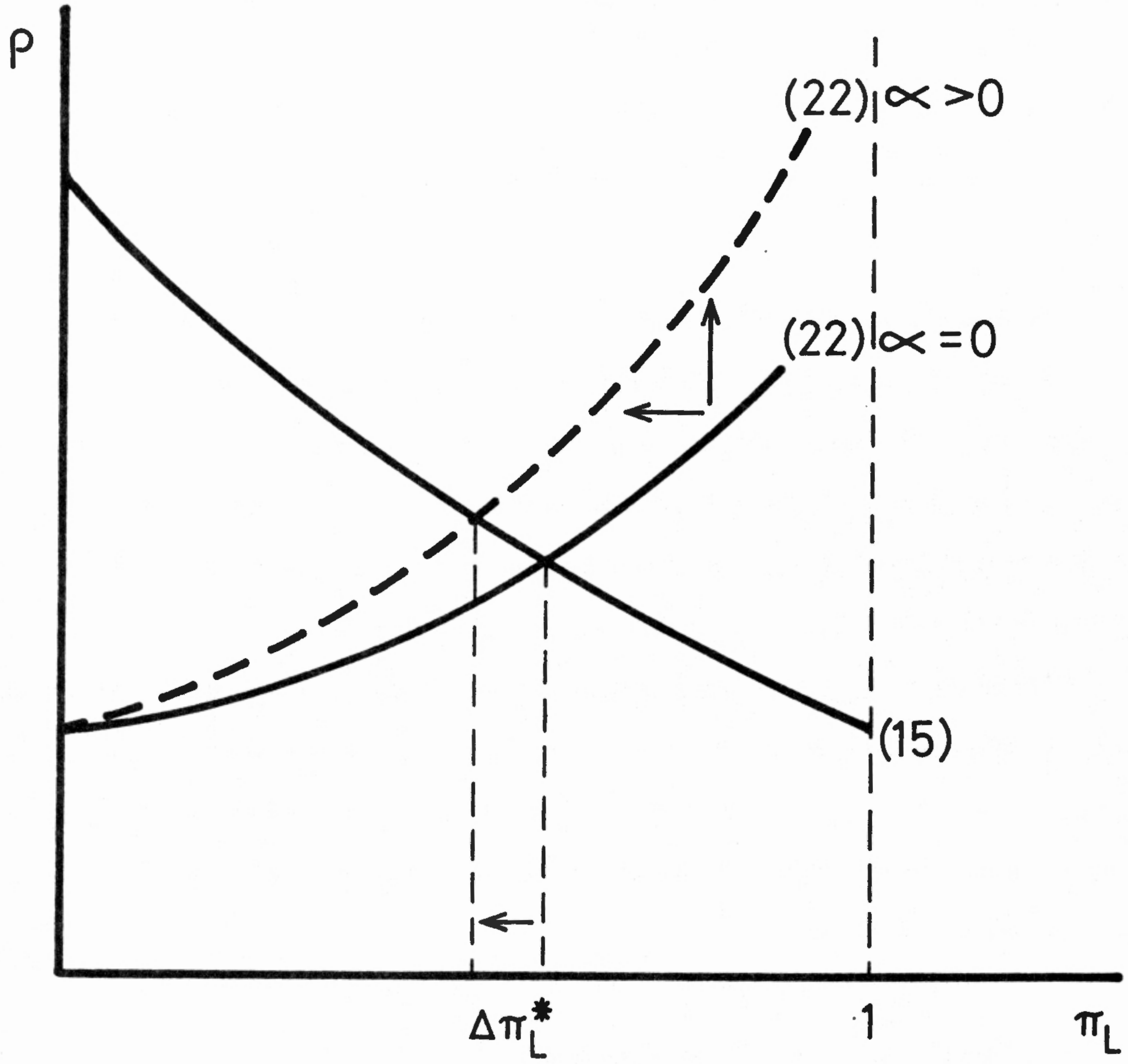
The preceding analysis suggests the following possibility. Increases in p_H (improvements in the "poorer" technology for producing capital) always increase growth rates. Over some range of parameter values, increases in p_L may reduce growth rates. Then it is possible that, from a growth perspective, improvements in "inferior" technologies may be more desirable than improvements in "superior" technologies for producing capital.

IV. Government Policy

We next consider the consequences of some government programs intended to channel credit to rationed groups. Such programs are common, even in the U.S.[15] However, they are particularly prevalent in less developed economies. For our purposes, credit policies in these economies can be divided into two broad groups. One is a set of policies that attempts to manipulate loan quantities, either through ceilings on loans to designated borrowers, or through direct government lending to targeted groups. The second is a set of policies designed to manipulate interest rates, with the intention of either reducing the cost of credit to targeted groups of borrowers, or of subsidizing certain kinds of loans. While all of these programs can be examined in the context of our model, we confine our attention to the second set of policies as these are somewhat simpler to analyze.

Even confining our attention to policies aimed at manipulating interest rates, there is a broad variety of government policies in use intended to accomplish this objective. One is the use of interest rate ceilings, intended to reduce the cost of credit to designated groups. A second is the use of loan guarantee or insurance schemes, designed to make certain loans more attractive to lenders while not increasing the cost of credit to borrowers. Some examples of loan guarantee programs in less developed countries are discussed by von Stockhausen (1983) and Chavez (1983). And finally, both direct and indirect interest rate subsidies are commonly employed. Indirect subsidies can take the form of allowing lenders to invest required reserves in particular ways, as discussed by Johnson (1983). Direct subsidies can also be quite large. For instance, Brazil in 1977 allocated more than 25% of all government expenditure to

Figure 5
A Loan Guarantee Program for Type L Borrowers



(23) $R_i = 1/[p_i + \alpha(1-p_i)] \equiv \tilde{R}_i;\ i = H,L$

and

(24) $$\pi_L = \frac{p_H(Q\rho-\tilde{R}_H) - \beta_H}{p_H(Q\rho-\tilde{R}_L) - \beta_H}.$$

All other equilibrium conditions are as in Section II.

The effects of an across–the–board loan guarantee program on ρ^* and π_L^* are depicted in Figure 6. As above, the solid loci in the figure represent the loci defined by (15) and (24) with $\alpha = 0$. Increases in α have no effect on the locus defined by (15). However the horizontal shift in the locus defined by (24) associated with a change in α is given by

$$\left.\frac{\partial\pi_L}{\partial\alpha}\right|_{d\rho=0} = \frac{p_H(1-p_H)\tilde{R}_H^2 - p_H(1-p_L)\pi_L\tilde{R}_L^2}{p_HQ\rho - p_H\tilde{R}_L - \beta_H} > 0.$$

Thus increases in α shift the locus defined by (24) to the right. They therefore increase π_L^* (reduce the extent of credit rationing) and reduce ρ^*. From (16′), this reduction in ρ^* will be associated with an increase in the steady state growth rate.

The result that this loan guarantee program increases the steady state rate of growth is at some level not surprising, since resources obtained from outside the economy are being utilized. However, the consequences of an across–the–board loan guarantee program are considerably different from those of a loan guarantee program directed only at type L borrowers. The differences derive from the different incentive effects of the two programs. An across–the–board loan guarantee represents a "larger" subsidy to type H than type L borrowers, since the former are more likely to default. Thus a guarantee program that treats all borrowers symmetrically operates to reduce the severity of the adverse selection problem in credit markets. It therefore results in a reduction in rationing of type L borrowers and increased rates of growth.

V. Discussion

Several aspects of the modelling strategy employed above, and of the equilibrium that emerged, merit comment. In particular, many of the assumptions that were made in section II served primarily to simplify the analysis. However, we believe that most of these assumptions are easily defensible in the context of a study of growth that focuses primarily on less developed economies.

To begin, consider the two important aspects of the production technology in the model. First, it was assumed that operating an investment project consumed the entire labor input of a borrower. This assumption introduces an indivisibility into the investment technology. That indivisibilities are an important aspect of investment decisions in less developed countries is a common theme in the development literature.[17] Second, it was assumed that the technology for producing the consumption good displays (social) increasing returns to scale. The presence of these increasing returns makes endogenous growth possible.

However, since other devices for generating endogenous growth are available,[18] this specification of technology merits some defense. First, that increasing returns are an observed feature of the technology in underdeveloped countries is widely asserted in the development literature [McKinnon (1973), p. 121; Bhatt (1988)]. Williams and Laumas (1984) present evidence on this point for India. In each industry that they investigated, they found evidence of increasing returns to scale in the range within which the industries operated. Second, the increasing returns to scale in our model, as in Romer (1986), are associated with "spillover externalities" in production. Such externalities are commonly argued to provide a role for government interventions in credit markets [Johnson (1983)], so that this specification is desirable in a study that includes an examination of government credit policies.

Another feature of the model that merits comment relates to interest rate determination. In the model of section II, interest rates on loans are determined entirely by the opportunity endowments may lack 'internal' production opportunities...." Our formulation captures this possibility.

Finally, it remains to comment on the kind of informational friction employed to generate credit rationing, and on whether this kind of rationing is actually important in less developed economies. There is no doubt that credit rationing is important in such economies, although much of it may simply be the result of government regulation of interest rates. However, credit rationing explained by informational frictions is also purported to be important. As argued by Gonzalez–Vega (1984, p. 130), "most of the imperfections that explain nonprice credit rationing, even in the absence of interest–rate restrictions, exist in the rural credit markets of LICs [low income countries]. Uncertainty, default risks, and transactions, information, and collection costs are all particularly high in these fragmented financial markets." Gonzalez–Vega goes on to suggest that rationing arises where it is particularly difficult to ascertain information concerning borrower "type".

In the model of sections II–IV, credit rationing arises because different borrowers have access to investment projects of different quality, and because it is not possible to identify ex ante which borrowers have access to which projects. McKinnon (1973, pp. 11, 18) identifies exactly these features as the key features of financial markets in less developed countries. Finally, we might note that a close relative of the kind of sorting model developed in section II to study credit extension has been employed by Braverman and Guasch (1984) to study lending between landlords and sharecroppers in developing countries.

A last comment concerns a feature of the equilibrium derived in section II. In particular, it may at first glance seem odd to have low risk borrowers be the rationed group. However, an important aspect of financial markets in underdeveloped economies is that "rates of return on some physical and financial assets are negative while extremely remunerative investment opportunities are foregone". [McKinnon (1973), p. 8] Thus it is important to produce a model which explains why some apparently "superior" investment projects are not funded, while at the same time inferior projects do receive funding. This outcome is explained

Notes

1. For an argument that "too much" investment in less developed countries is self–financed, see McKinnon (1973; Chapter 2), Shaw (1973; p. 10), and Patrick (1966). For an argument that much capital investment is financed through business loans, see van Wijnbergen (1983; p. 46). An argument that an understanding of the role of (presumably inside) money "as a conduit of resources from savers to investors" is "central" to an understanding of economic development is given by Khatkate (1982a; p. 689).

2. Clearly much credit rationing in developing countries is due to government regulation of interest rates. However, the government interventions themselves are motivated by the perception that there is a "problem" with the allocation of credit through market mechanisms. We therefore adopt the view that informational frictions are the cause of the credit rationing of interest here.

3. Increasing returns to scale are often viewed as an important feature of the technology in developing countries. This point is discussed further in section V below. It is also commonly argued in developing economies that the private and social returns to investments differ because of "external benefits". [Johnson (1983)]. This is captured in our formulation as well.

4. Equation (1) imposes a "single crossing" property on the (appropriately defined) indifference curves of borrowers. Equation (1) can be viewed as asserting that borrowers with access to superior investment opportunities also have access to a superior storage technology.

5. In addition to assuming that each borrower can contact only one lender, it is assumed that each lender can lend to at most one borrower. Thus the pooling of funds through an intermediary is ruled out. This assumption is a simplification that could be replaced

18. See, for instance, King, Plosser, and Rebelo (1988), Manuelli and Jones (1988), and Rebelo (1987).

19. Informal credit markets probably present the most appropriate comparison to our model, since we assume that each individual borrower deals with an individual lender.

20. See, for instance, Blinder and Stiglitz (1983).

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