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INTRODUCTION

It is often argued that a well–functioning system of financial markets has beneficial effects for countries in the early stages of industrialization [Cameron (1967), McKinnon (1973), Shaw (1973)]. Specifically, the development of a banking system has been viewed as playing a central role in determining both short–term real growth rates and long–run levels of output in such economies. It is also often suggested that the primary impediment to the development of an intermediary sector is legislative. In particular, government policies associated with "financial repression" hinder the development of banks, and promote self–financed investment and investment financed through "informal" (and presumably inefficient) money markets. These arguments raise the possibility that the "liberalization" of financial markets in developing countries can yield substantial benefits in the form of increased output.

Nevertheless, financial repression associated with high reserve requirements and deposit interest rate ceilings is widespread in developing countries. It has been recognized that such "repressive" policies have some justification in economies where the government is forced to monetize a sustained deficit. In particular, the kinds of arguments offered by Nichols (1974) and Bryant and Wallace (1984) can be applied to developing countries to suggest that efficient use of the inflation tax will also typically involve some legal restrictions to "augment" the demand for money. This reasoning implies that developing countries face a trade–off in the use of reserve requirements and interest rate ceilings: output losses from the use of such instruments must be weighed against benefits derived from more efficient use of the inflation tax. And indeed, analyses like that of McKinnon and Mathieson (1981) have considered the "optimal degree of financial repression" in developing economies forced to rely on the inflation tax.

This paper also addresses the question of the optimal extent of financial repression in a developing economy faced with a sustained deficit that must be monetized. The approach taken here departs from previous literature in two major ways. First, a general equilibrium model of the role of liquidity provision in the determination of output and inflation is provided. This model employs the insights of Diamond and Dybvig (1983) concerning the role of liquidity provision by banks in the resource allocation process. Specifically, the Diamond–Dybvig model of intermediation is embedded in an overlapping generations model with production, capital accumulation, and outside money. A government faced with a deficit that must be monetized is also introduced. As will be seen, the provision of liquidity by banks interacts with the capital accumulation process, so that financial intermediation affects the steady state level of output. The behavior of the banking system also interacts with the savings behavior of individuals to determine the steady state inflation rate associated with any given deficit and choice of reserve requirements or interest rate ceilings. Because the model specifies the interactions between government policies, the banking system, and the rest of the economy, the consequences of these policies for the steady state capital stock, output and inflation can be analyzed in general equilibrium.

Second, the model allows "optimal" choices of government policies to be derived when these policies affect not only the inflation rate, but also the steady state level of output. These results expand on the treatment of "optimal repression" offered by McKinnon and Mathieson (1981), which considers only the case where the time path of output is fixed exogenously. Here the government is required to consider the trade–off between output losses and more efficient use of the inflation tax when it chooses reserve requirements or interest rate ceilings. Financial repression may tend either to reduce output in steady states, or to interfere with efficient risk sharing in financial markets, or both. However, the model suggests that in an economy with a positive deficit that must be monetized, some financial repression typically will be desired on welfare grounds.

It is also possible to study, using this model, how the "optimal" degree of financial repression depends on the size of government deficits. As will be seen, it typically will be desirable to impose more severe (higher) reserve requirements in response to larger deficits. Another question asked is when reserve requirements as opposed to interest rate ceilings should be used. The answer is suggestive about the appropriate "order of financial liberalization" discussed by McKinnon (1982).

Finally, the model provides a different perspective on "the new structuralist critique" of financial liberalization, associated with Taylor (1980), van Wijnbergen (1983, 1985), Buffie (1984), and Lim (1987). Certain (arbitrary) choices of reserve requirements imply that an intermediary sector (operating subject to reserve requirements) will co–exist with an "informal" financial sector (not subject to reserve requirements). When "formal and informal" sectors co–exist, the model implies that all funds brought into the banking system via a financial liberalization will come from the "informal sector". Because banks operate subject to reserve requirements, savings channelled into investment through the informal sector result in more capital formation than savings placed in intermediaries. This will mean that "local" financial liberalizations do not have expansionary effects, which is the essence of the new structuralist critique. Nevertheless, it will be seen that such financial liberalizations are always desirable on welfare grounds.

The paper proceeds as follows. Section I describes the environment, and analyzes steady state equilibria in the presence of a constant deficit but without either binding reserve requirements or interest rate ceilings. Section II studies the same economy under reserve requirements (of less than 100%), focusing again on steady state equilibria. Adopting the welfare of the representative agent in a steady state equilibrium as the objective, this section analyzes "optimal" choices of reserve requirements. It is demonstrated that it is never optimal to repress the economy to the point where "formal" and "informal" financial markets co–exist. Also, responses of the optimal degree of repression and of inflation to changes in fiscal policy are considered. Section III analyzes interest rate ceilings on deposits, and discusses when the government has an incentive to impose such ceilings. Section IV comments on some of the assumptions employed, and their role in the analysis. Section V concludes. Throughout the model is one of a closed economy. We thus follow Taylor (1980) and McKinnon–Mathieson (1981) in looking only at closed economy issues.

I. THE MODEL: LAISSEZ–FAIRE

In the model constructed here, (a) there is a role for banks to provide liquidity, and (b) the provision of liquidity by banks plays a central role in determining equilibrium levels of output. This section studies the economy when banks are free of binding reserve requirements and interest rate ceilings.

A. The Environment

The economy consists of an infinite sequence of three period lived, overlapping generations. Time is discrete, and indexed by $t = 0,1,\ldots.$ Since only steady states will be analyzed, a description of initial conditions may be omitted.

In this economy, a non–storable consumption good is produced using capital and labor. For reasons that are given below, all capital is owned by a subset of old agents, henceforth called "firms". It is assumed that each firm can use only its own capital in production, or in other words, that there are no rental markets in capital.[1] Letting k_t denote the capital stock of a representative firm at t, letting L_t denote per firm employment, and letting y_t denote per firm output of the consumption good, $y_t = k_t^{\theta} L_t^{1-\theta}$; $\theta \in (0,1)$. The simplifying assumption is made that capital depreciates completely in one period.

Capital itself is produced using an investment technology according to which one unit of the consumption good invested at time t yields R units of capital at time t + 2. This gestation period may be interpreted as the lag between expenditures and receipts by firms that is frequently emphasized in models of developing economies.[2] Young agents and intermediaries have access to the investment technology. However, capital that accrues at t+2 can be received only by the originating investor. Thus any originating investor who does not operate a firm at t+2 loses his capital investment.[3]

Agents in the model are as follows. At each date a young generation is born. Young generations are identical (in particular, there is no population growth), and each contains a continuum of (ex ante) identical agents. Young agents are endowed with a single unit of labor, which is supplied inelastically (it is not an argument of agents' utility functions). Agents have no endowment of the consumption or capital good at any date, and can work only when young. Letting c_i denote age i consumption (i = 1,2,3), all young agents have the utility function

(1) $$u(c_1,c_2,c_3) = \ell n(c_2 + \phi c_3)$$

where ϕ is an individual–specific random variable realized at the beginning of age 2. ϕ is iid across agents, with probability distribution

(2) $$\phi = \begin{cases} 0 \text{ with probability } 1-\pi \\ 1 \text{ with probability } \pi \end{cases}$$

where $\pi \in (0,1)$. This formulation of preferences is, of course, very closely related to that of Diamond and Dybvig (1983). It implies a "desire for liquidity" on the part of savers that leads to the formation of financial intermediaries. Finally, it is assumed that only agents with ϕ=1 can operate firms.

(It will be noted that the preferences in (1) and (2) imply that all young period income is saved. This specification has the attractive feature that any changes in the financial environment resulting from government actions cannot affect savings rates. Therefore, no results here will depend on assumptions about the impact of government policies on savings behavior.)

There are two "primary assets" in this economy. One is investment in capital, which has already been described. The second is government issued fiat currency. M_t will denote the stock of (outside) money in circulation at t (in per capita terms),[4] and p_t will denote the time t price level (the dollar value of the consumption good). Share markets to capital in process are precluded, as are intergenerational loan markets.

The last two assumptions merit some discussion. First, these are common assumptions in the analysis of financially repressed developing economies. Taylor (1980, p. 467) contends that a relevant institutional detail in such economies is that "the only primary assets in the financial system are central bank liabilities (the monetary base) and the physical capital stock...". A similar argument is made by McKinnon and Mathieson (1981, p.4). Second, this paper focuses on situations in which government deficits must be monetized. In these situations the government must prevent other financial markets from "undermining" the demand for money. In the model below, the existence of either share markets in capital or markets for intergenerational lending will sometimes drive money out of the system (depending on the productivity of capital and the money growth rate). Thus governments facing a need to monetize deficits would also need to engage in "financial repression" in order to preclude such markets. In fact, restrictions on share trading intended to prevent such trading from undermining the banking system are not unknown historically [Arnold (1937), p. 8–9]. And finally, a role for banks in this model depends in part on restricting markets in claims to capital in process, just as in Diamond–Dybvig (1983).[5] Thus such markets are assumed not to exist. This assumption implies, of course, that only age 3 agents with $\phi=1$ will operate firms.

The final agent in the model is the government, which is assumed to expend the consumption good in real amount $g > 0$ at each date (g is measured in per capita terms). The government also levies a constant proportional income tax on young period wage earnings, at rate τ. Then, letting w_t denote the time t real wage rate, the (per capita) deficit at t is $g - \tau w_t$. This deficit must be monetized,[6] so the government budget constraint is ($\forall\ t \geq 1$)

(3) $$g = \tau w_t + (M_t - M_{t-1})/p_t.$$

The situation of interest, of course, is where $g > \tau w_t$.

B. Labor Markets

Equilibrium in the labor market is now described. This equilibrium is invariant to changes in financial markets or fiscal policy.

At each date t, each age 3 agent with $\phi = 1$ operates a firm. Since all agents were identical when young, these firms have the same inherited capital stock, k_t. Taking this capital stock and the real wage rate w_t as given, each firm chooses an employment level L_t to maximize $k_t^{\theta} L_t^{1-\theta} - w_t L_t$. The solution to this profit maximization problem is to set

$$(4) \qquad L_t = k_t [(1-\theta)/w_t]^{1/\theta}.$$

Note that the firm owner retains θy_t, and substituting (4) into the production function gives per firm profits (or the return to capital) at t as

$$(5) \qquad \theta k_t^{\theta} L_t^{1-\theta} = \theta k_t[(1-\theta)/w_t]^{\alpha},$$

where $\alpha \equiv (1-\theta)/\theta$.

While (4) gives per firm labor demand, per firm labor supply is $1/\pi$. This is because all young agents supply one unit of labor. There are equal numbers of young and old agents, but only old agents with ϕ=1 operate firms. Thus, by the law of large numbers, only a fraction π of old agents operate firms, and in equilibrium per firm employment must be $1/\pi$. Equating L_t from (4) with $1/\pi$ gives the labor market clearing condition

$$(6) \qquad w_t = (1-\theta)\pi^{\theta} k_t^{\theta}$$

C. <u>Portfolio Decisions</u>

Young agents may allocate their savings between the two primary assets described above (money and the capital investment), and bank deposits. Banks promise that for each unit of the consumption good deposited, r_1 units of the consumption good will be paid if withdrawal occurs after one period. For reasons to be discussed below, if withdrawal occurs two periods after making a deposit r_2 units of the *capital good* will be paid per unit of the consumption good deposited. Using equation (5), agents who withdraw after two periods then earn the return $\theta[(1-\theta)/w_{t+2}]^{\alpha}$ per unit of capital, or $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha}$ per unit deposited. (The absence of a time subscript associated with r_1 and r_2 anticipates the focus on steady state equilibria).

At date t, then, each young agent has real after tax income $(1-\tau)w_t$, all of which is saved. Let ψ_1 be the fraction of young period savings placed in bank deposits, ψ_2 be the fraction held as real balances, and $\psi_3 = 1 - \psi_1 - \psi_2$ be the fraction held in the form of direct capital investment ($\psi_i \in [0,1]$; i = 1,2,3).

If $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} > r_1$, it is straightforward to verify that bank depositors withdraw after one period iff they experience $\phi = 0$. This, along with two other facts, permits the portfolio problem of young agents to be derived. The first fact is that, when $g \geq \tau w_t$, $p_t/p_{t+1} \leq 1$ in steady state equilibrium. In this case all holdings of real balances will be liquidated after one period (whether $\phi = 0$ or not). Second, direct use of the investment technology has value only if $\phi = 1$, because only then will a firm be operated. If $\phi = 1$, one unit of savings placed in the investment technology returns R units of capital at t + 2. Using (5), the value of this capital, measured in terms of the consumption good, is $R\theta[(1-\theta)/w_{t+2}]^{\alpha}$. Then, assuming $p_t/p_{t+1} \leq 1$, young agents choose ψ_1 and ψ_2 to solve the problem[7]

$$
\begin{aligned}
(7) \qquad & \max \ell n[(1-\tau)w_t] + (1-\pi)\, \ell n[\psi_1 r_1 + \psi_2(p_t/p_{t+1})] \\
& + \pi \ell n\{\psi_1 r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} + \psi_2(p_t/p_{t+1}) \\
& +(1-\psi_1-\psi_2)\, R\theta[(1-\theta)/w_{t+2}]^{\alpha}\}; \quad 0 \leq \psi_i \leq 1; \;\; i = 1,2,3
\end{aligned}
$$

Real balances are liquidated after one period, so $\psi_2(p_t/p_{t+1})(1-\tau)w_t$ is consumed at t + 1. If $\phi = 0$ (which occurs with probability $1 - \pi$), an additional $\psi_1 r_1(1-\tau)w_t$ is consumed at t + 1. If $\phi = 1$ there is no additional consumption at t + 1, while consumption at t + 2 is $\psi_1 r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} + (1-\psi_1-\psi_2)R\theta[(1-\theta)/w_{t+2}]^{\alpha}$.

Assuming $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} > r_1$ and $p_t/p_{t+1} \leq 1$, it is easy to see that if $p_t/p_{t+1} \leq r_1$, then $\psi_2 = 0$. In this case, bank deposits dominate real balances as an asset for young savers. As will be shown below, whether or not reserve requirements are binding, $r_1 \geq p_t/p_{t+1}$ will hold. Therefore, $\psi_2 = 0$ will obtain for the remainder of this section (as well as in section II).

This, of course, means that all "money holdings" by individual savers are in the form of bank deposits. This result is not inconsistent with other formulations of the "financial repression" problem; for instance Taylor (1980) assumes it throughout his analysis.

Under the conditions of the previous paragraph, it is easy to derive the following solution to (7):

(8) $$\psi_1 = \min \left[\frac{(1-\pi)R}{R - r_2}, 1\right]$$

if $R \geq r_2$.[8]

D. <u>Intermediary Behavior</u>

Intermediaries accept deposits from young savers at t and use them to purchase primary assets. Let q denote the fraction of intermediary assets held in the form of capital, and $z = 1 - q$ denote the fraction held in the form of real balances. (Again, the absence of time subscripts anticipates the focus on steady state equilibria.) In addition to q and z, banks choose a value r_1 for payments made (per unit deposited) to agents who withdraw one period after making a deposit, and a value r_2 for payments received (per unit deposited) by agents who withdraw two periods after making a deposit.

As in Diamond and Dybvig (1983), banks are viewed as cooperative entities consisting of coalitions of young agents at t.[9] These coalitions choose r_1, r_2, q, and z to maximize the expected utility of a representative depositor, evaluated as of date t. In doing so they take the time paths of $\{w_t\}$ and $\{p_t\}$ as given, or in other words, intermediaries behave competitively. Their choices must, of course, satisfy a set of resource constraints. Assuming agents withdraw one period after making a deposit iff $\phi = 0$, the relevant resource constraints are

(9) $$(1-\pi)r_1 = z(p_t/p_{t+1})$$

(10) $$\pi r_2 = Rq$$

where $z = 1 - q$.[10] Notice that in this formulation, as in Diamond and Dybvig (1983), depositors who wait two periods to withdraw become residual claimants on the assets of the bank, and therefore receive all proceeds accruing from unliquidated assets. Such proceeds, of course, accrue in the form of the capital good. Thus all agents who withdraw two periods after making a deposit become firm owners (owners of capital).[11]

Assuming that $R\theta[(1-\theta)/w_{t+2}]^{\alpha} > p_t/p_{t+1}$ (so that money does not dominate capital as an asset), it is easy to see that, under laissez–faire, $\psi_1 = 1$ must hold. Then banks choose r_1, r_2, q, and z to maximize the expected utility of depositors given $\psi_1 = 1$, or in other words, to solve the problem

$$\max_{0\leq q\leq 1} \; \ell n[(1-\tau)w_t] + (1-\pi)\ell n\, r_1 + \pi \ell n\{r_2\theta[(1-\theta)/w_{t+2}]^{\alpha}\}$$

subject to (9), (10), and $z=1-q$. The solution to this problem sets $q = \pi$. Then (9) and (10) imply that[12]

(11) $\quad r_1 = p_t/p_{t+1}$

(12) $\quad r_2 = R.$

E. Steady State Equilibrium

In the absence of government intervention, $\psi_1 = 1$, so all capital formation is intermediated. In this case the time t + 2 (per firm) capital stock k_{t+2} is given by

(13) $\quad k_{t+2} = Rq(1-\tau)w_t/\pi.$

This is because $(1-\tau)w_t$ is time t savings, of which $q(1-\tau)w_t$ is invested in capital formation. The resulting per capita capital stock at t+2 is $Rq(1-\tau)w_t$, which is divided among the fraction π of agents who did not withdraw at t + 1. Substituting (6) into (13) and using $q = \pi$ gives the equilibrium law of motion for the per firm capital stock:

$$(14) \qquad k_{t+2} = R(1-\theta)(1-\tau)\pi^{\theta}k_t^{\theta}.$$

Then, in a steady state equilibrium, $k_{t+2} = k_t = k^*$, and from (14)

$$(15) \qquad k^* = \frac{1}{\pi}[R\pi(1-\theta)(1-\tau)]^{\frac{1}{1-\theta}}.$$

Remaining steady state equilibrium values are readily derived. Letting w^* denote the steady state equilibrium real wage rate, from (6)

$$(16) \qquad w^* = (1-\theta)[R\pi(1-\theta)(1-\tau)]^{1/\alpha}.$$

Then steady state real balances M_t/p_t are given by $\psi_1 zw^*(1-\tau) = (1-q)(1-\tau)w^* = (1-\pi)(1-\tau)w^*$. From the government budget constraint (3),

$$\frac{p_t}{p_{t+1}} = \frac{(M_{t+1}/p_{t+1}) - (g-\tau w_{t+1})}{(M_t/p_t)}.$$

Assuming $g > \tau w^*$, in steady state

$$(17) \qquad \frac{p_t}{p_{t+1}} = \frac{(1-\pi)(1-\tau)w^* - (g-\tau w^*)}{(1-\pi)(1-\tau)w^*}.$$

The derivation of this equilibrium used the assumptions that (a) the return on capital exceeds the return on real balances, and (b) $r_2\theta[(1-\theta)/w^*]^{\alpha} > r_1$. Since in equilibrium $r_1 = p_t/p_{t+1}$ and $r_2 = R$, these conditions are equivalent. It must be checked, then, that $R\theta[(1-\theta)/w^*]^{\alpha} > p_t/p_{t+1}$. From (16),

$$R\theta[(1-\theta)/w^*]^{\alpha} = 1/\pi\alpha(1-\tau).$$

Therefore (a) and (b) are satisfied iff $1/[\pi\alpha(1-\tau)] > p_t/p_{t+1}$, with p_t/p_{t+1} given by (17). Of course $1 > p_t/p_{t+1}$, so a sufficient condition for (a) and (b) is that $1/[\pi\alpha(1-\tau)] \geq 1$. Needless to say, this condition is not necessary, however.

Finally, for future reference, steady state welfare of young agents (in terms of their expected utility) is given. Using $\psi_1 = 1$, $q = \pi$, $r_1 = p_t/p_{t+1}$, and $r_2 = R$, steady state welfare is $\ell n[(1-\tau)w^*] + (1-\pi)\ \ell n(p_t/p_{t+1}) - \pi\ \ell n[\pi\alpha(1-\tau)]$, with w^* and p_t/p_{t+1} given by (16) and (17).

II. OPTIMAL REPRESSION: RESERVE REQUIREMENTS

This section analyzes the steady state equilibrium of this economy with an arbitrary binding reserve requirement imposed by the government. A reserve requirement can be viewed as specifying a maximum fraction ($\bar{q}$) of a bank's portfolio that can be held in the form of capital. From the results of the last section, clearly $\bar{q} < \pi$ must hold in order for the reserve requirement to be binding.

After finding the economy's unique steady state equilibrium under any binding reserve requirement, the government's "optimal" choice of $\bar{q}$ for a given deficit is characterized. This follows McKinnon and Mathieson (1981), who analyze steady state equilibria under a fixed deficit. Here, however, welfare effects of changes in the size of the deficit are also analyzed. Throughout, "optimal" choices refer to choices that maximize the expected utility of young agents in the steady state equilibrium. This is also the criterion used by McKinnon and Mathieson (1981).

A. An Economy with a Binding Reserve Requirement

Consider an economy in which banks are constrained to set $q \le \bar{q} \le \pi$.[13] One possibility is that $\psi_1 = 1$ continues to hold, or in other words, that all investment continues to be intermediated. The second possibility is that $\psi_1 < 1$, so that financial repression is sufficiently severe to force some investment to be self–financed. (One might also interpret self–financed investment as investment financed in unorganized "curb markets," which are not subject to reserve requirements.) In either case, (9) and (10) imply that[14]

$$r_1 = (1-\bar{q})(p_t/p_{t+1})/(1-\pi) \ge p_t/p_{t+1} \tag{18}$$

$$r_2 = R\bar{q}/\pi \le R. \tag{19}$$

From (8), all capital formation will still be intermediated ($\psi_1 = 1$) iff $(1-\pi)R \geq R - r_2$, which is equivalent to $r_2 \geq \pi R$. Using (19), this condition is satisfied iff $\bar{q} \geq \pi^2$. The remainder of this section considers reserve requirements satisfying $\bar{q} \in [\pi^2, \pi]$, so that $\psi_1 = 1$ holds. The case where financial repression is severe enough to allow curb markets to arise ($\bar{q} < \pi^2$) is discussed in section II.B.

Steady State Equilibrium

As in the case of laissez–faire, the equilibrium wage rate at t is given by equation (6). Since all wages are deposited, and since banks invest a fraction $\bar{q}$ of their time t deposits in capital, the per firm capital stock evolves according to

(20) $$k_{t+2} = R\bar{q}(1-\tau)w_t/\pi.$$

Substituting (6) into (20) gives the equilibrium law of motion for the capital stock:

(21) $$k_{t+2} = R(1-\theta)(1-\tau)\bar{q}\pi^{\theta-1}k_t^{\theta}.$$

Imposing $k_{t+2} = k_t = \hat{k}$ in (21) gives the steady state equilibrium value of the capital stock:

(22) $$\hat{k} = (\tfrac{1}{\pi})[R\bar{q}(1-\theta)(1-\tau)]^{\frac{1}{1-\theta}}.$$

As is clear from (22), an increase in the reserve requirement (a decrease in $\bar{q}$) reduces the steady state capital stock (and hence output).

From (6), the steady state value of the real wage rate ($\hat{w}$) is given by

(23) $$\hat{w} = (1-\theta)[R\bar{q}(1-\theta)(1-\tau)]^{1/\alpha} \equiv \hat{w}(\bar{q},\tau).$$

Since $\psi_1 = 1$, the steady state equilibrium level of real balances continues to be given by

(24) $$M_t/p_t = (1-\bar{q})(1-\tau)\hat{w} \equiv (1-\bar{q})(1-\tau)(1-\theta)[R\bar{q}(1-\theta)(1-\tau)]^{1/\alpha} \equiv m(\bar{q},\tau).$$

Then the government budget constraint implies that the steady state inflation rate is given by

(25) $\quad p_t/p_{t+1} = \{m(\bar{q},\tau) - [g - \tau\hat{w}(\bar{q},\tau)]\}/m(\bar{q},\tau).$

Of course, $m(\bar{q},\tau) > g - \tau\hat{w}$ must hold in order for deficit finance to be feasible at the reserve requirement $\bar{q}$. In this case the steady state inflation rate equals the steady state growth rate of the money stock.

For future reference, it will be useful to know something about how steady state real balances change with a change in the reserve requirement. From the definition in (24),

(26) $\quad m_1(\bar{q},\tau) = m(\bar{q},\tau)(\theta - \bar{q})/\bar{q}(1-\theta)(1-\bar{q}).$

Therefore $m_1(\bar{q},\tau) \geq (<)\ 0$ iff $\bar{q} \leq (>)\theta$, and changes in the reserve requirement have an ambiguous effect on real balances.

It remains to discuss conditions under which $r_2\theta[(1-\theta)/\hat{w}]^{\alpha} > r_1$. Using (18), (19), and (23), this expression is equivalent to

(27) $\quad (1-\pi)/\pi\alpha(1-\tau)(1-\bar{q}) > p_t/p_{t+1}.$

Since $p_t/p_{t+1} < 1$, (27) is satisfied if $(1-\pi)/[\pi\alpha(1-\tau)(1-\bar{q})] \geq 1$, for instance. In general, of course, (27) needs to be checked.

Discussion

Several features of the equilibrium just derived merit comment. First, McKinnon (1982, p. 162) has argued that, in developing countries, "the rate of price inflation is largely determined by the fiscal deficit and the way in which reserve requirements are set." As equations (24) and (25) make apparent, our equilibrium has this feature. Moreover, as can be seen from (22), reserve requirements also affect the steady state capital stock (and hence steady state output). This serves to emphasize that this formulation displays an essential link between "monetary policy" and the aggregate supply of goods, a link that is often emphasized in the development literature [see, for instance, van Wijnbergen (1983)].

Second, from (25), for $\bar{q} \in (\pi^2,\pi)$,

$$(28)\qquad \frac{\partial(p_t/p_{t+1})}{\partial\bar{q}} = [m(\bar{q},\tau)]^{-1}\left[\frac{\bar{q}(1-\theta)\tau\hat{w} + g(\theta-\bar{q})}{\bar{q}(1-\bar{q})(1-\theta)}\right].$$

A sufficient condition for local increases in reserve requirements (reductions in $\bar{q}$) to raise the inflation rate, then, is that $m_1(\bar{q},\tau) > 0$. The possibility that an increase in reserve requirements will increase inflation arises in McKinnon and Mathieson (1981) as well, although for much different reasons. Moreover, as mentioned above, increases in reserve requirements reduce the steady state capital stock. Therefore, as in Stockman (1981), the steady state inflation rate and the steady state capital stock can be inversely related. However, Stockman accomplishes this by subjecting investment expenditures to a cash–in–advance constraint.

Finally, consider the possibility that $m_1(\pi,\tau) < 0$ and $g - \tau\hat{w} > m(\pi,\tau)$. The latter condition implies that the deficit is too large to be monetized in the absence of financial repression. However, if the deficit is sufficiently close to $m(\pi,\tau)$, then $m_1(\pi,\tau) < 0$ raises the possibility that the imposition of binding reserve requirements will allow the deficit to be financed. This suggests that governments with large deficits may be required by simple considerations of feasibility to engage in financial repression.

Optimal Choice of Reserve Requirements

For the remainder of the section, we consider the case where $m(\bar{q},\tau) > g - \tau\hat{w}\ \forall\bar{q} \in [\pi^2,\pi]$. Using the expressions for r_1 and r_2 in (18) and (19), the expected utility level of a representative young agent in the steady state equilibrium can be written as

$$(29)\qquad \ln[(1-\tau)\hat{w}] + (1-\pi)\ln[(1-\bar{q})(p_t/p_{t+1})/(1-\pi)] + \pi\ln\{(R\bar{q}/\pi)\theta[(1-\theta)/\hat{w}]^{\alpha}\}$$

Substituting (23) and (25) into (29) and rearranging terms yields steady state expected utility as a function of $\bar{q}$ and τ:

$$(30)\qquad V(\bar{q},\tau) \equiv (\pi/\alpha)\ell n[R\bar{q}(1-\theta)(1-\tau)] + (1-\pi)\ell n[m(\bar{q},\tau) - (g-\tau\hat{w})] + \pi\ell n(\theta/\pi) - (1-\pi)\ell n(1-\pi)$$

$\forall\ \bar{q} \in [\pi^2,\pi]$.

One fact that is immediately apparent from (29) is that choosing $\bar{q}$ to minimize the steady state inflation rate (which is the objective in McKinnon and Mathieson (1981), for instance) does not maximize steady state welfare. This is, of course, because the equilibrium real wage rate is also a function of the reserve requirement.

We now suppose that, for given values of g and τ, the government chooses $\bar{q} \in [\pi^2,\pi]$ to maximize $V(\bar{q},\tau)$. (The effects of varying τ are considered below.) We establish in proposition 1 and its corollary that there are three possibilities concerning the optimal choice of $\bar{q}$: (i) $V_1(\bar{q},\tau) \geq 0\ \forall\ \bar{q} \in [\pi^2,\pi]$. In this case, the optimal reserve requirement is the "just binding" choice $\bar{q}=\pi$. (ii) $V_1(\bar{q},\tau) \leq 0\ \forall\ \bar{q} \in [\pi^2,\pi]$, in which case $\bar{q}=\pi^2$ is optimal. (iii) $V_1(\pi^2,\tau) \geq 0 \geq V_1(\pi,\tau)$.[15] In this case there is a unique $\bar{q} \in (\pi^2,\pi)$ that maximizes $V(\bar{q},\tau)$.

To establish that these are the only possibilities, we state the following proposition.

Proposition 1. Suppose that $\tau \leq 1-\theta$ holds.[16] Then $V_1(\bar{q},\tau) = 0$ for at most one $\bar{q} \in [\pi^2,\pi]$. If $V_1(\bar{q},\tau) = 0$ for any $\bar{q}$, $V_{11}(\bar{q},\tau) < 0$ also holds.

Proof. From (30),

$$(31)\qquad V_1(\bar{q},\tau) = \pi/\alpha\bar{q} + (1-\pi)m_1(\bar{q},\tau)[1+\theta\tau/(\theta-\bar{q})(1-\tau)]/[m(\bar{q},\tau) - (g-\tau\hat{w}(\bar{q},\tau))]$$

$$= \pi/\alpha\bar{q} + F(\bar{q})G(\bar{q})$$

where

$$F(\bar{q}) \equiv (1-\pi)m(\bar{q},\tau)/\{m(\bar{q},\tau) - [g-\tau\hat{w}(\bar{q},\tau)]\} > 0$$

$$G(\bar{q}) = [\theta - \bar{q}(1-\tau)]/\bar{q}(1-\bar{q})(1-\tau)(1-\theta),$$

and where the second equality in (31) follows from (26). There are now three cases to consider.

(a) $\theta \geq \pi(1-\tau)$. Then $G(\bar{q}) \geq 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$, and from (31), $V_1(\bar{q},\tau) > 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$.

(b) $\bar{q}(1-\tau) > \theta$ for some $\bar{q} \in [\pi^2,\pi]$. In this case $G(\bar{q}) < 0$ can hold, and $G(\bar{q}) < 0$ must hold for any $\bar{q}$ such that $V_1(\bar{q},\tau) = 0$. Also, from (31),

$$(32) \qquad V_{11}(\bar{q},\tau) = -\pi/\alpha\bar{q}^2 + F(\bar{q})G'(\bar{q}) + F'(\bar{q})G(\bar{q})$$

It is easy to show that

$$G'(\bar{q}) = -[\bar{q}^2(1-\tau) + \theta(1-2\bar{q})]/\bar{q}^2(1-\bar{q})^2(1-\tau)(1-\theta) < 0.$$

Then, since $G(\bar{q}) < 0$ when $V_1(\bar{q},\tau) = 0$, $V_{11}(\bar{q},\tau) < 0$ holds for such $\bar{q}$ if $F'(\bar{q}) \geq 0$. It is straightforward to verify that $F'(\bar{q}) \geq 0$ in this case iff $g \geq \tau\hat{w}(\bar{q},\tau)\bar{q}(1-\theta)/(\bar{q}-\theta)$. Hence if this condition holds, $V_{11}(\bar{q},\tau) < 0$ whenever $V_1(\bar{q},\tau) = 0$.

(c) $\bar{q}(1-\tau) > \theta$, $\tau \leq 1-\theta$, $\tau\hat{w}(\bar{q},\tau)\bar{q}(1-\theta)/(\bar{q}-\theta) > g$ for some $\bar{q} \in [\pi^2,\pi]$. In this case substitution of $V_1(\bar{q},\tau) = 0$ into (32) and considerable manipulation establish that $V_{11}(\bar{q},\tau) < 0$ whenever $V_1(\bar{q},\tau) = 0$.

Proposition 1 also has the following corollary.

Corollary (a) $V_1(\pi,\tau) > 0$ implies that $V_1(\bar{q},\tau) \geq 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$. (b) $V_1(\pi^2,\tau) < 0$ implies that $V_1(\bar{q},\tau) \leq 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$.

Proof. (a) Suppose to the contrary that $V_1(\bar{q}^*,\tau) < 0$ for some $\bar{q}^* \in [\pi^2,\pi]$. Then V has a local minimum in the interval $(\bar{q}^*,\pi)$. But this contradicts proposition 1. The proof of (b) is identical.

Proposition 1 and its corollary establish that the three cases listed above exhaust the possibilities with respect to the optimal choice of $\bar{q}$. We now discuss when each case occurs.

Case 1. $V_1(\pi,\tau) > 0$. Then from the corollary $V_1(\bar{q},\tau) \geq 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$, and $\bar{q}=\pi$ is the optimal choice of reserve requirement. $V_1(\pi,\tau) > 0$ occurs in either of two eventualities. First, from (31), it occurs if $G(\pi) \geq 0$, which holds if $\theta \geq \pi(1-\tau)$. Second, even if $\pi(1-\tau) > \theta$, (31) and the definitions of F and G imply that $V_1(\pi,\tau) > 0$ if

(33) $$[\theta-\pi(1-\tau) + \pi^2(1-\tau)(1-\theta)]\hat{w}(\pi,\tau) > \pi\theta g.$$

Intuitively, there are two possibilities as to why it is optimal to set $\bar{q}=\pi$ in this case. First, if $m_1(\pi,\tau) \geq 0$ (which occurs iff $\theta \geq \pi$), increases in reserve requirements (reductions in $\bar{q}$) reduce output <u>and</u> real balances. The latter effect raises the inflation rate, and hence imposing reserve requirements has no positive welfare consequences. If $m_1(\pi,\tau) < 0$, increases in reserve requirements do raise the inflation tax base. However, if g is sufficiently small, in a sense made precise by (33), any gains from this in the form of reduced inflation are more than offset by declines in output.

Case 2. $V_1(\pi^2,\tau) < 0$. Then from the corollary $V_1(\bar{q},\tau) \leq 0 \; \forall \; \bar{q} \in [\pi^2,\pi]$, and it is optimal to set $\bar{q} = \pi^2$. This is the largest reserve requirement consistent with $\psi_1=1$, so in this case heavy use of reserve requirements is optimal. From (31) and the definitions of F and G, $V_1(\pi^2,\tau) < 0$ iff

$$\pi\theta g > [\theta - \pi^2(1-\tau) + \pi^3(1-\tau)(1-\theta)]\hat{w}(\pi^2,\tau).$$

Thus high reserve requirements will be observed when the deficit is sufficiently large. In this case the gains from using reserve requirements to enhance the inflation tax base more than offset the loss in output (due to a reduced capital stock) resulting from such requirements.

Case 3. $V_1(\pi^2,\tau) \geq 0 \geq V_1(\pi,\tau)$. In this case the proposition implies that V cannot be constant on $[\pi^2,\pi]$, and hence V has a unique maximum in this interval. If $V_1(\pi^2,\tau) > 0 > V_1(\pi,\tau)$, then this maximum occurs where $V_1(\bar{q},\tau) = 0$. From (31) and the definitions of F and G, $V_1(\bar{q},\tau) = 0$ is equivalent to the condition

(34) $\pi\theta(1-\bar{q})(1-\tau)/(1-\pi)[\bar{q}(1-\tau) - \theta] = m(\bar{q},\tau)/\{m(\bar{q},\tau) - [g-\tau\hat{w}(\bar{q},\tau)]\}$.

Finally, from (31), $V_1(\pi^2,\tau) > 0 > V_1(\pi,\tau)$ obtains iff

(35) $[\theta-\pi^2(1-\tau) + \pi^3(1-\tau)(1-\theta)]\hat{w}(\pi^2,\tau) > \pi\theta g > [\theta-\pi(1-\tau) + \pi^2(1-\tau)(1-\theta)]\hat{w}(\pi,\tau)$.

(The interval defined by (35) is non–empty if, for instance, $\pi^2 \geq \theta$ and $(1-\tau)[1-\pi(1-\theta)] \geq \theta$.) Hence in this case intermediate values of g imply that reserve requirements should be raised until marginal welfare losses due to reduced output and poorer risk sharing exactly offset the marginal welfare gains that result from increasing the inflation tax base.[17]

<u>Changes in Fiscal Policy: Variations in Government Expenditure</u>

When an interior optimum obtains (case 3), the response of the optimal reserve requirement to a change in government expenditure can be analyzed. Setting $V_1(\bar{q},\tau) = 0$ and differentiating with respect to g yields

(36) $d\bar{q}/dg = -F(\bar{q})G(\bar{q})/V_{11}(\bar{q},\tau)\{m(\bar{q},\tau)-[g-\tau\hat{w}(\bar{q},\tau)]\} < 0$.

where the inequality follows from the fact that $G(\bar{q}) < 0$ at an interior optimum and proposition 1. Thus (36) asserts that increases in government spending (for fixed τ) require that optimal reserve requirements be raised ($\bar{q}$ be reduced).

It is also of interest to consider how the steady state inflation rate responds to changes in g when the reserve requirement is set optimally. From (25)

$$\frac{d(p_t/p_{t+1})}{dg} = -(p_t/p_{t+1})[(d\bar{q}/dg)F'(\bar{q})/F(\bar{q}) + 1/A],$$

where $A \equiv m(\bar{q},\tau)-[g-\tau\hat{w}(\bar{q},\tau)]$. It is tedious but straightforward to verify that $d(p_t/p_{t+1})/dg > 0$. Thus reductions in government expenditure (and for fixed τ, the deficit) imply that p_t/p_{t+1} will rise – or in other words, that the inflation rate will fall. However, it is also straightforward to verify that by choosing τ,π, and θ appropriately, $d(p_t/p_{t+1})/dg$ can be made arbitrarily close to zero. Then for economies where the reserve requirement is chosen optimally, the relationship between long–term deficits and the long–term inflation rate can be quite weak.

Varying Taxation

The results of this section have been obtained under the assumption that τ is set at a level implying a positive deficit. This raises the question of whether, for fixed g, it might be optimal to choose a tax rate that eliminates the deficit (rather than relying on reserve requirements). We now provide a partial answer to this question. From (30),

$$V_2(\bar{q},\tau) = \{(1-\pi)[\hat{w}(\bar{q},\tau)/A][\bar{q}(1-\tau)-\theta]-\pi\theta\}/(1-\theta)(1-\tau) = -(1-\tau)V_1(\bar{q},\tau)/\bar{q}.$$

Then if $V_1(\pi,\tau) > 0$, it is optimal to reduce τ whenever $\tau > 0$ (i.e., to increase the deficit). Similarly, if $V_1(\bar{q},\tau) = 0$, local variations in τ have no welfare consequences, or in other words, there is no welfare benefit from a (local) increase in taxation.[18] Thus, at least in cases 1 and 3 above, governments that choose τ optimally will not be expected to set τ so as to eliminate (or even reduce) their deficits.

B. Reserve Requirements in the Presence of an "Unorganized" Financial Market

If reserve requirements more severe than $\bar{q} = \pi^2$ are imposed $(0 < \bar{q} < \pi^2)$, young agents will place a fraction $1 - \psi_1 > 0$, of their savings directly in the capital investment, and will reduce the fraction deposited with banks to $\psi_1 = (1-\pi)R/(R-r_2) < 1$ (from (8)). In other words, sufficiently severe "financial repression" will cause some capital formation to be financed in a way that is not subject to reserve requirements. The avoidance of reserve requirements is, of course, regarded as an important characteristic of "unorganized" financial markets ("curb markets") in LDCs. The remainder of this section analyzes an economy with an active curb market.

At time t, banks receive deposits by young agents of $(1-\tau)w_t\psi_1$ (in per capita terms). Banks hold $\bar{q}$ of these deposits in the capital investment, and $(1-\bar{q})$ as real balances. Total per capita capital investment, then, is $w_t(1-\tau)(1-\psi_1+\bar{q}\psi_1)$. Not all time t investment yields productive capital at t + 2, however, since some agents will experience $\phi = 0$ at t + 1, and their capital investment is "lost". Taking this into account, the per firm capital stock at t + 2 is

(37) $$k_{t+2} = Rw_t(1-\tau)(1-\psi_1) + \psi_1 w_t(1-\tau)(R\bar{q}/\pi).$$

Using $r_2 = R\bar{q}/\pi$, the fraction of young period savings deposited in banks is

(38) $$\psi_1 = \pi(1-\pi)/(\pi-\bar{q}).$$

Substituting (38) into (37) yields

(39) $$k_{t+2} = \pi R w_t(1-\tau).$$

Finally, substituting (6) into (39) yields the equilibrium law of motion for the capital stock:

(40) $$k_{t+2} = (1-\tau)(1-\theta)R\pi^{1+\theta}k_t^{\theta}.$$

Note that when $\bar{q} < \pi^2$, causing $\psi_1 < 1$, the reserve requirement $\bar{q}$ does not appear in this equilibrium law of motion.

Imposing $k_{t+2} = k_t = \bar{k}$ in (40) gives the steady–state capital stock

(41) $$\bar{k} = \pi^{1/\alpha}[R\pi(1-\theta)(1-\tau)]^{1/(1-\theta)}.$$

Note that $\bar{k} < \hat{k} < k^*$. Finally, from (6), the steady state equilibrium real wage rate is given by

(42) $$\bar{w} = (1-\theta)\pi^{1/\alpha}[R\pi(1-\theta)(1-\tau)]^{1/\alpha},$$

while steady–state real balances are

(43) $$M_t/p_t = (1-\bar{q})(1-\tau)\psi_1\bar{w} \equiv z(\bar{q},\tau),$$

and the steady state inflation rate is

(44) $$p_t/p_{t+1} = [z(\bar{q},\tau)-(g-\tau\bar{w})]/z(\bar{q},\tau).$$

As above, the derivation of equilibrium values is predicated on the assumption that $r_2\theta[(1-\theta)/\bar{w}]^{\alpha} > r_1$. From (18), (19), and (43), this condition is equivalent to

$$(1-\pi)\bar{q}/\pi\alpha(1-\bar{q})(1-\tau)\pi^2 > p_t/p_{t+1}$$

which needs to be checked for particular choices of $\bar{q}$.

Optimal Choice of Reserve Requirements

When $\bar{q} \in (0,\pi^2)$, young agents deposit $\psi_1\bar{w}(1-\tau)$ and invest $(1-\psi_1)\bar{w}(1-\tau)$ directly in capital. If an agent experiences $\phi = 0$ in the next period, he withdraws his deposit and consumes $r_1\psi_1\bar{w}(1-\tau)$ (in particular, his capital investment is lost). If $\phi = 1$ consumption is postponed until age 3, in which case the amount of capital owned will be $r_2\psi_1\bar{w}(1-\tau) + R(1-\psi_1)\bar{w}(1-\tau)$ (the proceeds of deposits and direct investment, respectively). Since each unit of capital earns $\theta[(1-\theta)/\bar{w}]^{\alpha}$, the expected utility of a young agent in the steady state equilibrium is given by

$$(45) \qquad V(\bar{q},\tau) = (1-\pi)\ell n[r_1\psi_1\bar{w}(1-\tau)] + \pi\, \ell n\, \{\theta[(1-\theta)/\bar{w}]^{\alpha}[r_2\psi_1 + R(1-\psi_1)]\bar{w}(1-\tau)\}$$

for $\bar{q} \in (0,\pi^2]$. Substitution of (18), (19), and (38) into (45) yields the equivalent expression

$$(46) \qquad V(\bar{q},\tau) = \ell n[\bar{w}(1-\tau)] + (1-\pi)\ \ell n[(p_t/p_{t+1})\pi(1-\bar{q})/(\pi-\bar{q})] - \pi\ \ell n[\pi\alpha(1-\tau)];$$

$q \in (0,\pi^2]$.

Since the value of $\bar{w}$ given by (42) is independent of $\bar{q}$, reserve requirements affect welfare in the presence of active curb markets only through their effect on the term $(p_t/p_{t+1})(1-\bar{q})/(\pi-\bar{q})$. From (43) and (44),

$$(p_t/p_{t+1})(1-\bar{q})/(\pi-\bar{q}) = [z(\bar{q},\tau)-(g-\tau\bar{w})]/(1-\tau)\psi_1\bar{w}(\pi-\bar{q}),$$

which is increasing in $\bar{q}$ for $\bar{q} \in (0,\pi^2]$. Thus whenever financial repression is severe enough to result in the existence of an "informal" financial sector, welfare is always increased by a financial "liberalization" (a reduction in reserve requirements). Or, in other words, it is never optimal to set $\bar{q} < \pi^2$.

The "New Structuralist Critique"

The results obtained from this model when the government engages in severe financial repression ($\bar{q}<\pi^2$) bear on the "new structuralist critique" of financial liberalization. This "critique" argues that financial liberalization need not be expansionary if it simply draws funds into the intermediated sector from "unorganized" financial markets. On the basis of this argument, Buffie (1984), Lim (1987), and van Wijnbergen (1983, 1985) have suggested that the policies of financial liberalization advocated by McKinnon (1973) and Shaw (1973) – which are designed to reduce the role of self–financed investment and investment financed through "unorganized" markets – are potentially undesirable.

The analysis here is particularly closely related to arguments made by van–Wijnbergen (1983, 1985). In van Wijnbergen (1983), unorganized financial markets offer "more intermediation" than banks do; because bank deposits are subject to reserve requirements they result in less capital formation than does investment through unorganized markets. As argued by van Wijnbergen (1983, p. 435), "what really matters is the existence of a group of assets more 'productive' (leading to more pass–through into capital) than time deposits." In the presence of such assets (investment through unorganized markets), financial liberalization is not expansionary because it simply shifts funds away from informal markets into the formal banking system. It is suggested in van Wijnbergen (1985) that this has been the outcome of financial liberalization in Korea.

In the context of the model above, suppose that the government has (sub–optimally) set $\bar{q} \in (0,\pi^2)$ so that an "informal" or "self–financed" investment sector co–exists with an intermediated investment sector. Defining the "pass–through" rate of a sector as the expected units of capital generated per unit of the consumption good invested in that sector, the pass–through rate in the informal sector is π. In the intermediated sector the pass–through rate is $\bar{q} < \pi$. Also, any funds drawn into the banking system by increases in $\bar{q}$ come from the informal sector. Thus our model has all the features supposed by the "new structuralist critique".

As was shown above, the steady–state capital stock and steady–state output are independent of the reserve requirement when $\bar{q} \in (0,\pi^2)$. Therefore, a local increase in $\bar{q}$ will not change steady–state output. When this model displays an informal financial market, it therefore reproduces at least one aspect of the "new structuralist critique": financial liberalizations are not expansionary. Nevertheless, it has been seen that even a local financial liberalization is always welfare–improving in this situation. This is simply because, from a welfare perspective, it is desirable to draw resources into the banking system, where they are subject to the inflation tax, and where risk is shared more efficiently. Moreover, increasing $\bar{q}$ to its optimal value will eliminate the informal sector altogether.

III. INTEREST RATE CEILINGS

While the focus of attention so far has been on reserve requirements, it is also possible that it is optimal for the government to impose interest rate ceilings, or in other words, to impose restrictions that make currency more attractive relative to bank deposits. This possibility is now considered. In the interest of brevity, only the incentive for the use of interest rate ceilings is illustrated. A complete analysis of policy options is left for future research.

Intermediary Behavior

Suppose that $V_1(\pi,\tau) > 0$ (case 1 in section II.A). This suggests that it is desirable to force banks to hold more than the fraction π of their reserves in the form of capital. Such a conjecture is, in fact, correct, and the outcome can be accomplished by imposing an "interest rate ceiling" that interferes with liquidity provision by intermediaries.

It is convenient to represent an interest rate ceiling as a requirement that bank payments to depositors who withdraw after one period satisfy $r_1 \leq \beta(p_t/p_{t+1})$, where $\beta \leq 1$. (In view of the discussion of section II, $\beta = 1$ is a "just binding" interest rate ceiling.) An interest rate ceiling prevents deposits from being "too attractive" relative to currency. Imposing $r_1 = \beta(p_t/p_{t+1})$ in equation (9) and using $z = 1 - q$ yields the optimal portfolio choice of an intermediary when there is a binding interest rate ceiling. The fraction of deposits a bank places in the capital investment must satisfy $\beta(1-\pi)(p_t/p_{t+1}) = (1-\bar{q})(p_t/p_{t+1})$. Solving for $\bar{q}$ yields

$$\bar{q} = 1 - \beta(1 - \pi) \geq \pi, \tag{47}$$

where $\bar{q} > \pi$ iff $\beta < 1$. In other words, a binding interest rate ceiling has an equivalent representation as a portfolio restriction of the form $q \geq \bar{q}$, with $\bar{q}$ given by (47). From (10), bank payments to depositors who withdraw after two periods satisfy

$$r_2 = R\bar{q}/\pi \geq R. \tag{48}$$

Portfolio Decisions of Savers

As is clear from (48), bank deposits now dominate direct capital investment from the point of view of a young agent. Accordingly, young agents choose $\psi_1 \in [0,1]$ (the fraction of savings deposited) and $\psi_2 = 1 - \psi_1$ (the fraction of savings held in the form of real balances) to maximize their expected utility, taking r_1, r_2, $\{p_t\}$, the return on capital, and their labor income w_t as given. Then young agents choose ψ_1 to solve

$$\max_{0 \leq \psi_1 \leq 1} \ln[(1-\tau)w_t] + (1-\pi)\ln[r_1\psi_1 + (1-\psi_1)(p_t/p_{t+1})] + \pi\ln[\psi_1 r_2 \theta[(1-\theta)/w_{t+2}]^{\alpha} + (1-\psi_1)(p_t/p_{t+1})]$$

Assuming that $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} \geq r_1$, the solution to this problem sets

$$\psi_1 = \min\left[1, \frac{\pi}{1-\beta} - \frac{(1-\pi)(p_t/p_{t+1})}{r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} - (p_t/p_{t+1})}\right].$$

For the rest of this section, attention is restricted to the case where

$$(49) \qquad 1 \leq \frac{\pi}{1-\beta} - \frac{(1-\pi)(p_t/p_{t+1})}{r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} - (p_t/p_{t+1})},$$

so that the interest rate ceiling is not low enough to induce individual agents to hold outside money in addition to bank deposits. This condition clearly holds if $\beta = 1$ ($\bar{q} = \pi$), and therefore also holds in some neighborhood of $\beta = 1$.

Steady State Equilibrium

Since $\psi_1 = 1$, the law of motion for the capital stock is the same as when $\bar{q} \in [\pi^2,\pi]$, and is given by (21). Accordingly, all steady–state equilibrium values, as functions of $\bar{q}$, continue to be given by (22), (23), and (24). In addition, since r_1 and r_2 are given by (47), (48), and $r_1 = \beta(p_t/p_{t+1})$, $V(\bar{q},\tau)$ as given in (30) continues to describe the expected steady–state utility of young agents. If $V_1(\pi,\tau) > 0$, welfare can be improved by setting $\bar{q} > \pi$, using an interest rate ceiling of the form given in (47).

It may be the case that $V_1(\bar{q},\tau) > 0$ for all values of $\bar{q}$ consistent with ψ_1=1. In this case there is no interior optimum for a choice of $\bar{q}$ that implies ψ_1=1. However, if an interior optimum with $\psi_1 = 1$ exists, it continues to satisfy equation (35). Using this fact, it is straightforward to show that an interior optimum with $\psi_1 = 1$ exists if[19]

$$(50) \qquad [\theta/(1-\theta)]^2\, [2\pi - (\pi^2 + \theta + \theta\pi) + \theta\pi^2] \geq \theta\pi^2.$$

In other words, if (50) holds, steady–state equilibrium welfare is maximized by adopting an interest rate ceiling low enough so that ψ_1=1.

IV. DISCUSSION

At this point the roles played by several assumptions are briefly discussed. One aspect of the model that merits comment is the assumption that agents do not care about young period consumption. This assumption is one of convenience, so long as $\psi_1 = 1$. However, it has the attractive feature that changes in the degree of financial repression trivially cannot affect the overall savings behavior of the economy. Therefore, no results depend on financial liberalization having a positive effect on the savings rate. Any results that did depend on such an effect would be of dubious empirical validity [see, for instance, Diaz–Alejandro (1985)].

The assumption of logarithmic preferences plays a deeper role in the analysis. First, this assumption implies the existence of a unique steady state equilibrium. This derives from the fact that, with logarithmic preferences, the solution to an agent's portfolio allocation problem does not depend on p_t/p_{t+1}. Besides ensuring the existence of a unique steady state equilibrium, this feature of the model permits a complete characterization of when $\psi_1 = 1$ will hold, which in turn allows optimal government policies to be precisely described.

Finally, the assumption of logarithmic preferences links the analysis to several familiar monetarist assertions. For example, under a fixed reserve requirement (or interest rate ceiling), the model has the feature that changes in the steady state inflation rate (induced by changes in g, for instance) do not affect the level of steady state output, or the steady state return on capital (assuming less than 100% reserves). With logarithmic preferences, the model also implies (except with 100% reserves) that the income velocity of money is not affected by the inflation rate. This feature is frequently assumed [for instance, see Moore (1986)].

Closely related in terms of its implications for the analysis is the assumption that capital investments at t have no "scrap value" at t + 1. This assumption is of consequence only in section II.B so long as the scrap value of capital is less than p_t/p_{t+1}. In section II.B, the assumed absence of any scrap value for capital implies that the equilibrium portfolio allocation of young savers does not depend on p_t/p_{t+1}. This, in turn, permits easy characterization of when $\psi_1 < 1$ will hold, and is important in delivering a unique steady state equilibrium.

Finally, the analysis does not permit the simultaneous use of reserve requirements and interest rate ceilings. This is unfortunate, since it means that the model in its current form cannot be used to investigate policy prescriptions like that of McKinnon (1982, p. 160–1) that efficient use of the inflation tax requires interest rate ceilings on demand deposits, "against which reserve requirements should be kept commensurately high in order that the government should absorb excess bank profits." In our formulation banks are zero profit entities, so that there are no excess profits to absorb. However, it is possible to imagine extensions of the model in which banks are able to extract some rents, and in which McKinnon's prescription could be investigated.

V. CONCLUSIONS

It is often asserted that restrictions on the operation of financial markets and intermediaries have significant costs for developing economies in the form of lost output. Nevertheless, many developing countries impose high reserve requirements and/or interest rate ceilings on intermediaries. Moreover, among such "repressed economies" that have attempted financial liberalizations, there have been many "failures". This observation led McKinnon (1982), for instance, to argue that the "order of liberalization" matters. In particular, he argued that changes in fiscal policy must typically precede successful liberalizations.

The analysis of this paper is an attempt to formalize this reasoning, and to consider how much repression or liberalization is optimal (in steady state), given the state of fiscal policy. In the model presented here, reserve requirements do result in foregone output. However, they also have the potential benefit of increasing the inflation tax base. In general, the higher is government spending, the more significant are the gains from increasing the inflation tax base. Therefore, economies with large deficits and high reserve requirements will not generally find that financial liberalizations are welfare improving. However, for economies that set reserve requirements optimally, reductions in government spending will typically allow for some degree of welfare improving financial liberalization.

One criticism of the reasoning just described, associated with the "new structuralist critique," is that financial liberalizations need not expand output in the presence of curb markets if such liberalizations simply transfer funds from the "informal" to the "formal" financial sector. In our model this argument is correct, and when the economy is sufficiently repressed for curb markets to appear, financial liberalizations simply result in such transfers. Nevertheless, it is optimal to liberalize financial markets in this situation. This is because risk is shared more efficiently in the organized financial sector, and because such liberalizations increase the inflation tax base. Thus not all the gains from organized intermediation take the form of increased output.

NOTES

1. Because production displays constant returns to scale and agents are homogeneous ex ante, the assumption of no rental markets is innocuous. It does economize on notation, however.
2. See, for example, Cameron (1967, p. 10), Taylor (1980), Buffie (1984), and van Wijnbergen (1982).
3. At the expense of some complications in section II, it would be possible to allow capital investment to have a positive "scrap value" at t + 1, assuming of course that this scrap value is not too large. The assumption that capital has no scrap value at t + 1 substantially simplifies the subsequent analysis, however, and makes our specification of the investment technology quite similar to that of Jacklin and Bhattacharya (1988).
4. The stock of outside money, and later, government expenditure and the deficit are measured per person in any one generation.
5. For elaboration on this point, see Jacklin (1987).
6. As in Taylor (1980) and McKinnon–Mathieson (1981), there is no market for government bonds.
7. This problem is assumed to be solved under perfect foresight.
8. Notice that the solution to the portfolio problem in (8) satisfies a weak version of the gross–substitutes condition on portfolio behavior.
9. No differences would result from thinking of a fixed, finite set of intermediaries at each date that are Nash competitors. However, notice that all the customers of any bank at each date are members of the same generation. This is necessary in order to prevent banks from engaging in inter–generational, non–monetary trades, and thereby undermining the demand for money. Once reserve requirements are imposed, it would be possible to allow banks to be continuing entities, dealing with more than

one generation simultaneously. However, in such a formulation the maximand of a bank would be less obvious. Therefore the specification in the text is retained throughout.

10. It is logically possible that not all reserve holdings (holdings of real balances by banks) are liquidated at t + 1. Letting γ denote the fraction of bank reserves liquidated after one period ($\gamma \in [0,1]$), (9) and (10) would then be modified to read

(9′) $$(1-\pi)r_1 = \gamma z(p_t/p_{t+1})$$

(10′) $$\pi r_2 = Rq$$

(10″) $$\pi\tilde{r}_2 = (1-\gamma)z(p_t/p_{t+2})$$

where $\tilde{r}_2$ denotes payments in the form of the consumption good to agents who withdraw after two periods. However, it is easy to show that, as long as $R\theta[(1-\theta)/w_{t+2}]^{\alpha} > p_t/p_{t+1}$, banks optimally set $\gamma = 1$, as in the text.

11. This approach to modelling banks makes a bank, in effect, a form of investment pool. Lamoreaux (1986) documents that early banks in the U.S. often had the features of an investment pool.

12. It is easy to see that banks provide liquidity here since, under autarky, the gross return to agents who liquidate all assets after one period is $(1-\eta)(p_t/p_{t+1})$, where η is the fraction of the portfolio held in capital in autarky. The gross return to agents with $\phi = 1$ in autarky is $(1-\eta)(p_t/p_{t+1}) + \eta R\theta[(1-\theta)/w_{t+2}]^{\alpha}$. In autarky, $0 < \eta < 1$, so banks both provide liquidity, and raise the returns available to savers in the economy.

13. $\bar{q} = \pi$ is a "just binding" reserve requirement.

14. Since $q \leq \bar{q}$ is binding, (18) and (19) can fail to hold only if banks alter their optimal strategy with respect to asset liquidations. The only way they can do so is by (a)

attempting to induce agents with $\phi = 1$ to withdraw some of their deposits after one period, or (b) not liquidating all their reserves after one period. However, as long as $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} > r_1$, a bank can never induce depositors with $\phi = 1$ to withdraw voluntarily after one period. And, under the same condition (with r_1 and r_2 given by (18) and (19)), it is easy to show that (b) cannot increase the expected utility of depositors. A sufficient condition for $r_2\theta[(1-\theta)/w_{t+2}]^{\alpha} > r_1$ to hold in the steady state equilibrium is given below.

We might also note that (18) and (19) imply that banks hold no free reserves. This result is assumed by Taylor (1980), who offers a defense of its realism.

15. $V_1(\pi,\tau)$ should be interpreted as the left derivative of V at $\bar{q} = \pi$, and $V_1(\pi^2,\tau)$ should be interpreted as the right derivative at $\bar{q} = \pi^2$.

16. It is easy to check that tax revenue $\tau\hat{w}(\bar{q},\tau)$ is maximized when $\tau=1-\theta$. Then $\tau \leq 1-\theta$ holds so long as the economy is not on the "wrong side of the Laffer curve".

17. When (35) holds, it is easy to check the condition $r_2\theta[(1-\theta)/\hat{w}]^{\alpha} > r_1$. From (25) and (35),

$$p_t/p_{t+1} = (1-\pi)[\bar{q}(1-\tau) - \theta]/\pi\theta(1-\bar{q})(1-\tau).$$

Then (27) holds iff $\theta/(1-\theta)(1-\tau) > \bar{q}$.

18. It is straightforward to verify that, whenever $V_1(\bar{q},\tau) = V_2(\bar{q},\tau) = 0$, V attains a maximum.

19. (50) assumes that $\tau = 0$.

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