2 Financial Institutional Reform, Growth, and Equality

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2.1 Introduction

Trends toward less public regulation of financial markets for household debt are emerging in different parts of the world. Liberalization of financial markets in OECD countries since the 1980s is well documented. Examples of this are higher loan-to-value ratios, increased competition between mortgage institutions and banks, and higher borrowing limits on consumers' personal debt. In less developed countries, financial reform is more a question of creating lending institutions in order to promote investment in human and physical capital. A majority of developing countries is now undergoing significant structural transformations, one of the most controversial adjustment areas being that of financial markets and institutions. There is little consensus as to when to liberalize financial markets or how it should be done (see Fanelli and Medhora 1998). Finally, in Eastern Europe, a new financial intermediation system has been created allowing for credit to households in some segments of the market, but there is still some way to go.

Behind the slow implementation of reforms and/or the objections raised against liberalized financial markets, we find the idea that there are upfront costs that may be deterring. To understand the foundation of these criticisms, we study the medium- and long-term impact of credit reform on the growth and distribution of income in a life-cycle economy populated by agents who differ in their ability to acquire human capital.

In this economy, deregulation amounts to an anticipated lifting of all borrowing constraints on households; namely, it is equivalent to creating credit markets starting from a situation where such markets are absent. We describe the qualitative and quantitative outcomes of this financial "big bang" on incomes, inequality, and the welfare of particular social groups indexed by age and ability. Our starting point is that borrowing limits do not necessarily ration the poor, as it is assumed in much of the literature (see, e.g., Galor and Zeira 1993 and Piketty 1997). They may ration instead the most efficient accumulators of human skills, that is, households with high potential income growth.

Important clues to the answer we are seeking are identified in papers by Jappelli and Pagano (1994), De Gregorio (1996), and De Gregorio and Kim (2000), which link market liberalization to economic growth and distribution.[1] We call these clues the *level effect* and the *growth effect* from credit market reforms.

The level effect of financial deregulation is strongest in the short to medium run. It reduces *net* household saving, slows down physical capital accumulation, and raises yields in societies without human capital. This mechanism was identified by Jappelli and Pagano (1994), who found some support for it in a panel of OECD countries. They conclude that financial deregulation in the eighties has contributed to the decline in national saving and growth rates in the OECD countries.[2]

Opposed to the level effect is the growth effect, identified by De Gregorio 1996. It refers to the rise in borrowing for investments in human skills, and the corresponding boost to long-run growth in small open societies that rely on human capital as their growth engine. Evidence for this channel appears to be mixed.

De Gregorio and Kim (2000) also find that financial reform is welfare improving but may raise the dispersion of earnings by permitting the more able to specialize in learning and the less able to specialize in working. As Becker (1964) had suggested, relaxing constraints on society's ablest households contributes to earnings inequality.

This chapter is based on the assumption that physical and human capital need to be studied *jointly* both because they oppose each other and because they interact in subtle ways. For example, as the level effect raises yields and lowers wage rates, it will undermine the growth effect and itself by inducing less schooling by unconstrained people and greater labor supply. Without a complete general equilibrium model, it seems very hard to guess how financial reform now will affect output in the medium run as well as the welfare of each currently living household.

Accordingly, section 2.2 sets up a simple economy with heterogeneous households, one consumption good, and two reproducible inputs—physical capital and human capital. In section 2.3, we charac-

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terize equilibria with a perfect loan market and with an extreme form of credit rationing, that is, a prohibition on all loans. We prove that the return on capital is always higher in the economy with perfect markets. The transitional and long-term response of output and inequality to financial reform depends critically on how common credit rationing was before credit market liberalization.

The remainder of the chapter conducts dynamic simulation experiments of financial deregulation in a model calibrated to fit the long-run economic performance of a panel of less developed countries in the 1960s. Specifically, we explore in section 2.4 the quantitative implications for per capita income growth and the Gini coefficients in these countries. We pay particular attention to the changes in welfare by cohort and ability group. We find that, even when credit constraints initially bind on relatively few people, the macroeconomic consequences of removing these constraints can be large, with upfront costs from a lower capital intensity and delayed benefits from long-term growth. Initial responses to financial deregulation are dictated by the adverse level effect: a decline in the growth of output, coupled with a rise in inequality and in real yields. The growth effect eventually takes over, boosting long-term growth by about one third of 1 percent per year. The impact of liberalization is adverse for all young households at the time of the reform and also for skilled older people.

The robustness of these results to changes in technology is investigated in section 2.5. In particular we show that, with CES technologies and low substitutability between capital and labor, financial reform shrinks the basin of attraction to the higher of the two balanced growth states. If the economy considered has a low initial capital-labor ratio, or if its total factor productivity is not high enough, then the lifting of borrowing constraints that comes from financial reform may redirect economic growth toward a poverty trap. Section 2.6 sums up the costs and benefits from financial reform and discusses policies that would make liberalization more agreeable to a majority of households.

2.2 The Problem of the Household

The model is an overlapping generations model in the spirit of Azariadis and Drazen (1990), extending their approach to heterogeneous households and imperfect credit markets. Time is discrete and goes from 0 to $+\infty$. Each generation consists in a continuum of households, with mass expanding at a constant rate $n > -1$.[3]

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Each individual lives for two periods, youth and old age. The households of the same generation differ in their innate ability to work when young, ε^{Y}, and when old, ε^{O}. Ability ε^{Y} can be thought of as being related to physical *strength*, while ε^{O} incorporates elements related to the ability to learn, say *IQ*.[4] Their utility function is defined over consumption when adult c_t and consumption when old d_{t+1}:

$$\ln c_t + \beta \ln d_{t+1}, \qquad \beta \in \mathbb{R}_+. \tag{1}$$

A share of time λ_t is spent to build up human capital and $1 - \lambda_t$ to work. First-period income is allocated between consumption and savings s_t:

$$\varepsilon^{\mathrm{Y}}(1 - \lambda_t) w_t \bar{h}_t = c_t + s_t. \tag{2}$$

The individual variables c_t, s_t, λ_t, and d_{t+1} will generally depend on ability. Economy-wide variables are w_t, the wage per unit of human capital, and $\bar{h}_t$, which denotes the average human capital of the old generation at time t. The endowment of efficient labor when young is $\varepsilon^{\mathrm{Y}}\bar{h}_t$. Following Azariadis and Drazen (1990), each young person benefits from the average human capital of the previous generation. Old-age human capital depends on the time spent on education when young; on the ability when old, ε^{O}; and on the average value of the previous generation's human capital:

$$h_{t+1} = \varepsilon^{\mathrm{O}} \psi(\lambda_t) \bar{h}_t. \tag{3}$$

We think of $\bar{h}_t$ as a measure of teacher quality. As we can see from equation (3), the individual characteristic ε^{O} reflects both the ability to work when old and the ability to learn (i.e., to accumulate human capital). The function ψ is assumed to be increasing and concave, and satisfies boundary conditions

$$\lim_{\lambda \to 0} \psi'(\lambda) = +\infty, \qquad \lim_{\lambda \to 1} \psi'(\lambda) = 0, \tag{4}$$

which ensure that it is always optimal to spend a strictly positive time span building human capital.

The ability type $(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}})$ is distributed over each generation according to a cumulative function G defined on $\mathbb{R}_+^2$. The economy-wide average human capital is

$$\bar{h}_t = \int_0^\infty \int_0^\infty h_t \, \mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}).$$

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Old agents consume both labor earnings and capital income:

$$d_{t+1} = R_{t+1}s_t + w_{t+1}h_{t+1}. \tag{5}$$

R_{t+1} is the interest factor.

We denote the relative wage by

$$x_t \equiv \frac{w_{t+1}}{w_t R_{t+1}}.$$

From equations (2), (3), and (5), life-cycle income is proportional to the inherited human capital $\bar{h}_t$:

$$\Omega_t = w_t[\varepsilon^{\mathrm{Y}}(1-\lambda_t) + x_t\varepsilon^{\mathrm{O}}\psi(\lambda_t)]\bar{h}_t.$$

Since the duration of schooling λ_t does not enter the utility function, we can solve the household planning problem in two separate steps. When financial markets are perfect, there is no liquidity constraint on households, and the optimal length of schooling maximizes life-cycle income, satisfying the condition

$$\psi'(\lambda_t) = \frac{\varepsilon^{\mathrm{Y}}}{\varepsilon^{\mathrm{O}}x_t}. \tag{6}$$

This equation represents the trade-off between studying and working put forward by Ben-Porath (1967). This relationship implies that the length of schooling depends positively on discounted future wage (the benefit from education) and negatively on current wage (the opportunity cost). It also depends positively on the ratio of innate abilities $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}}$. Inverting equation (6), we obtain

$$\lambda_t = \varphi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}), \qquad \varphi' > 0,\ \varphi(0) = 0.$$

Optimal savings are computed by maximizing utility subject to the budget constraints (2) and (5):

$$(1+\beta)s_t = \left(\beta\varepsilon^{\mathrm{Y}}(1-\lambda_t)w_t - \frac{w_{t+1}}{R_{t+1}}\varepsilon^{\mathrm{O}}\psi(\lambda_t)\right)\bar{h}_t. \tag{7}$$

We define the increasing function as follows:

$$\Phi(a) \equiv \varphi(a) + \frac{a}{\beta}\psi(\varphi(a)) \qquad \Phi' > 0. \tag{8}$$

This allows us to rewrite savings as

$$(1+\beta)s_t = \beta w_t\varepsilon^{\mathrm{Y}}(1 - \Phi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\bar{h}_t. \tag{9}$$

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Note that there is a threshold $\tilde{\mu}$ bearing on relative ability $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}}$ above which households borrow from financial markets. Indeed, we note from equations (6) and (7) that savings are positive if, and only if, $\beta(1-\lambda_t)\psi'(\lambda_t) > \psi(\lambda_t)$. As $\psi(.)$ is increasing in the interval $(0,1)$ and $\psi'(\lambda_t)(1-\lambda_t)$ is decreasing in λ_t, this inequality defines a critical value for schooling, $\tilde{\lambda}$, independent of time and such that

$$\lambda_t < \tilde{\lambda} \Leftrightarrow s_t > 0.$$

Since λ_t is a monotone function $\varphi(.)$ of ability, we can define the ability threshold as a function of the relative wage:

$$\tilde{\mu}_t = \frac{\varphi^{-1}(\tilde{\lambda})}{x_t} \equiv \frac{B}{x_t}. \tag{10}$$

This threshold again separates borrowers from lenders, that is,

$$\frac{\varepsilon^{\mathrm{O}}}{\varepsilon^{\mathrm{Y}}} < \tilde{\mu}_t \Leftrightarrow s_t > 0.$$

Hence, households in cohort t with relative ability above $\tilde{\mu}_t$ (or, equivalently, with steeply rising wage profiles) will borrow while other households will lend.

We define an imperfect credit market as an environment in which young households cannot credibly commit their future labor income as a collateral against current loans. As in Kehoe and Levine 1993, we assume that individuals are allowed to borrow up to the point where they are indifferent between repaying loans and suffering market exclusion. Since everyone dies at the end of the second period, default involves no penalty and is individually optimal. The borrowing constraint then takes a very simple form: $s_t \geq 0$.[5]

We saw earlier that the households with ability ratio $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}}$ above the threshold $\tilde{\mu}_t = B/x_t$ borrow from financial markets. Those households will now be rationed. They will not participate to the credit market, maximizing instead an autarkic utility function obtained by replacing (2), (3), and (5) in (1):

$$\ln(1-\lambda_t) + \beta\ln(\psi(\lambda_t)) + \text{constants}.$$

The first-order condition is

$$\psi(\lambda_t) = \beta\psi'(\lambda_t)(1-\lambda_t).$$

Since $\psi(.)$ is increasing in the interval $(0,1)$ and $\psi'(\lambda_t)(1-\lambda_t)$ is decreasing in λ_t, this equation defines a unique solution $\tilde{\lambda}$, which does

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not depend on prices, or on ability type. It is the same as the threshold $\tilde{\lambda}$ defined in (10).

We can now summarize our results in the following proposition:

Proposition 1 Households whose ability profiles do not rise fast, i.e., $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}} < \tilde{\mu}_t$, save a positive amount given by equation (9); their investment in education λ_t equals $\varphi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}})$ and depends positively on $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}}$. Households with fast-rising ability profiles, i.e., $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}} > \tilde{\mu}_t$, are credit rationed, and invest the same amount in education, i.e., $\lambda_t = \tilde{\lambda} = \varphi(\tilde{\mu}_t x_t)$.

Households with a steep potential earnings profile would like to borrow in order to study longer, but credit rationing prevents them from doing so. All others have positive saving and study as long as they wish. Note that the threshold $\tilde{\mu}_t$ depends on prices through equation (10). For example, when yields are high, there will be fewer constrained households, other things being equal. Hence, although our borrowing constraint is very simple, *the proportion of rationed people depends on prices and hence varies over time.*

2.3 The Equilibrium

To characterize the equilibrium with perfect markets, we compute the average human capital of the next period as (using equation (3))

$$\bar{h}_{t+1} = \int_0^\infty \int_0^\infty h_{t+1}\,\mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}) = \int_0^\infty \int_0^\infty \varepsilon^{\mathrm{O}}\psi(\lambda_t)\bar{h}_t\,\mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}).$$

The growth rate of human capital, $g_p(x_t)$, is therefore

$$\frac{\bar{h}_{t+1}}{\bar{h}_t} = 1 + g_p(x_t) = \int_0^\infty \int_0^\infty \varepsilon^{\mathrm{O}}\psi(\varphi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\,\mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}). \tag{11}$$

We also equate aggregate saving with the value of the capital stock. First we compute saving per young household from

$$\bar{s}_t = \int_0^\infty \int_0^\infty s_t\,\mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}) = \frac{\beta}{1+\beta} w_t \bar{h}_t \mathscr{S}_p(x_t), \tag{12}$$

where the function $\mathscr{S}_p(x_t)$ is defined as

$$\mathscr{S}_p(x_t) = \int_0^\infty \int_0^\infty \varepsilon^{\mathrm{Y}}(1 - \Phi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\,\mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}).$$

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We assume that firms operate a constant return to scale technology $F(K_t, H_t)$ involving capital and labor inputs. Defining the capital-labor ratio as $k_t = K_t/H_t$, and an intensive production function $f(k_t)$, equilibrium factor prices are

$$w_t = f(k_t) - k_t f'(k_t) = \omega(k_t),$$

$$R_t = f'(k_t) = R(k_t).$$

This allows us to rewrite the relative wage x_t as a function of (k_t, k_{t+1}):

$$x_t = \frac{\omega(k_{t+1})}{\omega(k_t)R(k_{t+1})}. \tag{13}$$

The total labor supply per young person H_t is obtained by averaging over young and old workers, that is,

$$H_t = \mathscr{H}_p(x_t)\bar{h}_t, \tag{14}$$

where the function $\mathscr{H}_p(x_t)$ is defined as

$$\mathscr{H}_p(x_t) = \frac{1}{1+n} + \int_0^\infty \int_0^\infty \varepsilon^{\mathrm{Y}}(1 - \varphi(\varepsilon^{\mathrm{O}} x_t/\varepsilon^{\mathrm{Y}}))\, \mathrm{d}G(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}).$$

Equilibrium in the financial market requires

$$K_{t+1} = k_{t+1}H_{t+1} = \frac{\bar{s}_t}{1+n}.$$

After using equations (11), (12), and (14), we find the following:

$$\frac{(1+\beta)k_{t+1}}{\beta\omega(k_t)} \mathscr{H}_p(x_{t+1}) = \frac{\mathscr{S}_p(x_t)}{1+g_p(x_t)} \frac{1}{1+n} \tag{15}$$

Given initial conditions $(k_0, \bar{h}_0)$, a perfect foresight equilibrium can be characterized by a non-negative sequence $(x_t, k_{t+1}, \bar{h}_{t+1})_{t\geq 0}$, which solves equations (11), (13), and (15).

This dynamical system can be solved recursively when the production function is Cobb-Douglas, $f(k_t) = Ak_t^\alpha$, with complete depreciation of capital. Then we have

$$\frac{k_{t+1}}{\omega(k_t)} = \frac{\alpha}{1-\alpha} \frac{\omega(k_{t+1})}{\omega(k_t)R(k_{t+1})} = \frac{\alpha}{1-\alpha} x_t,$$

and equation (15) reduces to a first-order difference equation in x_t:

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$$\frac{(1+\beta)\alpha}{(1-\alpha)\beta}\mathscr{H}_p(x_{t+1}) = \frac{1}{x_t}\frac{\mathscr{S}_p(x_t)}{1+g_p(x_t)}\frac{1}{1+n}.$$

In the presence of rationing, the average human capital grows at a rate $g_c(x_t) = \bar{h}_{t+1}/\bar{h}_t - 1$, which reflects the weight of constrained households; that is,

$$1+g_c(x_t) = \int_0^\infty \int_0^{\varepsilon^{\mathrm{Y}}B/x_t} \varepsilon^{\mathrm{O}}\psi(\varphi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\,\mathrm{d}G(\varepsilon^{\mathrm{Y}},\varepsilon^{\mathrm{O}}) + \psi(\tilde{\lambda})\int_0^\infty \int_{\varepsilon^{\mathrm{Y}}B/x_t}^\infty \varepsilon^{\mathrm{O}}\,\mathrm{d}G(\varepsilon^{\mathrm{Y}},\varepsilon^{\mathrm{O}}). \tag{16}$$

Average saving is

$$\bar{s}_t = \frac{\beta}{1+\beta}w_t\bar{h}_t\mathscr{S}_c(x_t),$$

where the function $\mathscr{S}_c(x_t)$ is defined as

$$\mathscr{S}_c(x_t) = \int_0^\infty \int_0^{\varepsilon^{\mathrm{Y}}B/x_t} \varepsilon^{\mathrm{Y}}(1-\Phi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\,\mathrm{d}G(\varepsilon^{\mathrm{Y}},\varepsilon^{\mathrm{O}}),$$

instead of the expression in equation (12). Similarly, average labor supply no longer satisfies equation (14); it is given instead by

$$H_t = \mathscr{H}_c(x_t)\bar{h}_t,$$

where the function $\mathscr{H}_c(x_t)$ is defined as

$$\mathscr{H}_c(x_t) = \frac{1}{1+n} + \int_0^\infty \int_0^{\varepsilon^{\mathrm{Y}}B/x_t} \varepsilon^{\mathrm{Y}}(1-\varphi(\varepsilon^{\mathrm{O}}x_t/\varepsilon^{\mathrm{Y}}))\,\mathrm{d}G(\varepsilon^{\mathrm{Y}},\varepsilon^{\mathrm{O}}) + (1-\tilde{\lambda})\int_0^\infty \int_{\varepsilon^{\mathrm{Y}}B/x_t}^\infty \varepsilon^{\mathrm{Y}}\,\mathrm{d}G(\varepsilon^{\mathrm{Y}},\varepsilon^{\mathrm{O}}).$$

Labor supply is decreasing in x_t, that is, $\mathscr{H}_c'(.) < 0$, since better earnings prospects move households from work to school. Financial market equilibrium satisfies

$$\frac{(1+\beta)k_{t+1}}{\beta\omega(k_t)}\mathscr{H}_c(x_{t+1}) = \frac{\mathscr{S}_c(x_t)}{1+g_c(x_t)}\frac{1}{1+n}. \tag{17}$$

Given the initial conditions $(k_0, \bar{h}_0)$, a perfect foresight equilibrium with credit rationing is again a sequence $(x_t, k_{t+1}, \bar{h}_{t+1})_{t\geq 0}$, which solves equations (16), (13), and (17).

With the Cobb-Douglas production function, equilibria are solutions to the dynamical system:

$$\frac{(1+\beta)\alpha}{(1-\alpha)\beta}\mathscr{H}_c(x_{t+1}) = \frac{1}{x_t}\frac{\mathscr{S}_c(x_t)}{1+g_c(x_t)}\frac{1}{1+n}, \tag{18}$$

$$k_{t+1} = A\alpha x_t k_t^{\alpha}. \tag{19}$$

This system is recursive. Equation (18) can first be solved for the path of x_t. Equation (19) is obtained from the definition of x_t in equation (13); it describes the evolution of the capital-labor ratio. The growth rate of human capital is obtained from (16). The solution to (16), (18), and (19) is summed up in the following result:

Proposition 2 The system (16), (18), and (19) has a steady state (x_c, k_c, g_c) and equilibrium is unique in the neighborhood of that state.

Proof: See appendix. ∎

The same reasoning can be applied to the perfect market economy that also possesses a locally unique equilibrium in the neighborhood of the steady state (x_p, k_p, g_p).

As a general proposition, it is impossible to show that financial reform will spread inequality and promote long-term growth. For example, liberalization raises yields (see proposition 3) and improves the income of retirees. Since this effect is stronger for less able retirees with relatively high saving, it tends to reduce inequality. What happens to long-term growth depends on how young households weigh the mixed incentives they receive in free financial markets: less credit rationing permits them to invest more in schooling, while higher yields on physical capital shrink the present value of future earnings. We first state a key result according to which financial reform reduces aggregate saving and raises yields.

Proposition 3 Assuming a unique steady state, the economy with perfect markets has a lower long-run capital-labor ratio than the one with imperfect markets.

Proof: See appendix. ∎

To assess the effect of financial reform on the long-run growth rate of per capita output (which equals the long-run growth rate of average human capital), we should compare the perfect market growth rate, $g_p(x_p)$, with the credit-rationed growth rate, $g_c(x_c)$. Two opposite effects interact: for the same long-run yield $1/x$, $g_p(x) > g_c(x)$. Indeed, some agents are constrained in the imperfect market economy, they invest less than they want in education, and growth is slower. However, as the yield is higher in the perfect market economy ($x_p < x_c$), agents are discouraged from investing in education, and this may or may not outweigh the direct positive effect. The first effect will dominate if there are enough constrained agents in the economy with imperfect markets. To evaluate the effect on growth, we need to rely on numerical simulations.

What happens to the short-run growth rate of output depends on the interaction of several factors. First, the forward-looking relative wage x drops when the reform is announced, and investment in physical capital starts to fall immediately, which is bad for short-term growth (level effect). Second, the lifting of borrowing constraints permits more investment in education, which is good for growth (growth effect). Third, the supply of labor moves in the opposite direction from investment in education, which depresses short-run growth. Last, there are additional dynamic effects when the reform is anticipated. To assess the relative importance of these mechanisms, we must rely on simulations.

Two final comments on the specification of the model deserve attention.

In this model there are intergenerational externalities in human capital investment. The average level of human capital of the old generation raises the wage income of the young generation, and also raises the productivity of the human capital investment of the young generation. As a result, one would expect, even with perfect capital markets the market economy does not achieve the first best. When we compare the perfect market economy with the one with credit constraints, we are comparing two imperfect scenarios.[6] It will be of particular interest to study how the welfare of the different households is affected by financial reform.

At equilibrium there is also some inequality. The notion of inequality in this paper is very different from that in Galor and Zeira 1993 and Newman and Banerjee 1993. There, inherited wealth relaxes borrowing constraints. In these papers, there is nothing good out of inequality, and redistribution always improves efficiency. Here there is no inherited wealth, and inequality reflects differences in ability. Low inequality should therefore not be necessarily pursued on efficiency grounds.

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2.4 Dynamic Simulations

In section 2.3, we established that financial reforms that relax the borrowing constraints on households will lower the capital-labor ratio and improve growth in the long run if the number of constrained households is sufficiently high. However, the transitional impact of these reforms is less clear-cut and hard to characterize analytically. In order to study the interplay of long-run and medium-run forces along the transition path, we rely on simulations of a calibrated version of the model. This also allows us to assess the quantitative importance of liberalization for growth and inequality.

2.4.1 Calibration

We first choose functional forms for the production function of human capital and the distribution of abilities. The production of human capital has to satisfy the two limit conditions (4) to guarantee an interior solution for all agents. We use

$$\psi(\lambda) = b\left(\frac{1}{\gamma}\lambda^{\gamma} - \lambda\right).$$

The abilities index $(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}})$ is assumed to be distributed over the population according to a bivariate lognormal distribution; the mean[7] and variance-covariance matrix of the underlying normal distribution are respectively $(0, 0)$ and

$$\Sigma = \begin{pmatrix} \sigma_{\mathrm{Y}}^2 & \varrho\sigma_{\mathrm{Y}}\sigma_{\mathrm{O}} \\ \varrho\sigma_{\mathrm{Y}}\sigma_{\mathrm{O}} & \sigma_{\mathrm{O}}^2 \end{pmatrix}.$$

Since we have no direct information to calibrate the variance-covariance matrix, we carry out a sensitivity analysis of the correlation ϱ between the two ability variables and of their relative variance $\sigma_{\mathrm{Y}}^2/\sigma_{\mathrm{O}}^2$. The scope of the analysis is restricted by assuming a positive correlation, $\varrho > 0$. It also seems reasonable to assume that the ability to work when young is less widely dispersed than the ability to work when old. Indeed, ability in youth only reflects different endowments in efficient labor, while ability in old age also embodied the ability to accumulate human capital. We thus assume $\sigma_{\mathrm{Y}}^2/\sigma_{\mathrm{O}}^2 < 1$. Keeping this ratio constant, the absolute magnitude of the two variances are chosen to match an income inequality coefficient.

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The productivity parameter of the Cobb-Douglas production function A plays no role given that the utility is logarithmic; it only scales the output and capital levels. The capital share parameter α is fixed to one third according to the consensus in the literature. The psychological discount factor of households is set to 1 percent per quarter. Assuming that one period of the model is twenty-five years, we have: $\beta = 0.99^{100} = 0.366$.

For fixed ϱ and σ_Y^2/σ_O^2, there are four remaining parameters to calibrate: the growth rate of population n is directly observable; the productivity parameter b governs the long-term growth rate of output per capita; given b, the parameter γ determines the time spent on education in the first period of life; and, finally, the variance parameter σ_O^2 influences the distribution of income. We chose these parameters so that the steady state of the equilibrium with credit rationing matches some moments of a typical economy with imperfect credit markets. This representative economy is obtained from averaging eight economies considered by Bandiera, Caprio, Honohan, and Schiantarelli (2000) to have had strongly imperfect credit markets in the sixties. These are Chile, Ghana, Indonesia, Korea, Malaysia, Mexico, Turkey, and Zimbabwe.

The average growth rate of population and output is computed over the period 1960–1970 using the GDP data of the Penn World Tables. For the share of time devoted to education, we assume that the first period of the model covers ages 12–37 and the second one corresponds to ages 37–62. Doing so supposes that secondary and higher education are an alternative to working, but elementary education is not. The percentage of time devoted to schooling is therefore computed by adding the variables "average years of secondary schooling in the total population" and "average years of higher schooling in the total population" from Barro-Lee and dividing them by twenty-five. Finally, we summarize the distribution of income by a Gini index from Deininger and Squire (1996).[8]

These computations lead to the following four moments: an annual growth rate of population of 2.73 percent, a long-term per capita growth rate of 2.903 percent per year, a Gini coefficient of 0.458, and a share of time devoted to education of 2.901 percent. The value of n matching the growth rate of population is $n = 0.962$. The value of the other three parameters depends on the assumptions on ϱ and σ_Y^2/σ_O^2.

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Appendix 2A.4 gives the variance σ_{O}^2, which matches the Gini coefficient for different combinations of ϱ and $\sigma_{\mathrm{Y}}^2/\sigma_{\mathrm{O}}^2$. The parameters b and γ are picked to match output growth and schooling. Equilibrium outcomes are reported for the percentage of the young population rationed,

$$\int_0^\infty \int_{\varepsilon^{\mathrm{Y}} B/x_c}^\infty \varepsilon^{\mathrm{O}}\, dG(\varepsilon^{\mathrm{Y}}, \varepsilon^{\mathrm{O}}),$$

the saving rate,

$$\frac{1 - \alpha \mathscr{S}_c(x_c)}{\mathscr{H}_c(x_c)},$$

and the annual rate of return on capital,

$$\sqrt[25]{1/x_c} - 1.$$

We draw three conclusions from this sensitivity analysis. First, the percentage of households subject to a borrowing constraint is never large, and reaches at maximum 19 percent. Second, when the correlation between the two random ability indexes is large, few people are constrained: in that case, relative ability $\varepsilon^{\mathrm{O}}/\varepsilon^{\mathrm{Y}}$ displays little variation across households and few people want to borrow. Third, the saving rate lies between 8.8 percent and 9.8 percent[9] and the annual rate of return on capital is around 11.2 percent, whichever variance-covariance matrix we pick.

In order to choose a reasonable variance-covariance matrix Σ, we look at the characteristics of the distribution of income for different parameters values. Appendix 2A.5 reports income Gini indexes per cohort and the ratio of the mean to the median of the earnings distribution. We chose to use in the sequel $\varrho = 0.2$ and $\sigma_{\mathrm{Y}}^2/\sigma_{\mathrm{O}}^2 = 0.8$. A correlation of 0.2 seems reasonable, given a span of twenty-five years between the two ability shocks and the fact that ε^{O} incorporates the ability to learn while ε^{Y} does not. A relative variance of 0.8 reproduces a ratio of Gini indexes of $0.42/0.53 = 0.79$, which is close to U.S. data (see Diaz-Gimenez, Quadrini, and Rios Rull 1997). Figure 2.1 plots the corresponding density function of abilities. The vertical plane represents the threshold above which people are rationed. Constrained households lie on the left side of the picture and represent 15.5 percent of the population; they are those with a high income growth potential (either low ε^{Y} or high ε^{O}).

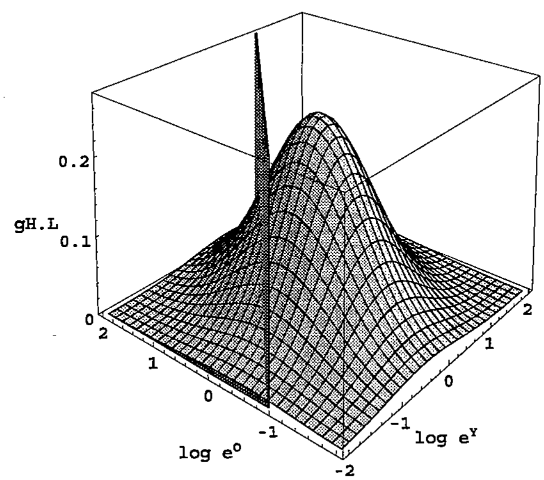

Figure 2.1
The distribution of abilities and rationed households.

2.4.2 *Response to Reform*

We now simulate the transition from a steady state with credit rationing to the one in the perfect market economy. The relaxation of the borrowing constraints takes place at time $t = 3$ and is anticipated one period in advance. Time $t = 1$ represents the initial steady state with credit constraints. Figure 2.2 represents the dynamic path of the three key variables, (x_t, k_t, and g_t^y), that is, relative wage, capital-labor ratio, and growth rate in per capita income. When liberalization is announced, the relative wage x_t looks forward; it jumps close to the steady-state level that will be reached at the time of the reform. This makes future wages less attractive and discourages investment in human capital at $t = 2$.

Because x_t is also the investment rate, the capital-labor ratio k_t starts declining at $t = 3$. The saving rate drops by half a percent. This decline in the stock of capital is key to explaining the drop in the annual growth rate at $t = 3$ from 2.9 percent to 2.7 percent over twenty-five years.

At $t = 3$ the ablest households are now allowed to borrow, increasing their investment in education and lengthening average schooling from 2.9 percent to 3.6 percent. This is not very large, but it is sufficient to drive growth above its initial level by about 0.15 percent.

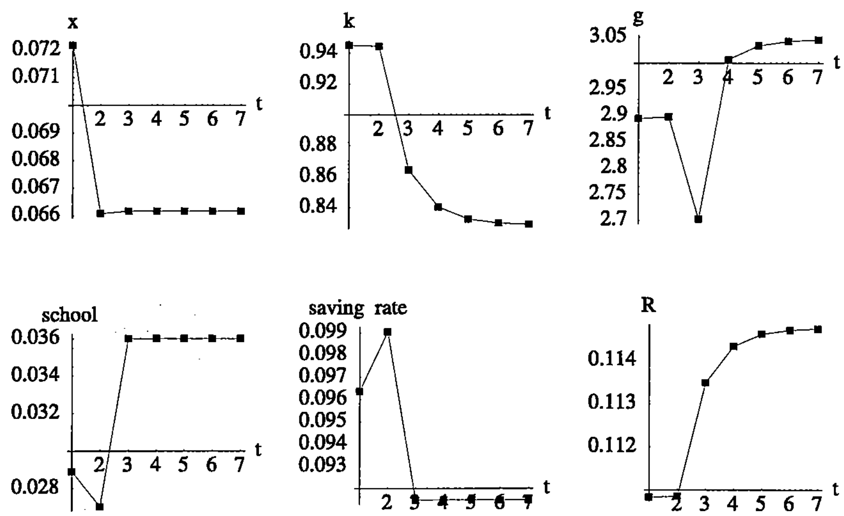

Figure 2.2
Dynamic responses to reform.

A sensitivity analysis of this magnitude to the chosen values of ρ and σ_Y^2/σ_O^2 is presented in appendix 2A.6: the gain is between 0 and 0.30 percent, and depends on the percentage of constrained households in the initial balanced growth path.

What might have happened if we had calibrated on the same set of economies for a different time period, or on an altogether different set of emerging economies? To see how our outcomes are sensitive to parameters, we summarize in table 2.1 the response of constraints, saving rates, and growth rates as the parameter structure changes relative to the baseline calibration. We conclude that the increase in long-term growth is largest in economies with high schooling and slow population growth, and smallest in economies with high capital share and low initial inequality. Changes typically show weak sensitivity to any single parameter and are almost completely insensitive to the pre-reform growth rate.

To better grasp the cost of this financial reform, figure 2.3 plots both the Gini coefficient and the difference between the GDP the economy would have enjoyed without reform and the one with the reform. Inequality peaks at $t = 3$ before stabilizing above its pre-reform level. The long-run effect is essentially explained by the fact that the ablest people can now fully exploit their advantage by going to school longer,

Table 2.1
Sensitivity analysis

	γ	B	σ_O^2	% constr.	Saving rate	Drop in saving rate	Gain in growth
Baseline case	0.234	0.739	0.74	15.5	9.6	−0.5	+0.15
More schooling (5% instead of 2.9%)	0.456	2.694	0.67	18.8	9.5	−0.6	+0.27
Slower population growth (1.6% instead of 2.9%)	0.210	0.619	0.74	18.0	8.5	−0.5	+0.17
Higher capital share ($\alpha = 1/2$)	0.370	1.982	0.67	8.2	8.1	−0.2	+0.08
Less inequality (Gini = 0.35)	0.232	0.877	0.41	10.5	8.8	−0.3	+0.07
Less output growth (1.5% instead of 2.9%)	0.234	0.523	0.75	15.6	9.6	−0.5	+0.15
More patience ($\beta = .995^{100}$)	0.152	0.359	0.77	12.1	14.0	−0.5	+0.08

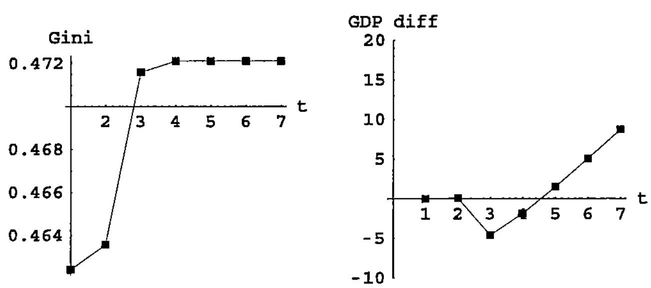

Figure 2.3
Costs of liberalization.

implying that old able persons are much richer in the perfect market economy than in the credit-constrained one.

The loss of output linked to the fall in physical capital also peaks at $t = 3$. It is around 5 percent at the time of the reform. It takes three periods to catch up and then overtake the level without reform.

Even though only 15.5 percent of the population was constrained in the initial state of the economy, financial reform leads to significant effects, both in the medium run and in the long run. We conclude that borrowing constraints may have a major impact on economic growth and inequality even if they affect a small fraction of households,

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provided that those include individuals with high income growth potential.

Gains from financial reform are displayed in figure 2.4, which describes the increment in life-cycle utility for members of different cohorts as a function of their abilities. Recall that the reform reduces the wage per unit of human capital from $t = 3$ onward and rises yields.

Looking first at the generations alive at the time of the liberalization, we can identify two gainers:

1. The cohort born at $t = 2$ (old at $t = 3$) with low relative ability $\varepsilon^{O}/\varepsilon^{Y}$ loses almost nothing in wages but do gain from the higher interest rate at $t = 3$; cf. the right side of panel (a).
2. The cohort born at $t = 3$ with high relative ability $\varepsilon^{O}/\varepsilon^{Y}$ gains from the lifting of the borrowing constraints; cf. the left side of panel (b).

On the contrary, a huge majority of young households born at $t = 3$ (cf. the right side of panel (b)) loses from liberalization, primarily because of lower wages per unit of human capital. Since in our model economy there is 1.962 young households for each old one, 32 percent of the total population living at $t = 3$ gains ($[1.962 \times 11 + 74]/2.962 = 32$).

Looking now at future generations, one out of two children of the generation born in $t = 4$ gain, essentially because they will benefit from the increase in GDP in their old days (see panel (c)). One hundred percent of the grandchildren gain (see panel (d)).

2.4.3 Compensating the Losers

Resistance to reform, which is at the root of slow financial liberalization, is directly related to a conflict going on between young and old, and between households with high- and low-income growth. Since this conflict will last for two generations and the reforms will increase total production, transfer schemes can be introduced to compensate the losers.

The timing of gains and losses suggests that public debt is one device that may allow all generations to share the gains from reform. In particular, suppose that the government pays subsidies to currently active households, by issuing public debt that will be repayed slowly by taxing future generations. Public debt will typically crowd out capital, amplifying the adverse level effect of the reform in the medium run

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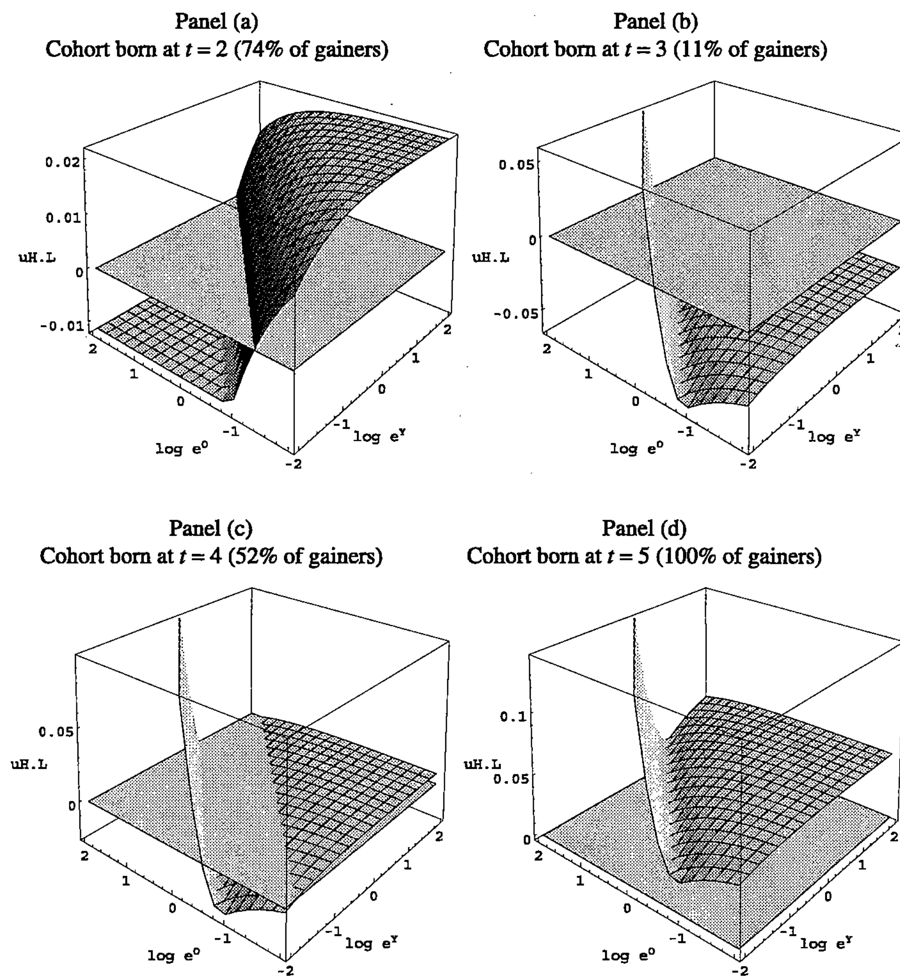

Figure 2.4
Gains in lifecycle utility by cohorts.

and undermining the favorable long-run growth effect. How to strike the right balance between medium-term redistribution and long-term incentives remains an open issue that deserves a careful analytical treatment.

Finally, as stressed by Fidrmuc and Noury (2003), ex ante acceptability of the reform can be ensured by a promise that the losers will be compensated ex post. However, such commitment may not be credible. Therefore, the reform program will likely receive greater political support ex ante when there are established frameworks for compensating losers such as an effective pension system compensating the old unskilled workers and/or when there are sufficient provisions for upholding the losers' interests (e.g., through a broadly representative system of government).

2.5 Reforms and Poverty Traps

Forty years ago, Arrow, Chenery, Minhas, and Solow (1961) taught us that economic analysis based on a unitary elasticity of substitution between labor and capital often leads to unduly restrictive conclusions. For example, estimates for developed countries consistently find that the elasticity of substitution is not different from unity, but much lower values have been found for LDCs.[10] This may reflect more limited technological options in emerging economies, namely, entrepreneurs choosing from the set of technologies in current or local use rather than from the broader set of all potential technologies.

In our specific context, we have two reasons to believe that lower substitution between production factors might affect the adjustment to financial reforms. First, it makes factor prices more sensitive to changes in the capital-labor ratio. Liberalization is thus expected to increase yields in a stronger way and to diminish the growth effect from human capital accumulation.

Second, CES technologies are consistent with poverty traps in the basic overlapping generations model (Azariadis 1996). If the initial capital-labor ratio is low enough, the economy will converge to the trivial steady state with zero capital instead of the one with high capital-labor ratio. In our setup, *financial reform tends to lower national saving and shrink the basin of attraction of the higher steady state*. As a result, more development paths will converge to the poverty trap. This is a powerful argument against reform: if the economy considered has an initial capital-labor ratio close to the region that leads to the poverty

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trap, the lifting of borrowing constraints that comes from financial reform may drive the economy *out* of the attraction basin of the high steady state.

Consider the class of CES production functions,

$$f(k) = A(\alpha k^{(\nu-1)/\nu} + 1 - \alpha)^{\nu/(\nu-1)},$$

with parameters $\nu, A > 0$ and $\alpha \in (0,1)$. We set the elasticity of substitution ν equal to one-half, which we regard as a lower bound on the actual elasticity. To better assess the role of the low elasticity of substitution, the parameters b, σ^2, β, and γ keep the same value as in the Cobb-Douglas case. We adjust the parameters A and α in order to obtain a high steady state as close as possible to the previous case in terms of both growth rate and capital share in production. With $A = 53.5$ and $\alpha = 0.425$, we obtain a steady state with imperfect market displaying the same growth and capital share as previously. All the other variables are very close to their level in the Cobb-Douglas case, and 15.8 percent of young households face borrowing constraints.

Figures 2.5 and 2.6 display the response to financial reform that follows the same timing as in the Cobb-Douglas case, namely, the reform is announced at $t = 2$ and takes place at $t = 3$. Compared to figures 2.2 and 2.3, we find three differences. First, as expected, the effect on yields is stronger: the return on capital rises from 11 percent to 11.7 percent instead of going from 11 percent to 11.5 percent as it did in the Cobb-Douglas case. Second, the drop in output at $t = 3$ is almost of the same magnitude as previously, but the long-run gain is *lower*. Third, the gains from the reform take more time to materialize: GDP takes four periods instead of three to catch up. As a consequence of the weaker growth effect, the long-term gains are much more modest; after seven periods, GDP is 4 percent greater than it would be without reform, instead of 10 percent in the Cobb-Douglas case.

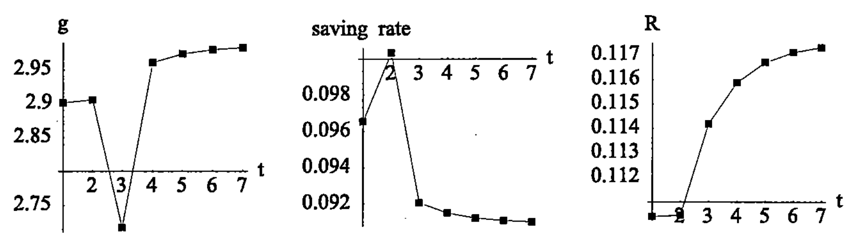

Figure 2.5
Dynamic responses to reform, CES case.

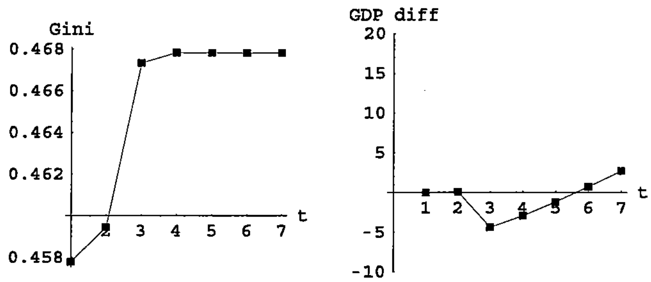

Figure 2.6
Costs of liberalization, CES case.

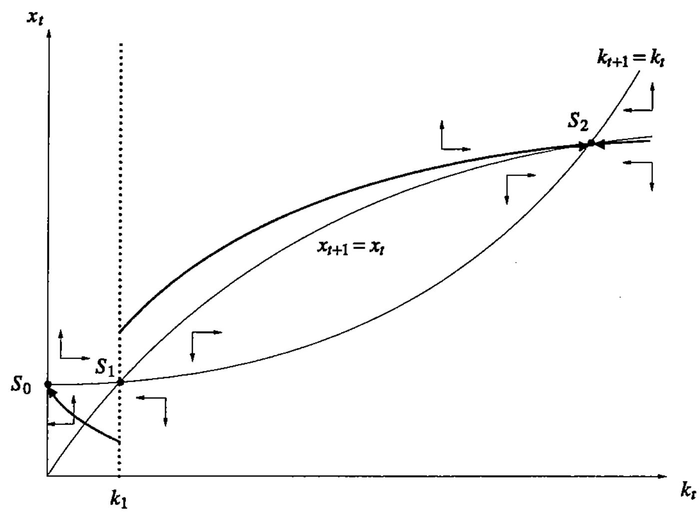

Figure 2.7
Phase diagram, CES case.

To evaluate more fully how financial reform alters the course of an emerging economy, we need to understand the global dynamics of an economy with credit rationing. This economy is described by equations (13) and (17), which lead to the phase diagram shown in figure 2.7. The phase lines $k_{t+1} = k_t$ and $x_{t+1} = x_t$ and the corresponding direction of motions are derived in section 2A.3. Depending on parameter values, the two phase lines may or may not intersect. Figure 2.7 represents the typical case where there are three steady states; point S_1 is a source and points S_0 and S_2 are saddles. If initial capital is below k_1, the equilibrium will converge to the trivial steady state S_0 in which there is no

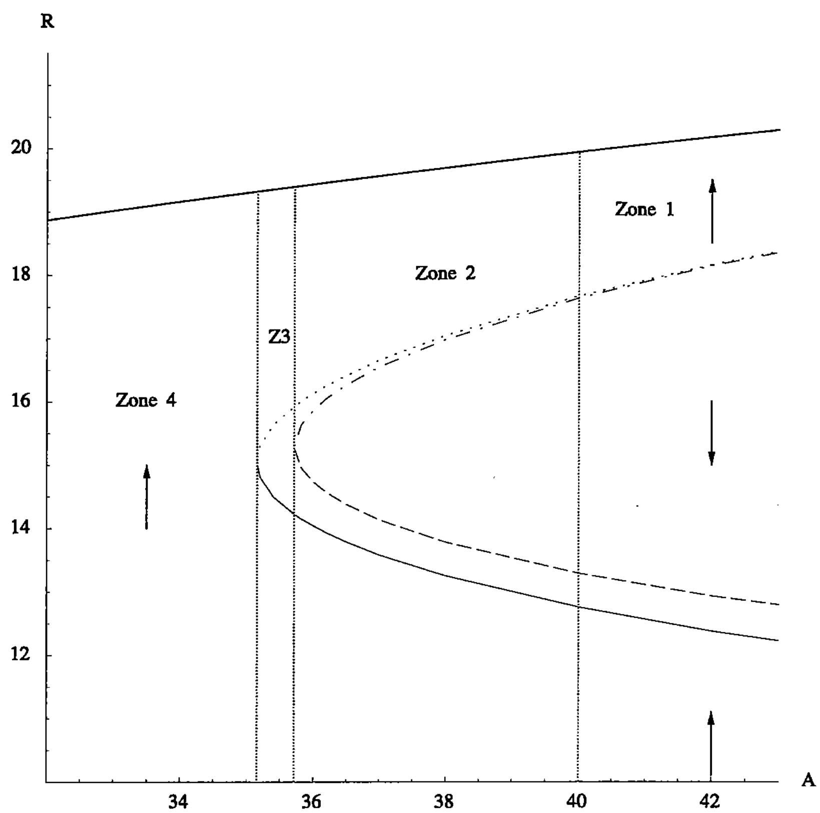

Figure 2.8
Bifurcation diagram for financial reforms.

production. If it is above, the equilibrium converges to S_2. Saddle paths are indicated by bold lines.

Credit market reform does not modify the position of the phase line $k_{t+1} = k_t$. Using the same arguments as in proposition 2, we can show that reforms moves the phaseline $x_{t+1} = x_t$ downward. Two situations may arise, depending on whether there is a positive steady state under a perfect credit market. This will depend crucially on values of the total factor productivity A and of the rate of time preference.

The bifurcation diagram in figure 2.8 shows how the existence of steady states, and their stability characteristics are sensitive to the value of the total factor productivity A. The annualized capital yield $R(k)$ is on the vertical axis, and total factor productivity on the horizontal one. All other parameters are set at their calibrated values of section