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PRIVATIZATION TRANSFERS AND CREDIT MARKET FRICTIONS

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This paper examines an economy in which output is produced by state-owned enterprises and private firms. Private-capital formation requires intermediation that is subject to a credit market friction. In this environment, I look at the effects of a privatization policy that transfers state-owned capital to the private sector. Multiple steady-state equilibria are possible. When these arise, the low-wage equilibrium features a relatively inefficient financial system and privatization transfers help to increase the aggregate capital stock by reducing the severity of the credit market frictions. On the other hand, privatization transfers may have adverse effects when the economy is at the high-wage equilibrium. Analysis of the dynamic characteristics of the model reveals that development trap phenomenon and endogenous fluctuations can be observed.

Keywords: Privatization, Credit Market Friction, Transition

1. INTRODUCTION

A notable feature of many developing and transitional economies is that a substantial fraction of output is produced by state-owned enterprises, which continue to coexist with the private sector. Although precise figures are difficult to obtain, estimates of the state-sector share of the 1998 GDP in transitional economies range from 80% in Belarus to 15% in Hungary [European Bank for Reconstruction and Development (1999)]. In China, approximately 25% of industrial output in 1997 was attributed to state-owned enterprises [*Statistical Yearbook of China* (1998)]. These numbers persist despite the fact that most governments in transitional economies have pursued active privatization programs that have transferred substantial amounts of formerly state-owned assets to private hands.

Another widespread characteristic of these economies is the presence of significant credit market inefficiencies due to problems such as informational asymmetries between lenders and entrepreneurs [McKinnon (1973)]. Manifestations of these financial market deficiencies include underdeveloped capital markets and credit market illiquidity or rationing in the manner of Stiglitz and Weiss (1981) or Williamson (1987). This view is supported by a recent World Bank survey that

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reported that managers of small- and medium-size enterprises in Central and Eastern Europe considered financing to be the second most problematic obstacle to doing business, dominated only by concerns about unreasonable tax regulation.[1]

The contribution of this paper is to analyze how privatization policies and credit market conditions interact during the transition. Toward this end, I consider a small, open-economy version of Diamond's (1965) neoclassical growth model, modified to include the following features: a state sector that coexists with the private sector, an explicit credit market friction that affects the financing of private-sector capital accumulation, and a privatization policy that transfers resources from the state to the private sector. The primary goal is to examine the relationships among the rate of privatization, macroeconomic indicators such as the aggregate capital stock, and the development and efficiency of financial intermediation. The conventional wisdom is that privatization generally is beneficial [Mackenzie (1997)], and the model permits us to evaluate the validity of these arguments.

A key feature of the analysis is that the private provision of capital suffers from a costly state verification (CSV) problem as originally developed by Townsend (1979), and subsequently extended by Gale and Hellwig (1985), Williamson (1986, 1987), Bernanke and Gertler (1989), and Boyd and Smith (1997, 1998). This friction implies that the provision of internal finance is significant for capital formation—the more internal finance a borrower can provide, the less severe is the CSV problem confronted by lenders. Because internal finance can be funded from wages or from privatization transfers received from the government, a high privatization rate may result in a relatively large amount of internal finance and a less serious credit market friction. This, in turn, facilitates the accumulation of private capital.

Before proceeding to the formal analysis, let me briefly sketch the setting and highlight important results. Production of the single consumption good is assumed to take place in either a state-owned enterprise or a private firm. State firms use state-owned capital whereas private firms use capital produced by a process that is subject to the CSV problem. All agents are free to work in either sector and they are assumed to supply labor only when young. To further distinguish the two sectors, I assume that labor's bargaining power in the state sector is relatively strong, possibly as a result of pressure on a government interested in influencing votes via wage concessions. Toward this end, wages in the state sector are modeled using a Nash bargaining process.[2] In the presence of labor mobility, economywide labor payments will be influenced by the outcome of this bargaining scheme.

Private capital is produced by entrepreneurs who have access to an investment technology that converts goods in any particular period into private capital in the succeeding period. There is a minimum scale at which this investment can take place and the indivisible input requirement for the investment technology is assumed to be large relative to the entrepreneur's internal resources. As a result, they are forced to seek external financing from financial intermediaries. Intermediaries can make loans domestically, or they can borrow and lend in international financial markets at a world rate of interest, which they take as given. As pointed out by

Huybens and Smith (1998) and Antinolfi and Huybens (1998), this setting allows for the existence of multiple steady-state equilibria due to the offsetting effects of capital accumulation and (endogenous) monitoring costs. Under conditions that I describe later, there are two steady states: high wage and low wage.

Privatization transfers offer a potential (internal) financing source for private-sector entrepreneurs. These resources can reduce the borrowing needs of entrepreneurs, thereby mitigating the credit market friction and promoting capital accumulation. However, the steady-state effects of resource transfers from the state sector to the private sector depend on the equilibrium that prevails. At the low-wage steady state—given two otherwise identical economies that differ only in their privatization rates—the economy that privatizes *faster* will feature a *higher* aggregate capital stock than the slower-privatizing economy. Intuitively, higher transfers from the government enhance the internal financing capabilities of private-sector borrowers, and thereby facilitate the production of capital. At the high-wage steady state, however, this behavior is reversed: The *faster*-privatizing economy exhibits a *lower* aggregate capital stock than its slower-privatizing counterpart. This result stems from the fact that faster privatization implies that wages in the state sector (and therefore wages economywide) must drop. This produces less overall internal finance and a concomitant fall in the aggregate capital stock.

The dynamic properties of the model depend significantly on the privatization policy that the government adopts. With no privatization transfers, the economy can only approach the low-wage steady state, which is thus a form of poverty or development trap. Higher rates of privatization introduce the possibility that the economy will attain the high-wage equilibrium. This presents an interesting conflict: On one hand, a policy of fast privatization renders the high-wage steady state feasible; on the other hand, it reduces the aggregate capital stock at the high-wage steady state. Finally, I find through simulations that varying privatization rates can introduce a broad array of complex dynamics, including the possibility of endogenous fluctuations and limit-cycle behavior.

The phenomenon of transition has resulted in an extensive literature examining the shift of productive resources from the state to the private sector and the consequences of policies adopted in these economies. The analysis presented here includes several of the themes appearing in the literature. In particular, one debate concerns the speed of the reforms.[3] With regard to privatization policies, faster implementation is advocated for diverse reasons, by Lipton and Sachs (1990), Blanchard et al. (1991), and Roland and Verdier (1994), among others. Arguments for slower privatizations are presented by Green (1993), McKinnon (1993), Roland (1994), and Murrell (1995).

Another strand of the literature concerns the time path and growth of private-sector activity during the transition. Part of this work was motivated by short-term concerns regarding the sharp drop in measured real activity in Eastern Europe immediately following reforms [see, e.g., Murphy et al. (1992), Aghion and Blanchard (1994), Blanchard and Kremer (1997), and Roland and Verdier (1999)].

Several other papers have analyzed long-term growth and development during the transition, treating the planned economy as an initial condition. Representative work along these lines includes that of Uhlig (1995), Atkeson and Kehoe (1996), and Brixiova and Kiyotaki (1997). All three of these latter papers focus on the growth and financing of an entrepreneurial private sector. In particular, the Uhlig and Brixiova–Kiyotaki papers examine how asymmetric information in financial markets can retard the undertaking of productive activities. In this respect, the current paper fits most closely into this portion of the literature. However, in addition to differences in modeling strategy, the framework presented here contrasts fundamentally with the previous work with regard to the treatment of the state sector; I explicitly model the evolution of both sectors, whereas the aforementioned work does not. Hence, all three are silent with regard to the interaction of privatization policies with credit markets and the joint evolution of the private and state sectors.

The remainder of the paper proceeds in the following manner. The next section describes the model economy, including labor and credit markets and the government's privatization program. Section 3 analyzes a full general equilibrium, focusing on steady-state characteristics, followed by a description of dynamic properties of equilibrium in Section 4. Finally, Section 5 presents a discussion and conclusion.

2. MODEL

The framework is an extension of Diamond's (1965) neoclassical growth model. Time is indexed by $t = 0, 1, 2, \ldots$. The economy consists of an infinite sequence of two-period-lived overlapping generations. Each generation is identical in size and composition and contains a large number of agents. Within each generation, there are two types of individuals: "potential borrowers" and "lenders." A fraction $\alpha \in (0, 1)$ of the population are potential borrowers.

A single, final consumption good is produced in either the government (i.e., state) sector or the private sector using capital, K, and labor, N, as inputs into a Cobb–Douglas technology, $Y_t^i = F(K_t^i, N_t^i) = A(K_t^i)^\theta (N_t^i)^{1-\theta}$, where K_t^i and N_t^i, $i = g$ or p (government or private), refer to the amount of capital or labor used in each sector. Capital is assumed to depreciate fully with use. Let the per-capita capital stock in each sector and the labor share of that sector be denoted $k_t^i = K_t^i/N$ and $n_t^i = N_t^i/N$, respectively. Clearly, $n_t^g + n_t^p = 1$.[4] Although the assumption that both sectors have access to the same technology may seem extreme, it is made for two reasons. First, there is no a-priori reason to assume that the state should use an inferior technology. Second, this assumption allows for a baseline model that abstracts from technological issues.

Young agents are each endowed with one unit of labor, which is supplied inelastically. Agents do not work when old. By assumption, all agents are risk neutral and care only about old-age consumption. Thus, all young-age-period income is saved.[5]

2.1. Factor Markets

Individuals first choose the sector in which they are employed. Once made, this decision is irreversible; workers may not later switch sectors.[6] In the government sector, wages are determined by a centralized (or collective) bargaining process between a "trade union" and the government. Both parties attempt to divide the total output of the state sector, a process modeled using the static Nash bargaining solution. Since labor is supplied inelastically, the only negotiating point is the wage rate. Let U_t^p be the union's payoff if there is an agreement and production takes place, and let U_t^{np} be the payoff if no production occurs. Similarly, let $\prod_t^p$ and $\prod_t^{np}$ represent the government's payoff when there is a production agreement and when there is no agreement, respectively. Then, following Devereux and Lockwood (1991) and Bertocchi (1997), wages, w_t^g, are determined as a share of total government output. Let the Nash product be defined as

$$\left(U_t^p - U_t^{np}\right)^\beta \left(\prod_t^p - \prod_t^{np}\right)^{1-\beta}, \tag{1}$$

with the constraints $U_t^p > U_t^{np}$ and $\prod_t^p > \prod_t^{np}$. The parameter β captures the union's bargaining strength relative to that of the government.[7] Any resources remaining after paying labor accrue directly to the government because the state sector owns the capital and the firms.

If production occurs, the union's payoff is $U_t^g = w_t^g N_t^g$ and the corresponding payoff to the government is $\prod_t^p = Y_t^g - w_t^g N_t^g$. In the event that no agreement is reached, production and wages are zero. Hence, $U_t^{np} = \prod_t^{np} = 0$. So, in every period t, the Nash product given by equation (1) is $(w_t^g N_t^g)^\beta (Y_t^g - w_t^g N_t^g)^{1-\beta}$. Let $f(\cdot)$ denote the intensive (i.e., per worker) production function. Then, the solution to the bargaining problem that results from maximizing equation (1) with respect to wages implies the following wage function and surplus per unit of government capital:

$$w_t^g = \beta f\left(\frac{k_t^g}{n_t^g}\right), \tag{2}$$

$$\pi_t^g = \frac{1-\beta}{k_t^g} f\left(\frac{k_t^g}{n_t^g}\right). \tag{3}$$

Unions are not present in the private sector, and so, factor payments are determined competitively. In particular, private-sector wages and rental rates are determined as

$$w_t^p = f\left(\frac{k_t^p}{n_t^p}\right) - \frac{k_t^p}{n_t^p} f'\left(\frac{k_t^p}{n_t^p}\right), \tag{4}$$

$$\rho_t = f'\left(\frac{k_t^p}{n_t^p}\right), \tag{5}$$

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where ρ_t is the rate of return on private capital. Market clearing in the labor market requires $w_t^g = w_t^p \equiv w_t$. The Cobb–Douglas technology, the wage equalization condition, and the fact that employment shares must sum to 1 imply that the capital/labor ratio in the government sector can be expressed as

$$k_t \equiv k_t^g / n_t^g = \lambda k_t^p + k_t^g, \tag{6}$$

where $\lambda = [(1-\theta)/\beta]^{1/\theta}$. Evidently, if the bargaining strength of the state labor union is high, then $\lambda < 1$. Using equation (6) the government's per-capita production can be written as

$$f\left(\frac{k_t^g}{n_t^g}\right) = Ak_t^{\theta}, \tag{7}$$

and wages, correspondingly, can be expressed as

$$w_t = \beta A k_t^{\theta}. \tag{8}$$

Clearly, economywide wages are an increasing function of k_t.

2.2. Credit Markets and Private-Capital Production

All agents save their entire young-period income, which consists of wages plus any privatization transfers they receive from the government. Lenders will save this income in the form of assets held abroad or (intermediated) loans to domestic borrowers. Funded borrowers, on the other hand, will wish to invest all of their income in their capital-production technology.[8] I will make assumptions, however, that will imply that borrowers must seek partial outside financing for their projects.

Potential borrowers and lenders are differentiated by the fact that each potential borrower has access to a stochastic, linear, capital-production technology that converts date t final goods into date $t+1$ capital goods. Lenders do not have access to this technology. The capital-production technology requires an indivisible investment of q units of the final good and each potential borrower has exactly one of these investment projects. If a borrower invests q units of goods at time t, the technology delivers $z \cdot q$ units of capital goods at time $t+1$. The random variable, z, is i.i.d. across agents. Let G denote the probability distribution of z, and assume that there is an associated differentiable density function, g, with support $[0, \bar{z}]$. Let the expected value of z be

$$\hat{z} = \int_0^{\bar{z}} z \cdot g(z)\, dz. \tag{9}$$

The project size, q, is assumed to be larger than the income (wages and transfers) of any agent. Let τ_t denote the transfers that a young agent receives from the government. Then, the following assumption guarantees that agents always require outside financing:

Assumption 1.

$$q > w_t + \tau_t.$$

Thus, potential borrowers will need to obtain

$$b_t = q - w_t - \tau_t \tag{10}$$

from external sources to operate their projects.

The amount of capital produced by this investment technology is observed costlessly only by the borrower who invested in the project. Any other agent can privately observe the return on the project only by bearing a fixed cost of γ units of capital.[9] Because the realization of z is private information, the contracts that arise in equilibrium must take into account the inherent incentive compatibility problem, and, as in Diamond (1984) and Williamson (1986), the nature of the Townsend (1979) CSV problem that results here will give rise to endogenous intermediation between borrowers and lenders.

To obtain funding, potential borrowers will offer loan contract terms to intermediaries. These terms must specify a set of project realizations, Z_t, for which monitoring of the project return occurs.[10] Denote the complement set of Z_t to be $Y_t = [0, \bar{z}] - Z_t$. If $z \in Z_t$, then monitoring occurs; otherwise, if $z \in Y_t$, no monitoring takes place. In the event that $z \in Z_t$, and monitoring occurs, the promised repayment can be made contingent on the actual project return. Thus, denote the promised repayment in a monitoring state as $R_t(z)$ per unit borrowed. In all other states, the repayment cannot meaningfully depend on the project return and the only incentive-compatible loan contract must specify that the repayment in a nonmonitoring state is a noncontingent payment of x_t (per unit borrowed). All payments are given in real terms.

Intermediaries either accept or reject announced loan contracts, and we can think of them as making all loans. So, intermediaries perform many of the financial services commonly associated with banking—they take deposits, make loans, and conduct monitoring of projects as set out in the contracts they accept. Assuming that any lender can set up an intermediary implies that, in equilibrium, intermediaries will earn zero profits, and their ability to diversify implies that they will not need to be monitored by their depositors.

Let r_{t+1} be the gross rate of return on deposits paid by banks between time t and $t + 1$. Then, in a competitive banking system, intermediaries will take the deposit rate as given and act as if they can obtain any quantity of funds at that rate. So, intermediaries are willing to accept any loan contract that offers them an expected return of at least r_{t+1}, and any acceptable loan contract must satisfy the following expected return constraint:

$$\int_{Z_t} [R_t(z)b_t - \rho_{t+1}\gamma]g(z)\,dz + x_t b_t \int_{Y_t} g(z)\,dz \geq r_{t+1}b_t. \tag{11}$$

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The expected monitoring cost depends on ρ_{t+1} because γ units of *capital* are used when projects are monitored. In addition, the contract must provide the incentive for borrowers to honestly signal that a monitoring state has occurred. This requires that

$$R_t(z) \leq z_t \quad \text{for} \quad z \in Z. \tag{12}$$

Following the convention established by Williamson (1986), borrowers will maximize their expected utility by choosing contract terms, subject to the constraints described. Thus, borrowers will pick loan terms to maximize

$$q\hat{z}\rho_{t+1} - b_t \int_{Z_t} R_t(z)g(z)\,dz - x_t b_t \int_{Y_t} g(z)\,dz \tag{13}$$

subject to (11) and (12), plus the following nonnegativity constraints:

$$R_t(z) \leq z_t q\rho_{t+1}/b_t; \qquad z_t \in Z_t, \tag{14}$$

$$x_t \leq \inf_{z_t \in Y_t} [z_t q\rho_{t+1}/b_t]. \tag{15}$$

Both of these constraints state that a borrower can never repay more than the real value of his investment project, which is equal to the real return on the investment technology, $z_t q\rho_{t+1}$.

The solution to the borrower's problem is a standard debt contract. The borrower either pays x_t (principal plus interest) or defaults on the loan. In the event of default, the intermediary monitors the project and retains any proceeds after paying for monitoring costs. The following proposition is proved by Gale and Hellwig (1985) and Williamson (1986).

PROPOSITION 1. *Suppose* $b_t = q - w_t - \tau_t > 0$. *Then, the optimal contract terms satisfy*

$$R_t(z) = z_t q\rho_{t+1}/b_t \quad for \quad z \in Z_t, \tag{16}$$

$$Z_t = [0, x_t b_t/q\rho_{t+1}), \tag{17}$$

$$\int_{Z_t} \left[R_t(z) - \rho_{t+1}\frac{\gamma}{b_t}\right] g(z)\,dz + x_t \int_{Y_t} g(z)\,dz = r_{t+1}. \tag{18}$$

Substituting equations (16) and (17) into (18) allows us to write the expected return to the lender, π, as a function of the gross loan rate, x_t, the amount of external finance required, b_t, and the next-period's relative price of capital, ρ_{t+1}:

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$$\int_{Z_t}\left[R_t(z)-\rho_{t+1}\frac{\gamma}{b_t}\right]g(z)\,dz+x_t\int_{Y_t}g(z)\,dz=x_t\left[1-G\left(x_t\frac{b_t}{q}\rho_{t+1}\right)\right]$$
$$-\left(\gamma\frac{\rho_{t+1}}{b_t}\right)G\left(x_t\frac{b_t}{q}\rho_{t+1}\right)+\int_0^{x_t b_t/q\rho_{t+1}}\left(q\frac{\rho_{t+1}}{b_t}\right)zg(z)\,dz$$
$$=x_t-\left(\gamma\frac{\rho_{t+1}}{b_t}\right)G\left(x_t\frac{b_t}{q}\rho_{t+1}\right)-\left(q\frac{\rho_{t+1}}{b_t}\right)+\int_0^{x_t b_t/q\rho_{t+1}}G(z)\,dz$$
$$\equiv\pi\left[x_t;\left(\frac{b_t}{\rho_{t+1}}\right)\right]=r_{t+1}. \quad (19)$$

Note that the second equality follows from integration by parts. As in Williamson (1987), we place some structure on π by the following assumption.

Assumption 2.

$$g(z)+(\gamma/q)g'(z)>0 \quad \text{for all} \quad z\in[0,\bar{z}],$$

which implies that $\pi_{11}<0$.

In addition, if $\pi_1[0;\,(b_t/\rho_{t+1})]>0$, then the function π has the configuration shown in Figure 1. Let $\hat{x}(b_t/\rho_{t+1})$ denote the unique value of x_t—which depends on the ratio b_t/ρ_{t+1}—that maximizes the expected return of the lender. This value is given implicitly by the relationship

$$\pi_1\left[\hat{x}\left(\frac{b_t}{\rho_{t+1}}\right);\left(\frac{b_t}{\rho_{t+1}}\right)\right]\equiv 1-\left(\frac{\gamma}{q}\right)g\left[\hat{x}\left(\frac{b_t}{\rho_{t+1}}\right)\left(\frac{b_t}{q\rho_{t+1}}\right)\right]$$
$$-G\left[\hat{x}\left(\frac{b_t}{\rho_{t+1}}\right)\left(\frac{b_t}{q\rho_{t+1}}\right)\right]\equiv 0. \quad (20)$$

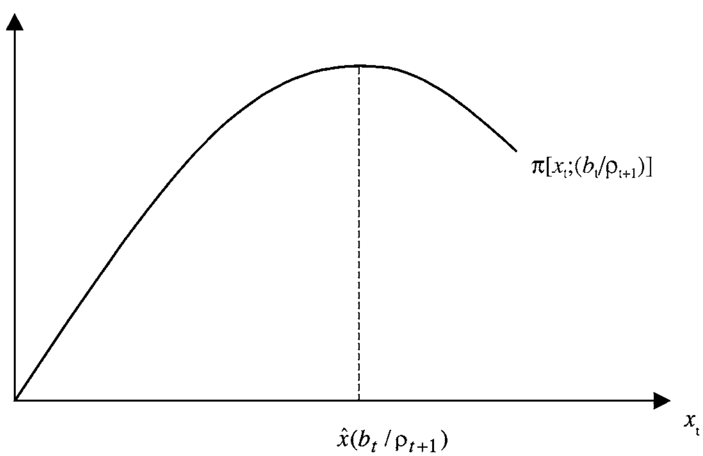

Figure 1. Expected return to intermediary.

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Equation (20) and Assumption 2 imply that

$$\hat{x}\left(\frac{b_t}{\rho_{t+1}}\right)\left(\frac{b_t}{q\rho_{t+1}}\right) \equiv \eta > 0, \tag{21}$$

where η satisfies $1 - (\frac{\gamma}{q})g(\eta) - G(\eta) \equiv 0$. When potential borrowers are offering contracts with loan rates that maximize intermediaries' expected returns, η is the minimum project return that will just cover the principal plus interest payments on the loan. This implies that monitoring will occur if and only if $z \in [0, \eta]$.

2.3. Credit Rationing

As noted by Gale and Hellwig (1985) and Williamson (1986, 1987), it is possible for equilibrium credit rationing to occur in this setting. In particular, if all borrowers wish to operate their projects, the total (per-capita) demand for investment capital is αq. In the absence of foreign capital flows, the total (per-capita) supply of funds at time t is $w_t + \tau_t$.[11] If the following assumption is satisfied for all periods $t > 0$, then credit demand will always exceed credit supply, resulting in rationing.

Assumption 3.

$$\alpha q > w_t + \tau_t.$$

If the economy suffers from credit rationing, then it is also true that for all $t > 0$,

$$x_t = \hat{x}(b_t/\rho_{t+1}). \tag{22}$$

In other words, the equilibrium loan repayment rate under credit rationing will be the rate that maximizes a lender's expected rate of return. When funded borrowers are paying this amount, unfunded (potential) borrowers who do not receive credit cannot obtain a loan by changing the contract terms they offer—for instance, by promising a higher x_t—since this would only *reduce* the expected return perceived by lenders.[12] Unfunded borrowers, then, will simply become lenders by depositing their income with an intermediary. If Assumption 3 and equation (22) hold, then credit rationing is an equilibrium outcome. For the rest of the discussion, I will focus on an economy where credit rationing occurs for all periods.[13]

Under the assumption of credit rationing, I next describe the expected payoffs received by lenders and funded borrowers. For lenders, equations (19) and (22) imply that

$$\begin{aligned} r_{t+1} &= \pi[\hat{x}(b_t/\rho_{t+1}); (b_t/\rho_{t+1})] \\ &= \rho_{t+1}(q/b_t) \cdot \left[\eta - (\gamma/q)G(\eta) - \int_0^\eta G(z)\,dz\right] \\ &\equiv \left(\frac{\rho_{t+1}}{q - w_t - \tau_t}\right) \cdot \psi, \end{aligned} \tag{23}$$

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where the constant ψ is defined as

$$\psi \equiv q\left[\eta - (\gamma/q)G(\eta) - \int_0^{\eta} G(z)\,dz\right]. \tag{24}$$

To understand (23), consider the situation in which an entrepreneur externally finances the entire investment project so that $(q/b_t) = 1$. Then, the term in the square bracket in the second line of (23) gives the maximum return that a borrower can offer—net of monitoring costs—at the prevailing rental rate ρ_{t+1}. With positive amounts of internal finance, $(q/b_t) > 1$ holds, reflecting the fact that an entrepreneur's own resources reduce the amount he needs to borrow. Hence, *ceteris paribus*, higher internal finance increases the expected return on the project. Note that under credit rationing the return to a lender depends only on the ratio ρ_{t+1}/b_t and constants.

Under the assumption of credit rationing, funded borrowers will receive an expected return equal to the average value of their project less expected interest payments and monitoring costs. Formally, their expected return is

$$q\hat{z}\rho_{t+1} - r_{t+1}b_t - \rho_{t+1}\gamma G(\eta) = q\rho_{t+1}[\hat{z} - (\gamma/q)G(\eta)] - r_{t+1}b_t. \tag{25}$$

As noted before, potential borrowers always have the option of not operating their projects and instead depositing their income into a bank that would yield them a return of $r_{t+1}(w_t + \tau_t)$. Thus, under credit rationing, borrowers will prefer borrowing and operating their projects over lending iff

$$q\rho_{t+1}[\hat{z} - (\gamma/q)G(\eta)] - r_{t+1}b_t > r_{t+1}(w_t + \tau_t). \tag{26}$$

Defining the constant

$$\xi \equiv [\hat{z} - (\gamma/q)G(\eta)] \tag{27}$$

and using (10) allows us to write the condition (26) as

$$\rho_{t+1}\xi > r_{t+1}. \tag{28}$$

The constant ξ represents the expected project yield in capital (per unit invested), net of monitoring costs. Substituting (23) into (28) gives

$$(q - w_t - \tau_t)\xi > \psi, \tag{29}$$

which must hold for all $t \geq 0$ in order for potential borrowers to prefer operating their projects over becoming depositors.

2.4. Foreign Assets

Domestic residents can export the consumption good and can thereby accumulate foreign assets that earn the real gross world interest rate, r^*, which they take as given and cannot influence. Likewise, foreigners can make deposits denominated in units of the domestic consumption good with domestic banks. Let a_t denote the net domestic per-capita holdings of foreign assets. To preserve the assumption of domestic credit rationing, Assumption 3 must be modified as follows:

Assumption 4.

$$\alpha q > w_t + \tau_t - a_t.$$

It is important to point out that, in this environment, credit rationing can still occur, despite the open-economy assumption. To see this, note that in equilibrium the domestic deposit rate must equal the return on foreign assets. Thus, $r^* = r_{t+1}$ must hold for all t. Equation (23) then implies the equilibrium condition

$$r^* = \left(\frac{\rho_{t+1}}{q - w_t - \tau_t}\right)\psi. \quad \textbf{(30)}$$

Let $\mu_t \in [0, 1]$ denote the fraction of borrowers who successfully receive credit at time t. Evidently, higher values of μ_t correspond to higher capital levels next period. Furthermore, at date t, wage and transfer income are determined by history. Because the marginal product of capital next period, ρ_{t+1}, is a monotonically decreasing function of k_{t+1}, it is possible that, at sufficiently high levels of credit, the domestic deposit rate given by the expression on the right side of equation (30) falls below the return on foreign assets. If this occurs, domestic agents will prefer to hold foreign assets and credit may continue to be rationed domestically.

2.5. Government

The government owns the capital used by the state enterprises. To focus solely on the issue of privatization, the government is assumed to perform a minimum of activities. First, it operates state-owned firms and compensates labor as described in Section 2.1. Second, it adopts a privatization plan that consists of an initial transfer of resources at $t = 1$ and a transfer rate $\phi \in [0, 1)$ of its period $t > 1$ surpluses to young agents in the private sector. For simplicity, once a value for the policy parameter ϕ is selected, the transfer rate is assumed to remain at that level forever.[14] Any remaining resources are either reinvested in new government capital or used to finance an exogenous, per-capita budget deficit of σ.[15] Therefore, for all periods $t > 1$, the government's budget constraint is

$$k^g_{t+1} = (1 - \phi)(1 - \beta)n^g_t f\left(\frac{k^g_t}{n^g_t}\right) - \sigma, \quad \textbf{(31)}$$

or using the assumption of a Cobb–Douglas production function and equation (6),

$$k^g_{t+1} = (1 - \phi)(1 - \beta)Ak_t^{\theta-1}k^g_t - \sigma. \quad \textbf{(32)}$$

Clearly, the privatization transfer is given by

$$\tau_t = \phi(1 - \beta)Ak_t^{\theta-1}k^g_t. \quad \textbf{(33)}$$

3. GENERAL EQUILIBRIUM

In any equilibrium, three conditions must hold. First, as mentioned in Section 2.4, the domestic deposit rate must equal the return on foreign assets. Second, the government budget constraint must be satisfied; and third, "sources" and "uses" of funds must be equated.

The two assets that are held by domestic savers are domestic bank deposits and foreign assets, and in equilibrium the returns on these two assets must be equal. As discussed earlier, this relationship is expressed by equation (30) which, under the assumption of a Cobb–Douglas production function, can be written as

$$\frac{r^*}{\psi} = \frac{\lambda^{1-\theta}\theta A k_{t+1}^{\theta-1}}{q - \beta A k_t^{\theta} - \phi(1-\beta) A k_t^{\theta-1} k_t^g}. \tag{34}$$

Second, the government budget constraint must hold for all t. Thus, equation (32) must be satisfied. Finally, private-sector "uses" must equal private-sector "sources" of funds. Uses of funds consist of loans to entrepreneurs and foreign asset holdings. Recall that μ_t denotes the fraction of borrowers who are successfully funded. Since each funded borrower requires $q - w_t - \tau_t$ units of funds, the per-capita quantity of loans is $\alpha\mu_t(q - w_t - \tau_t)$. Therefore, total per-capita uses of funds are expressed as $\alpha\mu_t(q - w_t - \tau_t) + a_t$. The sources of funds are per-capita private savings, which is $(1-\alpha)(w_t + \tau_t) + \alpha(1-\mu_t)(w_t + \tau_t)$. Equality between sources and uses of funds requires that

$$\alpha\mu_t q = w_t + \tau_t - a_t. \tag{35}$$

Since returns on the investment technology are i.i.d. across borrowers and since there is a large number of borrowers, there will be no aggregate uncertainty in this economy. So, the time $t+1$ private capital stock is simply $\hat{z}\alpha\mu_t q = \hat{z}(w_t + \tau_t - a_t)$ less capital exhausted by monitoring activities. Monitoring expenditures are $\gamma G(\eta)\alpha\mu_t = (\gamma/q)G(\eta)(w_t + \tau_t)$. This yields the following law of motion for the privately held capital stock[16]:

$$k_{t+1}^p = [\hat{z} - (\gamma/q)G(\eta)](w_t + \tau_t - a_t) = \xi(w_t + \tau_t - a_t). \tag{36}$$

Using equation (6) and the assumption of a Cobb–Douglas production function, this law of motion yields an expression for the value of foreign assets,

$$a_t = \beta A k_t^{\theta} + \phi(1-\beta) A k_t^{\theta-1} k_t^g - \frac{k_{t+1} - k_{t+1}^g}{\lambda\xi}. \tag{37}$$

Equations (32), (34), and (37) describe the evolution of equilibrium sequences of k_t^g, k_t, and a_t respectively, under the assumption of credit rationing.

3.1. Steady-State Equilibrium

A steady-state equilibrium satisfies the following steady-state versions of equations (34), (32), and (37):

$$\frac{r^*}{\psi} = \frac{\lambda^{1-\theta}\theta A k^{\theta-1}}{q - \beta A k^{\theta} - \phi(1-\beta)Ak^{\theta-1}k^g}, \tag{38}$$

$$k^g = \frac{\sigma}{(1-\phi)(1-\beta)Ak^{\theta-1} - 1}, \tag{39}$$

$$a = \beta A k^{\theta} + \phi(1-\beta)Ak^{\theta-1}k^g - \frac{k-k^g}{\lambda\xi}. \tag{40}$$

Equations (38) and (39) determine the steady-state values of k and k^g, and using these values in (40) implies the steady-state level of foreign assets, a.

3.2. Steady-State Equilibrium with $\phi = 0$

In the special case of no privatization ($\phi = 0$),[17] the steady-state government-sector capital/labor ratio, k—as determined in equation (38)—is independent of k^g. Furthermore, once an equilibrium value of k is established, the per-capita government capital stock, k^g, and foreign asset holdings, a, can be determined recursively from (39) and (40). Define the function $H(k)$ as

$$H(k) = \frac{\rho(k)}{q - w(k)} = \frac{\lambda^{1-\theta}\theta A k^{\theta-1}}{q - \beta A k^{\theta}}. \tag{41}$$

Clearly, steady-state equilibria satisfy $r^*/\psi = H(k)$, and therefore it is useful to characterize the properties of H. These are stated in the following Lemma.

LEMMA 1. *Define the value* $k^* = (q/\beta A)^{1/\theta}$. *Then,*

$$(a) \quad \lim_{k \to k^*} H(k) = \infty,$$

$$(b) \quad \lim_{k \to 0} H(k) = \infty,$$

$$(c) \quad H'(k) \begin{cases} < 0; & \forall k < k_{\text{mid}} \\ > 0; & \forall k > k_{\text{mid}} \end{cases},$$

where

$$k_{\text{mid}} = \left(\frac{(1-\theta)q}{\beta A}\right)^{1/\theta} < k^*.$$

Proof. Parts (a) and (b) follow directly from the definition of $H(k)$. Straightforward differentiation of $H(k)$ yields

$$H'(k) = \theta A \lambda^{1-\theta}(q - \beta A k^{\theta})^{-2} k^{\theta-2}[\beta A k^{\theta} - (1-\theta)q], \tag{42}$$

which establishes (c). ■

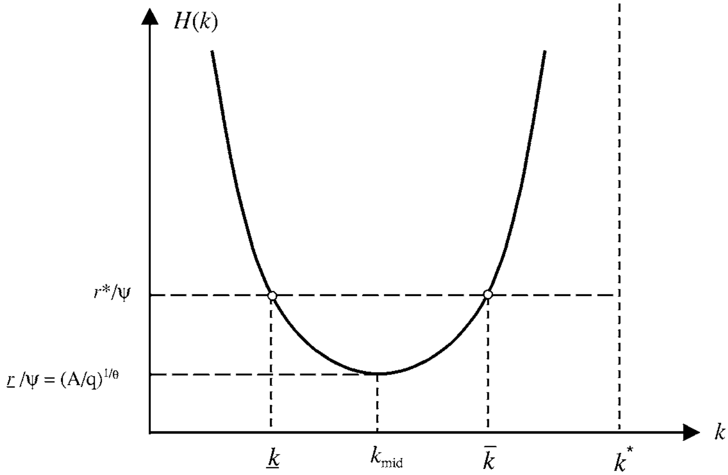

FIGURE 2. Determination of steady-state k when $\phi = 0$.

The characteristics described in Lemma 1 establish that the function $H(k)$ is U-shaped, as shown in Figure 2. The following proposition summarizes a necessary condition for the existence of a steady-state equilibrium.

PROPOSITION 2. *Let $\underline{r} \equiv \psi(A/q)^{1/\theta}$. Then for all $r^* > \underline{r}$ there exist two values of k that satisfy the equilibrium relationship (38) when $\phi = 0$. These are denoted $\underline{k}$ and $\bar{k}$ in Figure 2. For all $r^* < \underline{r}$, no steady-state equilibrium with credit rationing occurs.*

The proof follows from the fact that $H(k_{\text{mid}}) = (A/q)^{1/\theta}$. So, for $r^* > \underline{r}$, $r^*/\psi > H(k_{\text{mid}})$. From Lemma 1 (and Figure 2), it is then obvious that there are two values of k that satisfy (38). The converse follows similarly.

Proposition 2 asserts that an equilibrium with credit rationing exists only if the world interest rate is sufficiently high, as described in Proposition 2. The determination of k^g in equation (39) also imposes two restrictions on permissible steady-state values of $k \in \{\underline{k}, \bar{k}\}$. First, the relation $k \equiv \lambda k^p + k^g$ implies that values $k^g > k$ are not consistent with equilibrium.[18] Second, from equation (39), $k^g > 0$ requires that

$$k < [(1 - \beta)A]^{\frac{1}{1-\theta}} \equiv \hat{k}. \qquad \textbf{(43)}$$

It is straightforward to produce examples where equation (43) and our other assumptions are satisfied. For instance, consider the following:

Example 1

Let $f(\cdot) = 3.85\,k^{0.25}$, $g(z) = 1/\bar{z}$, with $\bar{z} = 5$, and $\lambda = 8$. Furthermore, let $\beta = 0.8$, $q = 2$, $\sigma = 0.01$, and $r^* = 4.67$.[19] These parameter values imply $\xi = 1.7$, which indicates that even inclusive of verification costs, the private sector is more efficient at capital production. The resulting steady-state government capital/labor ratios are $\underline{k} = 0.011$ and $\bar{k} = 0.128$. Furthermore, at these two equilibria, Assumptions 1 through 4 and equations (29) and (43) are satisfied. Wages associated with the two steady states are $\underline{w} = 0.996$ and $\bar{w} = 1.841$, respectively.

3.3. Steady-State Equilibrium with $\phi > 0$

In the case of a positive privatization rate ($\phi > 0$), the steady-state government-sector capital/labor ratio, k, and the per-capita government capital stock, k^g, are simultaneously determined by equations (38) and (39). The loci defined by (39) and (38) are depicted in Figure 3 and Figure 4, respectively. Clearly, equation (39) gives k^g as an increasing function of k and it is readily verified that it describes a locus passing through the origin. In addition, increases in ϕ shift the locus defined by (39) upward, as shown in Figure 3.

Similarly, rearranging terms in equation (38) yields

$$k^g = \frac{1}{\phi(1-\beta)A}\left[qk^{1-\theta} - \beta Ak - \frac{\psi}{r^*}\lambda^{1-\theta}\theta A\right] \equiv \frac{1}{\phi(1-\beta)A}J(k). \qquad (44)$$

Straightforward differentiation establishes that

$$J'(k)\begin{cases} > 0; & \forall k < k_{\text{mid}} \\ < 0; & \forall k > k_{\text{mid}} \end{cases}, \qquad (45)$$

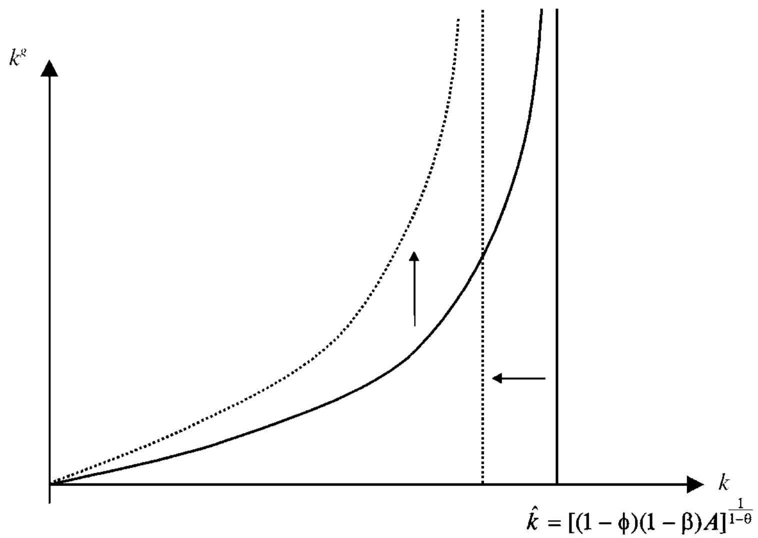

FIGURE 3. Effect of increasing ϕ on the government budget constraint.

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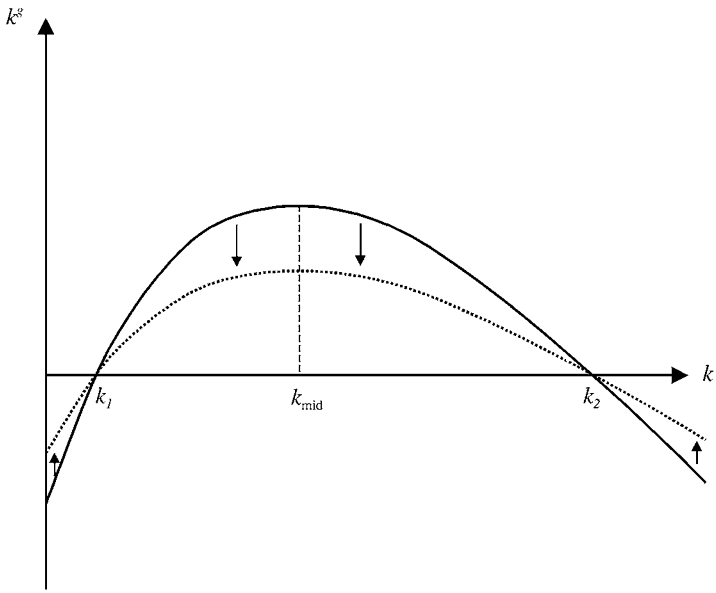

FIGURE 4. Effect of increasing ϕ on equation (38).

where k_{mid} is defined in Lemma 1(c). Hence, equation (44) has the configuration depicted in Figure 4.[20]

Denote the smaller and larger intersections of (44) with the horizontal axis in Figure 4 as k_1 and k_2, respectively. At these locations, changes in ϕ do not shift the locus defined by (44). However, for $k \in (k_1, k_2)$, $J(k) > 0$. As a result, $\partial k^g/\partial \phi < 0$ holds along the portion of (44) in the positive quadrant.[21] Hence, as ϕ increases, the locus described by equation (44) is shifted as shown.

The intersections of equations (38) and (39) determine the steady-state values of k and k^g. Graphically, this is shown in Figure 5, which depicts the case in which two steady-state values of the state-sector capital/labor ratio, $\underline{k}$ and $\bar{k}$ emerge. Of course this is not the only possible configuration because no steady states with positive government capital need exist if either the privatization rate or the primary government budget deficit is too large.

For the remainder of the discussion, I focus on the configuration with two steady states. In this event, the lower steady-state equilibrium at $\underline{k}$ features lower public- and private-sector wages. Using equations (39) and the definition of the privatization transfer, equation (33), it is possible to show that τ is also an increasing function of the steady state k. Hence, the low-wage equilibrium exhibits less internal finance than the high-wage equilibrium and, hence, a less efficient credit market.[22] At the high-income steady state, $\bar{k}$, the situation is reversed. When the state-sector capital/labor ratio is high, wages and transfers are high, there is a larger amount of internal finance, and, consequently, the credit market friction is less severe.

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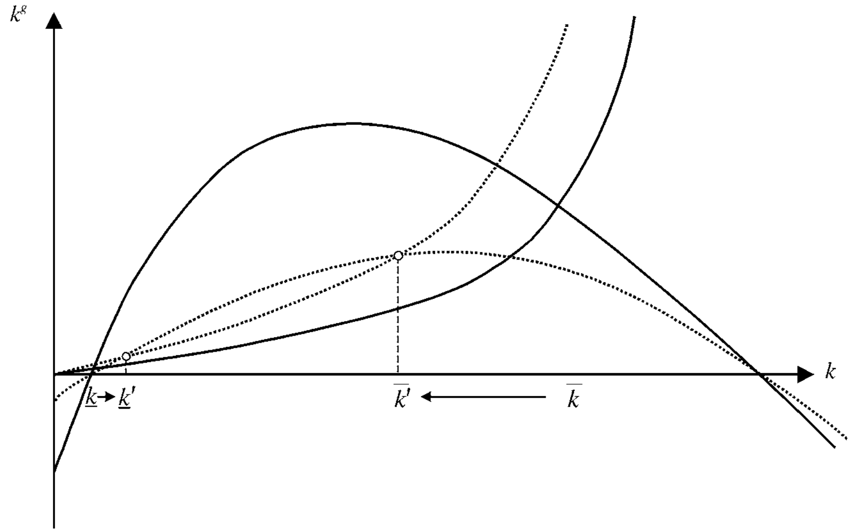

FIGURE 5. Movement of steady-state capital levels with an increase in ϕ.

Turning to the steady-state effects of increasing the privatization rate ϕ, the preceding discussion implies that an increase in ϕ will have the effect shown in Figure 5—$\underline{k}$ and $\bar{k}$ move toward each other. Hence, higher rates of privatization increase $\underline{k}$ and thereby increase wages in the low-wage steady state. However, in the high-wage steady state, higher rates of privatization decrease $\bar{k}$ and therefore decrease wages. This outcome is illustrated in the following example:

Example 2

Starting from the same parameter values used in Example 1, the rate of privatization, ϕ, is increased from 0 to 0.8 per period. This results in an increase in $\underline{k}$ from 0.011 to 0.012 and a decrease in $\bar{k}$ from 0.128 to 0.061. Wages in the low-wage steady state increase from 0.996 to 1.024, whereas wages in the high-wage steady state decline from 1.841 to 1.528. The value of transfers in the low and high steady state are 0.053 and 0.194, respectively.

The intuition underlying these observations comes from the fact that there are two separate sources of internal finance: transfers and wages. On the one hand, an increase in privatization transfers enhances internal finance, reduces the credit market friction, and increases the production of private capital. On the other hand, an increase in the privatization rate has a negative effect on wages because the transfers reduce the wages that the state sector can offer. This, in turn, leads to a reduction of internal finance via wages. The net result of these two forces depends on which source of internal finance is more important. At the low-wage equilibrium, the increase in internal finance from transfers is important relative to wage income. Hence, the net effect of the transfer is to enhance private-sector capital production. However, at the high-wage equilibrium, the (negative) wage

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effect dominates because wage income is a relatively important part of financing. Hence, the per-capita capital stock falls.

3.4. Steady-State Effects of β

Another exogenous parameter that is potentially interesting is the bargaining strength of the labor union, β. Previous work [e.g., Devereux and Lockwood (1991), Bertocchi (1997)] has found that, in the overlapping generations framework, higher union bargaining power actually increases the equilibrium per-capita capital stock because higher wages paid to the young effectively redistribute wealth to the agents with the highest propensity to save. Because of the complexity of the current model, an analytical characterization of the consequences of altering β are difficult to obtain. However, extensive numerical simulations revealed that, for all values of $\beta > (1-\theta)$, increases in β are associated with lower values of both $\bar{k}$ and $\underline{k}$.

4. LOCAL DYNAMICS

The dynamics of this economy are given by the laws of motion: (32), (34), and (37). Next, I discuss the dynamics of the model for the case $\phi = 0$, and later turn to the situation where $\phi > 0$.

4.1. Dynamics with $\phi = 0$

As previously noted, if $\phi = 0$, the aggregate capital stock evolves separately from the government capital stock. The law of motion governing the aggregate capital stock implied by equation (34) is

$$k_{t+1} = \left[\frac{\psi\lambda^{1-\theta}\theta A/r^*}{q - \beta A k_t^\theta}\right]^{\frac{1}{1-\theta}}. \qquad \textbf{(46)}$$

The following lemma summarizes some properties of equation (46) that are easily shown by standard methods.

LEMMA 2. *Let* $k^* = (q/\beta A)^{1/\theta}$ *as in Lemma 1. Then,*

$$(a) \quad \frac{\partial k_{t+1}}{\partial k_t} > 0$$

$$(b) \quad \lim_{k \to 0} \frac{\partial k_{t+1}}{\partial k_t} = \infty$$

$$(c) \quad \lim_{k \to k^*} \frac{\partial k_{t+1}}{\partial k_t} = \infty.$$

Thus, when there are two steady states, equation (46) has the configuration shown in Figure 6. From that figure, it is apparent that $\underline{k}$ is asymptotically stable and that $\bar{k}$ is unstable.

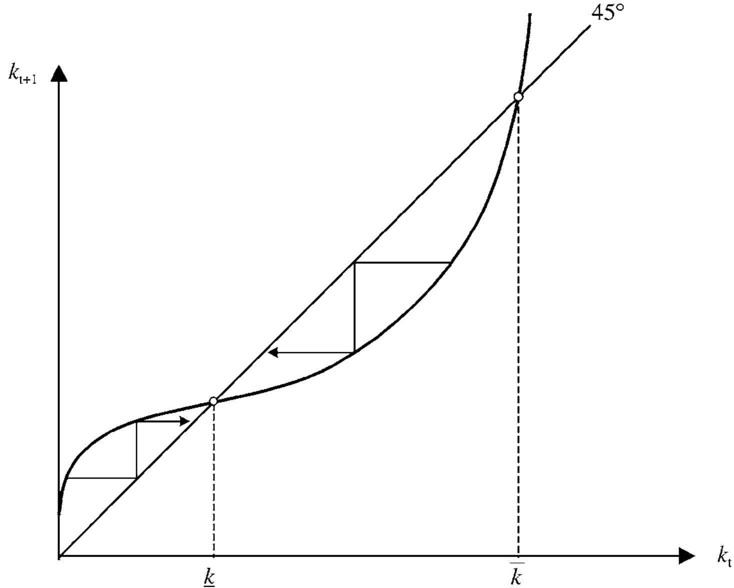

FIGURE 6. Law of motion for k_t when $\phi = 0$.

The corresponding law of motion for the government capital/labor ratio is

$$k^g_{t+1} = (1 - \beta)Ak_t^{\theta-1}k^g_t - \sigma. \quad \textbf{(47)}$$

Henceforth, I focus on the system described by equations (46) and (47).

The stability properties of $\underline{k}$ and $\bar{k}$ imply that, $k_{t+1} \geq k_t$ for $k_t \in [0, \underline{k}]$, and for $k_t \in [\bar{k}, \infty]$. Similarly, $k_{t+1} \leq k_t$ iff $k_t \in [\underline{k}, \bar{k}]$.

Equation (47) implies that $k^g_{t+1} \geq k^g_t$ iff

$$k^g_t \geq \frac{\sigma}{(1 - \beta)Ak_t^{\theta-1} - 1}. \quad \textbf{(48)}$$

Combinations of (k_t, k^g_t) along the locus defined by (48) at equality yield an unchanging state-sector capital/labor ratio; (k_t, k^g_t) combinations above (below) this phaseline feature $k^g_{t+1} > (<)\, k^g_t$. Thus, we obtain the phase portrait of the system depicted in Figure 7.

The (local) dynamics of the planar system represented by (46) and (47) are determined by analyzing the linearized dynamical system in the neighborhood of any steady-state equilibrium. This yields

$$\begin{bmatrix} k_{t+1} - k \\ k^g_{t+1} - k^g \end{bmatrix} = J \cdot \begin{bmatrix} k_t - k \\ k^g_t - k^g \end{bmatrix}, \quad \textbf{(49)}$$

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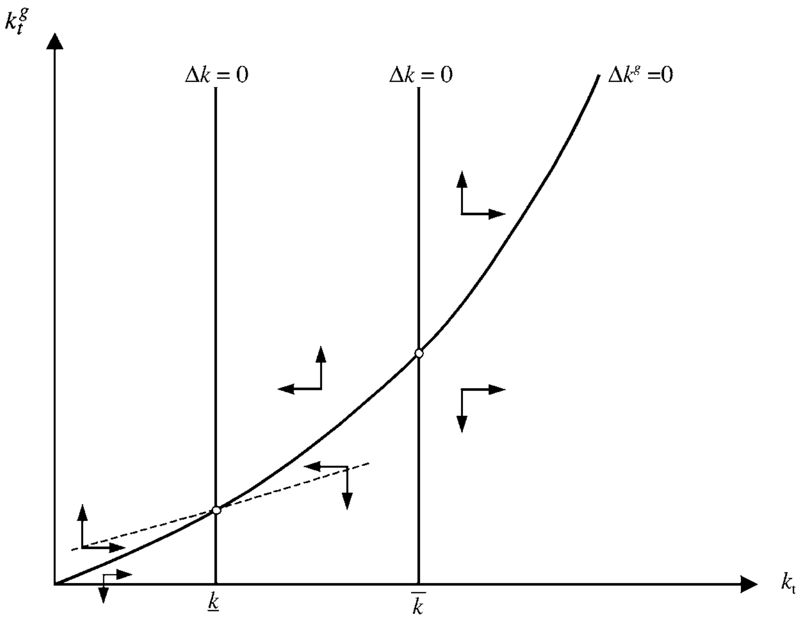

FIGURE 7. Phase diagram when $\phi = 0$.

where k and k^g denote the relevant steady-state values and where J is the Jacobian matrix

$$J = \begin{bmatrix} \dfrac{\partial k_{t+1}}{\partial k_t} & \dfrac{\partial k_{t+1}}{\partial k_t^g} \\ \dfrac{\partial k_{t+1}^g}{\partial k_t} & \dfrac{\partial k_{t+1}^g}{\partial k_t^g} \end{bmatrix},$$

with all partial derivatives evaluated at the appropriate steady state. A characterization of the local dynamics of the steady-state equilibria is summarized in the following proposition.

PROPOSITION 3. *Let $\phi = 0$. Then, the low-wage steady state is a saddle and the high-wage steady state is a source.*

Proof. Denote the eigenvalues of J evaluated at $\bar{k}$ and $\underline{k}$ as $(\bar{e}_1, \bar{e}_2)$ and $(\underline{e}_1, \underline{e}_2)$, respectively. Figure 6 establishes that $\bar{e}_1 > 1$ and $\underline{e}_1 < 1$. When $\phi = 0$, $\partial k_{t+1}/\partial k_t^g = 0$. Thus, without loss of generality, $e_2 = \partial k_{t+1}^g/\partial k_t^g = (1-\beta)A(k_t)^{\theta-1}$, where k_t is evaluated at the relevant steady-state value, $\underline{k}$ or $\bar{k}$. From (43), $\underline{k} < \bar{k} < \hat{k} = [(1-\beta)A]^{1/(1-\theta)}$. Note that $e_2(\hat{k}) = 1$. Since e_2 is a decreasing function of k, $\underline{e}_2 > \bar{e}_2 > 1$, which establishes the proposition. ■

The fact that the low-wage steady state, $\underline{k}$, is a saddle while the high-wage steady state, $\bar{k}$, is a source suggests that an economy that pursues no active privatization

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after the initial period can only approach the lower-activity steady state. Furthermore, to approach this steady state, the government will generically need to make an initial transfer in period 1. So, in the long run, the economy will suffer from a relatively low level of production and wages, a low amount of internal finance, and an inefficient credit market.

4.2. Dynamics with $\phi > 0$

The dynamics of the system are complicated considerably when the privatization rate ϕ is greater than zero. For positive rates of privatization, the dynamic system is given by

$$k_{t+1} = \left[\frac{\psi\lambda^{1-\theta}\theta A/r^*}{q - \beta A k_t^{\theta} - \phi(1-\beta)A k_t^{\theta-1} k_t^g}\right]^{\frac{1}{1-\theta}} \tag{50}$$

and equation (32), the law of motion for the government capital stock. Note that the evolution of k_t is no longer independent of k_t^g. However, when $\phi > 0$, equation (32) remains unchanged and thus the associated isocline is unaltered.

Equation (50) implies that $k_{t+1} \geq k_t$ iff

$$k_t^g \geq \frac{1}{\phi(1-\beta)A}\left[q k_t^{1-\theta} - \beta A k_t - \psi\lambda^{1-\theta}\theta A/r^*\right]. \tag{51}$$

Thus, equation (51) at equality represents the locus of (k_t, k_t^g) combinations where the capital/labor ratio in the government sector does not change. The shape of the phaseline has already been characterized in Section 3.3.[23] Points above (below) this phaseline have $k_{t+1} > (<)\, k_t$.

The resulting phase portrait in the case $\phi > 0$ is given in Figure 8. Since the local dynamics are sufficiently complicated to preclude analytical results, I next provide examples from numerical simulations that highlight the local stability properties of the linearized system in a neighborhood of each steady state. In all of the simulations examined (including those not reported here), the low-wage steady state was found to be a saddle. When $\bar{k}$ satisfies the conditions of a steady-state equilibrium, that steady state is usually a source. However, as shown in the following examples, it is possible that while the high-wage steady state is a source (or is invalid) for low values of ϕ, it can become a legitimate sink for higher values of ϕ.[24] Hence, these results illustrate that, in some cases, if the government picks a high enough privatization rate, it can escape the poverty-trap scenario that it faced under the no-privatization policy.

Example 3

Let $f(\cdot) = 3\,k^{0.5}$, $g(z) = 1/\bar{z}$, with $\bar{z} = 7.70$ and $\gamma = 9.23$. Furthermore, let $\beta = 0.6$, $q = 2$, $\sigma = 0.01$, and $r^* = 3.96$. These parameter values imply a value of $\xi = 2$. When the privatization rate is $\phi = 0$, $\underline{k} = 0.063$ and $\bar{k} = 0.740$. However, for all

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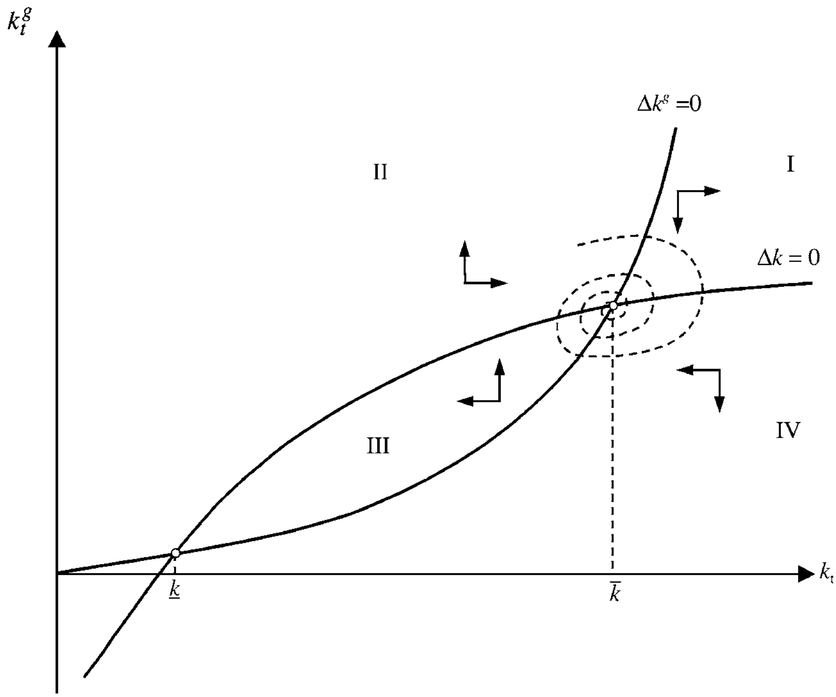

FIGURE 8. Phase diagram when $\phi > 0$.

$\phi \in [0, 0.46]$, the high-wage steady state violates at least one of the maintained assumptions; hence only the low-wage equilibrium is valid.

Example 4

Same parameter values as Example 3 but with the privatization rate in the interval $\phi \in (0.46, 0.60]$. In this case, the high-wage steady state satisfies all of the required conditions. However, the (complex) eigenvalues have modulus >1, implying that the high-activity steady state is a source.

Example 5

Same parameter values as before but $\phi \in [0.61, 0.70]$. For the high-wage steady state, this produces complex eigenvalues with moduli less than unity. Thus, the steady state becomes a (spiral) sink. Finally, for values of $\phi > 0.70$, no steady-state equilibria exist.

For this set of examples, high rates of privatization are sufficient to make the high-wage steady state approachable. For lower rates of privatization, the high-wage steady state is a source or does not qualify as a valid equilibrium. Moreover, as the privatization rate increases between Examples 4 and 5, the moduli of the eigenvalues pass through unity, implying that limit cycles may be observed.

Example 5 illustrates the possibility that certain privatization policies will lead to endogenous oscillations that may or may not die out asymptotically. Moreover, as indicated in Figure 8, there are instances on paths approaching the high-wage steady state where k_t and k_t^g move in opposite directions, implying that there may be long-lived fluctuations in the fraction of the labor force employed by the state sector. In particular, dynamic paths in quadrant I in Figure 8 are associated with a falling state-sector labor share whereas paths in quadrant III are associated with an increasing state-sector labor share. Consequently, the size of the state sector may undergo repeated periods of growth, even though the government is transferring resources to the private sector at a rapid rate.

Example 5 also illustrates another feature of this economy. There exists a "tension" at the high-wage steady state. Sufficiently high rates of privatization render the high-activity steady state stable, but at the same time, they reduce the income level at that steady state. In other words, to approach the high-wage steady state, privatization must be sufficiently fast, but the more rapid the rate of privatization, the lower the steady-state income levels. This observation poses a potentially interesting trade-off for policymakers in transitional economies.

5. DISCUSSION AND CONCLUSION

This paper has developed a model with features commonly found in developing and transitional economies. First, production in the economy is "mixed"—goods are produced by private firms and state-owned enterprises. Second, the state sector is inefficient in the sense that factors of production are not paid their marginal products due to the assumption that labor has a strong bargaining position in state enterprises. This upward pressure on wages further influences the private sector through the labor market. Third, private financial markets suffer from frictions whose severity depends on the degree of self-financing provided by entrepreneurs. Finally, the government follows a privatization policy that transfers resources between sectors.

The credit market friction produces the possibility of multiple steady-state equilibria. When this occurs, the steady-state effects of changes in the privatization rate depend on which equilibrium obtains. In the low-activity steady state, increasing privatization rates reduces the severity of the credit market friction by increasing entrepreneurs' ability to provide internal financing of investment, thereby leading to an increase in the aggregate capital stock. In the high-capital steady state, the effect surprisingly is reversed.

This last result is a counterexample to the conventional wisdom that privatization is typically beneficial for capital accumulation. For instance, the IMF has issued statements using partial-equilibrium reasoning that "voucher privatization has, if anything, a positive impact on domestic consumption and investment"[25] and that "privatization should not reduce consumption because, ..., it does not reduce private sector wealth."[26] Whereas these statements are consistent with the model's behavior in the low-wage equilibrium, the analysis presented here

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predicts exactly the opposite behavior for an economy in the high-wage steady state.

The model's dynamic properties imply the possibility of a development-trap situation. A transitional economy that does not continue to privatize over time can only approach the low-wage steady state in the long-run. However, as demonstrated by example, it is possible that sufficiently high privatization rates will allow the economy to approach the high-wage steady state—although with the added characteristic of endogenous fluctuations.

Thus, the findings of this paper are relevant for the "gradualism" vs. "big-bang" debate that dominated the early literature on transition. Many economists have argued that privatization should proceed as quickly as possible in order to generate efficiency gains, define property rights, provide effective corporate governance, and to avoid "spontaneous privatizations" where assets are illegally diverted by corrupt managers. The present analysis has focused on private-sector financing issues and we have seen that faster rates of privatization can have differing effects on steady-state equilibria for reasons unrelated to any of the above-mentioned justifications for rapid privatization. However, in terms of dynamic behavior, faster privatization rates may allow the economy to attain higher-activity equilibria.

A distinction that merits comment is the common modeling supposition that the benefits from privatization stem from the efficiency gains that result when resources are transferred to the private sector. These are the central assumptions in the analyses by Aghion and Blanchard (1994) and Atkeson and Kehoe (1996). It should be emphasized that this is *not* an essential factor in the present model. Although the state firms are inefficient because of the presence of the trade union, it is possible to choose the bargaining power of the union so that the income shares of output replicate the competitive outcome.[27] In this case, the aggregate capital stock likely would increase, but the relationship between the privatization rate and equilibrium behavior would remain unchanged because the effects of privatization in this model are induced by the impact of the transfers on private-sector financing. Furthermore, the labor bargaining device employed here is just one of many possible factors that explain why, in reality, state-run enterprises suffer from inefficiencies.

There are many ways the analysis could be extended. In particular, it would be interesting to link the labor union bargaining position to the amount of government capital. This would allow for significant interactions between privatization policies, financial markets, and labor markets. It also would be interesting to expand the government's range of financing methods by allowing it to levy capital or labor taxes on the newly formed private sector. Furthermore, the assumption of a constant privatization rate delivered analytical tractability and allowed for comparisons between different policies. However, more realistic methods of selecting the privatization transfer rate could be explored within the general framework presented here. Finally, examining the effects of alternative informational frictions would be a useful exercise. The CSV problem employed here produces a particular type of credit rationing where some agents are fully funded but others are not. It is well known that other settings will result in different types of rationing, such as quantity rationing, where agents cannot borrow all they wish at the market interest rate, as in Gale and Hellwig (1985) or Stiglitz and Weiss (1981).

NOTES

1. Brunetti et al. (1997).
2. Examples of others who use the Nash bargaining solution in an overlapping generations environment include Devereux and Lockwood (1991) and Bertocchi (1997).
3. Dewatripont and Roland (1995) point out that the division of the literature into "gradualist" vs. "big-bang" camps may be misleading because the transition is multidimensional. Thus, the "best" reform speed depends on the particular dimension under consideration. Nevertheless, they provide a summary of earlier literature organized along these lines.
4. All intensive variables are per young agent.
5. Risk neutrality is essential only for potential borrowers. The assumption that agents consume only when old is not essential to any results.
6. In equilibrium, wage rates are equalized across sectors so that, ex-post, there will be no motivation for a particular individual to prefer one sector over another. However, the irreversibility assumption is imposed to simplify the bargaining solution described later.
7. The parameter β also can be interpreted in an alternating-offers game as the relative "patience" of the parties involved. A high value of β implies that the labor union is more patient than the government. See Osborne and Rubinstein (1990) or Booth (1995).
8. This is due to the absence of a diversification motive and to the informational advantage of internal over external finance.
9. The assumption that monitoring consumes capital simplifies the problem and follows Bernanke and Gertler (1989) and Boyd and Smith (1997, 1998). Examples in which monitoring consumes consumption goods include Diamond (1984) and Williamson (1987).
10. Note that the problem described here only focuses on non-stochastic-state verification. Although it is possible that random auditing may be more efficient, as pointed out by Bernanke and Gertler (1989), Boyd and Smith (1994) show that the welfare gains from stochastic monitoring are small for realistic parameter values.
11. I will return to the issue of foreign assets in the next section.
12. The intuition for this result is that a higher x_t implies a higher probability of default and a correspondingly higher expected monitoring cost for the lender.
13. Although this assumption results in a technical simplification, it is also a reasonable reflection of the current state of financial markets in developing and transitional economies.
14. The assumption of a constant transfer rate greatly facilitates the comparison of policies; it is not motivated by any actual empirical regularity other than the observation that privatization rates differ dramatically among transitional economies.
15. As long as the government is "large" relative to the size of investment projects, it will never suffer from the financing problem that exists in the private sector.
16. Parameter values $\xi > 1$ capture situations in which the private sector is more efficient at capital production than the state sector.
17. Of course, this does not rule out a transfer of assets to the private sector in the initial period.
18. This requirement also will be necessary for the case of $\phi > 0$.
19. Assuming 30-year periods, r^* corresponds to an annual real interest rate of 5.3%.
20. It is easily verified that if $r^* > \underline{r}$, as defined in Proposition 2, then $J(k_{\text{mid}}) > 0$.
21. If $J(k) < 0$, then $\partial k^g / \partial \phi > 0$.
22. This is also true for the case of no privatization transfers because, there, only wages matter for internal finance.
23. Comparison of equation (51) at equality with equation (44) clearly shows that they are identical.

24. A valid steady state must satisfy Assumptions 1, 2, and 4 and equations (29) and (43). An invalid steady state would be one where at least one of these conditions fails.

25. IMF (1998), p. 92.

26. Mackenzie (1997), p. 14.

27. This would entail setting $\beta = (1 - \theta)$, which would result in $\lambda = 1$.

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