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Costly intermediation, the big push and the big crash

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Abstract

Why does financial activity generate large real effects? We argue that this may reflect a multiplicity of equilibria, due to dynamic interactions between worker's saving decisions and bank's monopolistic competition. We show that the equilibrium-responses of key aggregates to changes in investment uncertainty and intermediation costs depend crucially on intertemporal substitutability and aggregate employment. Small financial disturbances may cause the economy to shift between low and high-employment equilibria, thus providing explanation for the big push and the big crash. The high-employment, high-real-interest-rate equilibrium is consistent with the development experience of the financially repressed East Asian economies prior to July 1997. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Financial development is generally thought to play a crucial and causative role in economic development. The importance of finance for economic development has been emphasized by economists since Schumpeter (1934), who stressed the role of credit creation in the process of economic growth. The finance and development nexus was further explored by Goldsmith (1969), McKinnon (1973) and Shaw (1973) and more recently, in the context of endogenous growth models, by King and Levine (1993). The latter show that growth is positively correlated with a variety of indicators of financial development in cross-country data, empirically confirming the conjectures of many earlier authors. [3] Even at higher frequencies, the financial sector is generally believed to play a crucial role in determining the level and rate of change of aggregate activity. Thus, Bernanke (1983) argues that the post-1930 financial crisis (which arose in a relatively free and unregulated financial system) is key to explaining the magnitude and duration of the Great Depression in the US. Gertler (1988) provides a comprehensive survey of the literature on the relationship between financial factors or real output growth and fluctuations.

However, one of the great paradoxes of the Asian miracle is that in many cases rapid growth seemed to occur in countries with relatively underdeveloped or repressed financial sectors. Specifically, Japan, South Korea and Taiwan experienced rapid growth rates of per capita income in the 1960s and 1970s when the financial sectors in all three countries were highly repressed. Ishi (1982) reviews the development of the Japanese financial sector through the early 1980s and documents the key role that indirect finance through a highly regulated financial intermediary sector (primarily banks) played in postwar Japanese economic growth. The famously high savings of Japanese households were invested mainly in time deposits with financial institutions (80% vs. only about 10% for securities), while the returns on these deposits were tightly regulated under the Temporary Interest Rates Adjustment Law of 1947. Ishi also notes that ''Smooth operation of the financial system has been of prime concern to government whereas *competition has not*'' (p. 121, emphasis added). A descriptive account of the role of the financial sector in the postwar development of South Korea is provided by Nam and Park (1982). They document the intimate involvement of the central government in the allocation of credit and the weak position of the Bank of Korea which contributed to poor inflation performance as the economy grew. [4] Liang and Skully (1982) outline the Taiwanese experience with finance and development, documenting the dominant position of government-owned commercial banks in

[3] The evolution of the literature on the finance-development nexus since the seminal studies of McKinnon and Shaw is comprehensively reviewed by Fry (1995).

[4] Inflation in Korea averaged 19.50% annually during the 1970s. By contrast, inflation in Japan and Taiwan during the same period was 8.20% and 8.90%, respectively.

the provision of credit. Yang (1994) sees the New Banking Law of 1989 (which was followed by the establishment of 16 new banks) as the first major step towards liberalization of the financial system in Taiwan.

The experiences of these three countries run counter to conventional wisdom and have spurred a number of economists to argue that under certain circumstances non-market allocation mechanisms may in fact produce superior outcomes for developing countries. Thus, Kim (1995) examines the role of government in the credit allocation process in Korea and argues that active government involvement was a crucial factor in the rapid pace of Korean economic development. In their review of the South Korean development experience, Dornbusch and Park (1987) note the positive role played by financial repression, arguing that ‘‘Financial repression helped finance budget deficits in a relatively noninflationary way [!]... supported financial stability in other important ways... [and] mobilized resources for investment in targeted areas’’ (pp. 417–418). The collection of papers in (Patrick and Park, 1994) present a comparative analysis of the role of the financial system in the postwar development of all three countries.

In this paper, we propose a simple framework for thinking about the interaction between the financial and real sectors and use the model to glean some insights into the finance-development nexus. Our model is one where intermediation is costly in the sense of absorbing real resources. We depart from standard practice in arguing that there are potential ‘externality effects’ that make the volume of resources absorbed by the financial sector depend intimately on aggregate activity. The idea is that the financial sector provides a variety of services, among which *relationship banking* and *arms-length* services are particularly important. A key feature of relationship banking services is that they are characterized by diseconomies of scale due to capacity or congestion effects. This contrasts with the dominant feature of arms-length services, where scale economies in intermediation costs seem to prevail. Our characterization of relationship banking through cost technology can be thought of as complementary to the commitment view of Mayer (1988) and Petersen and Rajan (1994) who focus on the informational underpinnings of relationship banking. The banking cost economies of arms-length services, on the other hand, capture the effects of a market-participation externality in the spirit of Diamond (1982) and Cooper and Ejarque (1994).

Our model generates equilibria that depend on the dominant banking technology with multiple equilibria possible under certain parameter configurations. In this sense, our framework is reminiscent of the analysis of Cooper and Ejarque (1994) who consider a participation externality, with the cost of financial intermediation depending negatively on the mass of consumers, to generate multiple equilibria. However, the source of the multiple equilibria in our model is due to the dynamic interactions between worker’s saving and bank’s monopolistically competitive behavior. Since small changes in the economic environment (specifically in financial sector conditions) can move the economy from one equilibrium to another, such changes will also be associated with large changes in real activity.

As pointed out by Gurley and Shaw (1960), the *raison d'etre* of financial intermediaries is to transform the securities issued by firms into securities that have desirable characteristics for final savers. The functions of financial intermediaries range from pooling of funds to overcome indivisibilities and providing liquidity services to diversifying borrower-specific risks, providing credit risk assessment and loan monitoring services. [5] In this paper, we generate a role for a financial intermediary by assuming that it serves as an efficient agent for diversifying risky investments, in a manner related to Cooley and Smith (1995). In contrast to previous work, banks are assumed to be monopolistically competitive, earning zero profit in equilibrium. We postulate that there is a continuum of households, each consisting of a worker and a homemaker or shopper. Household savings are intermediated, providing funds for firms to undertake investment in physical capital and production of a single homogeneous good. The financial sector consists of a discrete number of intermediaries (or, in short, banks), each of which must pay a start-up fee upon entering the industry. The start-up fee precludes individuals from direct involvement in firms and gives rise to the monopolistically competitive structure of the financial sector, with the endogenous number of banks reflecting financial product variety and innovation. We assume that the financial sector is monopolistically competitive, so banks enter until all are earning zero profits. [6] Bank activity consists of intermediating funds from savers to borrowers, as well as diversifying the risks of investment projects. [7]

A central feature of the paper is the generation of multiple equilibria. The multiplicity of equilibria arises from the interaction of the intertemporal consumption-saving decisions of workers and the monopolistically competitive behavior of banks. We characterize the various equilibria by examining the comparative static effects of changes in the pure rate of time preference, investment uncertainty and bank costs. We find that the results depend crucially on the intertemporal elasticity of labor supply and the aggregate level of employment. Importantly, small changes in the financial system may cause the economy to shift between low and high-income equilibrium.

The remainder of the paper is organized as follows. In Section 2, we describe the basic environment of the financially intermediated economy. While Section 3 solves for multiple steady-state equilibria, Section 4 characterizes the various equilibria by performing comparative-static analysis. We then elaborate on the model implications and draw conclusions in Section 5.

[5] See Pagano (1993) and Becsi and Wang (1997) for critical surveys of the related literature.

[6] Note that Park (1994) emphasizes the limited degree of competition in the Korean banking sector even after the liberalizations of the 1980s.

[7] For more a complete general-equilibrium analysis of financial development with monopolistic competition, the reader is referred to Becsi et al. (1998).

2. The basic environment

Time is discrete. There are three types of agents in the economy: households, firms and banks. A unit mass of households, each of which consists of a worker and a shopper, choose a path of consumption of a single good, employment activity and the amount of funds to be deposited with the banking sector. [8]

The goods sector is populated by a continuum of firms of unit mass, which produce a single final good from (physical) capital and labor. For simplicity, capital is assumed to depreciate fully at the end of each period. The output of each firm is subject to an idiosyncratic random shock. To facilitate production, firms arrange financing with the banking sector before the realization of this shock. Idiosyncratic risks require pooling of funds and risks and give rise to the banking sector.

Banks pool risks by offering households a safe rate of return on the interest-bearing portion of their deposit. There is a fixed cost for setting up a bank. Individual banks can affect their lending rates to firms, but competition forces them to break even, at which point the mass of banks is endogenously determined. During any particular period, banks determine the total amount of funds lent to the goods sector and set the interest rate on deposits but prior to realization of the output shocks.

We describe below the optimizing behavior of households, final goods producers, and banks. We consider a continuum of households, each of which consists of a worker and a homemaker. With their wage incomes, the working members of each household can save the unconsumed portion in banks to smooth intertemporal consumption needs. Household preferences are given by a standard time separable utility functional form:

$$\sum_{t=0}^{\infty} \beta^t \left(\ln(c_t) - \gamma \frac{N_t^{1+\sigma}}{1+\sigma} \right) \tag{1}$$

where c_t denotes consumption at date t, $N_t \in (0,1)$ denotes the fraction of workers in each large household, and the discount factor $\beta \equiv 1/(1+\rho)$ satisfies $0 < \beta < 1$ where $\rho > 0$ is the pure rate of time preference.

The representative household enters period t holding ‘gross’ bank deposits, b_t. These assets, net of a banking ‘club fee’ to be discussed below, generate a (gross) rate of return of $(1 + r_t^b)$. [9] Households also receive income from supplying labor

[8] We focus on equilibria where individuals have financially intermediated capital accumulation. Mayer (1990) finds empirical support to this assertion in eight industrialized countries.

[9] That is, interest rates subscripted period t denote returns from holding instruments between periods $t-1$ and t.

services to the market, $w_t N_t$. Thus the representative household faces the budget constraint:

$$c_t + b_{t+1} = (1 + r_t^b)\left(b_t - e_t^b(\overline{N}_t)\right) + w_t N_t \tag{2}$$

with $b_0 > 0$ given. Here $b_{t+1} - b_t$ is the total amount of funds supplied to the banking sector during period t, which consist of interest-bearing deposits, b_t, and the banking fee, e_t^b. This banking fee is best thought of as a shorthand for bank capital requirements. Implicitly, we are assuming that depositors are shareholders in the bank and the amount of capital that they are obliged to put up depends on the scale of economic activity (as measured by aggregate employment). [10] For analytic convenience, we assume that the club fee is proportional to the amount of funds the household supplies, i.e., $e_t^b = e(\overline{N}_t)b_t$, where the constant of proportionality, $e(\overline{N}_t)$, depends on aggregate employment, $\overline{N}_t$, and where obviously $1 \geq e(\overline{N}_t) > 0$. [11] Note that $\overline{N}_t = N_t$ in equilibrium, but aggregate employment is exogenous as far as individual consumers are concerned. The household maximizes lifetime utility (Eq. (1)) subject to the budget constraint (Eq. (2)).

Without loss of generality, we will consider a specific functional form for the banking fee: $e(\overline{N}_t) = \overline{N}_t^{\theta}$, with $-1 \leq \theta \leq 1$. First, the case of $\theta = 0$ presents a benchmark with no externality. Second, for $\theta \in (0,1]$, the banking cost captures the effects of a 'congestion externality' where higher aggregate employment, $\overline{N}_t$, increases the cost of banking. This characterizes relationship banking through cost technology and can be thought of as complementary to the commitment view of Mayer (1988) and Petersen and Rajan (1994) who focus on the informational underpinnings of relationship banking. Finally, for $\theta \in [-1,0)$, the banking cost capture the effects of a 'market participation externality' in the spirit of Diamond (1982) and Cooper and Ejarque (1994).

The distinction between banking cost technologies with congestion or participation externalities can be thought of as capturing differences between relationship and arms-length banking services. In particular, arms-length services exhibit economies of scale over relationships formed by banks, because they economize on manpower and training and development costs as well as on the costs of coordination and developing clienteles and good reputations that are the hallmark of relationship services. We assume that the economies or diseconomies vary with the number of relationships, not with the value of the deposits. Also, relationships are linked to employment which captures retail banking relationships with deposi-

[10] This club fee can also be regarded as the cost of forming a 'bank coalition' in the sense of Boyd and Prescott (1986). It is also conceptually consistent with the literature considering bank capital requirements as in (Vinals and Berges, 1988).

[11] It is interesting to note that Kitagawa and Kurosawa (1994) comment on the relatively high level of bank fees in Japan as compared to the US.

tors and commercial banking relationships with firms. Thus, the per unit cost of deposits rises with employment for arms-length services and falls for relationship banking services.

For each firm, production of the final good is carried out by means of a standard Cobb–Douglas technology:

$$y_t(z) = A_t(z)k_t(z)^{\alpha}N_t(z)^{1-\alpha} \tag{3}$$

where $y_t(z)$ denotes output of the zth firm at date t, $k_t(z)$ is the quantity of physical capital employed in market production by the zth firm at date t, $N_t(z)$ denotes labor employed in the zth production activity at date t, and $A_t(z)$ denotes the level of total factor productivity at date t. The optimization problem faced by the representative final goods producer is as follows:

$$\max_{k_t, N_t} \; E\{\pi_t^y | I_t(z)\} = E\{y_t(z) - (1+r_t^k)k_t(z) - w_t N_t(z) | I_t(z)\} \tag{4}$$

where $y_t(z)$ is given by Eq. (3), $1 + r_t^k$ is the gross unit cost of capital (i.e., the cost from the principle and the interest of the bank loan) and $I_t(z)$ is the information available to the zth firm at the time period t decisions need to be made. Since both goods and factor markets are perfectly competitive, in equilibrium the aggregate profit of the final goods producing sector is zero, although individual firms will make profits or losses depending on their realization of the technology shock.

To simplify the analysis, we treat each firm symmetrically and assume that the ex ante distribution of the production shocks A_t facing each firm is the same. We assume that the shocks have a stationary distribution with two possible realizations: a ‘good’ outcome, $(1+\delta)a$, and a ‘bad’ outcome, $(1-\delta)a$, where $a > 0$ and $1 > \delta > 0$, with probabilities $\mathrm{Prob}(A = (1+\delta)a) = \psi$ and $\mathrm{Prob}(A = (1-\delta)a) = 1 - \psi$. Under log utility the certainty equivalent value of A, which we will denote $\bar{A}$, is equal to $\bar{A} = a\sqrt{(1-\delta^2)} < a$, with δ measuring the degree of riskiness. In the steady state analysis below we will consider only the certainty equivalent allocation, which enables us to focus on other relationships. Throughout the paper we will consider an increase in production (or financial investment) uncertainty as an increase in δ. This ex ante uncertainty about production assures the existence of financial intermediation. Finally, by symmetry and unit mass, it is not necessary to distinguish individual firms from the aggregate.

Households make deposits with banks that are then lent to firms. The representative bank’s profit maximization problem is as follows:

$$\begin{aligned}&\max_{D_{t+1}, L_{t+1}} \; E\{\pi_t^b | I_t^b\} \\ &\quad = E\{(1+r_{t+1}^k)L_{t+1} - (1+r_{t+1}^b)D_{t+1} - \Omega^b - \mu L_{t+1} | I_t^b\}\end{aligned} \tag{5}$$

subject to the balance sheet constraint

$$\frac{N_{t+1}e_{t+1}^b(\bar{N}_{t+1})}{M_{t+1}} + D_{t+1} = L_{t+1} \tag{6}$$

Here μ denotes the unit cost of processing a loan for an individual firm, while Ω^b is the fixed cost incurred to set up and run a bank. [12,13] We use E to denote the expectations operator, while I_t^b denotes the information available to bank b at date t. Note that with the balance sheet identity (Eq. (6)), it is a matter of indifference whether we specify the bank's profit function using gross or net rates of interest. The balance sheet identity also reflects our assumption that the provision of banking services involves a real resource cost to society of $(1-N_{t+1})e_{t+1}^b(\overline{N}_{t+1})$. Note also that risk neutral banks resemble mutual funds with a perfectly diversified portfolio of loans that is inaccessible to individual households because of prohibitive start-up costs. For simplicity, the amount of funds obtained from households, b_{t+1}, and loans made to firms, k_{t+1}, is assumed to be distributed equally over all M_{t+1} banks (i.e., all banks are also treated symmetrically). The household funds are divided into net deposits, D_{t+1}, and bank capital, e_{t+1}^b. Thus, equating funds inflows and outflows gives:

$$D_{t+1} = \frac{b_{t+1} - N_{t+1}e_{t+1}^b\left(\overline{N}_{t+1}\right)}{M_{t+1}} \tag{7}$$

$$L_{t+1} = \frac{k_{t+1}}{M_{t+1}} \tag{8}$$

3. Equilibrium

We will proceed with the first-order conditions for households, firms and banks and use them to solve for interior equilibria. First, the first-order conditions for the firm are the standard conditions equating real factor returns and marginal products:

$$\alpha\frac{y_t}{k_t} = 1 + r_t^k \tag{9}$$

$$(1-\alpha)\frac{y_t}{N_t} = w_t \tag{10}$$

where we have dropped the z-index that distinguishes firms since they all make

[12] Similar fixed costs also appear in (Williamson, 1986b; Greenwood and Jovanovic, 1990) and are shown to be consistent with empirical evidence in (Sussman and Zeira, 1995), who find that total bank costs per unit of extended credit has fallen with financial development.

[13] Also, note that loan processing costs are assumed to be independent of congestion or participation externalities which have already been captured in the banking fee. Having relationship externalities explicitly as part of lending activities would more closely complement the commitment view of Mayer (1988) and Petersen and Rajan (1994) who emphasize the contractual relationship of banks and firms under informational asymmetry. In the present work, loan processing costs may contain real resources devoted to information gathering and monitoring, in the sense of Diamond (1984) and Williamson (1986a).

the same decisions. The (ex-ante) first-order conditions for banks can be combined to form:

$$r^k_{t+1}\left(1-\eta^i_{r^kL}\right)-\mu=r^b_{t+1} \tag{11}$$

where $\eta^i_{r^kL}\equiv-[L(i)/r^k(i)][\mathrm{d}r^k(i)/\mathrm{d}L(i)]$ is the inverse of the interest rate elasticity of the demand for bank loans. It can be shown that the financial mark-up (of the loan rate over the deposit rate) is $r^k(i)\eta^i_{r^kL}=(1-\alpha)(1+r^k)$. Substituting this into the lefthand side of Eq. (11) yields $r^k_{t+1}=(r^b_{t+1}+\mu+(1-\alpha))/\alpha$. The loan-deposit interest rate differential is thus

$$r^k_{t+1}-r^b_{t+1}=\frac{1}{\alpha}\left((1-\alpha)\left(1+r^b_{t+1}\right)+\mu\right)=(1-\alpha)\left(1+r^k_{t+1}\right)+\mu \tag{12}$$

which implies $(r^k-\mu)-r^b=(1-\alpha)(1+r^k)$. In a perfectly competitive framework $\alpha=1$, the mark-ups of the firms are driven to zero and the loan-deposit interest rate differential is nothing but the unit loan processing cost, μ.

Eqs. (5)–(8) and (12) can be combined to yield:

$$b_{t+1}=k_{t+1} \tag{13}$$

$$\left[\left(\left(1-\alpha\left(1-e\left(\overline{N}_{t+1}\right)\right)\right)\left(1+r^k_{t+1}\right)\right)-e\left(\overline{N}_{t+1}\right)\mu\right]k_{t+1}=\Omega^bM_{t+1} \tag{14}$$

Eq. (13) summarizes the implications of the bank's balance sheet (all capital is intermediated), while Eq. (14) is the zero profit condition.

The necessary conditions for household optimization are standard and are given by

$$\gamma c_tN_t^{\sigma}=w_t \tag{15}$$

$$1=E\left\{\left[\beta\left(1+\left(1-e\left(\overline{N}_{t+1}\right)\right)r^b_{t+1}\right)\frac{c_t}{c_{t+1}}\right]\middle|\, I^h_t\right\} \tag{16}$$

$$c_t=\left(1+r^b_t\left(1-e\left(\overline{N}_t\right)\right)\right)b_t-b_{t+1}+w_tN_t \tag{17}$$

where we denote the information set of the representative household as I^h_t. We can combine these equations to obtain

$$\left(1-\gamma N^{1+\sigma}\right)c_t=\left(1+r^b_t\left(1-e\left(\overline{N}_t\right)\right)\right)b_t-b_{t+1} \tag{18}$$

Finally, by unit mass and symmetry, we have

$$\overline{N}_t=N_t \tag{19}$$

We can now define an interior, financially intermediated equilibrium:

Definition 1. An equilibrium with financial intermediation is a tuple of positive quantities and prices $\{c_t,b_t,k_t;y_t,D_t,L_t,N_t,\overline{N}_t,M_t;r^b_t,r^k_t,w_t\}_{t\geq 0}$ such that:

(i) consumers optimize subject to the budget constraints (Eqs. (2), (15) and (16));

(ii) producers optimize subject to the production technology (Eqs. (3), (9) and (10));
(iii) banks optimize subject to the balance sheet conditions (Eqs. (11) and (13));
(v) producers and banks all reach zero profit (Eqs. (12) and (14));
(v) deposit, loan, goods and labor markets all clear (Eqs. (7), (8), (17) and (19)).

Of course, by Walras's law and due to the constant-return technology, two of the constraint, zero-profit and market-clearing equations, Eqs. (2), (3), (12)–(14), (17) and (19), are redundant. Throughout the rest of the paper, we will focus only on characterizing the properties of steady-state equilibrium with financial intermediation:

Definition 2. A steady-state equilibrium with financial intermediation is an equilibrium with financial intermediation with all quantities and prices being positive constants.

4. Characterization of equilibrium

To characterize the equilibrium of our model in more detail we will combine the equations above that characterize the optimal decisions of households, firms and banks. From Eq. (16), we obtain the steady-state deposit rate:

$$r^b = \frac{\beta^{-1} - 1}{1 - e(N)} = \frac{\rho}{1 - e(N)} \equiv r^b(\rho, N) \tag{20}$$

In the absence of the banking cost or capital requirements, $e = 0$ and the steady-state deposit rate is simply the pure rate of time preference, ρ. The steady-state loan rate is then obtained using Eqs. (12) and (20):

$$\begin{aligned} r^k &= \frac{1}{\alpha}\left(\frac{\beta^{-1} - 1}{1 - e(N)} + \mu + (1 - \alpha) \right) \\ &= \frac{1}{\alpha}\left(\frac{\rho}{1 - e(N)} + \mu + (1 - \alpha) \right) \equiv r^k(\rho, N, \mu) \end{aligned} \tag{21}$$

where obviously $\partial r^k / \partial \rho > 0$ and $\partial r^k / \partial \mu > 0$. Thus, an increase in the pure rate of time preference or in banks' loan processing cost will lead to a higher steady-state loan rate.

Next from Eqs. (3) and (9), we can derive a relationship between k and N:

$$k = \left(\frac{\alpha \bar{A}}{1 + r^k} \right)^{1/1-\alpha} N \tag{22}$$

Also, Eqs. (9), (10) and (15) can be combined to form

$$\frac{1-\alpha}{\alpha}\frac{k}{N} = \frac{\gamma c N^{\sigma}}{1+r^k} \tag{23}$$

From Eqs. (12) and (20), one can derive

$$1+r^b = \alpha(1+r^k) - \mu \tag{24}$$

$$1+r^k = \frac{1}{\alpha}\left(\frac{\rho}{1-e(N)} + 1 + \mu\right) \tag{25}$$

Eq. (25) gives us the locus of (gross) real returns on capital, $(1+r^k)$, and employment levels, N, which allow the banking sector to break even.

Substituting Eq. (25) into Eqs. (22), (3) and (14) yields

$$\left[\left((1-\alpha(1-e(N)))\frac{1}{\alpha}\left(\frac{\rho}{1-e(N)} + 1 + \mu\right)\right) - e(N)\mu\right]k = \Omega^b M \tag{26}$$

$$y = (\bar{A})^{1/1-\alpha}\left(\frac{\rho}{1-e(N)} + 1 + \mu\right)^{-\alpha/1-\alpha} N \tag{27}$$

$$k = \left(\frac{1}{\bar{A}}\right)^{1/\alpha-1}\left(\frac{1}{\alpha}\right)^{2/\alpha-1}\left(\frac{\rho}{1-e(N)} + 1 + \mu\right)^{-1/1-\alpha} N \tag{28}$$

Using Eqs. (13) and (17), we obtain the familiar result that steady-state consumption is proportional to capital and can be expressed as:

$$c = \frac{r^b(1-e(N))}{1-\gamma N^{1+\sigma}} b = \frac{r^b(1-e(N))}{1-\gamma N^{1+\sigma}} k = \frac{\rho}{1-\gamma N^{1+\sigma}} k \tag{29}$$

Substituting Eq. (29) into Eq. (23) and rearranging terms yields a key relationship for determining the equilibrium of this model:

$$1+r^k = \frac{\alpha\gamma}{1-\alpha}\rho\frac{N^{1+\sigma}}{1-\gamma N^{1+\sigma}} \tag{30}$$

Eq. (30) gives us the locus of real returns on capital and employment that are consistent with production efficiency.

The intersection of Eqs. (25) and (30) yields solution(s) for N that we graph in Fig. 1. For illustrative purposes, we will call the equilibrium ‘banking break-even’ relationship (Eq. (25)), the ‘BB locus’ and the equilibrium ‘production efficiency’

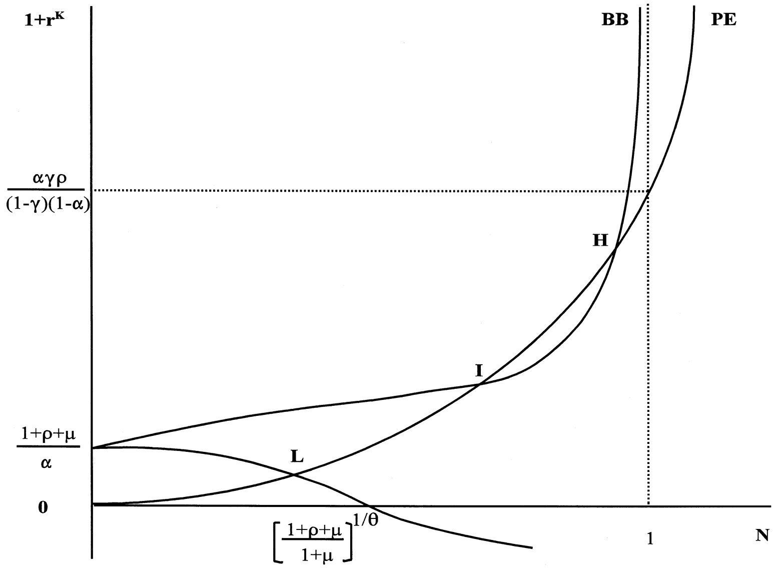

Fig. 1. Existence and multiplicity of steady-state equilibria.

relationship (Eq. (30)), the 'PE locus'. To ensure that the BB and PE loci will intersect, we assume:

Condition E. (*Existence*) $\frac{\gamma}{1-\gamma}\frac{\alpha}{1-\alpha}\rho \geq \frac{1+\rho\mu}{\alpha}$.

Under this condition, there exists at least one solution for $\{N, r^k\}$ in steady-state equilibrium. Once the solutions for $\{N, r^k\}$ have been found we use the solutions with Eqs. (20), (26) and (27) to obtain corresponding solutions for r^b, k and y. The steady-state values of M and c are then derived from Eqs. (28) and (29). Finally, we use Eqs. (7), (8), (13) and (19) to obtain the steady-state values of b, D, L and $\overline{N}$.

The results can be summarized by:

Proposition 1. *(Existence) Under Condition E, there exists a steady-state equilibrium with financial intermediation.*

The key task is to characterize the steady-state equilibria in the (r^k, N)-space using Eqs. (25) and (30), i.e., the BB and PE loci. It is straightforward to verify that the PE locus is always upward sloping and convex in N. When $N=0$, the (gross) rate of loan is at minimum: $1+r^k|_{\rm PE}=0$; when $N>0$, we have $1+r^k|_{\rm PE} > 0$. The shape of the BB locus, however, depends crucially on the value of θ. It is obvious that when $\theta=0$ (i.e., the financial-market externality is absent), the BB locus is horizontal, which together with the PE locus pins down a unique solution for N. When $\theta = 0$, we need to distinguish between two cases: $\theta \in [-1,0)$ vs. $\theta \in (0,1]$.

For the first case, there will be unique determination of N. When $\theta \in [-1,0)$, the BB locus is downward sloping from $(0, (1+\rho+\mu)/\alpha)$ to $((1+\mu)/(1+\rho+\mu)^{-1/\theta}, 0)$. Since $(1+\mu)/(1+\rho+\mu)^{-1/\theta} < 1$ for negative values of θ, the unique solution for N is obtained within the unit interval, [0, 1]. On the other hand, it is obvious that for $\theta = 0$, the BB locus is horizontal. Therefore, as long as Condition E is satisfied, an equilibrium value of $N \in [0,1]$ can still exist. The case with downward sloping BB locus is plotted in Fig. 1, whereas for the sake of brevity, we do not present graphically the latter case (i.e., with flat BB locus).

We next turn to the case of $\theta \in (0,1]$ that produces multiple equilibria. In Fig. 1, we demonstrate that the BB locus is upward sloping: it is concave when N is small but convex when N is large; as N approaches unity, the BB curve asymptotes. The key is now to show the existence, that is, the PE and BB loci intersect within the region of $N \in [0,1]$. This is guaranteed when the slope of the PE locus is sufficiently steep for a given shape of the BB locus. More specifically, this requires that either the capital income share, α, is sufficiently high or the intertemporal elasticity of labor supply, σ^{-1}, is sufficiently low. With the existence of a solution established, it is clear that the PE and BB loci intersect twice and thus multiple equilibria emerge, which will be referred to as the high-employment and intermediate-employment equilibria, respectively. [14] Comparing equilibria across positive and negative values for θ, it is clear that equilibrium employment (and interest rates) are lower when the BB locus is downward sloping than when the locus slopes upward. Thus, we refer to the case where θ is negative as the low-employment equilibrium.

We summarize our discussion as follows:

Proposition 2. *(Possibility of Multiple Equilibria) When banking costs are independent of aggregate activity or incorporate market participation externalities, there is a single steady-state equilibrium with financial intermediation. When banking costs reflect congestion externalities, there are multiple steady-state equilibria with financial intermediation, if the capital income share is sufficiently high or the intertemporal labor supply is sufficiently inelastic.*

It is important to note that the selection of equilibrium need not be history-dependent. To be specific, it depends crucially on self-fulfilling prophecies. Should a consumer expect higher returns on deposits, he or she would work harder to save more, enabling more funds channeled into the banking sector, which becomes available for investment loans. Under zero profit, banks receive higher loan rates.

[14] We ignore the uninteresting knife-edge case where the BB locus is tangent to the PE locus.

Since there exists a congestion externality, the associated higher level of aggregate employment results in a larger club fee. Using Eq. (20), the rate of return on deposit turns out to be higher, fulfilling the expectations. Similar arguments apply to the case when a consumer expects lower returns on deposits.

We are now prepared to perform comparative static exercises, in particular for the case of banking congestion externality-related multiple equilibria. We restrict our attention to changes in the pure rate of time preference, ρ, production or investment uncertainty (i.e., the parameter δ) and loan processing costs, μ. An increase in the pure rate of time preference raises the loan rate unambiguously, but its effect on the employment rate is uncertain. From Eqs. (25)–(27), this results in a lower capital–labor ratio and output per worker, which is consistent with standard Ramsey models. According to Eqs. (26)–(28), when uncertainty increases, δ rises and the certainty equivalent measure of productivity $\bar{A}$ declines, thus reducing output as well as the marginal profitability of firms and by diminishing returns requiring a higher level of investment. In order to facilitate investment loans, new banks enter, thus increasing banking competitiveness. [15]

Moreover, an increase in the loan processing cost enlarges the loan-deposit interest rate spread. Interestingly, a higher loan processing cost shifts up the BB locus and thus both N and r^k decrease (increase) around the high- (intermediate-) employment equilibrium. Utilizing Eqs. (26) and (27), we can see that the capital-labor ratio and output per worker are higher (lower) correspondingly. Finally, for either time preference or loan processing cost changes, the result on M is ambiguous. This is due to the two opposing effects via the size of the investment loan, k, and via the net loan-deposit interest rate spread $(r^k - r^b - \mu)$. [16]

These comparative-static results are summarized in Tables 1 and 2 and in the following propositions.

Proposition 3. *(Characterization of Congestion Externality Equilibria) When bank costs reflect a congestion externality, the steady-state equilibria possess the following features.*

(i) An increase in the rate of time preference raises the loan rate, but lowers the capital-labor ratio and output per worker; its effect on aggregate employment and banking competitiveness are ambiguous.

(ii) An increase in production / investment uncertainty reduces aggregate productivity and output, but increases banking competitiveness.

[15] Note that since the loan rate is defined in the certainty equivalent form, it will not be affected by the degree of uncertainty.

[16] The comparative static effects on capital and output depend critically on the sign of θ and on the indirect effects through changes of equilibrium N. For example, if $\theta \leq 0$, $\mathrm{d}k/\mathrm{d}N > 0$ and $\mathrm{d}y/\mathrm{d}N > 0$, and if $\theta \in (\alpha\gamma, 1]$, $\mathrm{d}k/\mathrm{d}N < 0$ and $\mathrm{d}y/\mathrm{d}N < 0$. However, when $\theta \in (0, \alpha\gamma]$, these indirect effects may go either way depending on the size of the initial N.

Table 1
Comparative-static results: high-employment equilibrium

Effect on	Rate of time preference ρ	Uncertainty δ	Loan processing cost μ
$1+r^k$	+	0	−
N	?	0	−
k/N	−	+	+
y/N	−	−	+
M	?	+	?

The results reported are based on the case when bank costs reflect congestion externalities.

(iii) A higher loan processing cost reduces (raises) aggregate employment and loan rates, but increases (decreases) the capital-labor ratio and output per worker around the high- (low-) employment equilibrium.

The next proposition is straightforward to verify:

Proposition 4. *(Characterization of Participation Externality Equilibrium) When bank costs reflect a participation externality, the steady-state equilibrium with financial intermediation responds to changes in time preferences, production / investment uncertainty, and loan processing costs in a fashion analogous to the low-employment equilibrium when bank costs capture a congestion externality.*

So far we have considered both types of externalities separately. However, it might be more appropriate to think of both forms of externalities coexisting at the same time with one or the other dominating for some period of time. Thus, if market participation externalities dominate congestion externalities for banking costs, then θ is negative. However, the sign of θ may change to positive once the

Table 2
Comparative-static results: low- and intermediate-employment equilibria

Effect on	Rate of time preference ρ	Uncertainty δ	Loan processing cost μ
$1+r_k$	+	0	+
N	?	0	+
k/N	−	+	−
y/N	−	−	−
M	?	+	?

The results reported are based on the case when bank costs reflect congestion externalities which we refer to as the intermediate-employment equilibrium.
The unique (low-employment) equilibrium that arises when bank costs reflect market participation externalities possesses the same properties.

congestion externality dominates. Such a structural change to financial markets may then have large real effects. As can be seen graphically, such a structural financial change causes the BB curve to move from having a negative slope to a positive one. Since one can rank employment and interest rates for all equilibria, we have the following proposition:

Proposition 5. *(Characterization of Financial Repression Shock) When bank costs change from reflecting participation externalities to capturing congestion costs, the steady-state equilibrium with financial intermediation jumps to one with higher employment and interest rates but with a lower capital-labor ratio and output per worker*.

This high-employment, high interest rate equilibrium may be thought of as one which arises in a financially repressed economy such as Japan, Korean or Taiwan prior to recent liberalizations.

5. Conclusions

This paper develops a dynamic general equilibrium model with financial intermediation in which multiple equilibria may emerge as a result of dynamic interactions between worker's saving and bank's monopolistically competitive behavior. We characterize the equilibria by considering the comparative static responses of major aggregates to changes in the pure rate of time preference, investment uncertainty and bank costs. We find that the results depend crucially on the intertemporal elasticity of labor supply and the aggregate level of employment.

In the case where multiple steady-state equilibria with financial intermediation emerge, small changes in the financial system may cause the economy to shift between low and high-income equilibria. The selection of equilibrium depends crucially on self-fulfilling prophecies rather than history. One of the surprising results of our analysis is that the greater the club fee associated with participation in the banking system (whether due to greater capital requirements or greater resource costs associated with intermediation), the higher equilibrium employment is likely to be. In this sense, our model can partially account for rapid development in economies such as those of Japan, Korea and Taiwan that also had highly repressed financial sectors. That is, by interpreting 'financial repression' in terms of congestion externalities for the banking (or more broadly, financial intermediation) sector, we can generate equilibria with high employment and high real interest rates not unlike the rapid growth experiences of Japan, Korea and Taiwan in the postwar period prior to recent years, where relationship banking services seemed to prevail. Similarly by characterizing the pre-Depression banking system in the US in terms of participation externalities or arms-length services, we can generate a low interest rate, low employment equilibrium similar to that experienced by the US during the Great Depression. Also notably, in response to small changes of the structure of the financial system, an economy may shift from high to low equilibrium due to economy-wide shifts in expectations. This may serve to explain part of the on going financial crisis in several Asian economies since July 1997.

The analysis in this paper is of course highly incomplete. We have said nothing about the welfare properties of the various equilibria, nor have we tried to characterize the near steady-state dynamics associated with each. These questions remain topics for future research, although the work of Greenwood and Jovanovic (1990) should convince the reader that such an undertaking would be far from a trivial task. Future work would also provide a structure that relies more on primitives to motivate our posited 'club fee' schedule which is crucial for the multiplicity result. Our guess is that modeling the primitives of financial repression in a more rigorous manner will not change the qualitative nature of our results. However, such a task would involve the consideration of Boyd and Prescott (1986) notion of strategic bank equilibria. Finally, it remains to be seen how well a model such as that proposed above performs qualitatively when calibrated to match key features of the data on postwar development in Southeast Asia.

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