An Endogenous Growth Model of Money, Banking, and Financial Repression

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Abstract: In this paper, we develop an endogenous growth model with financial intermediation to examine the effects of financial repression on growth, inflation, and welfare. By limiting the liquidity provision, binding reserve requirements always suppress economic growth while their effect on inflation is a function, among other things, of the degree of repression. For example, contrary to previous claims, if financial repression is severe enough so that an informal financial sector emerges, liberalization is inflationary. Notwithstanding, liberalization in these cases is always welfare improving. Finally, we characterize the condition that gives rise to a unique optimal level of binding reserve requirements, i.e., the optimal degree of "moderate" financial repression.

JEL classification: E44, O16, O42

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1. Introduction

The term financial repression was originally coined by economists interested in developing economies (LDCs). Authors such as McKinnon (1973) and Shaw (1973), who were among the first to spell out the notion of financial repression, define it as the set of government legal restrictions imposed on financial intermediaries. This set includes interest rate ceilings, compulsory credit allocation, and "high" reserve requirements. Most of the research on financial repression claims has focused on the inflationary and growth consequences of repressing the financial system. Not surprisingly, with the birth of endogenous growth models, there has recently been a surge in the re-examination of most financial repression claims. Equipped with models featuring endogenous growth, some authors have, for example, aimed at corroborating the inefficiency as well as the negative inflation-growth correlation postulated in economies displaying financial repression.[1] Although financial repression was first studied in the context of LDCs, nothing precludes developed economies from engaging in financial repression, and in fact they do. Thus, the re-

[1] Among the first such examples are Roubini and Sala-i-Martin (1992, 1995).

examination of financial repression is pertinent to both developed and developing economies. We argue that rather than thinking about repressed versus liberalized financial systems, it is more productive to think in terms of the degree of repression exhibited by a financial system. This, we believe, enhances the appeal of current work on financial repression.

Borrowing from the insights of Diamond and Dybvig (1983) and Schreft and Smith (1994) concerning banks liquidity provision and its relationship to the process of resource allocation, we model financial intermediaries ("banks") explicitly. Thus, our paper links the financial intermediation-growth literature (e.g., Bencivenga and Smith 1991) to the financial repression-growth literature. As pointed out in Brock (1989), Espinosa (1995), and Bencivenga and Smith (1991), a common form of financial repression is the imposition of binding reserve requirements. Because we model financial intermediaries explicitly, the analysis of the impact of alternative reserve requirements on the intermediaries' portfolios and their consequent implications for inflation, welfare, and growth arise quite naturally. Our analysis displays the widely accepted negative impact of financial repression on growth. Furthermore, the existing literature on financial repression and growth concludes that "high financial [re]pression will be associated with high inflation rates, high seigniorage, and low economic growth. This will tend to generate a spurious negative correlation between inflation and growth" (Roubini and Sala-i-Martin 1995, p. 298). In this paper, the interaction between the inflation tax rate and the seigniorage base is such that it generates a "Laffer-curve" type relation between inflation and repression. This in turn implies that growth and inflation are not necessarily negatively correlated. This, we think, may in turn help explain some of the recent mixed empirical evidence on the inflation and economic growth correlation.[2]

Another issue studied in this paper is the welfare implications of financial repression. Roubini and Sala-i-Martin (1995) suggest that although financial repression is growth-suppressing and inflationary, given high costs of collecting alternative taxes, governments may still adopt it to finance expenditures since "the financial sector is the potential source of 'easy' resources for the public budget" (p. 277). We take as our point of departure a second-best world and proceed to characterize the optimal degree of financial repression. Given a tax scheme, we show the condition for the existence and uniqueness of the optimality of financial repression.

The organization of the paper is as follows. The next section provides a de-

[2]For an excellent summary of the evidence on inflation and growth, see Chari, Jones, and Manuelli (1995).

scription of the basic model while section 3 performs the equilibrium analysis of the steady state. Section 4 examines the effects of financial repression in the form of binding reserve requirements. Section 5 studies the situation when financial repression is so severe that "curb markets" emerge. We then analyze the welfare consequences of financial repression in section 6. Section 7 concludes the paper.

2. The Model

The present model follows closely the one developed in Espinosa and Yip (1995). Consider an economy that consists of an infinite sequence of two-period-lived overlapping generations as well as an initial old generation. Time is discrete and indexed by $t = 0, 1, ...$ There are two symmetric locations (indexed by $j = 1, 2$) in the economy to which young agents are assigned at each date. Without loss of generality, each location is assumed to contain a continuum of young agents with unit mass.

In each location of the economy, a perishable consumption good is produced by individual firms using capital and labor according to the production function[3]

$$y_t = A\bar{k}_t^{1-\alpha} k_t^{\alpha} L_t^{1-\alpha}, \tag{2.1}$$

[3]Non-storability is defined to be across both time and locations.

where y_t and k_t denote output and capital stock per firm, $\overline{k}_t$ is the "average" per firm capital, L_t represents employment per firm, $A > 0$, and $\alpha \in (0,1)$. Following Bencivenga and Smith (1991, 1992), we assume that each firm uses only its own capital in production and there are no rental markets for capital. As in Romer (1986), we assume an externality in production, $\overline{k}_t$, in order to generate perpetual growth. Except for the initial old generation, agents have no endowment of capital or consumption goods.

There are two assets in this economy: capital and fiat money. Capital is produced by forgoing current consumption and is location-specific. Specifically, one unit of consumption can be transformed into one unit of capital in the next period. For simplicity, full depreciation of capital is assumed. Per capita stock of fiat money in circulation at time t is denoted by M_t while p_t is the price level at t. Moreover, we preclude share markets to capital as well as markets for intergenerational loans.[4]

All young agents are identical ex ante and are endowed with one unit of labor that they supply inelastically. They do not work when old and they only care about old-age consumption. Let c_{it} be the age i consumption of a representative

[4]See Bencivenga and Smith (1992) for a justification of these simplifying assumptions (p. 239).

agent of generation t, her lifetime utility is then given by[5]

$$u(c_{1t}, c_{2t}) = \ln c_{2t}. \tag{2.2}$$

At the beginning of each period, agents are completely isolated and transactions in goods, labor, and asset markets are then made autarkically within each location. Next, in each location, a fraction $\pi \in (0,1)$ of young individuals is selected randomly to relocate to the other location. The probability of relocation, π, is constant across periods, *i.i.d.* across agents, and is known to all agents. As in Townsend (1987) and Champ, Smith, and Williamson (1992), our model implies that fiat money is the only asset for interlocation exchange. Relocated agents give up their claims to the returns of capital and can only consume in other locations if they hold fiat money.

Finally, the government in our model has per capita expenditure g_t, which is financed by both income taxation and seigniorage. Income taxation takes the form of a proportional tax of rate τ on young agents' wage earnings (w_t). The

[5]One can adopt a more general specification of preferences such as the constant intertemporal elasticity type. This enriches the results for the case where binding reserve requirements are absent, since the optimal ratio q_t will then depend on the equilibrium rate of inflation (see the discussion in Espinosa and Yip 1995). However, for cases where the reserve requirement is binding, the more general structure of preferences has no extra mileage.

government budget constraint is

$$g_t = \tau w_t + (M_t - M_{t-1})/p_t. \tag{2.3}$$

To be consistent with perpetual growth, we take government spending as a constant proportion of national income, i.e., $g_t = \beta y_t$. Notice that β is the parameter indicating the relative size of government in the economy. Finally, from now on, we concentrate on cases where there is a positive deficit to be financed, i.e., cases where $\beta > \tau(1 - \alpha)$.

3. Equilibrium Analysis

The model constructed in the previous section implies that there is a role for banks to provide liquidity. Liquidity provision, indeed, plays an important role in determining the equilibrium growth rate of the economy. In this section, we study the benchmark case, where financial intermediaries are free from any form of financial repression such as binding reserve requirements.

3.1. Factor Markets

At each date t, perfectly competitive firms in each location employ services from capital and labor to maximize profits. Given the average per firm capital stock, $\overline{k}_t$, the real wage rate, w_t, and the rental rate of capital, r_t, profit maximization implies that factors of production are paid by their marginal productivity, i.e.,

$$r_t = \alpha A\overline{k}_t^{1-\alpha} k_t^{\alpha-1} L_t^{1-\alpha}, \tag{3.1}$$

$$w_t = (1-\alpha) A\overline{k}_t^{1-\alpha} k_t^{\alpha} L_t^{-\alpha}. \tag{3.2}$$

In equilibrium, $\overline{k}_t = k_t$ and $L_t = 1$. Substituting these factor market equilibrium conditions into (3.1) and (3.2) yields

$$r_t = \alpha A, \tag{3.3}$$

$$w_t = (1-\alpha) A k_t. \tag{3.4}$$

3.2. Intermediaries' Portfolios

Financial intermediaries accept deposits from young savers at each date t and use them to acquire primary assets: money and capital. They choose q_t, the fraction of banks' assets held as capital, i.e., $q_t = k_{t+1}/[(1-\tau)w_t]$, to maximize the expected lifetime utility of a representative depositor, subject to

$$\pi R_t^a = (1 - q_t) R_t^m, \tag{3.5}$$

where R_t^a is the return to those agents relocating to *another* location, $R_t^m \equiv p_t/p_{t+1}$ and

$$(1 - \pi) R_t^s = q_t r_{t+1}, \tag{3.6}$$

where R_t^s is the return to those agents who *stay* in the same location, because there is no aggregate uncertainty.

Assuming that capital return dominates real balances, which is true whenever $\beta > \tau(1 - \alpha)$, as we show below, agents savings are done 100% through intermediaries. Formally, the intermediaries' optimization problem can be stated as

$$\max_{0\leq q_t\leq 1} v_t = \ln[(1-\tau)w_t] + \pi \ln[(1-q_t)(R_t^m)/\pi] + (1-\pi)\ln[q_t r_{t+1}], \tag{3.7}$$

where R_t^m and r_{t+1} are taken to be given. The solution to this problem is given by

$$q_t = q = 1 - \pi. \tag{3.8}$$

Portfolio Decisions

The portfolio optimization problem of the young agent is as follows. At each date t, young agents save all their after-tax real income $(1-\tau)w_t$ in the forms of d_t, k_t, and m_t so as to maximize their lifetime utility given by (2.2). Letting Ψ_1 be the fraction of savings placed in bank deposits, Ψ_2 be the fraction held as real money balances, and the remaining $(1-\Psi_1-\Psi_2)$ be the fraction held as capital, agents solve the following problem

$$\begin{aligned}&\max_{\Psi_1,\Psi_2} \ln[(1-\tau)w_t] + \pi \ln(\Psi_1 R_t^a + \Psi_2 R_t^m) \\ &+(1-\pi)\ln\left[\Psi_1 R_t^s + \Psi_2 R_t^m + (1-\Psi_1-\Psi_2)r_{t+1}\right].\end{aligned} \tag{3.9}$$

Assuming $r_{t+1} > R_t^m$, which as we said is an implication of $\beta > \tau(1-\alpha)$, $\Psi_2 = 0$, i.e., the money holdings by young savers are exclusively those implicit in their bank deposits. Solving (3.9) under the condition that $\Psi_2 = 0$, we obtain the following optimal solution for Ψ_1:

$$\Psi_1 = \frac{\pi r_{t+1}}{r_{t+1} - R_t^s} \tag{3.10}$$

with $r_{t+1} \geq R_t^s$. Clearly, because R_t^s's upper bound is r_{t+1}, whenever $r_{t+1} = R_t^s$, $\Psi_1 = 1$.

3.3. Steady-State Growth

In the absence of any legal restrictions on financial intermediaries, $\Psi_1 = 1$ and all primary asset holdings are intermediated in equilibrium. Market clearing requires that

$$k_{t+1} = q(1-\tau)w_t. \tag{3.11}$$

Substituting (3.4) and (3.8) into (3.11), we obtain the equilibrium gross growth rate of the capital stock:

$$\theta \equiv k_{t+1}/k_t = (1-\pi)(1-\tau)(1-\alpha)A. \tag{3.12}$$

Since along the balanced growth path $Y_t = AK_t$, θ is also the equilibrium rate of output growth. From (3.12), it is clear that the growth rate of capital is constant along a balanced-growth equilibrium path. Indeed, this economy has no transitional dynamics and is always in steady-state growth in which all extensive variables grow at the rate θ given by (3.12). The equilibrium rate of inflation is readily derived. Using the money market equilibrium condition, $m_t = (1-q_t)(1-\tau)w_t$, together with (3.4) and (3.8), we get

$$m_t/k_t = \pi(1-\tau)(1-\alpha)A. \tag{3.13}$$

Substituting (3.13) into the government budget constraint (2.3) and manipulating, we get

$$\beta = (1-\alpha)\tau + \left[1 - \frac{R^m}{\theta}\right]\pi(1-\tau)(1-\alpha). \tag{3.14}$$

Since R_t^m is the inverse of the equilibrium inflation rate, (3.14) implies the commonly observed inverse relationship between growth and inflation. Figure 1 summarizes the determination of growth and inflation in the balanced-growth equilibrium, where the QQ and OB loci are derived from (3.12) and (3.14), respectively.

4. Binding Reserve Requirements

In this section, we introduce an arbitrary binding reserve requirement imposed by the government into the balanced-growth equilibrium of the economy. Following Bencivenga and Smith (1992), we specify the reserve requirement as a ceiling on the fraction of a bank's portfolio that can be held as capital. Let $\overline{q}$ denote the reserve requirement. From (3.8), we restrict $\overline{q} < (1 - \pi)$ so that the reserve requirement becomes binding.

With the introduction of the binding reserve requirement in the economy, banks are constrained to set $0 \leq \overline{q} < (1 - \pi)$. In this case, Ψ_1, given by (3.10), need not be 1, which is to say, in equilibrium, not all of the primary asset holdings may be intermediated. When financial repression is sufficiently severe, $\Psi_1 < 1$, so that some investments are forced to be internally financed. In the presence of binding reserve requirements, resource constraints (3.5) and (3.6) then become

$$R_t^a = [(1 - \overline{q})/\pi](p_t/p_{t+1}) > p_t/p_{t+1}, \tag{4.1}$$

$$R_t^s = \overline{q}r_{t+1}/(1 - \pi) < r_{t+1}. \tag{4.2}$$

From (3.10) and (4.2), one can obtain the interval within which the monetary authority can repress the financial system and still have everybody intermediate all of their savings. In particular, $\Psi_1 = 1$ if and only if $\overline{q} \in [(1-\pi)^2, (1-\pi)]$.

Since banks are restricted to invest a fraction $\overline{q}$ of their deposits in capital, the equilibrium growth rate interval of per firm capital stock is given by

$$\overline{\theta} = \overline{q}(1-\tau)(1-\alpha)A. \tag{4.3}$$

With $\overline{\theta} \in (\theta^l, \theta^h)$, $\theta^l \equiv (1-\pi)^2(1-\tau)(1-\alpha)A$ and $\theta^h \equiv (1-\pi)(1-\tau)(1-\alpha)A$. Figure 2 depicts the effect of a decrease in $\overline{q}$ on growth and inflation. A higher degree of financial repression shifts the QQ locus to the left while rotating the OB locus up. Thus, a higher degree of repression reduces economic growth. However, as depicted also in Figure 2, the effect of a higher degree of financial repression on the equilibrium inflation rate is ambiguous. From the government budget constraint and the money market equilibrium condition, we derive

$$\overline{R}^m = \left[1 - \frac{\beta - (1-\alpha)\tau}{(1-\overline{q})(1-\tau)(1-\alpha)}\right]\overline{q}(1-\tau)(1-\alpha)A. \tag{4.4}$$

From (4.4) it is clear that in the presence of financial repression, given a fixed government deficit and a fixed rate of return on currency, there is more than one equilibrium reserve ratio, as depicted in Figure 3. It follows that the effect of an increase in the reserve requirement on the equilibrium rate of inflation will be a function of the original equilibrium inflation rate and the government's "slice of the pie." For future reference, from (4.4) one can compute $\overline{q}^*$, the degree of repression that minimizes inflation (or maximizes $\overline{R}^m$):

$$\overline{q}^* = 1 - \left(\frac{[\beta - (1-\alpha)\tau]}{(1-\tau)(1-\alpha)}\right)^{1/2}. \tag{4.5}$$

From (4.4), the effect of an increase in the reserve requirement on the equilibrium inflation rate depends on the size of the government deficit share, $\beta - (1-\alpha)\tau$, the initial equilibrium inflation rate and the locus of $\overline{q}$ in relation to $\overline{q}^*$. This result highlights the lack of proper qualifications in most claims regarding the impact of financial repression on inflation. For example, in the economic development literature higher degrees of financial repression are believed to always be associated with higher rates of inflation. In this model, increases in reserve requirements are deflationary in cases where financial repression is "mild" (i.e., in cases where $\overline{q} > \overline{q}^*$) whereas a higher degree of financial repression is associated with higher inflation rates in cases where financial repression is harsher (i.e., in cases where

$\overline{q} < \overline{q}^*$). However, one should be careful not to read these results as reproducing the conventional and economic development claims that state (respectively) that higher reserve requirements are deflationary (inflationary). In principle, one cannot read the features of the alternative equilibria as representing developing or developed economies; for starters, in this economy, all capital accumulation is intermediated, a feature of developed economies. Furthermore, note that $\overline{q}^*$ is the degree of financial repression that minimizes the rate of inflation. We summarize this section's findings in the following proposition:

Proposition 4.1. *Whenever financial repression is "moderate," so that all capital formation continues to be intermediated, i.e., whenever* $\overline{q} \in [(1-\pi)^2, (1-\pi)]$, *an increase in the reserve ratio retards economic growth while its effect on inflation is ambiguous.*

5. Underdeveloped Financial Markets

A characteristic of developing economies is the fact that not all capital accumulation is intermediated. In our model, part of capital formation is not done through intermediaries (i.e., $\Psi_1 < 1$) whenever financial repression (as represented by a forced low q) is severe, in particular, whenever $\overline{q}$ is set below the lower bound

$(1-\pi)^2$. From (3.10), when financial repression is severe, young savers will only deposit $\Psi_1 = [\pi r_{t+1}/(r_{t+1} - R_t^s)]$ with financial intermediaries and the rest in "curb markets." Since curb markets are not subjected to reserve requirements, it is not surprising that whenever financial repression becomes severe, savers turn to them. This coincides with what one observes in real economies. Most economies experience a degree of financial repression. In most developed economies, however, curb markets are almost non-existent while they thrive in several developing economies. In what follows, we study the effects of an active curb market on growth and inflation in this section.

Substituting (4.2) into (3.10), we have

$$\Psi_1 = \frac{\pi(1-\pi)}{1-\pi-\overline{q}}, \tag{5.1}$$

where $\overline{q} \in (0, (1-\pi)^2]$. The capital stock per firm is given by

$$k_{t+1} = (1-\tau)w_t r_{t+1}[(1-\pi)(1-\Psi_1) + \Psi_1 \overline{q}], \tag{5.2}$$

where Ψ_1 is given by (5.1) above. The first term on the RHS represents the fraction of self-financed capital formation while the second term gives the financial intermediaries' capital investments. Using (3.4), (5.1), and (5.2), we derive the economic growth rate of this curb-market economy (θ^c) as

$$\theta^c = (1-\pi)^2(1-\tau)(1-\alpha)A \equiv \theta^l, \tag{5.3}$$

so that under the presence of a curb market, the highest rate of growth an economy can aim for is the lower bound under financial repression with 100% intermediation. This confirms the conventional wisdom that the higher the degree of financial repression, the lower the rate of economic growth. Under financial repression, the economy's rate of growth cannot go below the lower bound θ^l because agents always have the option of bailing out of financial intermediation altogether. Clearly, when financial repression is severe enough to drive part of the capital accumulation out of the formal intermediation sector, the equilibrium rate of inflation is given by

$$R^{mc} = \left[1 - \frac{\beta - (1-\alpha)\tau}{(1-\overline{q})(1-\tau)(1-\alpha)}\right]\theta^c, \tag{5.4}$$

so that when financial repression is severe, the ambiguity regarding the impact of repression on the inflation rate is eliminated. In fact, when financial repression is severe, easing on the degree of repression will always be inflationary

$$\frac{dR^{mc}}{d\overline{q}} = -\frac{[\beta - (1-\alpha)\tau]\theta^c}{(1-\overline{q})^2(1-\tau)(1-\alpha)} < 0. \tag{5.5}$$

Figure 4 illustrates this result. We summarize these findings in the following proposition:

Proposition 5.1. *For $\overline{q} \in (0, (1-\pi)^2]$, a curb market emerges and the growth performance is minimized. An increase in the reserve requirement ratio is deflationary.*

This result differs sharply from most claims in the economic development literature, where liberalization is always associated with lower rates of equilibrium inflation rates. In our model, these claims hold for some ranges of moderate financial repression. However, when financial repression is severe—in the sense of forcing the emergence of curb markets—liberalization is inflationary. The explanation lies in the fact that given a deficit to be financed, under financial liberalization, the drop in holdings of the seignorage tax base will have to be compensated with increases in seignorage tax rates.

6. Welfare

In this section, we study the effects of financial repression from a welfare perspective. Since our main concern is allocative efficiency rather than distribution, we ignore the initial old agents' utility and identify the discounted lifetime indirect utility of the representative agent as the welfare criterion:[6]

$$V = \sum_{0}^{\infty} \rho^t v_t, \tag{6.1}$$

where v_t is the indirect utility function given in (3.7). For future reference, we list the properties of this welfare indicator in the following proposition:

Proposition 6.1. *The welfare criterion, V_t, is an increasing function of the economic growth rate (θ) and a decreasing function of the inflation rate (R_m).*

Proof. Substituting (3.3) and (3.4) into (3.7) and using the fact that $k_t = \theta^t k_0$, we can express (6.1) as

$$V = \frac{\rho \ln \theta}{(1-\rho)^2} + \frac{\pi \ln R_m}{1-\rho} + \frac{\pi \ln(1-q) + (1-\pi)\ln q}{1-\rho} + K, \tag{6.2}$$

[6]For further details on competitive efficiency of overlapping generations, see Wang (1993).

where $K \equiv \frac{1}{1-\rho}\{\ln[(1-\alpha)(1-\tau)Ak_0 + (1-\pi)\ln(\frac{\alpha A}{1-\pi}) - \pi \ln \pi\}$. Straightforward differentiation then yields

$$\frac{\partial V}{\partial \theta} > 0 \text{ and } \frac{\partial V}{\partial R^m} > 0.\square$$

We are now ready to examine the welfare consequences of an increase in financial repression. As indicated by (6.2), there are two types of effects on welfare brought about by changes in binding reserve requirements: one, the effect due to changes in θ caused by changes in $\overline{q}$, and the other one, changes in R^m caused by changes in $\overline{q}$.

Proposition 6.2. *The net effect on welfare of a change in "moderate" financial repression is ambiguous.*

Proof. From (4.3), we get $d\theta/d\overline{q} = (1-\tau)(1-\alpha)A > 0$, it is straightforward from (6.2) to show that $(\partial V/d\overline{q}) > 0$. These together with the discussion following (4.5) generate the results.□

Since an increase of the reserve requirement reduces the fraction of the intermediated capital and hence is inefficient, it creates a direct negative effect on welfare. The effect on inflation is slightly more complicated and will depend on the original equilibrium $\overline{R}_m$. If $\overline{q} < \overline{q}^*$, moderate increases in financial repression will result in a welfare loss for they will result in both higher inflation and a lower rate of growth. If on the other hand, $\overline{q} > \overline{q}^*$, increases in moderate financial repression are ambiguous because they will result in lower inflation but also a lower rate of growth. The ambiguous effect via inflation on welfare implies that there may exist an optimal degree of financial repression in this model.[7] Such a result is given in the following proposition:

Proposition 6.3. *Under any binding reserve requirement where* $\overline{q} \in [(1-\pi)^2, (1-\pi)]$, *there exists a unique optimal level of* $\overline{q}$ *that maximizes welfare if the following condition (Condition Q)* $\frac{[1-(1-\pi)(1-\rho)]}{[1+\pi(1-\rho)]}\pi < \frac{\beta-(1-\alpha)\tau}{(1-\tau)(1-\alpha)}\frac{1}{[1+\pi(1-\rho)]} < (1-\pi)\pi + \frac{[1-(1-\pi)(1-\rho)]}{[1+\pi(1-\rho)]}\pi$ *holds.*

Proof. First, we show that if fiat money is to be valued under financial repression, V is concave. Combining the direct and indirect effects on welfare, we get

$$\frac{dV}{d\overline{q}} = \frac{(1-\overline{q})(\overline{R^m}/\theta) - (1-\rho)\pi\overline{q}}{\overline{q}(1-\overline{q})(1-\rho)^2(\overline{R^m}/\theta)} \tag{6.3}$$

and

[7]See McKinnon and Mathieson (1981) and Brock (1989) for a discussion on the concept of the optimal degree of financial repression.

$$
\begin{aligned}
\frac{d^2V}{d\overline{q}^2} = &-\left(\frac{1}{(1-\rho)}\frac{1}{q}\right)^2 - \frac{\pi}{(1-\rho)}\frac{\overline{\theta}}{R^m}\left(\frac{1}{(1-q)}\right)^2 \\
&-\frac{\pi}{(1-\rho)}\left(\frac{1}{(\overline{R^m}/\overline{\theta})^2}\frac{\beta-(1-\alpha)\tau}{(1-\tau)(1-\alpha)(1-q)^2}\frac{1}{(1-q)}\right) < 0.
\end{aligned} \tag{6.4}
$$

To obtain the optimal level of reserve requirement, we set (6.3) equal to zero and obtain the optimal level of reserve requirements.

$$
\widehat{\overline{q}} = \left[1 - \frac{\beta - (1-\alpha)\tau}{(1-\tau)(1-\alpha)}\right]\left[\frac{1}{1+\pi(1-\rho)}\right].
$$

Furthermore, defining $\Phi(\overline{q}) \equiv (1-\overline{q})(\overline{R^m}/\overline{\theta}) - (1-\rho)\pi\overline{q}$ (the numerator of (6.3)), one can verify that $\Phi(0) < \Phi((1-\pi)^2) < 0 < \Phi(1-\pi) < \Phi(1) \equiv \infty$, which guarantees that $\widehat{\overline{q}} \in [(1-\pi)^2, (1-\pi)]$.□

In general, given a positive deficit (as a fraction of total output) to be financed, higher degrees of financial repression may under some conditions represent lower equilibrium inflation rates, which in turn have a positive impact on welfare. Press ahead with repression, however, and the benefits of lower equilibrium inflation rates disappear. At the same time, higher degrees of repression always have a negative impact on growth and consequently welfare. Proposition 5 says that when financial repression is moderate, there is a degree of financial repression that best balances the trade-offs between the seignorage tax base, tax rate, and an economy's growth rate. Furthermore, notice that from a welfare perspective, one should not necessarily prescribe a level of financial repression that minimizes inflation. In principle, the welfare-maximizing degree of repression, $\hat{\overline{q}}$, will not coincide with the inflation-minimizing degree of financial repression, $\overline{q}^*$.

Finally, we analyze the welfare consequence of severe financial repression where the curb market emerges. The welfare criterion for this case is :

$$V^c = \frac{\rho \ln \theta^c}{(1-\rho)^2} + \frac{\pi \ln R^c_m}{1-\rho} + \frac{\pi \ln(1-\overline{q}) - \pi \ln(1-\pi-\overline{q})}{1-\rho} + K^c, \tag{6.5}$$

where $K^c \equiv \frac{1}{1-\rho}\{\ln[(1-\alpha)(1-\tau)Ak_0] + (1-\pi)\ln[(1-\pi)\alpha A] + \pi \ln(1-\pi)\}$. Directly differentiating (6.5), we get

$$\frac{dV^c}{d\overline{q}} = \frac{\pi^2\theta^c}{(1-\pi-\overline{q})(1-\rho)(1-\overline{q})(R^c_m)}\left[1 - \frac{\beta-(1-\alpha)\tau}{\pi(1-\tau)(1-\alpha)}\right]. \tag{6.6}$$

Our last proposition states that it is never a good idea to repress the financial system to the point where curb markets emerge.

Proposition 6.4. *When financial repression is severe (in the sense defined above), on net, reducing the degree of repression improves welfare.*

Proof. Suppose not; then $\frac{dV^c}{d\bar{q}} \leq 0$, So that

$$(1-\bar{q})(1-\tau)(1-\alpha) - [\beta - (1-\alpha)\tau] \leq (1-\bar{q})(1-\tau)(1-\alpha)\frac{(1-\pi-\bar{q})}{(1-\bar{q})},$$

$$\text{or } 1 \leq \frac{\beta - (1-\alpha)\tau}{\pi(1-\tau)(1-\alpha)}, \text{ which contradicts (3.14)}\Box.$$

7. Concluding Remarks

This paper develops a dynamic general equilibrium model of financial intermediation and endogenous growth to examine the effects of financial repression on growth, inflation and welfare. We have verified that by limiting liquidity provision, financial repression in the form of binding reserve requirements depresses economic growth. However, for the case of moderate financial repression, its effect on inflation is ambiguous. Furthermore, contrary to most studies of developing economies, whenever financial repression is severe enough so that "curb markets" emerge, lessening the degree of repression is inflationary.

We also found that as long as the size of the government budget deficit is within the reasonable range, so that all financial intermediation is done through the formal channels, i.e., the required financial repression is moderate, there exists a unique optimal level of reserve requirement. If, on the other hand, "curb markets" emerge as a reaction to the severe degree of repression imposed in response to the need of financing high levels of government deficits, financial liberalization, in spite of being inflationary, is always welfare improving. This is so because the positive effect on economic growth outweighs the negative impact of inflation on welfare.

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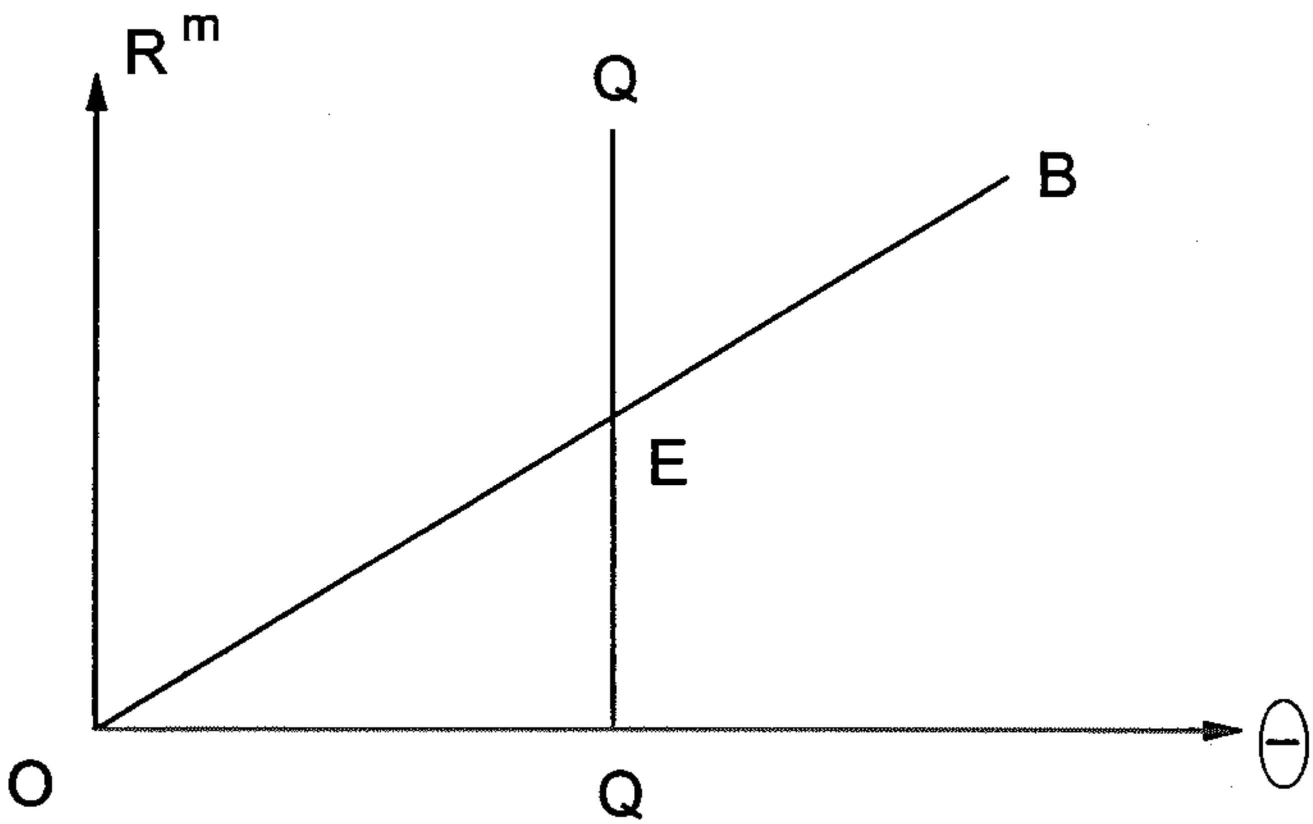

Figure 1

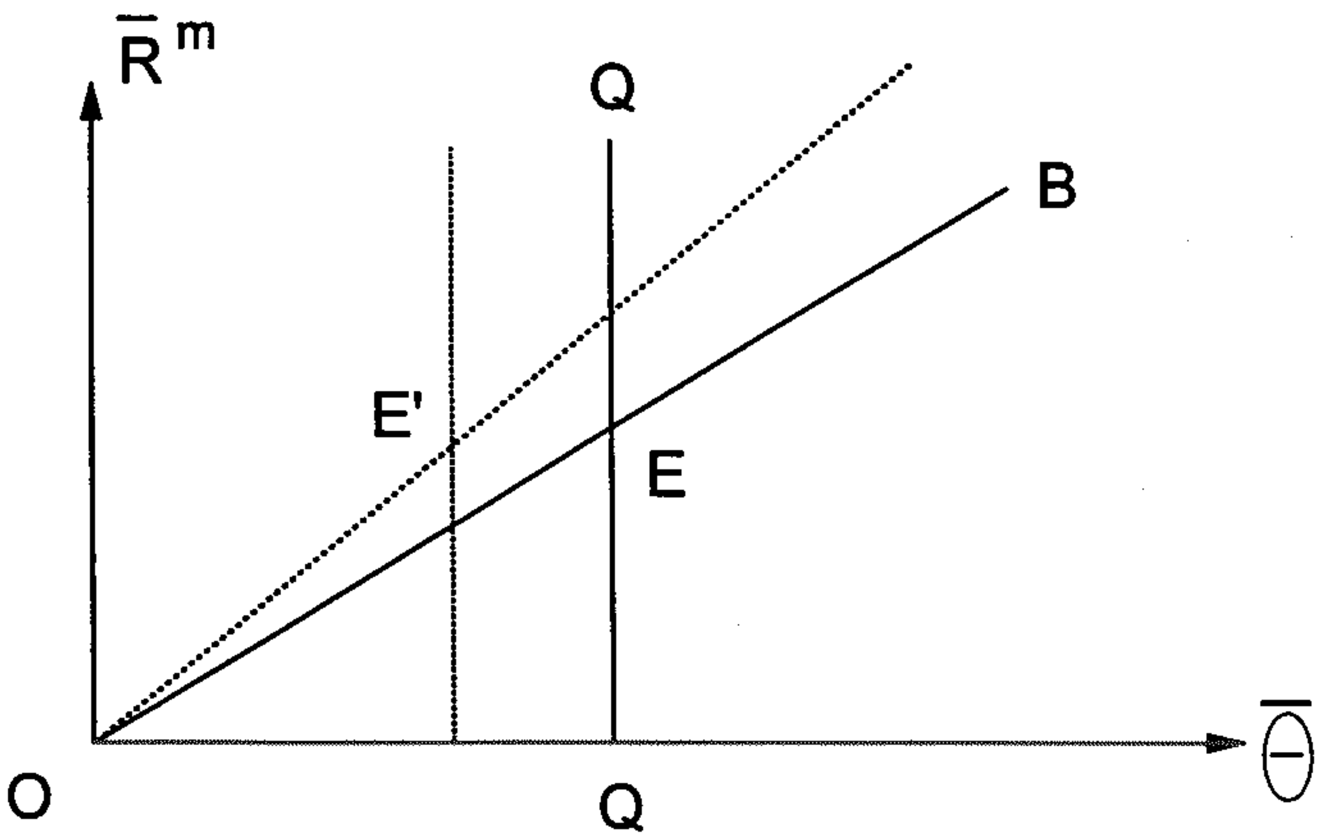

Figure 2

THE "MODERATE" REPRESSION CASE

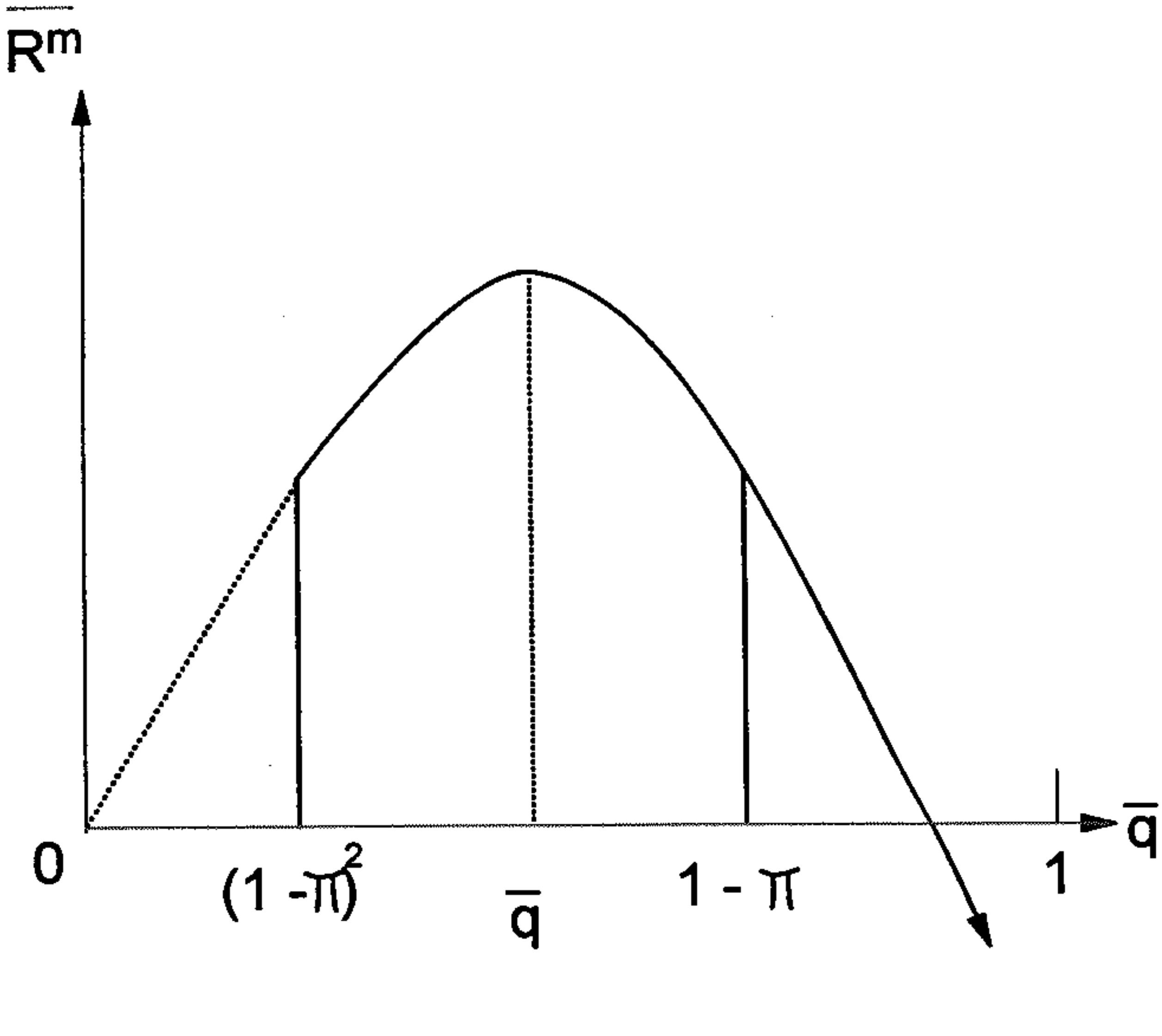

Figure 3

THE "SEVERE" REPRESSION CASE

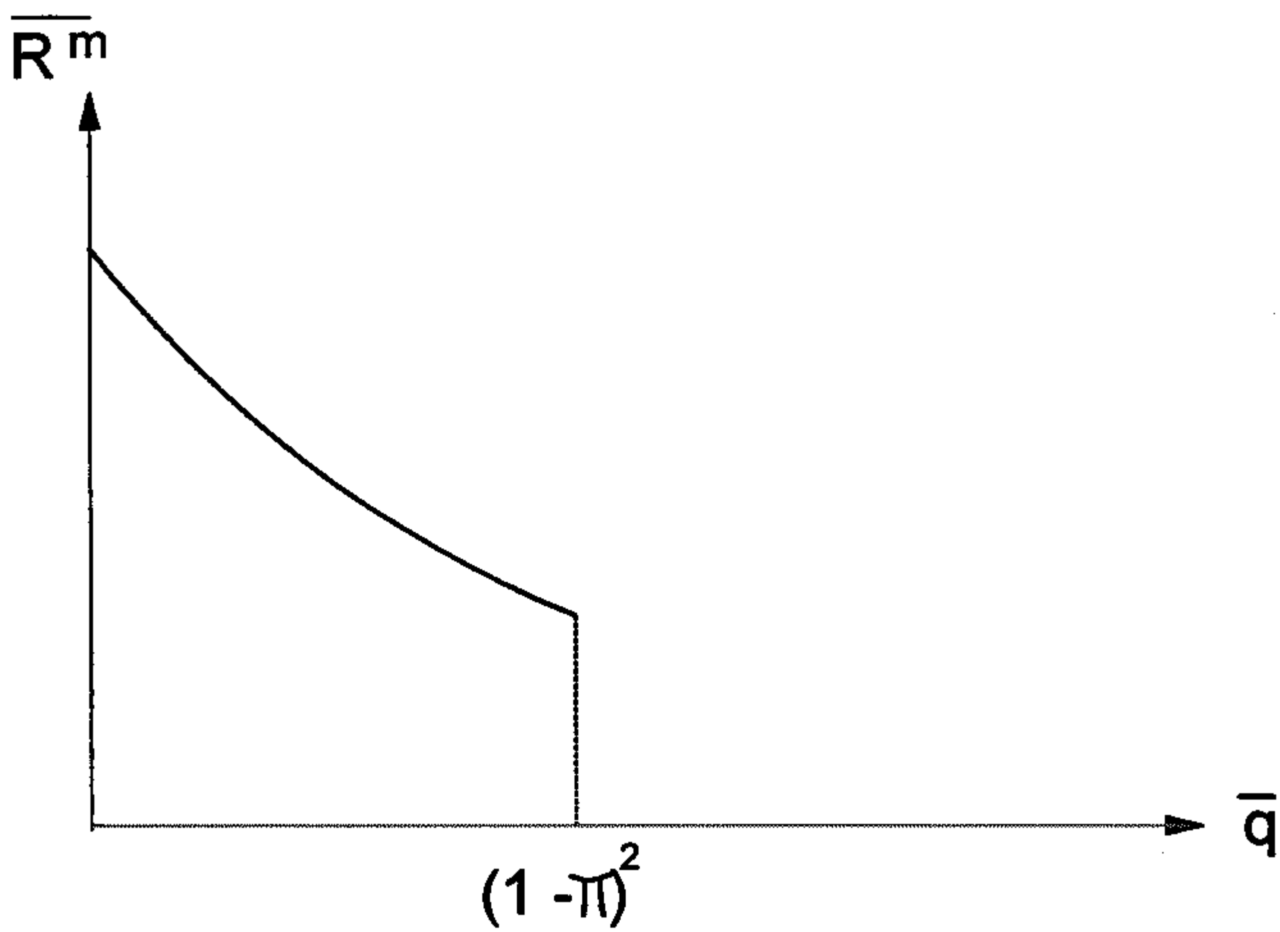

Figure 4