The Coevolution of the Real and Financial Sectors in the Growth Process

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The role of debt and equity changes over time and with the level of development. What are these changes, and why should they systematically occur across different countries and time periods? This article characterizes financial innovation as a dynamic process that both influences and is influenced by the development of the real sector. It focuses on the emergence and development of equity markets, using a model that allows for growth and for capital accumulation that is financed externally through a combination of debt and equity. As an economy develops, the aggregate ratio of debt to equity will generally fall; yet, debt and equity remain complementary sources for the financing of capital investments. The results suggest how various government policy actions might affect capital accumulation and equity market activity.

Economists have long believed that financial markets and institutions are important factors in determining “the wealth of nations.” In the last five years or so, there has been a veritable renaissance of interest in this topic. This growing, recent literature has produced several important new reasons to think that financial institutions matter very much in the development process. Most of this research, however, considers economies with a very limited class of financial markets, and often all investment is by assumption entirely financed either with debt or with equity. Debt and equity markets are therefore not active simultaneously.

Moreover, with some exceptions, the level of activity in financial markets does not evolve along with the economy, and the status of various markets is often exogenously imposed. Examples of the kind of literature we have in mind include Bencivenga and Smith (1991), Cooley and Smith (1992), Greenwood and Jovanovic (1990), Levine (1991), and Bencivenga, Smith, and Starr (1994, 1995, 1996). In the first three papers, all investment is financed by bank lending; in the last four papers, all investment is financed either inter-
nally or by issuing equity. Of this literature, only Greenwood and Jovanovic (1990) has a volume of financial market activity that explicitly evolves over time.

The treatment of financial markets in the modern theoretical literature is in sharp contrast with standard accounts of the role of financial markets in the growth process, such as those given by Gurley and Shaw (1955, 1960). They describe financial innovation as a dynamic process that both influences and is influenced by the development of the real sector. In poor, primitive environments, they observe, capital formation is accomplished primarily with entrepreneurs’ savings. As the economy grows, specialized lending institutions, such as banks, emerge and help finance additional capital investment. The loan claims produced in this process are held by the banks themselves and rarely traded. At this stage of development, entrepreneurs remain the only source of equity capital and are the sole residual claimants. With further increases in per capita income and wealth, markets for tradable securities, both debt and equity, emerge and complement (but do not replace) bank lending.

Gurley and Shaw did not ignore the fact that technological innovation can affect financial arrangements. But technological change was not the centerpiece of their theory of finance and development; rather, the endogenous, dynamical interaction of the financial and real sectors was. Their account of events is well supported by the data. Michie (1987) and Gurley and Shaw (1967) show how equity market development was strongly associated with real development in the history of the United States and the United Kingdom. And Antje and Jovanovic (1992) and Demirgüç-Kunt and Levine (1993, 1994) demonstrate that measures of equity market activity are positively correlated with measures of real activity, across different countries (and that the association is particularly strong for developing economies). Such observations are supported by the data reported in table 1.

The objective of this article is to provide a better understanding of the coevolution of the real and financial sectors of an economy as it develops. We are particularly interested in whether it is possible to produce a theoretical framework that stylistically reproduces the evolution of financial markets in the growth process. We focus here especially on the emergence and development of equity markets, and we put particular emphasis on three main questions: (a) Why does the development of equity markets occur relatively late in the development process? (b) When this development occurs, what social costs and what social benefits result? and (c) What kinds of government policy actions are likely to foster or inhibit the development of equity markets? These questions are clearly of central importance in the context of economic development: as Levine and Zervos (1995) demonstrate, measures of equity market activity are very strongly correlated with measures of real economic performance.

Since our focus here is on the interactions among real development, equity market development, and the financing of capital investment, we must pose these questions in an environment that allows for growth and capital accumulation. In addi-
Table 1. *Average Market Capitalization, Selected Economies, 1980–91*

| Economy                  | Percentage of GDP |
|--------------------------|-------------------|
| Australia                | 0.49              |
| Austria                  | 0.08              |
| Belgium                  | 0.31              |
| Brazil                   | 0.11              |
| Canada                   | 0.46              |
| Finland                  | 0.17              |
| France                   | 0.23              |
| Germany                  | 0.24              |
| Hong Kong                | 1.26              |
| India                    | 0.07              |
| Italy                    | 0.15              |
| Japan                    | 0.98              |
| Jordan                   | 0.48              |
| Korea, Republic of       | 0.22              |
| Malaysia                 | 0.88              |
| Mexico                   | 0.10              |
| Netherlands              | 0.46              |
| New Zealand              | 0.38              |
| Norway                   | 0.18              |
| Pakistan                 | 0.04              |
| Singapore                | 0.95              |
| Spain                    | 0.21              |
| South Africa             | 1.35              |
| Sweden                   | 0.43              |
| Switzerland              | 0.75              |
| Thailand                 | 0.21              |
| Turkey                   | 0.05              |
| United Kingdom           | 0.86              |
| United States            | 0.61              |
| Zimbabwe                 | 0.10              |

Source: Demirgüç-Kunt and Maksimovic (1995).

...tion, we need a model in which capital accumulation is financed externally through a combination of debt and equity, and in which the level of development of debt and equity markets itself affects investment behavior. Such a model is developed and formally analyzed in Boyd and Smith (1994c, 1995); here we sketch the main components and results of their analysis. We then use that analysis as a basis for a discussion of how a variety of different government policy activities might affect the development of equity markets. Section I presents an overview; section II describes the model we use; section III analyzes the contractual relation between borrowers and lenders. Sections IV and V describe, respectively, the nature of the contracts and the evolution of the real and financial sectors; section VI focuses on possible policy implications; and section VII offers conclusions.

I. Overview

The composition of the external finance that investors—and firms more generally—obtain represents the solution to a constrained minimization prob-
lem. Given the quantity of external finance required, and given constraints on the availability of certain kinds of finance, entrepreneurs will raise external funding in the lowest-cost way. Of course in practice the cost of external funds depends on a number of factors, including the level of market interest rates, the existence of various taxes, and the existence of various subsidies implicit in things like government credit or loan guarantee programs. It is these factors that suggest why government policy can be expected to affect the level of activity in equity markets.

The issue of what is the lowest-cost way of raising external funding is of necessity a somewhat subtle one, however. Modigliani and Miller, for example, described circumstances under which the composition of a firm's liabilities is completely irrelevant to the cost of obtaining external funding. Obviously, any theory that can successfully address why equity market development and real development are related must find a way of evading this implication of the justly celebrated Modigliani-Miller Theorem.

A common formulation that does evade the Modigliani-Miller Theorem, and often delivers a determinate liability structure, is the introduction of so-called bankruptcy costs, which are incurred when entrepreneurs cannot make contractual payments to creditors. Since the contractual payments called for by debt, unlike those called for by equity, are not contingent on firm performance, the composition of a firm's debt and equity affects the probability of bankruptcy and hence expected bankruptcy costs. The composition of a risk-neutral firm's external finance will be chosen to minimize the expected costs of raising funds externally, inclusive of these bankruptcy costs.

Under a theory of this type, if the role of debt and equity is changing over time and with the level of development, it must be the case that entrepreneurs will be perceiving corresponding changes in bankruptcy costs. But what are these changes, and why should they occur in a systematic way across different countries and time periods with the process of economic development? An answer to this question requires that we take a stand on the nature of these bankruptcy costs.

Fortunately, a well-developed model of the microeconomic foundations of bankruptcy costs exists, and we will exploit that model here. Specifically, we employ a standard costly state verification (CSV) model of the type originally developed by Townsend (1979), and subsequently extended by Diamond (1984), Gale and Hellwig (1985), and Williamson (1986). In this model, external creditors can observe some component of a firm's returns only by bearing a (fixed) cost. So long as the firm honors its contractual commitments, there is no need to monitor the firm's returns, and the external creditors do not incur monitoring costs. By contrast, when the firm cannot honor its commitments, external creditors must verify the firm's returns, and therefore incur these costs.

In the most standard CSV environments, the entire set of firm returns is unobservable (Diamond 1984; Gale and Hellwig 1985; Williamson 1986). This fact has a strong implication. Since equity claims promise payments based on firm
performance, and since firm performance is costly to observe, the use of equity would require that excessive verification costs be incurred. It is therefore optimal for firms to be 100 percent debt financed. Indeed, debt claims make contractual payments contingent on firm performance only in the event of a bankruptcy, and therefore the use of debt minimizes expected verification costs.

The CSV model cannot be adequate for our purposes because it predicts that equity markets will never be active. However, the CSV environment does provide a simple and tractable explicit model of bankruptcy costs. Therefore, we pursue the implications of a CSV model altered in one basic way. Whereas the conventional CSV literature gives investors access to only a single investment technology with unobservable returns, we give investors access to two technologies. In particular, we assume that physical capital can be produced using either of two technologies. One, the unobservable-return technology, yields a return that is freely observable only by the initiating investor, and hence is subject to the CSV problem. The other, the observable-return technology, yields a return that is freely observable to all agents. Under the assumption that the expected amount of capital produced (exclusive of verification costs) by the former technology exceeds that produced by the latter, agents undertaking capital investments face a tradeoff. The technology with the unobservable return is intrinsically more productive, but it is also associated with larger bankruptcy costs. Our analysis allows capital producers to make a choice as to how heavily they will use each technology; their choice will depend on the relative expected returns on the two technologies and on the perceived costs of state verification. When the perceived costs of verification are low, the unobservable-return technology will be particularly attractive, and its higher expected return implies that—when costs are perceived to be low enough—it will be used exclusively. In this event our model mimics the conventional CSV environment, and expected verification costs are minimized by having firms be 100 percent debt financed. Equity markets will not be active.

As the perceived costs of state verification rise, it will eventually become economical for capital producers to take actions to reduce the expected costs of state verification. The action they can take is to use more heavily the observable-return investment technology. The higher perceived verification costs are, the more heavily the observable-return technology will be used. Because the return on this technology is observable, it is not costly to issue claims that bear payments contingent on some aspects of firm performance, and hence some use of equity can be optimal. At the same time, so long as the unobservable-return technology is in use at all, the expected verification costs associated with it must be minimized. To do so, firms will continue to issue some debt. Indeed, as we demonstrate formally later, the minimization of expected verification costs will dictate that firms issue a determinate amount of debt and equity. Moreover, the

1. If the expected amount of capital produced by the observable-return technology is higher than that produced by the unobservable-return technology, then the latter technology is dominated and will never be used. This would leave us with a model where the Modigliani-Miller Theorem applies.
issue of some equity—when equity is used—reduces the cost of issuing debt. In this important sense, equity finance is not just a substitute for debt finance, but rather a complement of debt finance. This theoretical result is consistent with many empirical findings, such as those of Demirgüç-Kunt and Levine (1994), Rojas-Suarez and Weisbrod (1994), and Demirgüç-Kunt and Maksimovic (1995), suggesting the complementary nature of debt and equity market activity in the financing decisions of a firm, and in the general process of development.

According to the scenario we have described, the volume of equity market activity must increase as an economy develops because capital producers are more actively using the observable-return technology in an effort to reduce the expected costs of state verification. Why should capital producers be expected to use this technology more intensively as an economy becomes more developed? They will do so if and only if the perceived costs of state verification rise along with the development process.

In the model we describe later, entrepreneurs perceive relative verification costs that rise during the development process because entrepreneurs are engaged in the production of physical capital. As an economy develops, we typically expect the relative price of capital to fall, a proposition that is supported by a wealth of empirical evidence (see, for example, Greenwood, Hercowitz, and Krussell 1995). Suppose that state verification technologies use some combination of inputs, possibly capital and labor; the relative price of labor will rise in the development process, and certainly will rise relative to the price of capital. As a consequence, the costs of state verification must rise relative to the value of what entrepreneurs produce as an economy develops. This rise in perceived costs will, as we have argued, induce firms to use the observable-return technology more intensively and to raise more of their funds in equity markets. There is good evidence both that developing economies have higher per unit costs of bankruptcy (World Bank 1989) and that their firms rely less heavily on equity markets (Demirgüç-Kunt and Maksimovic 1995; Levine and Zervos 1995).

Although we think that this scenario is itself highly plausible, the intuition underlying it depends on few details of the model we present. Indeed, an intuitively simpler (but formally more complex) scenario is that development is associated with the use of increasingly more specialized and complex technologies. Thus as economies develop, external monitoring becomes more difficult, other things being equal; as a result, firms take more actions to economize on monitoring costs. This scenario will generate the same conclusions we have just described.

Our analysis also suggests that financial market frictions will be less severe in industrial economies than in developing economies. This appears to be consistent with observation (World Bank 1989), and indeed it is often argued that developing economies are less developed because their financial market frictions are more severe than those of their more developed counterparts (McKinnon 1973; Shaw 1973). In all our examples, economies that are more developed lose fewer resources (per unit of funding) because of the presence of intermediation.
costs than do less mature economies (see section V and Boyd and Smith 1995), a social benefit yielded by the development of equity markets and an endogenous outcome. Financial market frictions become less severe over time as a natural consequence of development. In this sense, the evolution of financial markets in the development process does tend to provide an economy with a more efficiently functioning set of capital markets.

Finally, our results provide several suggestions about the consequences of various government policies, both for the level of real activity and for the level of activity in equity markets. After pursuing the formal analysis, we offer an informal discussion of how various policy actions might affect capital accumulation and equity market activity. We focus particularly on policies that affect the opportunity costs of external finance, as many government policies do in practice. The analysis of how such policies affect both the financial system and the level of real activity has not previously been formally undertaken. Our results indicate that government policies which lower the opportunity cost of external funds should be expected to attenuate equity market development. A particular finding is that high inflation—which acts to reduce real interest rates—will interfere with the development of equity market activity. Again, such a finding is well supported empirically (Choi, Smith, and Boyd 1995).

II. THE MODEL

In this section we lay out a model that formalizes the intuition described in section I. Specifically, we consider an economy populated by a sequence of two-period-lived, overlapping generations, plus an initial old generation. Each generation has the same large population, and is identical in its composition. In particular, agents in each young generation are divided into two types, which we term borrowers and lenders. All borrowers are identical, ex ante, and borrowers constitute a fraction \( \alpha \in (0,1) \) of the population. All lenders are also identical, ex ante, and they constitute a fraction \( 1 - \alpha \) of the population. Lenders are endowed with one unit of labor when young, which they supply inelastically. They are retired when old. Borrowers are endowed with no labor, but are endowed with access to high-return investment projects, which are described later. All agents, both borrowers and lenders, are risk neutral and care only about old-period consumption; thus, all young-period income is saved.

There is a single consumption good at each date, which is produced according to a standard, commonly available constant-returns-to-scale production function with capital and labor as inputs. In particular, if \( K_t \) is the capital stock at time \( t \), and \( L_t \) is the labor input at time \( t \), then the production of final goods and services is given by \( F(K_t, L_t) \). In addition, if \( k_t = K_t/L_t \) is the capital-labor ratio at \( t \), then \( f(k_t) = F(k_t, 1) \) is the intensive production function. We maintain standard assumptions on \( f \); that is, \( f(0) \geq 0, f'(k) > 0, f''(k) > 0 \) for all \( k \geq 0 \), and \( f \) satisfies the usual Inada conditions. For simplicity, we also assume that capital is used in production and then depreciates completely.
Capital Production Technologies

Our assumptions imply that agents who can produce capital (borrowers or entrepreneurs) require external funding in order to do so. Our primary focus is on whether they raise this funding through debt or equity markets, and on the extent to which each set of markets is used. As argued in section I, an interesting analysis of this question requires that some type of bankruptcy cost be present. We therefore assume that capital can be produced at each date using one or more of the following three technologies:

a. There is a commonly available, nonstochastic linear technology whereby one unit of current output invested at \( t \) yields \( r > 0 \) units of capital at \( t + 1 \). In addition, there are two stochastic linear technologies that convert current output into future capital.

b. Technology \( \sigma \) (for observable return) produces \( y \) units of capital at \( t + 1 \) per unit invested at \( t \), where \( y \) is an independent and identically distributed (iid) (across agents and across time periods) random variable, realized at \( t + 1 \). We assume that \( y \in \{y_1, y_2, \ldots, y_N\} \), and we let \( p_n = \text{prob}(y = y_n) \). Obviously \( 0 < p_n < 1 \) for all \( n \), and \( \Sigma p_n = 1 \). Finally, we assume that for any investor the amount of capital yielded by investments in technology \( \sigma \) is publicly observable at zero cost.

c. Technology \( u \) (for unobservable return) is assumed to produce \( w \) units of capital at \( t + 1 \) per unit invested at \( t \); \( w \) is a continuous, iid (across investors and periods) random variable with cumulative density function \( G \) and probability density function \( g \); \( g \) is continuously differentiable with support \([0, w] \). In addition, the return on investments in technology \( u \) can be observed (by any agent other than the initiating investor) only by bearing a fixed cost of \( \gamma > 0 \) units of the current consumption good. Thus, a CSV problem arises for investments in technology \( u \).

We assume that only borrowers are endowed with access to the investment technologies \( \sigma \) and \( u \), and ownership of these investment opportunities cannot be traded. Moreover, we impose an upper bound on the scale at which any borrower can operate the investment technologies. Thus, we let \( i^o \) be the investment in technology \( \sigma \), and \( i^u \) be the investment in technology \( u \), by a representative borrower at \( t \), and we let \( i = i^o + i^u \). Then each borrower faces the maximum scale of operation constraint \( i \leq q \), where \( q \) is an exogenously given parameter. The assumption of linear capital production technologies, along with the existence of an upper bound on their operation, will make it easy to determine how much external finance each entrepreneur desires. Finally, we define \( \theta = \frac{i^o}{i^o + i^u} \) to be the fraction of total investment done in technology \( \sigma \) by a representative borrower.

Define \( \hat{y} = \Sigma n p_n y_n \) to be the expected gross return (in units of capital) on investments in technology \( \sigma \), and \( \hat{w} = \int \hat{w} \text{eg}(w)dw \) to be the expected gross return (in units of capital), not inclusive of verification costs, on investments in technol-
ogy u. We assume that \( w > y > r \). Thus, the commonly available technology is relatively unproductive. It should be clear that, unless \( w > y \) holds, the unobservable-return technology will never be employed.

Finally, we assume that the initial old agents are endowed with \( K_0 > 0 \) units of capital per capita. No agents thereafter are endowed with either capital or the consumption good.

### Trade and Finance

Two kinds of trade take place in this economy: capital and labor are rented in competitive factor markets, and funds are transferred from lenders to borrowers. The inherited capital stock (the proceeds of the previous period's investment) and labor are both supplied inelastically. Both factors are demanded by competitive producers and hence are paid their marginal products. Thus, if \( \omega_t \) is the real wage rate at time \( t \), and \( p_t \) is the rental rate for capital at time \( t \), we have

\[
(1) \quad \rho_t = f'(k_t)
\]

\[
(2) \quad \omega_t = f(k_t) - k_t f''(k_t) = \omega(k_t).
\]

Clearly, \( \omega'(k_t) > 0 \) holds, for all \( k_t \).

We assume throughout that the potential supply of funds by lenders is at least as great as the demand for funds by borrowers. The supply of funds by lenders is \((1 - \alpha)\omega_t\) at \( t \), since lenders save their entire young-period income. The maximum demand for funds by borrowers is \( c q \). Hence we assume that

\[
(3) \quad (1 - \alpha)\omega(k_t) \geq \alpha q
\]

for all relevant values of \( k_t \). When equation 3 holds, any marginal savings must be invested in the commonly available technology, yielding \( r \) units of capital per unit invested. Thus, the opportunity cost of funds faced by lenders at \( t \) must equal \( r \rho_{t+1} \), since the rental value of the capital obtained at \( t + 1 \) is \( \rho_{t+1} \).

### III. Funding Contracts between Borrowers and Lenders

A funding contract specifies a quantity of resources that will be transferred to a particular borrower \( i_t \), as well as how these resources will be allocated among technologies o and u. We assume that external investors can observe both \( i_t \) and the allocation of investments among the two investment technologies. In addition, the contract specifies a set of payments that are contingent on firm performance. Since the return \( y \) is observable, repayments can always be made contingent on it. However, since the return \( w \) can be observed externally only if monitoring (or verification) occurs, repayments can only meaningfully be made contingent on \( w \) if state verification occurs. Hence a contract must specify a set
of states $A_t(y)$, in which monitoring will occur, and $B_t(y)$, in which monitoring will not occur at $t + 1$. This set can obviously be conditioned on $y$. In monitoring states only, repayment can also be made contingent on $w$. We let $R_t(w, y)$ be the promised repayment at $t + 1$, in units of consumption and per unit borrowed at time $t + 1$, if monitoring occurs at that date. In addition, we let $x_t(y)$ be the promised repayment at $t + 1$, in units of consumption and per unit borrowed at time $t + 1$ if monitoring does not occur.

Funding contracts are assumed to be announced by borrowers and either accepted or rejected by lenders. In order to avoid rejection, such contracts must satisfy the following three constraints.

a. Contracts must be feasible, that is, specify nonnegative consumption levels for borrowers. Thus, a borrower’s repayment can never exceed the borrower’s total available resources, or

$$R_t(w, y) \leq \rho_{t+1}(\theta, y + (1 - \theta)w)$$

must hold. Note that $\rho_{t+1}$ appears as it does in equation 4a since investment returns are in units of capital, while repayments are in units of consumption.

b. Contracts must be incentive compatible, so that borrowers have an incentive to announce truthfully when a monitoring state has occurred. They will do so if and only if repayments are lower in monitoring than in nonmonitoring states, or if and only if

$$R_t(w, y) < x_t(y), \quad \text{for all } w \in B_t(y).$$

c. Since lenders can always invest in the commonly available technology, the expected repayment—per unit borrowed—must at least equal the opportunity cost of funds ($\rho_{t+1}$) plus expected monitoring costs (which, without loss of generality, we assume are born by lenders). Note that we abstract from stochastic monitoring (see Boyd and Smith 1994b for a defense). Thus, contractual repayments must satisfy the expected return constraint

$$\sum_{\omega \in A_t(y)} R_t(\omega, y) g(\omega) dw + \sum_{\omega \in B_t(y)} x_t(y) g(\omega) dw \geq \rho_{t+1} I_t.$$
subject to equations 4, 5, and 6.

This completes the specification of the model environment and the description of how agents behave. We now describe the solution to the contracting problem of borrowers as a prelude to an analysis of the evolution of the capital stock, real activity, and the volume of equity market transactions.

IV. THE NATURE OF EQUILIBRIUM CONTRACTS

Boyd and Smith (1994c) show that equilibrium contracts between borrowers and lenders have the following properties. First, borrowers operate their investment projects at the largest possible scale, so that $i_t = q$. There is no reason for them not to do so, since the fact that $\hat{y} > r$ implies that unused capacity can always be profitably exploited. Second, if the borrower’s ex post return $[\theta_t y + (1 - \theta_t)w]_{p_{t+1}}$ is no less than the promised payment $x_t(y)$, it is feasible for borrowers to fully meet their external commitments and to avoid state verification, thereby minimizing verification costs. Third, if the ex post return is less than $x_t(y)$, it is not feasible for borrowers to meet their contractual commitments. In this case, providers of external funding monitor the firm, learn the true value of $w$, and retain the entire value of the firm’s output. All of these results are direct analogs of findings in conventional CSV models (Diamond 1984; Gale and Hellwig 1985; Williamson 1986).

It will now be useful to define a new variable. Let

$$z_{nt} = \frac{[x_t(y_n)]}{p_{t+1}} \times \theta_t y_n / (1 - \theta_t).$$

Formally, $z_{nt}$ is the smallest possible realization of $w$, conditional on $y = y_n$, that enables an entrepreneur to meet contractual commitments and to avoid verification. In other words, if $y = y_n$ at $t$, then monitoring occurs if and only if the return on technology $u$ is less than $z_{nt}$. In effect, then, the variables $z_{nt}$ govern the conditional probability (and expected cost) of state verification. If $y = y_n$ at $t$, the probability of monitoring is just $G(z_{nt})$. In addition, since $w$ and $y$ are independent, if the borrower’s optimization problem displays enough concavity, borrowers will wish to smooth monitoring costs across realizations of $y$. Hence $z_{nt} = z_{nt} = \ldots = z_{nt} = z_t$ holds, and the probability of state verification, $G(z_t)$, will be independent of the realization of $y$. Thus, the variable $z_t$ indexes the amount of state verification that is associated with a particular contract.

The optimal value of $z_t$ depends on two endogenous factors. First, it depends on the composition of a borrower’s investment between technologies $o$ and $u$; that is, on $\theta_t = i_t / i_r$. Note that this composition is chosen by the borrower. The higher is $\theta_t$, the more investment is done in the observable-return technology,
permitting less monitoring to occur, so that higher values of \( \theta \) are associated with lower values of \( z \). Second, \( z \) depends on the relative cost of monitoring, \( \tau_{t+1} = \gamma q p_{t+1} \). Monitoring uses \( \gamma \) units of final goods and services; \( \gamma q \) is this cost relative to the size of individual investment projects. Dividing this quantity by the relative price of capital gives monitoring costs measured in units of capital. Since investment projects yield capital, this puts monitoring costs and investment returns in comparable units. The cost of monitoring is taken as parametric by the borrower, but it is endogenous to the economy. To denote the dependence of \( z \) on \( \theta \), and on \( \tau_{t+1} \), we write \( z = z(\theta; \tau_{t+1}) \). \( z(\theta; \tau_{t+1}) \) must be chosen, given \( \theta \) and \( \tau_{t+1} \), so that providers of external funding receive the market-expected return \( (r p_{t+1}) \) on their investments at \( t \).

As we have argued, the probability of monitoring is simply \( G(\theta) = G[z(\theta; \tau_{t+1})] \). Entrepreneurs then want to choose \( \theta \) to maximize the expression

\[
q p_{t+1}[\theta \gamma + (1 - \theta) \hat{w} - r - \tau_{t+1} G[z(\theta; \tau_{t+1})]].
\]

In particular, \( q p_{t+1}[\theta \gamma + (1 - \theta) \hat{w}] \) is the expected amount of capital produced, valued at the market price of capital; \( q p_{t+1} r \) is the expected return that must be offered to obtain \( q \) units of funds, and \( q p_{t+1} \tau_{t+1} G[z(\theta; \tau_{t+1})] \) represents the expected costs of state verification. Each borrower chooses \( \theta \) to maximize the expression in equation 9. That expression clearly reflects the following tradeoff: higher values of \( \theta \), reduce the expected amount of capital produced, but they also reduce the probability of monitoring, \( G[z(\theta; \tau_{t+1})] \). The higher is \( \tau_{t+1} \), the greater is the value of a reduction in monitoring costs; hence we expect the optimal choice of \( \theta \), to rise with \( \tau_{t+1} \). To denote the relation between the choice of \( \theta \) and the scaled monitoring cost \( \tau \), let \( \theta^*(\tau) \) denote the borrower’s optimal choice of \( \theta \). Boyd and Smith (1994c) describes formal conditions under which the intuition above is valid and, in particular, under which

\[
(10) \quad d\theta^*/d\tau \geq 0.
\]

The solution to the borrower’s problem is completely summarized by the composition of investment \( [\theta^* = \theta(\tau_{t+1})] \), by the amount of monitoring called for \( [z^* = z(\theta^*; \tau_{t+1})] \), and by the repayment schedules \( x_t(y) \) and \( R_t(u, y) \). Once the borrower’s problem has been solved, however, we are left with the further problem of how the optimal contract can be supported in the marketplace. We now describe how an optimum can be implemented by having borrowers issue an appropriate mix of debt and equity.

An optimal funding contract calls for a repayment rate of \( x_t(y) \) if state verification does not occur at \( t + 1 \), where

\[
(11) \quad x_t(y) = \rho_{t+1}[(1 - \theta)z(\theta; \tau_{t+1}) + \theta \gamma].
\]

Notice that this promised repayment consists of the sum of two terms;
\( p_{t+1}(1 - \theta_i)z(\theta_i; t_{t+1}) \), which is not contingent in any way on firm performance, and \( p_{t+1}\theta_iy \), which depends on the observable component of firm performance \( y \). Standard usages of the terms direct us to label the first component as the return to debt holders in nonmonitoring states, and the second component as the return to equity holders. In the CSV literature, payments that are not contingent on firm performance in nonverification states are associated with debt. In addition, Boot and Thakor (1993) call securities that use information about firm performance (here about \( y \)) "equity," while they call securities that do not use information about firm performance "debt." Both terminologies are consistent with our usage of the terms debt and equity. (It should be noted that no part of our analysis is inconsistent with the possibility that a firm's debt—or even equity—is held by intermediates.)

In order to determine the amount of debt and equity issued by a representative firm, it is necessary to determine how monitoring responsibilities are allocated between debt and equity holders. Following standard interpretations, we assume that debt holders are paid first. If it is infeasible to make the promised total payment, which is \( q(1 - \theta_i)z(\theta_i; t_{t+1})p_{t+1} \), to debt holders, debt holders monitor and become residual claimants on investment returns. If the returns on investments are large enough to repay debt holders, but not large enough to fully repay both debt and equity holders—in the amount \( qx_i(y) \)—debt holders are fully repaid while equity holders receive less than promised. Equity holders then verify the return and retain all firm income (net of monitoring costs), less payments to debt holders. We assume that both debt and equity holders can coordinate their monitoring activity, thereby avoiding duplication of monitoring effort.

This interpretation of monitoring—and of which agents perform it—is inconsistent with the standard terminology employed in the existing CSV literature in one significant way. Specifically, equity holders cannot literally be construed as forcing firms into bankruptcy proceedings, and therefore we should no longer refer to all states in which monitoring occurs as bankruptcy states. Nonetheless, the interpretation that some monitoring is done by equity holders does reflect what is often observed in practice when firms experience low profits but are still able to cover their payments of principle plus interest. Under these circumstances there is likely to be a conflict between the outside equity holders and the inside owner-managers. Outside equity holders cannot force bankruptcy, but they can undertake a variety of costly actions against inside owner-managers; such actions, among other things, have the effect of uncovering information about the firm and include the hiring of outside auditors, various attempts to force changes in firm policies, or even attempts to replace the incumbent management. These kinds of actions may be channeled through the board of directors, or even through formal class action suits, and hence are coordinated among external equity holders. In the model all of these activities are, of necessity, represented by costly monitoring.

Given these allocations of payments and monitoring responsibilities among debt and equity holders, the quantities of debt and equity issued by any bor-
rower are determined by two considerations. First, the real value of debt \(d_t\) and equity \(e_t\) issued at \(t\) must raise the necessary external funds (that is, \(i_t = q = d_t + e_t\) must hold). Second, both debt and equity holders must obtain the market expected return \((r_{p_t})\) between \(t\) and \(t + 1\) on their assets. These two sets of conditions completely determine \(d_t\) and \(e_t\). Loosely speaking, it is economical to issue equity only when technology \(o\) is used. Thus, if \(\theta_o = 0\), then \(e_t = 0\). By the same token, debt is employed to minimize the verification costs associated with technology \(u\). Thus, if \(\theta_u = 1\), no debt is required, and \(e_t = q\) (the firm is 100 percent equity financed). For values of \(\theta\), between 0 and 1, higher values of \(\theta\), are generally associated with greater use of equity, for given values of the relative monitoring cost parameter \(t_{u,1}\).

It is also true that, for given values of \(\theta\), higher values of \(t_{u,1}\) (higher monitoring costs) tend to be associated with less use of equity. (See Boyd and Smith 1994c for a formal statement.) When \(t_{u,1}\) rises, in general entrepreneurs will be induced to take actions to further economize on state verification, so that \(\theta^*\) will rise as well. Such actions tend to increase the volume of equity issued. Thus, theoretically, the net effect of higher values of \(t_{u,1}\) on the volume of equity issued is ambiguous. Examples produced by Boyd and Smith (1994c, 1995) suggest that, when \(t_{u,1}\) rises, we should typically expect \(\theta(t_{u,1})\) to rise enough so that firms increase their reliance on equity finance. In other words, it is reasonable to expect that higher perceived monitoring costs lead to the increasingly heavy utilization of technology \(o\). Since investment in this technology is associated with the use of equity, higher perceived monitoring costs are also typically associated with a greater volume of equity market activity.

V. General Equilibrium: The Evolution of the Real and Financial Sectors

In this section, we integrate the analysis of investment and financing choices of a firm into a conventional neoclassical growth model of the Diamond (1965) variety. The result is a standard one-sector growth model, with one exception. As in most one-sector growth models, starting from some initial capital stock, the economy will (under one technical condition) converge monotonically to a steady-state capital stock and output level. Again, as in most (one- and two-sector) growth models, the accumulation of capital will imply that the marginal product of capital, and hence its relative price, declines as an economy develops.

In our model, this decline in the relative price of capital has three closely related implications that are not present in more standard models. First, entrepreneurs are engaged in the production of capital, but state verification consumes final goods and services. The latter is not essential, as we discuss in more detail below. Thus, the price of what entrepreneurs produce falls relative to the cost of monitoring or, in other words, the perceived relative cost of monitoring rises in the development process. Second, as we have argued, the decline in the relative price of capital causes entrepreneurs to shift the composition of invest-
ment toward the observable-return technology, in order to economize on (increasingly expensive) state verification. This shift in the composition of investment is typically associated with the increasingly heavy use of equity markets. And third, as the composition of investment changes, less monitoring occurs, and the quantity of resources consumed by the presence of the CSV problem declines. This is the social benefit associated with the development of equity markets, and it conforms to the observation that the development of direct transactions in securities tends to reduce the costs of intermediation (Watson and others 1986).

Of course this benefit is gained only at some cost. The shift in the composition of investment implies that less capital is being produced over time per unit invested. It is this cost—which is highest when the capital stock is relatively low and capital has a high relative price—that prevents large levels of equity market activity early in the development process. We now formalize this intuition.

Capital Accumulation and Production

If the capital-labor ratio at time $t$ is $k_t$, then each young lender earns $\omega(k_t)$, all of which is saved. Hence per capita savings is $(1 - \alpha)\omega(k_t)$. Each young borrower seeks to obtain $q$ units of funds, and hence the per capita demand for external funding is $\alpha q$.

In equilibrium, any savings in excess of $\alpha q$ must be invested in the publicly available capital production technology. Hence, the level of investment in this technology is—in per capita terms—$(1 - \alpha)\omega(k_t) - \alpha q$, and the quantity of capital at $t + 1$ produced using this technology is $r[(1 - \alpha)\omega(k_t) - \alpha q]$. In addition, of the $\alpha q$ units of funds obtained by borrowers, a fraction $\theta^*_o$ is invested in technology $o$ at $t$, yielding $\hat{y}$ units of capital per unit invested, while $1 - \theta^*_o$ is invested in technology $u$ at $t$, yielding $\hat{w}$ units of capital per unit invested. The per capita capital stock at time $t + 1$ is given by the sum of these terms;

$$K_{t+1} = \alpha q[\theta^*_o\hat{y} + (1 - \theta^*_o)\hat{w} - r] + r(1 - \alpha)\omega(k_t).$$

Converting the left-hand side of equation 12 into a capital-labor ratio $[K_{t+1}/(1 - \alpha)]$ yields

$$k_{t+1} = [\alpha(1 - \alpha)]q[\hat{w} - r - (\hat{w} - \hat{y})\theta^*_o] + r\omega(k_t).$$

Given the initial capital-labor ratio $k_0$, equation 13 describes the evolution of the equilibrium sequence of capital stocks $[k_t]_{t=0}^{\infty}$.

If equation 10 holds, then it is easy to confirm that equation 13 gives $k_{t+1}$ as an increasing function of $k_t$. This function is depicted for a particular set of parameter values in the upper right-hand quadrant of figure 1. In this figure there is a unique, asymptotically stable, steady-state equilibrium capital-labor ratio, denoted by $k^*$. Boyd and Smith (1995) shows that, if equation 10 holds and if $\gamma \alpha q \geq k(1 - \alpha)$, then there necessarily exists at least one asymptotically
IV. Quantity of monitoring

State verification occurs if $w < z_t$

Composition of investment, $\theta^*$

III. Composition of investment

II. Equity ratio

Equity ratio, $E/Q$

I. Capital stock

Next-period capital stock, $K_{t+1}$

Current-period capital stock, $K_t$

stable steady-state equilibrium with $(1 - \alpha)\omega(k^*) > \alpha q$. Any such steady-state equilibrium is approached monotonically. If $k_o < k^*$ holds, the capital stock—as well as the level of real activity—will rise over time as the steady state is approached.
Relative Monitoring Costs Rise over Time

As we have just described, under the appropriate technical assumptions \( \{k_i\} \) is an increasing sequence. It follows that \( \{t_i, i\} = \{t(k_i, i)\} \) is an increasing sequence as well, so that borrowers perceive effective monitoring costs that are rising over time. This fact has an important implication. If equation 10 holds (which it does uniformly in the examples reported by Boyd and Smith 1994c, 1995), then \( \{\theta^*_i\} \) is also increasing over time. Thus, as an economy develops, an increasing fraction of investment will take place in the observable-return technology. As a consequence, the development process will be accompanied by a declining (gross of verification cost) return on investment.

This shift in the composition of investment also allows for the possibility that total resources consumed in state verification decline as an economy grows. In particular, resources used in monitoring in real terms are given by \( \alpha_\gamma C[z(\theta^*_i; t_{i^*})] \), per capita. As \( k \) rises, the variable \( z_i = z(\theta^*_i; t_{i^*}) \) that describes the amount of monitoring can, theoretically speaking, either rise or fall. However, it is intuitive that it should fall; an intuition confirmed by all of the numerical examples reported by Boyd and Smith (1995). Thus, we expect more advanced economies to typically use fewer resources (and a smaller fraction of total resources) in dealing with financial intermediation costs. Because our model has a fixed quantity of total resources \( (\alpha q) \) always being transferred to entrepreneurs, the analysis does not distinguish between a decline in the unit costs and a decline in the total costs of intermediation. A more general analysis would have more funds being transferred in financial markets as an economy develops. Such an analysis would then predict that the unit costs of intermediation fall with development, although the behavior of total costs would depend on the rate of growth of intermediary activity.

In this sense, then, developing economies will appear to face financial market frictions that are more severe than those their industrial counterparts face. However, in the model, this outcome is purely endogenous and does not depend on their financial systems being intrinsically more severely flawed. In the sense described above, the evolution of financial market activity provides an economy with an increasingly more efficient set of financial markets as that economy develops. Developing economies naturally tend to display relatively large costs associated with informational asymmetries.

Activity in Equity Markets

The equilibrium equity ratio \( e'/q \) may, theoretically, either increase or decrease with the growth process. However, all of the numerical examples produced by Boyd and Smith (1994c, 1995) have the property that \( e'/q \) is increasing in \( t \). Thus, as an economy develops, capital is accumulated, and \( t \) increases, our results suggest that the typical observed pattern should be that the volume of equity market activity increases over time. This prediction is consistent with a wealth of empirical evidence documenting the strong positive correlation be-
between the level of activity in equity markets and real development (Antje and Jovanovic 1992; Demirgüç-Kunt and Levine 1993, 1994; Demirgüç-Kunt and Maksimovic 1995; Gurley and Shaw 1967; Levine and Zervos 1995; Michie 1987).

In order to illustrate the theoretical coevolution of the real and the financial sectors in the growth process predicted by our model, we present a numerical example that is fully general equilibrium in nature. Given a specification of a probability distribution for \( w \), equation 13 and the definition of \( \ell(k, t) \) describe the equilibrium law of motion for \( k, t \) which we trace out and represent diagrammatically in figure 1. Once \( k, t+1 \) is obtained for each value of \( k, t \), we can compute the corresponding values of the equilibrium relative monitoring cost parameter, \( \varepsilon^* \), the equilibrium composition of investment, \( \theta^* \), the equilibrium quantity of monitoring, which is related to \( z^* \), and the equilibrium equity ratio \( e^* \). Figure 1 depicts how each of these variables evolves as the economy moves along its growth path. In addition, the total resources consumed by monitoring (measured in units of current consumption) at \( t \) are \( \alpha \gamma G(z^*_{t-1}) \). Thus, figure 1 illustrates how the resource loss implied by the existence of the credit market friction changes as an economy develops.

In order to trace out the equilibrium law of motion for \( k, t \), it is necessary to specify a set of parameter values \( (w, y, r, \alpha, q, \gamma, B, \beta) \), a production function \( f(k) \), and a probability distribution for \( w \). Here we assume Cobb-Douglas production, so that \( f(k) = Bk^\alpha \). In addition, we assume that \( w \) has the following triangular distribution:

\[
g(w) = \begin{cases} 
\frac{4w}{w^2}; & 0 \leq w \leq \bar{w}/2 \\
\frac{4(\bar{w} - w)}{w^2}; & \bar{w}/2 \leq w \leq \bar{w}.
\end{cases}
\]

Equation 14 yields an analytically tractable, symmetric, and unimodal distribution of returns on technology \( u \).

Given our assumptions on the production function and the probability distribution of returns on technology \( u \), a specification of the vector \( (\hat{w}, \hat{y}, r, \alpha, q, \gamma, B, \beta) \) is sufficient to allow us to derive the values of \( k, t+1, \ell, t+1, \theta^* \), and \( z^* \), corresponding to each value of \( k, t \). In addition, the determination of \( e^* \) requires that the entire probability distribution for \( y \) be specified.

An Example

This example is drawn from Boyd and Smith (1995). We set \( N = 2, y_1 = 0.01, \) and \( y_2 = 4.551 \), with \( p_1 = p_2 = 0.5 \). Thus, \( \hat{y} = 2.2805 \). Equation 14 implies that \( \hat{w} = \bar{w}/2 \). In addition, we set \( \hat{w} = 2.5, r = 0.5, \alpha = 0.5, q = 1.0, \gamma = 0.8, B = 2.0, \) and \( \beta = 0.5 \).

Figure 1 depicts various aspects of how the capital stock (or capital-labor ratio) and other equilibrium quantities evolve as an economy develops. The upper right-hand quadrant of figure 1 represents the equilibrium law of motion for
$k$, given these parameter values. As noted previously, $k_{t+1}$ is a monotone increasing function of $k_t$. There is a unique nontrivial steady-state equilibrium capital-labor ratio satisfying all of our hypotheses and, in addition, the steady state is asymptotically stable. The steady-state value of the capital-labor ratio is approximately 2.83, and steady-state per capita output is about 1.68.

The lower right-hand quadrant of figure 1 depicts what the equilibrium equity ratio ($e^*_t/q$) would be for each value of the current capital-labor ratio. For low-enough values of $k$, the relative cost of state verification is small enough that $\theta^* = 0$. When this occurs, all investment by borrowers is done in technology $u$, all external finance takes the form of debt, and the equilibrium quantity of equity is zero. Thus, at low current capital stocks, there is no equity market activity.

Over time, of course, $\{k_t\}$ will be an increasing sequence, and once $k_t$ is large enough (here greater than or equal to about 1.2), equity market activity will begin to be observed. The steady-state equilibrium value of the equity ratio for this economy is approximately 0.1, so at the early stages of its development this economy can have no equity market activity. As it approaches its steady state, however, equity market activity will emerge endogenously, and ultimately equity finances a significant fraction of capital investment. For this example, market capitalization is about 3 percent of gross domestic product (GDP) in the steady state. This approximates observed market capitalizations in Pakistan and Turkey (see table 1).

The upper left-hand quadrant of figure 1 shows the value of $z^*_t$ (the return realization below which monitoring occurs) corresponding to each value of $k_{t+1}$. If $\{k_t\}$ is an increasing sequence, $\{z^*_t\}$ is a decreasing sequence so that, as this economy develops, the quantity of resources expended in state verification declines. (This property is shared by all of the examples reported in Boyd and Smith 1995.) In this sense, the evolution of the debt and equity markets that goes on during the development process provides this economy with more-efficient capital markets.

This reduction in monitoring costs is made possible by the fact that the composition of investment ($\theta^*_t$) changes along with $k$. The behavior of $\theta^*_t$ is displayed in the lower left-hand quadrant of figure 1. As this figure suggests, the variation of $\theta^*_t$ over time is quite important in delivering the fairly intuitive result that financial market frictions consume fewer resources as an economy develops.

Of course we do not intend to imply that the share of the intermediary sector in real activity typically declines in the development process. This is obviously not the case. What we do mean to imply is that the per unit costs of intermediation typically decline as an economy develops. Such a prediction is, indeed, consistent with an array of evidence on transactions costs in developing countries compared with those in industrial countries (World Bank 1989).

In our model, simplicity has dictated that a constant quantity of total investment be intermediated over time. Thus, the declining unit costs of intermediation are reflected in declining total resources consumed by this activity. A richer
model would allow for the total volume of financial activity to grow over time; such growth would be facilitated by a decline in unit costs.

The fact that the composition of investment is endogenous is important in our model. If \( \theta \) were exogenously fixed, as it is in more conventional CSV environments, more resources would necessarily be employed in state verification as an economy developed. This would imply that financial market frictions loom larger as an economy develops, and it would also imply that equity market activity declines with increased real development. Both implications appear contrary to observation. Thus, we believe that a full understanding of the coevolution of the real and the financial sectors in the development process requires confronting firms with an endogenous decision regarding their investment composition.

**Summary**

Over time, as an economy develops, its agents become wealthier and accumulate more capital. As capital becomes relatively more abundant, its price declines. This change in relative prices has several effects. The one most central to this model is that, as the price of capital falls, the relative cost of monitoring—as perceived by borrowers—rises. This happens because we have assumed that the monitoring technology employs the final good as an input, a good whose price rises relative to capital in the growth process. However, the assumption that monitoring uses final goods is not essential to the results, although it does yield a substantial simplification. It deserves emphasis that the same forces would be at work if monitoring employed only labor, or if it employed some combination of labor and capital. Under any of these specifications, borrowers will perceive relative monitoring costs that rise with the level of development. As a consequence, borrowers substitute away from investment technologies that are monitoring-intensive (technology u), and into technologies that economize on monitoring (technology o).

As the allocation of investment changes, so too will the optimal mix of financial claims used to finance that asset allocation. As in more standard CSV environments, debt is employed to minimize the amount of monitoring necessitated by financial contracts. As technology o is used more extensively, the amount of monitoring will fall of its own accord, and firms will therefore make increasing use of equity relative to debt as an economy develops.

Our model necessarily abstracts from a number of important issues concerning the role of financial markets in economic development. Perhaps most important among these is market integration—meaning the extent to which assets with the same risk exhibit the same expected rates of return. As discussed in Bekaert and Harvey (1995), market integration varies considerably across developing nations (and over time). And these differences have important implications for the level and composition of capital investment, as well as for financial contracting. However, our model cannot deal with such issues since (for tractability) we have assumed universal risk neutrality.
VI. TOWARD A SET OF POLICY IMPLICATIONS

We have yet to undertake a systematic welfare analysis of the competitive equilibrium allocations that arise in this economy. Nor have we formally analyzed the consequences of specific policy actions. However, in this section we make a few observations about the likely consequences of various policy interventions that might be contemplated in this context.  

We have displayed an example economy in which equity markets may be inactive early in the development process. This lack of equity market activity is not necessarily a signal of any allocative inefficiency, and at this phase attempts to stimulate equity market activity would, at best, simply benefit some agents at the expense of others. Indeed, it is easy to think of interventions intended to stimulate the development of equity markets that would be harmful. By the same token, in an economy with active equity markets, there would be no obvious case for interfering with the level of activity in these markets. However, for developing economies, it is not likely that financial (or other) markets will be operating free from government interference. Many specific forms of government intervention can easily be analyzed in our framework, and we now offer some speculations about the consequences of certain kinds of policy interventions.

Many government policies have the effect of altering the opportunity cost of funds perceived by borrowers. Policies that affect the real rate of return to savings can be expected to do so, as can changes in the tax treatment of interest or dividend income, or various interest subsidy or loan guarantee programs.

Examples constructed in Boyd and Smith (1995) suggest that a reduction in the opportunity cost of funds tends to depress Q%, other things being equal, that is, tends to favor the increased use of technology u. Since technology u is more productive than technology o (gross of verification costs), this tends to result in more capital accumulation and in a corresponding upward shift in the law of motion for the capital stock. It also tends to attenuate the level of equity market activity. Thus, policies that reduce the opportunity cost of funds to borrowers are likely to depress the level of activity in equity markets and to increase the reliance on debt finance.

Inflation

A particularly obvious macroeconomic factor that affects the opportunity cost of funds to borrowers is the rate of inflation. Higher rates of inflation act to reduce the real rate of return on real balances, or on any other savings instru-

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2. A technical observation is that competitive equilibrium allocations in our economy are what Balasko and Shell (1980) term "weakly Pareto Optimal"; that is, it is not possible to achieve a Pareto improvement by transferring resources between a finite number of generations. However, this does not imply that competitive equilibrium allocations are fully Pareto optimal; capital overaccumulation is still possible, as it is in the standard Diamond (1965) model. If our economy does not display capital overaccumulation—that is, if steady-state real interest rates are not too low—and if there are no other interventions, then competitive equilibria will be Pareto optimal, and any policy interventions that are not entirely negative in their consequences must necessarily be redistributive. In this situation, policies must be evaluated with respect to whether these redistributions are deemed socially desirable.
ment bearing a fixed nominal return. In addition, particularly in many developing countries, binding nominal interest rate ceilings limit the flexibility of nominal returns, and relatively high reserve requirements force banks to hold large amounts of real balances. Both kinds of factors will tend to allow increases in the rate of inflation to put downward pressure on real returns to savings. Indeed, Choi, Smith, and Boyd (1995) document that in several countries the real rate of return on both safe savings instruments and on equity is very strongly negatively correlated with the rate of inflation. Thus, higher rates of inflation will tend to reduce the real returns perceived by savers and to lower the opportunity cost of funds to borrowers.

Our previous observations, then, suggest that higher rates of inflation are likely to reduce $\theta_2$ and hence to depress the volume of activity in equity markets. This conjecture that high inflation is detrimental to equity market activity is consistent with the finding of Tun Wai and Patrick (1973), Choi, Smith, and Boyd (1995), and Boyd, Levine, and Smith (1995) that higher rates of inflation do tend to be injurious to stock market operations. At this point, we withhold any conjectures about the effects of higher inflation on real activity. An analysis of this issue would require a monetary version of the present model. This is a sufficiently large modification that we do not currently want to speculate about the consequences of higher inflation for, as an example, the steady-state capital stock.

If we are correct, higher rates of inflation lead to heavier use of the investment technology that is subject to the CSV problem, and to a greater volume of resources being consumed by state verification. In this sense, higher rates of inflation would appear to make an economy's financial markets function less efficiently. Thus, macroeconomic policies that are conducive to price stability will tend to favor the development of equity markets, and to foster the efficient operation of capital markets in general. For further theoretical results on this point, see Choi, Smith, and Boyd (1995) or Boyd and Smith (1994a).

There are, of course, any number of other methods by which government interventions can be used to reduce the opportunity cost of funds to borrowers. For instance, a reduction in ceiling rates of interest paid on deposits would tend to do so, as would an increase in the effective tax rate on capital income. Our previous reasoning suggests that these actions would tend to shift the composition of investment in favor of technology $u$. The shift in favor of technology $u$ would typically favor increased capital formation, depending on whether savings rates are sufficiently insensitive to variations in the real (after tax) rate of interest, an assumption that we make in our formal analysis. The shift in favor of technology $u$ would also tend to reduce the volume of equity market activity; in addition, it would tend to lead to more resources being consumed in the state verification process. In this sense, high real returns to savers tend to be conducive to the development of equity markets and to economizing on the resources consumed by monitoring.
The Relation between Debt and Equity Markets

A final issue of government policy concerns the relationship between debt and equity markets. It is often argued that the allocative importance of equity markets in developing economies is not very great, as debt markets constitute an effective substitute for them (see, for instance, the discussion in Rojas-Suarez and Weisbrod 1994). We believe that this argument is called into serious question by our analysis. In particular, by using equity markets appropriately, firms in our model substantially reduce their costs of issuing debt. Indeed, Boyd and Smith (1994c) produce examples in which it is impossible for firms to issue debt without issuing some equity, simply because the costs of 100 percent debt finance are too great for this to be feasible. This situation is most likely to obtain as economies become relatively developed, and it suggests that at some levels of development equity markets will be a necessary complement to debt markets. When this occurs, equity market activity will appear endogenously if it is not hampered by government intervention.

VII. Conclusions

We have developed a model in which capital is produced by investors who make use of two technologies. One yields a high expected return, but is subject to an informational friction. The other yields a lower expected return, but has the advantage of full public observability. Investors must make a decision regarding how heavily they will use each technology. This decision depends, among other things, on the relative price between capital and the resources used in state verification.

As an economy develops, investors will perceive a relative cost of monitoring that rises over time. As a result, under conditions that we typically expect to prevail, less use will be made of the unobservable-return, and more use will be made of the observable-return technology. Since investment in the unobservable-return technology is generally associated with the use of debt finance, while the use of the observable-return technology is associated with equity, we also typically expect the ratio of equity finance to rise as an economy develops. This intuition is confirmed by all of the examples in Boyd and Smith (1994c, 1995).

Moreover, as we have seen, it is possible to produce parameter values such that—at low levels of development—there will be no use of equity markets. Equity market activity can be observed for such parameters only once the economy attains a critical level of real development. Such examples support the conclusion of Gurley and Shaw (1960, p. 92) that “the selection of financial assets evolves in the growth process,” and that the variety of financial claims increases as well.

It is also the case that, in all of our numerical examples, the quantity of resources consumed by monitoring declines as an economy develops. This pro-
vides a sense in which the endogenous evolution of debt and equity markets in the development process provides an economy with a more efficient set of capital markets.

Finally, our analysis provides a sense in which debt and equity markets function as complements rather than substitutes. A case against the importance of equity markets in financing real development is often made on the basis that existing credit markets are close substitutes for equity markets. Our analysis calls the validity of such arguments into serious question.

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