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How do National Policies Affect Long-run Growth?

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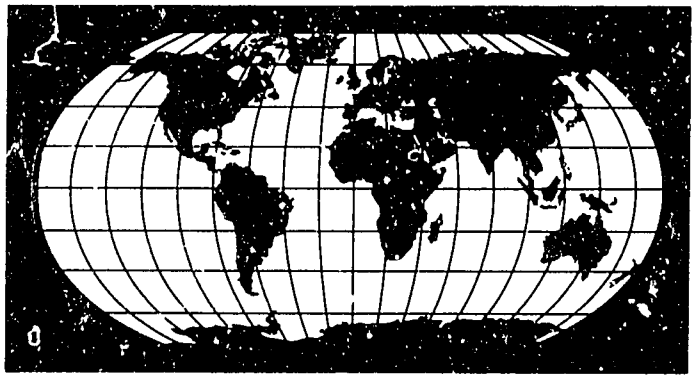

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"Finance, Entrepreneurship, and Growth"

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FINANCE, ENTREPRENEURSHIP, AND GROWTH:

Theory and Evidence

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Abstract

What are the implications of financial institutions for the growth of nations? In this paper, we construct an endogenous growth model in which financial institutions play a key role in the economic growth process. Financial institutions evaluate prospective entrepreneurs and make loans to the most promising for the purpose of undertaking intangible capital investments that raise productivity. Consequently, financial sector distortions can exert a first order effect on economic growth. With this theory in hand, we review a range of evidence on connections between financial development and economic development, including: cross-country studies, case studies of the aggregate impact of financial sector reforms, microeconomic evidence on the links financial reform and productivity of individual firms, and the consequence of financial development for the growth effects of nonfinancial policy reforms. All of this evidence supports the view that financial institutions are important for productivity growth and economic development.

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A prominent feature of the recent literature on economic growth has been a renewed interest in the links between financial institutions and the pace and pattern of economic development. On the theoretical side, there is a new battery of economic models articulating mechanisms by which financial institutions may affect long run growth, stressing that financial markets enable small savers to pool funds; that they allocate investment to the highest return use; and that they partially overcome problems of adverse selection in credit markets.[1/] On the empirical side, a range of financial indicators have been shown to be robustly positively correlated with cross-country indicators of economic growth. [2/] Increasingly, economists are willing to entertain the idea that government policies toward financial institutions may have an important causal effect on long run economic growth.

In traditional development economics, there were two schools of thought with sharply differing perspectives on the potential importance of financial markets. Economists like Goldsmith [1969], McKinnon [1973] and Shaw [1973] saw financial markets as playing a key role in economic activity. In their view, differences in the efficiency of financial institutions could partly explained why countries grew at different rates. But many more economists accepted Robinson's [1952] view that finance was essentially the handmaiden to industry, responding passively to other factors that produced cross-country differences in growth. In part, this skeptical view was also associated with the mechanics of the neoclassical growth model: many saw the effects of financial market regulations as relatively unimportant for the rate of investment, and the effects of investment rate changes on sustained growth were viewed as relatively minor given Solow's [1956, 1957] analyses.[3/]

In this paper, we develop an endogenous growth model that features

connections between finance and economic growth suggested by insights of Frank Knight [1951] and Joseph Schumpeter [1911].[4/] We combine the Knightian role of entrepreneurs in initiating economic activities with two ideas of Schumpeter: first, the well known Schumpeterian view that innovations are driven by the extent of the temporary monopoly profits that they secure and, second, the less well known Schumpeterian suggestion that financial institutions are important to development due to the role that they play in evaluation and external finance of innovative activity. We view innovative activity broadly: in addition to the invention of new products, we include enhancement of existing products; costly adoption of technology from other countries; and production of an existing good using new business methods.[5/]

At the center of our theory is the endogenous determination of productivity growth, which is taken to be the result of rational investment decisions in intangible capital goods. Productivity growth is thus influenced by standard considerations of costs and benefits. The efficiency of financial institutions is one factor that we argue is particularly important. Financial institutions are linked to innovative activity by two mechanisms in our analysis: (i) they evaluate prospective entrepreneurs and (ii) they fund innovative activity for those who are most promising. Financial institutions can provide these research, evaluative and monitoring services more effectively and less expensively than individual investors; they also are better at mobilizing and providing appropriate financing to entrepreneurs than individuals. Overall, the evaluation and sorting of entrepreneurs lowers the social cost of investing in intangible capital—productivity—and hence stimulates economic development. Financial sector distortions can therefore reduce the rate of economic growth.

Our view of the relevant economic mechanisms is consequently quite

different from existing theories, new and old. First, in contrast to traditional development work, we do not require that financial institutions mainly exert influence via physical capital (either in the extent of physical capital accumulation or the efficiency of its allocation across activities).[6/] Second, relative to other recent theoretical research, we articulate a new mechanism by which finance may affect growth: financial institutions play a direct, active role in evaluating, managing, and funding the entrepreneurial activity that leads to productivity growth. Indeed, we believe our mechanism is the channel by which finance must have its dominant effect, due to the central role of productivity growth in development.

With this theoretical model as background, we then present various types of evidence on the links between financial institutions and economic development. We begin by reviewing the cross-country evidence on links between financial indicators and economic growth, discussing key results from our earlier work in this area and undertaking some extensions. Next, we discuss evidence about the relationship between financial institutions and three sets of public policy interventions. First, we look at a number of case studies of how financial indicators have responded to government interventions designed to liberalize financial markets. Second, we review recent studies of the effects of financial sector reforms in two developing countries: reforms produced a reallocation of credit toward higher productivity firms. Third, we look at how financial development has been related to the success of World Bank structural adjustment lending programs.

The organization of the paper is as follows. In section I, we articulate our theory of the links between finance and growth. In section II, we review a range of evidence on financial institutions and economic growth.

I. Theoretical Linkages

Our model economy has three main components. First, we develop a model of links between financial institutions and innovation. Second, we develop the links between innovation and economic growth. Third, we put these features together with a description of saving behavior to determine the equilibrium behavior of our economy. Our model highlights the importance of economic incentives to the growth process.

Finance and Innovation: We capture the links between finance and innovative activity with two key ideas. First, there are some individuals in society who seek to be entrepreneurs and to produce new or improved products. Not all prospective entrepreneurs are equally qualified to do so. Consequently, financial institutions expend resources to evaluate prospective entrepreneurs and select those with the highest probability of success. Generally, financial institutions provide research, evaluation, and monitoring services more effectively and less expensively than if each investor had to undertake these activities independently. In our model, financial institutions will undertake evaluative activity to the point where the cost of evaluation equals the expected benefit from discovering a qualified entrepreneur. Second, innovative activity requires the investment of resources with an uncertain return: it takes some time to produce new or improved product ideas and a highly qualified entrepreneur may not actually produce an economically valuable innovation. Further, on discovering a qualified entrepreneur, financial institutions must also supply him with external finance, since any individual typically has limited wealth. (More generally, financial institutions are better at mobilizing funds and providing financing to entrepreneurs than entrepreneurs are at trying to collect funds from disparate individual investors.) In return, the financial institutions

secures claims to the expected rents from a future innovation. These expected innovation rents depend positively on the probability of successful innovation and the present value of profits from such an innovation; they depend negatively on the cost of undertaking innovative activity.

With the institutions that prevail in the U.S. economy, these two parts of our model could be interpreted as a start-up high technology firm and a venture capitalist, working together to produce a new product. In Chile, the model could be viewed as exemplifying investment in processes that more effectively obtain, use or ship copper derivatives, where these innovative activities are financed by a bank or pension fund. Similarly, the basic intuition of the model may be applied to a rural financier selecting the most capable farmers to implement new strands of seed in, for example, India. The crucial characteristic of the model is that financial institutions play an active role in evaluating, selecting and financing entrepreneurs.

Innovation and Growth: In studying the links between innovation and economic growth, we draw heavily on models of "endogenous technical change" developed by Aghion and Howitt [1992], Grossman and Helpman [1991], and Romer [1990]. In our model, an innovation makes it possible to produce or use one of many intermediate products—e.g., a type of computer or better fertilizer—at lower cost than one's competitors. Hence, the innovator captures a stream of profits that continue until there is an additional innovation, which brings about a new leader in his particular intermediate product category. From the standpoint of the economy as a whole, declines in the cost of intermediate products increase the economy's ability to produce final products, i.e., they lead to an increase in the aggregate productivity of the economy. In particular, in the model economy that we develop, there is a direct positive link between the part of sociey's resources that are

devoted to innovation and the rate at which the economy grows.

General Equilibrium: Finally, we combine the previous material with a description of saving behavior on the part of the economy, i.e., with a description of the preferences that individuals have for current consumption versus future consumption. This permits us to determine a simple formula for the long term growth rate of the economy in general equilibrium. In the model, better financial systems select and finance entrepreneurs with higher probabilities of succesfully innovating, i.e., bringing new or better products to market. The greater the rate of innovation, the faster the economy grows. Thus, financial development can stimulate productivity improvements and economic growth. We demonstrate analytically and graphically how financial sector taxes or distortions affect our model economy. We find that higher financial sector taxes or greater distortions reduce the incentives that individuals have to invest in innovative activity and, hence, retard the growth of the economy.

For the reader's convenience, Table I-1 summarizes the notation that we use to represent various economic variables in our model.

A. Roles for Financial Intermediation

Our theoretical framework contains two roles for financial intermediaries. First, intermediaries evaluate prospective entrepreneurs, determining which individuals in a pool of candidates are capable of executing a project of sufficient economic value to warrant investment of resources. Second, intermediaries provide external finance for innovative activity. We presume—but do not formally model—that these activities are bundled together because the first stage generates information, previously unknown by both parties, which has important proprietary value.[7/]

1. Entrepreneurial Selection

We assume that some individuals in society intrinsically possess the skills to be potentially capable entrepreneurs.[8/] Each potential entrepreneur has (i) the endowment of a project; and (ii) the skills to capably manage the project with probability α (otherwise the individual has no ability to manage a project). These capabilities are unknown to both the entrepreneur and intermediary. The actual capacity of an individual to manage a project can be ascertained at a cost of "f" units of labor input: by paying this cost, the intermediary learns that the individual is either capable or not. Thus, under some conditions that we will detail below, there is an economic demand for a "rating" activity that will sort potential entrepreneurs: if the market value of a "rated" entrepreneur is "q" and the wage rate is "w", then competition among such organizations requires

$$\text{(ES)} \qquad \alpha q = w f$$

if there is to be positive output of this industry and, more generally, we must have $\alpha q \leq wf$. That is, our entrepreneurial selection condition (ES) requires the expected income from rating prospective entrepreneurs (αq) must equal the the cost of that activity (wf).

2. Financing of Innovative Activity

Each rated entrepreneur requires a total of x labor units (including his own time) to realize a marketable innovation with probability π. Production of innovations takes time: it is necessary to put in the "x" labor units and pay wages prior to the realization of the uncertainty about the outcome of innovative activity. Hence, external finance is important for innovation.

We assume that there is a positive relationship between the size of the labor allocation to a innovation firm, x, and its probability of success $\pi(x)$. We begin by assuming that it simply takes x individuals to assure a given probability, as shown in Figure I-1a: we view this as a convenient simplification of the more realistic relationship shown in Figure I-1b and we return later to discuss that alternative case.

The value of a successful innovation is that one captures a stream of profits when the innovation is realized. (In the general equilibrium model developed below, this reward is measured by the present value of profits earned by a firm that is the current productivity leader, i.e., can produce products at the lowest cost: as in Grossman and Helpman [1991], we call this reward the stockmarket value of the incumbent firm).

Under the technology described above, one must put in x units of labor input (with cost wx) at the start of the innovation process and has the expected reward $\pi\ \rho_{t+\Delta t,t}\ v_{t+\Delta t}$, where $\rho_{t+\Delta t,t}$ is the discount factor at t for cash flows at $t+\Delta t$ and $v_{t+\Delta t}$ is the future stock market value of being an incumbent firm. For notational convenience in the expressions below, we write this as $\pi\ \rho\ v'$ suppressing the time subscripts. Thus, the expected <u>innovation rents</u> to an individual innovation firm are given by

$$\text{(IR)} \qquad q = \pi\ \rho\ v' - w\ x.$$

The entrepreneurial selection (ES) and innovation rents (IR) conditions imply that q, w and v must share common long-term growth rates if there is a constant discount factor (ρ) and constant labor level (x) in the long run.

3. Economic Viability of Selection

To this point, we have presumed that costly selection is an equilibrium

outcome. However, this assumed economic viability requires some restrictions on the technologies of the model economy. The alternative to costly evaluation is to simply invest funds in "unrated" entrepreneurs. Under this strategy, one has expected profits of $\alpha\ \pi\ (\rho\ v') - x\ w$ since labor costs are paid for both capable and other entrepreneurs. Economic viability of selection requires that rewards to the evaluation strategy, $\alpha\ q - w\ f = \alpha\ [\pi\ \rho\ v' - x\ w] - f\ w$, exceed the rewards to such blind investment, i.e., $\alpha\ q - w\ f > \alpha\ \pi\ (\rho\ v') - x\ w$. This condition simply requires that the expected net savings in labor costs from evaluation, $f - \alpha\ x$, exceed the labor costs of blind investment, or $x > \alpha\ x + f$. We assume that evaluation costs are sufficiently small that this condition always holds in our analysis.

4. Financial Distortions

We can identify two general ways in which financial distortions might arise in our setup. First, there might be explicit or implicit taxes on financial intermediary income, expenses or income. Second, there might be quantitative controls on the size of loans to individual innovative firms or on the aggregate volume of loans. We focus on the initial channel in this section and defer discussion of quantitative restrictions to section E below. A tax, τ, on the gross income from loans would alter intermediary income to $\pi(1-\tau)\rho\ v'$ and the condition (IR) to $q = \pi(1-\tau)\rho v' - wx$.

5. Equilibrium Financial Intermediation

Combining the two equilibrium conditions for financial intermediation activity, entrepreneurial selection (ES) and innovation rents (IR), we find that equilibrium in the financial intermediation sector requires:

(FI) $\pi \rho v' = a(\tau) w$

where the coefficient $a(\tau) = (\frac{f}{\alpha} + x)/(1-\tau)$ reflects the combination of two influences. First, there is the full labor requirement of an innovation project, $a(0) = (\frac{f}{\alpha} + x)$, which includes evaluation resources per funded project (f/α) as well as the direct labor requirements (x). Second, there is the effect of financial sector distortions costs as summarized by τ. In the our analysis below, we will encounter both $a(\tau)$, which measures the supply conditions in financial and innovative activity, and a(0), which measures the resources consumed in these sectors by each project that is undertaken.

B. Market Innovation and the Stock Market

We now discuss three topics that are necessary to a general equilibrium treatment of the connections of finance and innovation to economic growth. To this point, we have discussed the supply conditions in the finance and innovation industries, given probability of a successful innovation (π) for an individual and given security market valuations of firms ($\rho v'$). We now turn to issues related to the interrelationship of the market for innovation and the security markets.

1. Interaction in Innovation

In any given area of innovative activity, when there are multiple entrepreneurs undertaking product development activity, one must distinguish between the individual entrepreneur's probability of success (which we called π above) and the probability that some entrepreneur will successfully innovate (which we call Π). Our assumption is that the aggregate innovation probability is simply proportional to the number of individual participants,

so that if there are "e" participants then $\Pi = \pi e$. This is a standard assumption in growth models, but it is worth noting that it requires a form of coordination among the participants in the research process.[9/]

2. Innovation Races and Stock Market Valuations

We let v_t denote the market value—prior to distribution of dividends d_t—of a firm producing a given product. We will study a representative industry since industries will not differ in the determinants of stock prices in equilibrium. In doing this, we use the fact that each industry is assumed small in terms of (certain) aggregate wealth. Thus, an industry's risk is diversifiable, so securities are priced as if individuals were risk neutral.

Previously, we noted that an innovation in the industry at date t permits the innovator captures a stream of rents equal in value to the stockmarket valuation of the incumbent monopolist. Correspondingly, a capital loss is inflicted on the stock holders of the currently dominant firm. Hence, the equilibrium condition for holding a share of stock from t to $t+\Delta t$ is:

$$\text{(SM)} \qquad (1-\Pi)\, \rho_{t+\Delta t,t}\, v_{t+\Delta t} = v_t - d_t.$$

In this expression, the left hand side is the expected discounted value of the future stock value, taking into account the probability of capital losses; the right hand side is the "ex dividend" firm value.

3. The Stock Market and Financial Institutions

In our model economy, stock markets play two roles. First, stock markets provide a vehicle for pooling and hedging risks. Second, stock markets reveal the value of firms as determined by the evaluations of rational investors.

The financial intermediaries in our model have significant cost advantages relative to individual investors in terms of researching firms, evaluating entrepreneurs, and monitoring managers. Hence, corporate financing occurs through intermediaries and not through direct issuance of stock to individual investors. Indeed, our model does not require the existence of a formal stock exchange, although the model does require that property rights be clearly defined and enforced. Risk pooling and firm valuation may be performed by various institutions without the existence of a stock exchange. This is important because we want the basic concepts in the model to apply to countries without well functioning formal stock exchanges. Thus, our model identifies important financial services like risk pooling, valuation, resource mobilization, and corporate financing; it does not focus on the precise form of contracts and institutions that provide these services. For example, corporate financing could be loans from a bank, the purchase of ownership by venture capitalists, stock issuance to mutual funds or other institutional investors, or local financiers financing projects with a mix of debt and equity claims. Instead of focusing on these contracting issues, we study a few incentives for financial intermediaries to form—information acquisition and resource mobilization cost advantages—and then explore the role that these intermediaries play in determining the rate of productivity growth.

C. Industry Equilibrium Given Productivity

We now develop some of the basic elements of our growth model, which is in the tradition of recent research on Schumpeterian models of technical progress. We follow Grossman and Helpman [1992] in studying an economy with a continuum of products, indexed by ω on the interval $0 \leq \omega \leq 1$, that are

subject to technical improvement. As in their analysis, innovations move a particular product's technology one step along a ladder with steps $j=0,1,\ldots$ realizing levels Λ^j with $\Lambda > 1$. Inventions are cost-reducing as in Aghion and Howitt [1992] and apply to an intermediate product as in Romer [1990]. As in Grossman and Helpman [1992], the timing of individual innovations is random but the aggregate economy evolves deterministically.

1. Intermediate Product Technology

The production technology for the leading firm in industry ω at ladder position j is:

$$y_t(\omega) = A_t(\omega)\, n_t(\omega) = \Lambda^j\, n_t(\omega)$$

where $y_t(\omega)$ is physical output of intermediate product ω, $A_t(\omega)$ is the level of productivity at date t in industry ω, and $n_t(\omega)$ is the level of labor input. Thus, at given wage rate w_t, unit cost is

$$w_t n_t(\omega)/y_t(\omega) = w_t/A_t(\omega) = w_t/\Lambda^j$$

i.e., unit cost is raised by the wage and lowered by higher productivity.

2. Final Goods Production

The goods subject to technical innovation are assumed to be intermediate inputs into the production of a single final good, C. Letting $z(\omega)$ be the quantity of input ω demanded, the production technology for this good is

$$\log(C) = \int_0^1 \log(z(\omega))\, d\omega,$$

which is the continuum analog of the standard Cobb-Douglas production

function with constant returns-to-scale imposed.[10/] Notice that the production function for the final good is time-invariant, so that all technical progress is embodied in intermediate products: this makes the consumption good a natural numeraire in our economy.

Given that intermediate product ω is priced at $p_t(\omega)$, we can determine that factor demands are $z_t(\omega) = C_t/p_t(\omega)$, assuming that the numeraire is consumption (so $\int_0^1 p(\omega)z(\omega) = 1$ for $C = 1$).

3. Pricing of Intermediate Products

As in Grossman and Helpman [1992], we assume that there is a unique lead firm in industry ω that prices its product at its rival's unit costs, leading to a gross markup $M=\Lambda$ over the lead firm's unit cost:

$$p_t = M\, w_t / A_t(\omega).$$

We carry along this separate notation for the markup so that we may later see how it influences the nature of the growth process.

The producer of intermediate product ω earns a stream of profits $d_t(\omega) = p_t(\omega)y_t(\omega) - w_t n_t(\omega)$. Given the pricing rule, these profits are simply $d_t(\omega) = m\, w_t n_t(\omega)$, with $m=(M-1)$ being the net markup. In product market equilibrium, labor allocations are invariant across product sectors, $n_t(\omega) = n_t$, which is a conventional result in Cobb-Douglas economies. Thus, profits in all sectors are identical: $d_t(\omega) = m\, w_t n_t$.

4. A Technology Aggregate and Its Dynamics

This framework leads to a natural measure of the state of aggregate, $A_t = \exp(\int_0^1 \log(A_t(\omega))\, d\omega$. This technology aggregate permits us, for example, to

express the production function for consumption goods as $C_t = A_t n_t$. Later on, we will describe the growth of our model economy in terms of the evolution of this technology aggregate.

The individual components of this aggregate obey the dynamic equations

$$A_{t+\Delta t}(\omega) = \begin{cases} A_t(\omega)\ \Lambda & \text{with probability } \Pi \\ A_t(\omega) & \text{with probability } 1-\Pi \end{cases}$$

for $0 \leq \omega \leq 1$. For small time intervals, the technology aggregate obeys

$$dA_t/dt = A_t\ \Pi\ \lambda,$$

where we define $\lambda = \log(\Lambda)$. That is, λ is the maximum continuously compounded rate of growth for which the remainder of the model makes sense: it occurs if the probability of innovation is unity in each industry. Hence, the actual the growth rate of technology $\gamma = [dA/dt]/[A_t]$ is linearly related to the aggregate innovation probability for each of the identical industries.[11/] In the analysis below, this growth rate will be linearly related to the equilibrium allocation of innovative talent and the scale of resources allocated to this activity. Further, this growth rate will be shared by other key economic quantities in the model, such as consumption, wages, profits, and the stock market value of incumbent firms.

D. General Equilibrium

Our analysis of general equilibrium splits the problem into two parts. First, we discuss linkages between interest rates and growth rates that arise in market equilibrium on the side of production: faster growth rates plausibly lead to lower real returns. Our framework enables us to describe

how financial market distortions and efficiency affect this tradeoff. Second, we discuss the implications of optimal choice of consumption over time for the preference-side relation between growth and returns. Then, we put these components together in a general equilibrium analysis.

1. Production-Side Linkages Between Returns and Growth

In our framework, three market equilibrium conditions determine the supply side relationship between growth and returns: the financial intermediation equilibrium condition (FI), the stock market equilibrium condition (SM) and the labor market equilibrium condition (LM).

Financial Equilibrium Conditions: To bring our model into line with other recent models of economic growth, the specific versions of the first two equilibrium conditions that we will use are the relevant conditions for short periods (continuous time). This pair of equations is:

$$\text{(FI)} \qquad \pi\, v_t = a(\tau)\, w_t$$

$$\text{(SM)} \qquad dv_t/dt = \Pi\, v_t - d_t + r_t\, v_t$$

where r_t is the real interest rate prevailing between t and t + Δt, i.e., $\rho_{t+\Delta t,t} = \exp(r_t\, \Delta t)$. As above, these conditions describe a representative industry. Moving to continuous time has some advantages in terms of the simplicity of results and their comparability to the literature, but does come at the cost of not having discount factors (financial intermediary interest rates) enter directly in the condition (FI).[12/]

Labor Market Equilibrium: The labor market equilibrium condition is given by the requirement that

$$\text{(LM)} \qquad n_t + a(0)\, e = N$$

where $n_t = \int_0^1 n_t(\omega)\, d\omega$ is the total quantity of labor allocated to production of intermediates, a(0)e is the quantity of labor evaluated to intermediation and innovation, and N is the total stock of available labor.

Taking these three conditions together with the requirement that the aggregate innovation probability is $\Pi=\pi e$ and $d_t = m\, w_t n_t$, we can determine a "production side" relationship between the growth rate and the real interest rate in the model's steady state (which it is always in). We proceed to describe this relationship as follows.

First, after imposing $dv_t/dt = \gamma\, v_t$, the stock market equilibrium condition may be rewritten as:

$$v = \frac{d}{r-\gamma+\Pi}.$$

Treating r,d, and Π as fixed, this expression has the familiar implication that an increase in the growth rate raises the stock value, since it increases the stream of future dividends. In our general equilibrium setting, this familiar result is tempered by two other considerations. First, the probability of a capital loss, Π, and the growth rate are positively related since each is affected by the rate of innovation. More formally, we know from above that $\gamma = \lambda\, \Pi$. Hence, we can write the denominator as $r - \phi\, \gamma$ with $\phi = [(\lambda-1)/\lambda]$. If the instantaneous growth rate $\lambda = \log(\Lambda)$ corresponding to the size of a productivity ladder step is smaller than unity, then it follows that $\phi < 0$ and the real stock price declines with the growth rate. Second, the extent of profits earned by intermediate good producers is negatively related to the growth rate in general equilibrium. From above, we know that profits in each industry are d=mwn. Given the labor market equilibrium condition, $N = n + a(0)\, e$, as well as the link between

entrepreneurship and the growth rate, $\gamma = \lambda \pi e$, we find that profits are negatively related to the growth rate, $d(\gamma) = m w (N-\theta\gamma)$, with $\theta = \lambda\pi/a(0)$. Hence, the growth rate's overall effect on the stock market is ambiguous.

Under the assumption that the growth rate and the value of the stock market are negatively related, however, growth and returns must be negatively related. That is, since the financial instermediation (FI) equilibrium condition is that $v = a(\tau) w$, there is a <u>production-side</u> relation:

$$\text{(PS)} \qquad a(\tau) = \pi \frac{d(\gamma)/w}{r-[(\lambda-1)/\lambda]\gamma}$$

This relationship is graphed in Figure I-2a, under the assumption that higher growth rates lead to lower stock market values. With a little manipulation, the line defined by (PS) may be written as

$$r = \{\phi - \frac{m}{\lambda}(1-\tau)\}\ \gamma + \{\frac{m}{\lambda}(1-\tau)\}\ \bar{\gamma}$$

where $\bar{\gamma}$ is the maximum feasible growth rate, defined by $\bar{\gamma} = (N\lambda\pi/a(0))$. This growth rate obtains if all labor is allocated to innovative activity.

From this specification, as illustrated in Figure I-2b, we see that increases in τ rotate the (PS) curve inwards leaving intact the point with $r=\phi\bar{\gamma}$ and $\gamma=\bar{\gamma}$, i.e., the position in which all resources are allocated to innovative activity. Increases in $\bar{\gamma}$, by contrast, shift the (PS) locus up in a parallel fashion as shown in Figure I-2c.

2. <u>Preference-Side Linkages Between Returns and Growth</u>

We close our model by describing saving behavior of an immortal family with a utility function of the standard form:

$$U_t = \int_0^\infty u(c_{t+s})\ e^{-\nu s}\ ds$$

and momentary utility given by

$$u(c_t) = [c_t^{(1-\sigma)} - 1]/[1-\sigma].$$

In this specification, there are two parameters which describe intertemporal preferences: the intertemporal elasticity of substitution in consumption is $(1/\sigma)$ and the pure rate of time preference is ν.

The preference-side relationship between the real return and the growth rate is given by:

$$\text{(F)} \quad \gamma = [r-\nu]/\sigma.$$

Hence, as stressed by Fisher [1911], there is a positive relationship between the rate of return and the growth rate; the strength of this relationship is determined by the intertemporal elasticity of substitution. This positive relationship is shown in Figure I-2d.

<u>The Equilibrium Growth Rate</u>

We can solve for the optimal growth rate by equating (PS) and (F), which leads to the following expression for the growth rate in market equilibrium:

$$\text{(MG)} \qquad \gamma = [\tfrac{1}{\lambda}\,\bar{\gamma}\,(1-\tau) - \nu]/[\sigma - \phi + \tfrac{m}{\lambda}\,\bar{\gamma}\,(1-\tau)].$$

As in endogenous growth models with perfect competition, this market equilibrium growth rate depends on aspects of preferences and technology. It is higher if there individuals discount the future less (lower ν) or are are more willing to substitute through time (lower σ). The growth rate is also higher if the economy is more productive (in the sense of a higher maximum feasible growth rate $\bar{\gamma}$). But it also depends positively on the extent of markups (m) and negatively on the extent of capital losses that are inflicted

on investors by technical progress (ϕ), reflecting the imperfect competition features of the model.

In section C below, we put the two halves of the scissors in Figure I-2 together to analyze the effects of financial market distortions on economic growth graphically. Before proceeding to that activity, however, we briefly discuss the nature of returns and optimal growth.

3. A Digression on the Real Return and Optimal Growth

It is useful to consider the optimal growth solution for our aggregative model, which is obtained by maximizing utility subject to the resource constraints, $C_t = A_t\ n_t$, $dA_t/dt = A_t\ \lambda\pi\ e_t$, and $n_t + a(0)\ e_t = N$. These conditions may be summarized by

$$\text{(OG)} \qquad \theta\ C_t + dA_t/dt = \bar{\gamma}\ A_t$$

where $\theta = \lambda\pi/a(0)$ and $\bar{\gamma}$ is the maximum feasible growth rate, $\bar{\gamma} = N\ \theta$. Hence, the optimal growth version of this model has a linear technology structure, consisten with the general framework that Rebelo [1991] uses to discuss the effects of various policy distortions on the growth process. Solving for the optimal growth rate, we find that

$$\gamma^* = [\bar{\gamma}-\nu]/\sigma$$

so that $\bar{\gamma}$ plays the role of the constant rate of return. Some discussions of the effect of finance on development, such as Greenwood and Jovanovic [1990], Roubini and Sala-i-Martin [1991,92], and King and Levine [1992b], consider the effect of financial distortions essentially as they effect returns in a setting such as this. Such analyses assume that other markets are functioning efficiently while finance is distorted. In our context, this

would amount to considering a taxation of resources allocated to innovative activity, so that we would modify the return to $\bar{\gamma}(1-\tau) = N\ \lambda\pi/a(\tau)$.

E. Financial Market Distortions and Economic Growth

We now consider the consequences of the two types of financial distortions that were discussed earlier.

1. Tax-Equivalent Financial Distortions

Many financial sector policies effectively involve the taxation of gross income from financial intermediation and, consequently, involve shifts in our parameter τ holding fixed the other parameters of the model. In practice, financial taxes come in many forms. Chamley and Honohan [1990] discuss examples of explicit financial sector taxes such as taxes on gross receipts of banks, value added taxes, taxes on loan balances, taxes on financial transactions, and taxes on intermediary profits. They also define and measure implicit or quasi-taxes on financial intermediaries such as high, non-interest bearing reserve requirements, forced lending at below market interest rates to the government and state enterprises, and interest ceilings on various loans and deposits. Chamley and Honohan [1990] show that financial intermediary taxation in some African countries amounted to seven percent of gross domestic product during the 1980s. Similarly, Giovannini and de Melo [1990] find that financial intermediary taxes—especially implicit taxes—were above two percent of GDP for a broad cross-section of countries. Figure I-3a demonstrates the implications of increases in τ on the real return and the growth rate. Increases in these taxes raise the cost of innovation, $a(\tau)$, lowering the market equilibrium growth rate.

2. Undercapitalization of Innovative Activity

Other financial sector policies essentially involve quantitative controls on either (i) the amount of resources that are available for aggregate financing of innovative activity or (ii) the scale of funding for individual innovation projects. We next discuss the consequences of each of these types of interventions in turn.

Aggregate Lending: In our model, the volume of lending for innovative activity is $x\ w$ and, scaling by consumption (final output), this is $L = e\ x\ w\ /\ w\ n = ex/[N-a(0)e]$. There is thus a direct relationship of this loan measure to the growth rate, since $\gamma = \pi\ e\ \lambda$. Reductions in the aggregate volume of loans for the purpose of innovative activity will thus have a negative effect on economic growth.

Individual Lending: The model developed to this point assumes that all projects are funded at the necessary level x, which results in a successful innovation with a given probability $\pi(x)$, as shown in Figure I-1a. Clearly, in the presence of the specified relationship between loan size and innovation outcomes, there would be Draconian effects of undercapitalization of individual innovation projects (i.e., there would be zero aggregate innovation). However, in the presence of the smoother tradeoff depicted in Figure I-1b, there can still be very important effects. These modifications will have the effect of lowering $\bar{\gamma} = N\ \lambda\pi/a(\tau)$, since $\pi(x)/[\frac{f}{\alpha}+x]$ will diminish with x. The consequences of this change are shown in Figure I-3b.

F. Applications and Extensions

We now discuss some extensions to our analysis, which will serve to link the theoretical model more fully to the empirical analysis conducted in the next section of the paper.

1. Directed Lending

In many developed and developing countries, governments regulate financial intermediaries so as to direct a portion of their lending activity to specific recipients. Typically, this directed lending takes the form of a fraction of total intermediary lending that is required to be awarded to recipients that would not otherwise receive funds.

In our model, one specific type of directed lending can be of some importance for the growth process. Suppose that for each loan to a "rated" entrepreneur, our intermediary must make ψ loans to unrated entrepreneurs. The entrepreneurial selection condition is then modified to:

$$\alpha\ [q + \psi\ b] = w\ f,$$

where $b = \alpha\ \pi\ \rho\ v' - x\ w$ is the expected reward to making a blind loan, as discussed in I.A.3 above. Thus, we obtain an altered financial intermediation equilibrium condition (FI) specifying

$$\text{(FI)}' \qquad a(\psi) = [\frac{f}{\alpha} + (1+\psi)x]/[1+\alpha\psi] = \pi\ \rho\ \frac{v'}{w}.$$

The directed lending scheme essentially works to increase the labor requirements of innovation, so that it retards growth.[13/]

2. Endogenous Scale of Innovative Activity

To this point, we have taken as exogenous the scale of innovative activity conducted by an individual entrepreneur. However, we can easily extend the analysis to consider the endogenous determination of the scale of innovative activity. In the process, we can also discuss an additional set of financial distortions that may stem from this channel. Nevertheless, the

nature of the equilibrium as we have described it so far, including the tax interventions we considered, are not affected by this extention. This is because the optimal scale of the firm is invariant to the interventions considered.

The economics of the combined finance and innovation sector may be understood by considering an industry in which firms face a fixed cost of entry (e.g., a licensing fee) and then have a diminishing returns to scale production function. At any given relative price of the industry's product (measured in terms of input costs), an individual firm can determine its optimal scale and this action generates a flow of rents (the level of which depends positively on the relative price). Competitive entry requires that the flow of rents just offset the fixed cost: the relative price adjusts to satisfy this requirement, so that there is a horizontal supply curve for the industry at a specific price. Further, taxation of output in the industry simply raises that supply price by the same amount, leaving invariant the optimal scale of the individual firm. Hence, for our combined finance/innovation industry, changes in the tax rate τ simply leave invariant the scale of individual firms.

The components of our industry work as follows. When the scale of the innovative firm, x, is a choice variable for the entrepreneur it will be selected to maximize the value of innovation rents,

$$q(x) = \pi(x)\ (1-\tau)\ \rho\ v' - w\ x.$$

Profit maximization implies that marginal expected benefit, $D\pi(x)\ (1-\tau)\ \rho\ v'$, equal marginal expected cost w. (In deriving this expression, we assume that the individual innovator is small enough so that his actions are presumed to have no effect on the stock market value via the capital loss (Π is invariant

to π)). Hence the optimal scale of the firm will depend positively on the ratio $\kappa = (1-\tau)\ \rho v'/w$, which rises with stock prices and with declines in wages or in interest rates. We describe this optimal scale of the individual firm by the function $x(\kappa)$: its exact form depends on the characteristics of the $D\pi$ function, which is the marginal product function for this activity.

The level of the innovation rents may be written as $q = \pi\ (1-\tau)\ \rho\ v' - w\ x = w[\kappa\pi(x(\kappa)) - 1]$, so that increases in κ lead to increases in innovation rents. Indeed, locally, the response of $q(\kappa)/w$ to κ is the same as in the fixed scale case that we explored earlier.[14/]

The financial intermediary's costly evaluation provides the "fixed cost" element of the problem. From above, the entrepreneurial selection condition implies that

$$\text{(ES)} \qquad q(\kappa)/w = f/\alpha.$$

Hence, the "relative price" $\kappa = (1-\tau)\ \rho\ v'/w$ is determined so that (ES) is satisfied.[15/] Changes in τ do not affect the scale of individual innovation units, although they have the effect of increasing the cost of innovation and, hence, reducing the size of the finance and innovation industries in general equilibrium.

This analysis also indicates that other financial sector distortions—such as the featherbedding of employees in ways that increased "f"—would not lead to an invariant scale of the individual innovation firm. In particular, increases in f would lead to (inefficient) increases in the scale of firms and increases in the price κ. In equilibrium, then, this intervention would lead to a decline in the rate of growth.

G. Implications of the Theory: A Brief Summary

In our model economy, the efficiency of financial institutions is a key determinant of the rate of productivity growth, which is the sole determinant of the long run growth rate. In moving to the study of actual economies—in which increases in physical capital, human capital, and population are also present—are as follows. First, there is a connection between overall growth and the performance of financial institutions. Second, there is a specific linkage via productivity. These predictions can be studied using differing types of evidence: by looking across different countries; by looking at financial and other reforms within a country; and by looking at the productivity of specific sectors and firms.

II. Empirical Linkages Between Financial Markets and Growth

We use four types of empirical evidence to evaluate the theory's predictions regarding the links between financial development and long-run growth. Primarily, we study a broad cross-section of about 80 countries over the 1960-1989 period. This focus on examining many countries over many years has costs and benefits. The major benefit is that we can capture general tendencies for a diverse group of economies. The major cost is that due to data availability, the broad cross-country approach forces us to use aggregate indicators of financial development, not country-specific information or measures of executable policies. Consequently, we augment the broad cross-country evidence and attempt to draw a link between policies toward financial systems and financial development by (a) studying five case studies of financial sector reform, (b) reviewing recent firm-level studies of the effects of financial reform on the allocation of credit, and (c) investigating how the success of general economic policy reforms depend on

financial development.

We find that the evidence from each empirical approach corresponds well with the model. The broad cross-country analysis shows that the services provided by financial intermediaries are importantly linked to economic growth and productivity improvements, and the level of financial development predicts future economic growth and future productivity advancements. We also find that our aggregate measures of financial development move in predictable ways following identifiable financial policy reforms, which suggests a link between financial sector policies and long-run growth. Moreover, firm level studies show that financial liberalization tends to increase the funding of more efficient firms at the expense of less efficient firms. Finally, after controlling for a variety of initial conditions, the initial level of financial development is positively associated with the beneficial effects of nonfinancial policy reforms, and when nonfinancial policy changes are accompanied by financial reform, success tends to be even larger. Thus, the success of other policy reforms depends on the financial system as suggested by our model.

We organize the empirical evaluation into five sections. We first motivate and define the variables in our study. Four measures of financial development form the core of our cross-country empirical investigation. In addition, we decompose real per capita GDP growth into two components. First, we study the rate of physical capital accumulation, measured both as an estimate of the per capita growth rate of physical capital and the ratio of investment to GDP. Second, we study productivity improvement, which we measure as a growth residual after controlling for physical capital accumulation. We call real per capita GDP growth, the rate of physical capital accumulation, the ratio of investment to GDP, and the rate of

productivity advancement "growth indicators." This decomposition permits us to examine the channels through which financial development may be related to economic growth. In the theoretical model, financial intermediary services influence growth primarily by improving productivity growth.

The second section uses cross-country regressions to evaluate the strength of the relationship between the financial development indicators and the growth indicators. We find that the average level of financial development is strongly tied to the average value of the growth indicators over the 1960-1989 period, both before and after controlling for initial conditions and other country characteristics. We also find that the level of financial development importantly predicts economic growth over the next 10 to 30 years.

The third section uses five case studies—Argentina, Chile, Indonesia, Korea, and the Philippines—to show that our four financial development indicators tend to increase when these countries implemented financial sector reforms. Thus, our indicators correspond appropriately with identifiable policy changes. These case studies also illustrate some of the limitations of the broad cross-country approach. Most of these financial reform efforts were unsuccessful and were quickly followed by financial crises. Thus, the aggregate approach does not illuminate a path of specific policy changes which will promote effective financial sector development and long-run improvements in human welfare. Furthermore, the Korean experience suggests that nonbank financial intermediary advancement importantly contributed to financial development, but this element of financial development is not captured by our indicators.

In the fourth section, we review firm-level evidence on the effects of financial sector reform from a recent World Bank research project (Caprio,

et. al., [1993]). In Ecuador and Indonesia, financial sector reform produced a reallocation of credit to more efficient firms. This conforms with our model, which predicts that financial intermediaries will seek out and fund better projects when freed from directed credit requirements.

Finally, we study the interactions between the level of financial development, financial reform, and other policy changes. Our theoretical model predicts that (a) other policy reforms—trade liberalization, tax reduction, etc.—will have a larger beneficial effect on economic growth when the financial system is better developed at the start of the reforms and (b) financial reform in conjunction with other policy reforms will promote growth more effectively than if reforms are taken independently. We present empirical work consistent with these predictions and hope that it stimulates additional research into the linkages between policy reforms and their joint effect on economic growth.

A. Measurement

We begin by discussing the measurements that we undertake to construct financial indicators and growth indicators.

1. Financial Indicators

In the model, financial intermediaries evaluate entrepreneurs and fund projects with relatively good chances of success. Financial intermediaries and markets may also facilitate risk management, ease financial transactions, and monitor managers. We employ the four indicators of financial development constructed by King and Levine [1993] to reflect the financial services provided by financial institutions to nonfinancial firms. First, in the tradition of Goldsmith [1969], McKinnon [1973] and others, we use a measure

of financial depth, which equals the overall size of the formal financial intermediary sector divided by GDP. The assumption behind this measure is that the size of the financial intermediary sector is positively correlated with the provision of financial services. We define financial depth as the ratio of liquid liabilities to GDP and call this variable DEPTH.[16/] Liquid liabilities equal currency held outside of the banking system plus demand and interest bearing liabilities of banks and nonbank financial intermediaries. For most countries, DEPTH equals M2/GDP. The relative size of the financial system in the economy, however, may not accurately reflect the provision of financial services. The central bank, for example, may play a relatively large role in the economy but not provide the types of financial services examined in our model.

Consequently, we try to isolate and measure those financial intermediaries which we believe are more likely to provide the evaluation, monitoring, and risk sharing services suggested by theory and intuition from financial institutions that are less likely to provide these services. Our second financial development indicator, BANK, equals the ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets. Banks seem more likely to provide the types of financial services emphasized in our model than central banks, so that higher values of BANK should correspond to more financial services and higher levels of financial development. There are also problems with this measure of financial development. Other financial institutions augment the information content of investment decisions. Indeed, nonbank financial intermediary growth may be an important component of financial development. But, insufficient data exist on mutual funds, venture capital institutions, postal savings institutions, investment banks, pension funds, etc. to construct

indicators of these financial intermediaries for a broad cross-section of countries over the 1960-1989 period. Another shortcoming with BANK is that many governments strongly influence the activities of banks, so that in some cases measuring the relative importance of banks vis-a-vis the central bank may not accurately reflect the degree of government intervention in credit allocation decisions or the provision of financial intermediary services. Nonetheless, banks are the main non-central bank financial intermediary internationally, and BANK will augment the first financial development indicator, DEPTH, by measuring the relative importance of a group of financial institutions that are more likely to provide the services emphasized by theory than are central banks.

A large financial system, DEPTH, or large banking sector, BANK, that simply funnels resources to the public sector or state owned enterprises is unlikely to be providing the types of financial services examined in the theoretical part of this paper. In light of this concern, we construct the third and fourth financial development indicators which are designed to measure to whom the financial system is allocating credit. PRIVATE equals credit issued to private enterprises divided by credit issued to the central and local governments plus credit issued to public private enterprises. PRIVY equals credit issued to private enterprises divided by GDP. Higher values of PRIVATE reflect a redistribution of credit from public enterprises and government to private firms. Higher values of PRIVY indicate more credit to the private sector as a share of GDP. Thus, if financial sector interactions with the private sector are more positively associated with the provision of financial services than financial sector interactions with the public sector, higher values of PRIVATE and PRIVY should indicate more financial services and higher levels of financial development. Along with

DEPTH and BANK, PRIVATE and PRIVY should help characterize the degree of financial development across countries. We also examined measures of a very repressed interest rate, as in Gelb [1989], but found that these indicators were not robustly linked to growth.

2. Growth Indicators

To examine the channels through which financial development may be linked to long-run growth, we decompose real per capita GDP growth into two components: the rate of physical capital accumulation and everything else. Specifically, let y equal real per capita GDP, k equal the real per capita physical capital stock, x equal other determinants of per capita growth, and α is a production function parameter, so that $y = k^{\alpha} x$. Taking logarithms and differencing yields $GYP = \alpha(GK) + PROD$, where GK is the growth rate of the real per capita physical capital stock and PROD is the growth rate of everything else. We measure GYP and GK directly, choose a value for α and define PROD as $GYP - \alpha(GK)$.[17/] We experimented with values of α between 0.2 and 0.4 and found that our results were not importantly affected; we report the results with $\alpha = 0.3$ and refer to the growth residual PROD as the growth rate of productivity.[18/]

The term PROD may consist of many factors. Technology growth, quality advances, improvements in the employment of factor inputs, human capital accumulation, increases in the number of hours worked per worker, and improvements in the employment of factor inputs would increase PROD. We attempted to account for human capital accumulation by including various measures of educational attainment improvements in our growth accounting exercise, but this did not alter our results.[19/] Consequently, if GK accurately reflects changes in physical capital and under the assumption that

the average hours worked per worker is relatively stable when averaged over decades, PROD should provide a reasonable conglomerate indicator of technology growth, quality advances, and improvements in the employment of factor inputs. These concepts correspond well with the theoretical model, where improvements in the allocation of society's resources improve the rate of innovation of better quality goods.

B. Broad Cross-Country Study of Financial Development and Growth

King and Levine [1993] do an in-depth study of the relationship between the four financial development indicators and the four growth indicators. The four growth indicators are real per capita GDP growth (GYP), per capita physical capital growth (GK), per capita human capital growth, and a residual measure of the rate of productivity improvements (PROD). The four financial development indicators are the size of the formal financial intermediary sector divided by GDP (DEPTH), the importance of banks relative to the central bank in allocating domestic credit (BANK), the fraction of credit allocated to private firms as opposed to the government and state enterprises (PRIVATE), and credit issued to private firms divided by GDP (PRIVY). Here, we summarize and extend the findings in King and Levine [1993].

1. Summary Statistics

Table II-1 provides summary statistics on the four growth indicators and the four financial development indicators for 77 countries averaged over the 1960-1989 period. There exists a wide range of values across countries. For example, Korea enjoyed an average annual real per capita growth rate of 6.6 percent from 1960 through 1989, while real per capita GDP actually fell at an annual rate of 1.2 percent in Niger. Similarly, the average value of DEPTH

in Switzerland was 1.13, while the corresponding figure in Rwanda was 0.11. The correlations among the growth and financial indicators presented in Table II-1 show that (a) each financial development indicator is positively and significantly correlated with each growth indicators at the 0.01 significance level and (b) the financial development indicators are all highly and significantly correlated with each other. These summary statistics suggest a positive association between financial development and economic growth.

2. Contemporaneous Financial Development and Growth

Using cross-country regressions, King and Levine [1993] evaluate the strength of the partial correlation between each growth indicator and each financial development indicator using the average value of the growth and financial indicators over the same time period, 1960-1989. In the tradition of recent cross-country empirical growth studies (e.g., Kormendi and Meguire [1985], Barro [1991], Levine and Renelt [1992]) regress the rate of real per capita GDP growth on initial conditions and economic and social indicators. Specifically, King and Levine [1993] regress GYP on the logarithm of initial income (LY0), the logarithm of the initial secondary school enrollment rate (LSEC), and each financial development indicator. We also include the ratio of trade (exports plus imports) to GDP (TRD), the ratio of government spending to GDP (GOV), and the average inflation rate (PI) to enlarge the information set on which we condition our evaluation of the importance of each financial indicator's coefficient.

King and Levine [1993] find that every financial development indicator is significantly related to every growth indicator at the 0.05 significance level. (See, for example, regression (1) in Table II-2). Financial depth, the importance of banks relative to central banks, the proportion of credit

allocated to private firms, and the ratio of private sector credit to GDP are positively and significantly associated with the growth rate of real per capita GDP, the rate of per capita physical capital accumulation, the share of investment in GDP, and the rate of productivity growth after controlling for initial conditions and frequently used economic indicators. Thus, in correspondence with our theoretical model of financial services and growth, the data suggest a statistically significant link between financial development and long-run growth.

The sizes of the coefficients further imply that the ties between financial and economic development are economically important. For example, King and Levine [1993] find a coefficient on BANK of 0.032 in a benchmark GYP regression. This implies that countries that raised BANK from the mean of the slowest growing (0.60) to the mean of BANK for the fastest growing quartile of countries (0.80) would have grown 0.7 percent faster per year. This change in BANK alone would eliminate about 15 percent of the difference between the fastest and slowest growing quartile of countries. Thus, differences in financial development may explain an important portion of the differences in economic growth rates observed across countries. But, this example should be viewed as illustrative: it does not address issues of causality nor does it suggest which policies should be changed to promote increases in BANK or the provision of financial services more generally.

King and Levine [1993] show that the strong association between financial development and growth withstands numerous sensitivity checks. The results also hold using pooled cross-section, time-series data with variables averaged over each decade, using various subsets of countries, or when including continent dummy variables, and with White's heteroskedastic consistent standard errors. Furthermore, based on Levine and Renelt [1992],

King and Levine [1993] alter the conditioning information set by using various combinations of variables such as population growth, changes in the terms of trade, the number of revolutions and coups, the number of assassinations, the level of civil liberties, the standard deviation of inflation, domestic credit growth, the standard deviation of domestic credit growth, etc. The strong connections between the financial indicators and growth are robust to alterations in the conditioning information set. This strong link contrasts sharply with Levine and Renelt's [1992] finding that almost all other economic indicators have very fragile ties with growth.

3. Initial and Predetermined Financial Development and Growth

In addition to predicting a strong contemporaneous association between financial services, growth, and the rate of productivity improvements, our model suggests that improvements in the provision of financial services will promote future economic growth and future technological innovation. Although the model also suggests a reverse channel of causation where exogenous improvements in technology may stimulate the provision of financial service, we are not now seeking to fully characterize the interactive relationship between financial services and growth.

Instead, we want to shed some empirical light on whether improvements in the financial sector can generate improvements in living standards; is there a basis in cross-country regressions for believing that financial sector policy reforms can stimulate increases in long-run growth rates? Although we cannot unequivocally answer this question, we can refute some views of links between finance and growth. First, the link between finance and growth is not just a contemporaneous link, arising because countries that develop rapidly during the sample period also have rapidly growing financial markets.

Second, finance does not only follow growth. Third, the positive association between growth and finance does not only exist because the shocks to finance and growth are positively correlated.

Specifically, we show that the predetermined or predictable component of financial development is related to future long-run growth rates using three forms of evidence. First, countries with well developed financial system in 1960 grew faster over the next thirty years than countries with less well developed financial systems. Second, countries that began each decade – the 1960s, 1970s, and 1980s – with well developed financial systems grew faster and enjoyed faster productivity growth over the respective decade. Third, using instrumental variables, we show that the predictable component of financial development is strongly associated with faster economic growth. Thus, the broad cross-country evidence suggests that countries with initially well developed financial systems enjoy faster rates of economic growth and productivity advancement over the next 10, and the predictable component of financial development is positively and significantly related to economic growth and the rate of productivity improvement.

Initial financial depth in 1960 and subsequent growth

This subsection addresses the question: After controlling for other initial conditions, other policies, the political environment, and geographical location, did countries that were financially deep—high values of DEPTH—in 1960 grow faster, have higher rates of physical capital accumulation, higher rates of human capital accumulation, and more rapid rates of technological advancement over the 1960-1989 period? The answer is "yes." Regression (2) in Table II-2 indicates that countries with higher initial depth in 1960 grow faster after controlling for a variety of initial

conditions and country characteristics. We only study one financial development indicator, DEPTH, because of a lack of data on BANK, PRIVATE, and PRIVY in 1960. These other three indicators are included in pooled cross-section, decade analyses discussed below.

To exemplify these results, we rank countries by the value of DEPTH in 1960, break the countries into quartiles according to their DEPTH in 1960 ranking, and compute the average per capita growth rate for each quartile. We find a revealing "step" relationship depicted in Figure II-1: countries with more well developed financial systems in 1960 grew faster over the next thirty years. Even when we predict growth over the 1960-1989 period using LYO, LSEC, an index of civil liberties, the number of revolutions and coups, the number of assassinations, and indicators of monetary, fiscal and trade policy, the unpredicted component of growth is linked to initial financial depth: countries with well developed financial systems in 1960 had faster than predicted growth as show in Figure II-2.

Decade initial financial development and subsequent growth

King and Levine [1993] examine the relationship between initial financial development and future values of the growth indicators using pooled cross-section, decade data. Thus, each country has three observations, data permitting, for the 1960s, 1970s, and 1980s. They confirm using the pooled cross-section time series data that the four measures of initial financial sector development - DEPTH, BANK, PRIVATE, and PRIVY are good predictors of subsequent economic growth.

To illustrate these results, Figures II-3 and II-4 use the quartile procedure described above for one financial development indicator, DEPTH. The Figures show the "step" relationship between initial financial depth at

the beginning of each decade and both future productivity growth and the unpredicted component of future productivity growth. Specifically, countries with well developed financial systems at the start of each decade enjoyed faster rates of productivity growth over the next ten years; and productivity growth over each decade was faster than predicted in countries that began the decade with relatively well developed financial systems.

Predetermined financial development and growth: 3SLS

We also use instrumental variables to evaluate whether the predictable component of the financial development indicators are significantly related to the economic growth indicators. For instruments, we use LYO, LSEC, GOVI, PII, TRDI, and initial values of the financial development indicators. We let the constant differ across decades but restrict the constant to be equal across countries and the slope parameters to be equal across periods and countries. Tests of these restrictions are discussed below.

Panel A of Table II-3 summarizes the three stage least squares (3SLS) results. The predictable components of (a) financial depth, (b) the relative importance of banks as opposed to central banks, and (c) the ratio of private credit to GDP are positively and significantly related to each growth indicator. The predictable component of financial development tends to be very strongly associated with growth and the sources of growth as suggested by theory.

We find the results on the predetermined and predictable components of financial development to be fairly stable. The findings are insensitive to estimation technique. Inclusion of continent dummies or the change in the terms of trade tends to strengthen the results, while adding political stability indexes, population growth, or GDP growth rates from the previous

decade does not alter the conclusions. The basic results hold when we restrict the sample to just developing countries, just Sub-Saharan African countries, or just non-Sub-Saharan African countries. Omitting outliers does not affect the results.[20/] Finally, we conduct the analysis over each decade. The results for the 1960s and especially the 1980s are similar to the results reported in panel A of Table II-3. In the 1970s, LLY and PRIVY enter with significant coefficients in the 3SLS growth results.

Since our residual measure of efficiency may be particularly prone to skepticism, we performed the 3SLS with GYP as the dependent variable and INV as an endogenous explanatory variable. We add the investment share in the previous decade as an instrument. Panel B of Table II-3 summarizes the results. While these results should be viewed with caution, the predictable component of (1) financial depth, (2) the relative importance of banks, and (3) the ratio of private sector credit to GDP are all significantly related to growth after including the predictable component of investment. Interestingly, the "exogenous" component of investment does not enter with a significant coefficient (and indeed enters with a negative coefficient). More effort should be devoted toward examining the characteristics of the endogenous relationship between investment and growth.

C. Case Studies

The broad cross-country regressions use financial development indicators, not measures of executable policies. In this subsection, we see whether identifiable financial sector reforms were associated with increases in the financial development indicators. We rely on Bisat, Johnston, and Sundararajan's [1992] careful study of the financial sector reforms in Argentina, Chile, Indonesia, Korea, and the Philippines. While these reform

episodes differ in terms of design and speed, there are basic similarities. Pre-reform, the government typically exerted a heavy hand in directing credit, setting interest rates, and restricting the activities and emergence of financial institutions. Reform involved the liberalization and relaxation of these controls and restrictions. Using the dates in Bisat, Johnston, and Sundararajan [1992], we examine (1) the pre-reform years and (2) the years following the onset of financial sector reform, or post-reform years.21/

Table II-4 provides pre-reform and post-reform values of the four financial development indicators that we use in our broad cross-country analysis. The financial development indicators tend to rise following financial sector reform. BANK, PRIVATE, and PRIVY rise in all cases except one. Financial depth, DEPTH, rises in Indonesia, Korea, and the Philippines and remains fairly stable in Argentina and Chile. Furthermore, the ratio of currency held outside of banks to bank deposits, CURRENCY, falls during every financial reform program, and the real interest rate, REAL-RATE, rises in all reform cases except one. These findings suggest using a broad range of financial development indicators.

It is important to note, however, that following the financial reforms Argentina, Chile, and the Philippines suffered financial crises. Between March 1980 and March 1981, Argentine authorities liquidated financial institutions holding about 20 percent of total deposits. In Chile, by 1983, almost 20 percent of commercial bank and finance company loans were in default. While in the mid-1980s, the Philippine authorities had to move 30 percent of the banking system's assets, which were nonperforming, to a government agency. Behind each of these crisis, one can see an unhealthy mix of financial liberalization combined with explicit or implicit official deposit guarantees and insufficient supervisory capabilities. For example,

in Argentina the weakest financial institutions offered the highest deposit interest rates, while onsite inspections by the Central Bank fell from 23 percent of banks before the reforms to 10 percent in 1981. As argued by Dornbusch and Reynoso [1989], one interpretation of these case studies is that the financial sector is only important to the production of goods and services when there is a financial crisis. This interpretation, however, does not coincide with other evidence: the aggregate cross-country evidence strongly suggests that the level of financial development helps predict future economic growth and, as shown below, firm level data suggests that financial reform improves resource allocation. Thus, we believe the appropriate interpretation of the case studies is that the broad financial indicators are positively associated with financial sector reform, but the broad financial indicators do not illuminate a successful financial sector reform strategy.

Furthermore, the available financial indicators may miss important developments. Figures II-5 and II-6 illustrate this for the case of Korea. Figure II-5 shows that nonbank financial intermediaries flourished during the mid-1980 financial liberalization, but Figure II-6 shows that the importance of banks in the economy, BANK, did not grow substantially during this period. Thus, our inability to capture financial institutions outside of banks for a broad cross-section of countries may be an important omission for some countries.

D. Firm Level Studies of Financial Reform and Credit Allocation

Our theoretical model predicts that these reforms should alter the flow of credit; more efficient firms should get a larger fraction of credit, and less efficient firms should get a smaller fraction of credit. As part of the

World Bank research project discussed in Carpio [1993], individual studies by Jaramillo, Schiantarelli and Weiss [1992], Harris, Schiantarelli, and Siregar [1992], and Siregar [1992] use firm level panel data to examine the effects of financial sector reform in Ecuador and Indonesia on the allocation of credit. The use of firm level panel data allows investigators to examine precisely the reallocation of credit following financial liberalization. Both Ecuador and Indonesia implemented substantial market-oriented financial sector reforms in the 1980s.

The authors examine the efficiency with which Ecuador and Indonesia allocate credit. They estimate a production function and compute the distance that each firm lies from the production possibilities frontier. Firms that are closer to the frontier have higher "technical efficiency."[22/] Jaramillo, Schiantarelli and Weiss [1992] show, using a panel of several hundred Ecuadorian firms, that "... ceteris paribus, there has been an increase in the flow of credit accruing to technically more efficient firms, after liberalization, controlling for other firms' characteristics." (Caprio, et. al., [Chapter 5, 1993]). The authors provide considerable evidence that the results are robust to different production function specifications and estimation procedures. Furthermore, using data on about two hundred Indonesian firms, Harris, Schiantarelli and Siregar [1992] and Siregar [1992] show that, for Indonesia as well, credit flowed to more efficient firms following financial liberalization. Thus, financial liberalization in Ecuador and Indonesia was associated with an alteration in the flow of credit to more efficient firms. This coincides with predictions of our model and our conception that financial intermediaries "add-value" by improving the selection and funding of entrepreneurs.

E. Structural Adjustment and Financial Development

An important set of predictions from the model involves the interactions between financial liberalization and other policy reforms. The model implies that the starting level of financial development will be positively associated with the success of nonfinancial policy reforms. The model also predicts that when financial liberalization accompanies nonfinancial policy reforms, the effect on growth will be greater than if financial reforms do not coincide with nonfinancial reforms. In practice, the interactive effects of financial and nonfinancial policy reforms on growth will depend on many factors, including precisely which policies change, the order and speed of these changes, and the condition of the economy as a country initiates policy alterations.

Given the daunting complexities inherent in measuring the array of relevant executable policies across countries, incorporating predictions regarding the sequencing of liberalization, and designing appropriate econometric tests, we do not formally evaluate the interactive effects of executable financial and nonfinancial policy reforms on growth. Instead, we present suggestive evidence regarding the interactions between financial development, general policy reforms, and economic growth and hope that this work stimulates more detailed investigations.

Specifically, we study whether the success of countries that engaged in intensive structural adjustment during the late 1980s depended on (a) the initial level of financial development and (b) financial liberalization during the reform episode. We define success in terms of the growth rate of per capita GDP. We define intensive structural adjustment in terms of the World Bank's Third Report on Adjustment Lending. The Report classifies 27 nations as "intensive adjustment lending" (IAL) countries during the second

half of the 1980s. This group is defined as countries that received at least two structural adjustment loans or three adjustment loans of any type (either structural or sectoral) between 1986 and 1990. These adjustment operations focused on trade liberalization, agricultural policy reforms, fiscal policy changes, removing restrictive regulatory practices, and public enterprise reform. Sometimes structural adjustment lending contained conditions on financial sector policy reforms. The Report shows that IAL countries grew faster in the late 1980s than countries that did not receive any adjustment lending or countries that received limited adjustment lending. Furthermore, the Report shows that IAL countries tended to implement policy reforms: deficits fell, trade restrictions eased, black market premia fell, internal relative prices moved toward world levels, and IAL countries divested public companies.[23/]

Using these IAL countries, we ask two questions. First, did IAL countries that began the adjustment period with relatively well developed financial systems enjoy more success than IAL countries with relatively underdeveloped financial systems? Second, did IAL countries that also experienced above average financial development during the 1985-1990 period grow faster than IAL countries with less than average financial development? In Figure II-7, we show that IAL countries with above average financial depth, DEPTH, in 1985 grew much faster than IAL countries with less than average DEPTH in 1985. Since the evidence in Figure II-7 does not account for other growth determinants, we compute grow residuals from the regression of per capita GDP growth on initial income, initial secondary school enrollment, the initial ratio of government spending to GDP, the initial ratio of international trade to GDP, and the initial inflation rate. Figure II-8 shows that IAL countries with above average DEPTH had much higher growth

residuals than IAL countries with less than average DEPTH; IAL countries with faster than predicted growth tended to be IAL countries with initially well developed financial systems. Thus, the success of structural adjustment tends to be positively associated with the initial level of financial development after controlling for other economic and policy characteristics.[24/]

We now turn to the second question: did IAL countries with rapid financial development in 1985-1990 enjoy more successful adjustment than IAL countries with less financial development? We define financial development as the growth rate of DEPTH over the 1985-1990 period. Figure II-9 shows that IAL countries with DEPTH growth faster than average grew much faster than IAL countries with DEPTH growth less than average. Moreover, Figure II-10 shows that IAL countries with above average DEPTH growth had much higher growth residuals than IAL countries with less than average DEPTH growth; IAL countries with faster than predicted growth tended to be IAL countries with financial systems that grew relatively rapidly. Thus, the success of structural adjustment tends to be positively associated with financial development after controlling for other economic and policy characteristics.

The results are not conclusive: the five year period (1985-1990) is short; structural adjustment programs sometimes include financial reforms; and adjustment is an ongoing process sometimes starting before 1985. The results do, however, suggest an important relationship between the success of nonfinancial policy reforms and financial development that should motivate further research into the interactions between policy changes and their joint influence on economic welfare.

III. Summary, Conclusions and Directions for Future Work

In this paper, we articulated a specific economic mechanism by which financial institutions may figure in the process of long term economic growth. Financial institutions research and produce information about the economic viability of intangible and tangible capital investments. In our view, financial institutions can play an active role in evaluating, selecting, and funding entrepreneurs. By producing and processing information about potential projects, financial intermediaries can improve the allocation of resources and enhance the probability of successful innovation, which translates into faster productivity growth and faster per capita growth rates.

We then reviewed a range of different evidence concerning links between financial sector development and growth, including: cross-country evidence; case studies of the aggregate effect of financial sector and other economic reforms; and case studies of the microeconomic productivity effects of such reforms. Overall, the evidence supports the core ideas advanced in the theory; namely, financial intermediaries can promote faster productivity and economic growth by better selecting to which firms to funnel society's resources. It is also clear that great care must be taken in designing particular financial sector reform packages or financial crises may ensue.

We conclude that there is further reason to believe that government policies toward financial institutions may have an important causal effect on long run growth. Quantitatively, finance does not explain everything, but it appears to be important in the various experiences that we review.

Our current work raises two sets of additional questions that are natural next steps for research in this area. In particular, we found it striking that initial financial sector development was importantly linked to the

success of intensive adjustment lending activity, suggesting an interaction of the effects of different economic policies. Each of the new questions requires consideration of growth in open economies, in contrast to the analysis tnat we have conducted so far. First, what are the benefits and costs to a developing country if it permits free trade in financial services, importing its financial institutions from abroad? Second, how do the effects of financial reforms interact with those of other reforms, particularly trade liberalizations and fiscal reforms?

NOTES

1/ An overview of this literature is contained in Pagano [1993] and a detailed survey of this literature is forthcoming in Greenwood and Smith [1993]. Key early references are Greenwood and Jovanovic [1990] and Bencivenga and Smith [1991]. GJ stress that of financial markets pool the funds of small savers and in allocate capital to its highest valued use. Working with a variant of the general equilibrium model of financial intermediation due to Diamond and Dybvig [1983], BS stress the importance of financial markets in providing liquidity to small savers, thus permitting a reallocation of funds to an illiquid, higher return technology. Boyd and Smith [1992] discuss how financial intermediaries may partially overcome negative consequences of adverse selection in financial markets. Levine [1991] and Saint Paul [1992] stress that stock markets provide portfolio diversification that can stimulate growth.

2/ Some recent empirical studies of links between finance and growth are Gelb [1989], Roubini and Sala-i-Martin [1991,1992], King and Levine [1992a,c]. See also The World Development Report [1989].

3/ For a further detailing of these arguments, see King and Levine [1992b].

4/ Recent research has developed models that embed Schumpeterian ideas of "creative destruction" in general equilibrium frameworks, following Shleiffer [1986]. Our research draws heavily on recent endogenous growth models in the class developed by Aghion and Howitt [1992], Romer [1990] and most closely, Grossman and Helpman [1991].

5/ For some additional expository discussion, see King and Levine [1992b].

6/ Our formal model emphasizes this view in an extreme ways since it abstracts entirely from the mechanics of physical capital formation.

7/ See Bhattacharya [1992] for a detailed discussion of financial intermediation in settings with proprietary information.

8/ Technically, we assume that there is a continuum of individuals in the economy understudy who have names on the unit interval $0 \leq i \leq N$, each of whom is endowed with one unit of labor. Some of these individuals are also endowed with characteristics that give them to be the potential to be entrepreneurs: we assume that these are individuals with the names $0 \leq i \leq E$.

9/ A physical analogy may be aid in discussing the nature of the coordination implicitly assumed. Suppose that one has lost a watch somewhere along the side of a football field (of unit length) and has N searchers each of whom can search an interval of length ϕ within a given time period. Assume further that $N\phi < 1$ so that there is never a

possibility of a certain outcome. If the searchers are allocated so that there is no overlap in the intervals searched, the the probability that one is successful (and only one may be) is $\Phi = N\ \phi$. But if the searchers are allocated randomly along the side of the field, then the probability is $\Phi = 1-(1-\phi)^N$, since $(1-\phi)$ is the probability of failure for an individual and $(1-\phi)^N$ is the probability that there are no successes from N draws of the binomial (see, e.g., Feller, [1968, p.148]).

10/ The standard production function would be

$$\sum_{h=1}^{H} \nu_h \log(y_h) \text{ with } \sum_{h=1}^{H} \nu_h = 1.$$

11/ For a fixed length of time (Δt), the evolution equation is $\log(A_{t+\Delta t}) = \int_0^1 \log(A_t(\omega))\, d\omega = \{\Pi\ (\log(A_t)+\log(\Lambda)) + (1-\Pi)\ \log(A_t)\}\Delta t$. Hence, $\log(A_{t+\Delta t}/A_t) = \Pi\log(\Lambda)\ \Delta t$ and by driving $\Delta t \to 0$, we obtain $dA_t/A_t = \Pi\ \log(\Lambda))$.

12/ To derive the continuous time version of (FM), we proceed as follows. First, we write the equilibrium condition as $\pi\ \rho_{t+\Delta t,t}\ v_{t+\Delta t}\ \Delta t = a(0)\ w_t\ \Delta t$, which involves the fact that we are measuring innovation probabilities and wage rates on a "per period" basis while we change the period length. Then, we drive $\Delta t \to 0$, the discounted stock price simply becomes v_t and other aspects of the equation are unchanged.

To derive the continuous time version of the condition (SM), we proceed as follows. First, as in the preceding note, we write the specification as:

$$(1-\Pi\ \Delta t)\ \rho_{t+\Delta t,t}\ v_{t+\Delta} = v_t - d_t\ \Delta t$$

Then we set $\rho_{t+\Delta t,t} = \exp(-r_t\ \Delta t)$, so that r_t is a per period return:

$$(1-\Pi\ \Delta t)\ v_{t+\Delta} = [v_t - d_t\ \Delta t]\ \exp(\ r_t\ \Delta t).$$

Then, we reorganize the condition as follows:

$$(v_{t+\Delta t} - v_t)/\Delta t = \Pi\, v_{t+\Delta t} - d_t \exp(r_t\, \Delta t) + \frac{1}{\Delta t}[\exp(r_t\, \Delta t)-1]\, v_t.$$

Taking limits as $\Delta t \to 0$ and using $\lim_{\Delta t \to 0} \frac{1}{\Delta t}[\exp(r_t\, \Delta t)-1] = r_t$, we arrive at the expression reported in the text.

13/ In models where some sectors have beneficial external effects, appropriate interference by the government could promote innovation and growth. Thus, the growth effects of government directed credit programs is an important empirical issue.

14/ The profit maximization condition involves setting partial derivative of $(q/w) = \kappa\, \pi(x) - x$ with respect to x equal to zero: this is $\kappa\, D\pi(x)-1 = 0$. This implies that there is a generally a positive derivative of $x(\kappa)$. The effect of a change in κ on (q/w) is

$$\frac{\partial(q/w)}{\partial\kappa} = \pi(x) - [D\pi(x) - 1]\frac{\partial x}{\partial\kappa} = \pi(x)$$

so that, to a first order approximation, this measure of innovation rents displays the same relationship to κ irrespective of the elasticity of scale x with respect to the price κ. Further, there is a positive second derivative of the (q/w) function with respect to the price κ

$$\frac{\partial^2(q/w)}{\partial\kappa^2} = D\pi(x)\, \frac{\partial x}{\partial\kappa} > 0.$$

15/ That is, given that q/w is zero at $\kappa = 0$ and increasing, there is some level of κ at which $q/w = f/\alpha$.

16/ See King and Levine [1993] for a description of the data sources.

17/ We use Benhabib and Spiegel's [1992] physical capital stock estimates. They assume that the relationship between the capital-output ratio and the capital-labor ratio are constant across time and countries. They then use an iterative procedure using investment data to construct capital stock data.

18/ We obtain similar results using the change in real per capita GDP divided by investment as an alternative measure of "productivity."

19/ We could not get complete, comparable data on the average number of hours worked per worker for the countries in our data set.

20/ To test for country effects (as opposed to continent effects), we subtracted the 1960-1989 mean of each variable from its value in each decade, computed the 3SLS results, and did a Hausman-type test to determine whether the coefficients on the two sets of results are

significantly different from one another. This amounts to including dummy variables for each country and testing whether the coefficients on the financial indicators change. We find that the coefficients are not significantly different, which implies that we are not missing crucial country specific effects. However, numerous coefficients change noticeably, but the standard error in the means-removed-regression is such that means-removed coefficients are frequently less than one standard error away from the values in Table II-6. Thus, there may be some important country specific effects that we are missing. As Easterly, et. al. [1992] show, real per capita GDP growth varies much more across decades than the economic indicators used to explain growth. Put differently, it will be difficult for cross-country growth regressions to explain fully a country's growth experience because much of growth seems rooted in country specific characteristics that are difficult to capture using available data on many countries over long time periods. The first stage results indicate that the best predictor of the average level of financial development is past financial development. This emphasizes the relative lack of variability in the explanatory variables we are using to explain growth.

21/ The term "post-reform" is a sight misnomer since policy changes continued during these years.

22/ See the individual papers for detailed discussion of the procedure.

23/ The Report also notes that adjustment takes years, and there may be significant recessions during the adjustment. The poor seem to benefit the most in the longer-run from structural adjustment but may suffer as the economy adjusts.

24/ These results hold when using the other financial development indicators BANK, PRIVATE, and PRIVY. Also, those results hold when using the values in 1980 to compute the initial state of financial development.

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Table I-1: Notation

General

ρ:	discount factor
r:	real interest rate
d:	dividends (profits)
v:	stock market value
w:	real wage rate (in commodity units)
C:	consumption (final output)
A:	productivity aggregate
N:	total labor quantity

Financial Sector

α:	probability of an entrepreneurial candidate being capable of running project
f:	labor input requirements (financial sector)
q:	economic value of rated project.
v:	real stock price
L:	aggregate lending

Innovation Sector

Π, π:	aggregate and individual probabilities of innovation
e:	fraction of society engaged in entrepreneurial activity
x:	team size (labor input requirements) in innovative sector
Λ:	productivity ladder step.
$\lambda=\log(\Lambda)$:	continuously compounded productivity ladder step.

Table I-1, Continued

Intermediate Product Sector

$A(\omega)$:	productivity in intermediate product ω
$y(\omega)$:	output of intermediate product ω
$n(\omega)$:	labor input into intermediate product ω
$z(\omega)$:	input demand for intermediate product ω
$p(\omega)$:	price of intermediate product ω
$d(\omega)$:	profits (dividends) in ω
M:	markup ($M=\Lambda$)

Preferences:

σ:	$(1/\sigma)$ is intertemporal substitution elasticity
ν:	pure rate of time preference

Growth Rates:

γ:	continuously compounded growth rate of consumption, wage, stock price, etc.
$\bar{\gamma}$:	maximum attainable growth rate (if all resources are allocated to innovative activity)
γ^*:	optimal growth rate

Compound Parameters

$a(0)$:	$(\frac{f}{\alpha} + x)$	full labor requirement of innovative activity
$a(\tau)$:	$a(0)/(1-\tau)$	equilibrium parameter for FI
m:	$m = (M-1)$	net markup
$\theta =$	$\lambda\pi/a(0)$	social opportunity cost of investment in new technology
$\bar{\gamma} =$	θN	maximum feasible growth rate

Table II-1:
Properties of Growth and Financial Indicators

A. Summary Statistics: 1960–1989

	GYP	GK	INV	EFF	DEPTH	BANK	PRIVATE	PRIVY
Mean	0.019	-0.003	0.203	0.020	0.364	0.715	0.598	0.256
SD	0.019	0.014	0.052	0.013	0.217	0.172	0.172	0.185
Min	-0.012	-0.032	0.092	-0.007	0.106	0.235	0.176	0.037
Max	0.066	0.028	0.318	0.059	1.132	0.979	0.920	1.119

B. Contemporaneous Correlations: 1960–1989

	GYP	GK	INV	EFF	DEPTH	BANK	PRIVATE
GK	0.77 [0.001]						
INV	0.58 [0.001]	0.65 [0.001]					
EFF	0.98 [0.001]	0.64 [0.001]	0.50 [0.001]				
DEPTH	0.56 [0.001]	0.69 [0.001]	0.54 [0.001]	0.47 [0.001]			
BANK	0.44 [0.001]	0.56 [0.001]	0.59 [0.001]	0.36 [0.002]	0.59 [0.001]		
PRIVATE	0.37 [0.001]	0.49 [0.001]	0.49 [0.001]	0.30 [0.008]	0.45 [0.001]	0.79 [0.001]	
PRIVY	0.50 [0.001]	0.65 [0.001]	0.48 [0.001]	0.41 [0.001]	0.82 [0.001]	0.63 [0.001]	0.68 [0.001]

[p-values in brackets]

GYP = Real per capita GDP growth rate
GK = Real per capita capital stock growth rate
INV = Ratio of investment to GDP
EFF = GYP – (0.3)*GK
DEPTH = Ratio of liquid liabilities to GDP
BANK = Deposit bank domestic credit divided by deposit bank domestic credit plus central bank domestic credit
PRIVATE = Ratio of claims on nonfinancial private sector to domestic credit
PRIVY = Gross claims on the private sector to GDP

Table II-2:
Growth and Financial Depth

Independent Variable	(1)	(2)
C	0.029***	0.040***
	(0.007)	(0.007)
LYO	-0.008***	-0.013***
	(0.003)	(0.003)
LSEC	0.008***	0.011***
	(0.002)	(0.002)
Index of Civil Liberties	0.001	0.001
	(0.001)	(0.001)
Number of Revolutions	-0.012*	-0.006
	(0.007)	(0.008)
Number of Assassinations	-0.001	-0.001
	(0.001)	(0.003)
DEPTH average 1960-1989	0.029***	
	(0.007)	
DEPTH in 1960		0.028***
		(0.007)
R^2	0.52	0.55
Observations	92	63

(Standard errors in parentheses)

Dependent variable: GYP: Average Annual real per capita GDP growth 1960-1989

* significant at 0.10 level
** significant at 0.05 level
*** significant at 0.01 level

LYO = log of initial real per capita GDP in 1960
LSEC = log of secondary school enrollment rate in 1960

Table II-3
Instrumental Variables Estimates for
Pooled Cross-Section Time Series

A. Sources of Growth and Financial Indicators

Dependent Variable:	Coefficient on: LLY	BANK	PRIVATE	PRIVY
GYP	0.035***	0.036***	0.014	0.035***
	(0.006)	(0.011)	(0.010)	(0.009)
	[0.001]	[0.001]	[0.184]	[0.001]
R^2:	0.47	0.39	0.33	0.54
GK	0.027***	0.034***	0.011	0.032***
	(0.005)	0.009)	(0.008)	(0.008)
	[0.001]	[0.001]	[0.187]	[0.001]
R^2:	0.48	0.54	0.42	0.51
INV	0.064***	0.010***	0.055**	0.060**
	(0.018)	(0.031)	(0.026)	(0.028)
	[0.001]	[0.002]	[0.044]	[0.035]
R^2:	0.27	0.18	0.24	0.32
EFF	0.030***	0.035***	0.005	0.028**
	(0.007)	(0.011)	(0.010)	(0.011)
	[0.001]	[0.003]	[0.660]	[0.012]
R^2:	0.39	0.40	0.22	0.47

Table II-3, Continued
B. Growth, Finance and Investment

Dependent Variable: GYP

Coefficient on				
INV:	-0.027	-0.044	-0.016	-0.35
	(0.079)	(0.080)	(0.073)	(0.076)
	[0.731]	[0.840]	[0.830]	[0.648]
Financial Indicator:	LLY	BANK	PRIVATE	PRIVY
	0.034***	0.041**	0.020*	0.041***
	(0.012)	(0.016)	(0.012)	(0.014)
	[0.005]	[0.012]	[0.094]	[0.003]

(standard errors in parentheses) [p-values in brackets]

(*,**,***) significant at the (.10, .05, .01) level Observations = 169

Definitions of variables: See Table II-1 above.

Other explanatory variables: log of initial income, log of initial secondary school enrollment rate, ratio of government expenditures to GDP, inflation rate, and ratio of exports plus imports to GDP.

Instruments: Decade dummy variables, log of initial income, log of initial secondary school enrollment rate, initial ratio of government expenditures to GDP, initial inflation rate, and initial ratio of exports plus imports to GDP. Panel A regressions include initial value of the pertinent financial indicater; panel B regressions also include INV in the prior decade.

Table II-4:
Before and After Financial Sector Reform

Country	BANK	PRIVATE	PRIVY	DEPTH	CURRENCY	REAL-RATE
Argentina (1974-1976)	0.41	0.41	0.17	0.22	0.45	-44.70
Argentina (1978-1980)	0.81	0.59	0.16	0.21	0.26	-14.13
Chile (1970-1973)	—	—	0.08	0.18	0.31	< 0
Chile (1977-1981)	0.45	0.64	0.28	0.17	0.19	8.80
Indonesia (1978-1982)	0.53	0.40	0.09	0.15	0.38	-3.61
Indonesia (1984-1989)	0.63	0.51	0.18	0.19	0.22	8.97
Korea (1978-1980)	0.75	0.70	0.29	0.30	0.13	-0.94
Korea (1983-1985)	0.80	0.74	0.43	0.36	0.07	6.58
Philippines (1975-1979)	0.77	0.72	0.22	0.22	0.13	-2.09
Philippines (1981-1984)	0.72	0.65	0.29	0.26	0.12	-3.03*

* If the 1984 value of -19.40 is omitted, the average annual real deposit interest rate over the 1981-1983 period is 2.33.

Figure I-1 a:
Innovation Success and Inputs: Basic Assumption

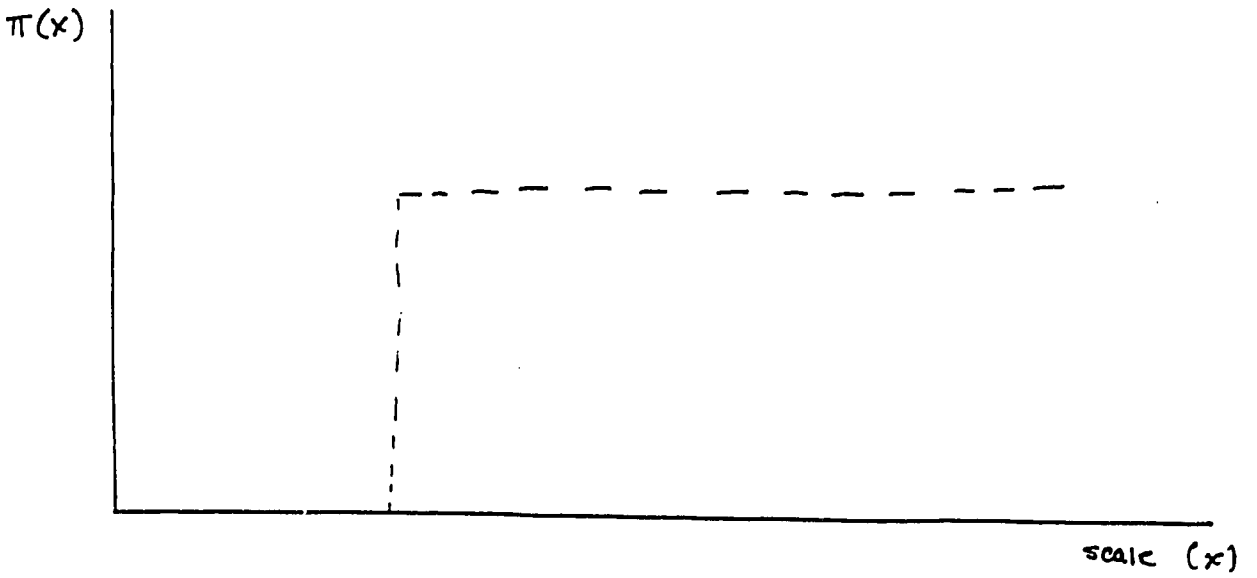


Figure I-1 b:
Innovation Success and Inputs: More Realistic Assumption

Figure I-2 a:
Real Return and Growth Rate: Production-Side Market Equilibrium Linkages

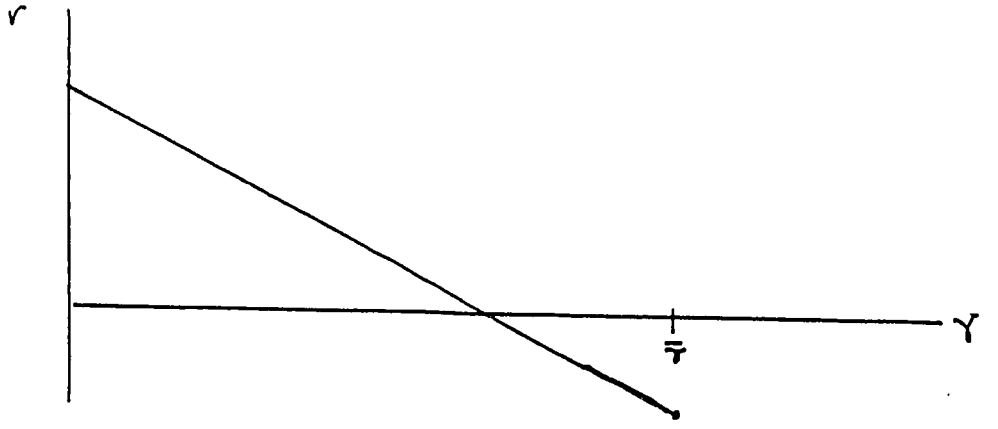


Figure I-2b:
Effects of Changes in τ

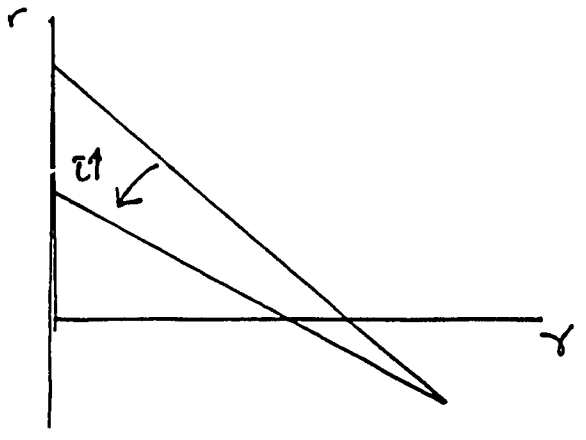


Figure I-2c:
Effects of Changes in $\bar{\gamma}$

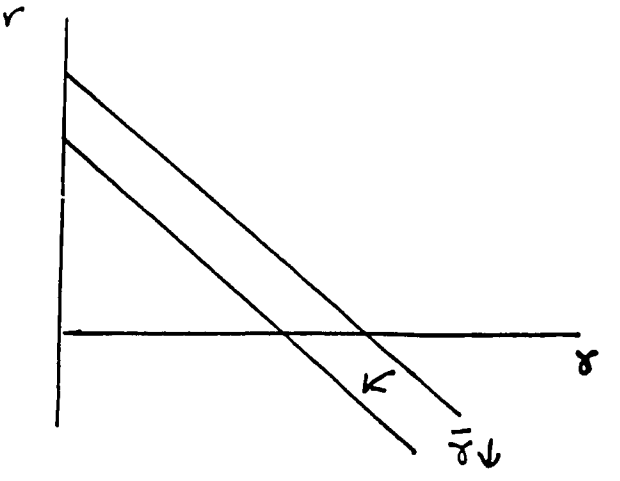


Figure I-2 d:
Real Return and Growth Rate: Preference-Side Linkages

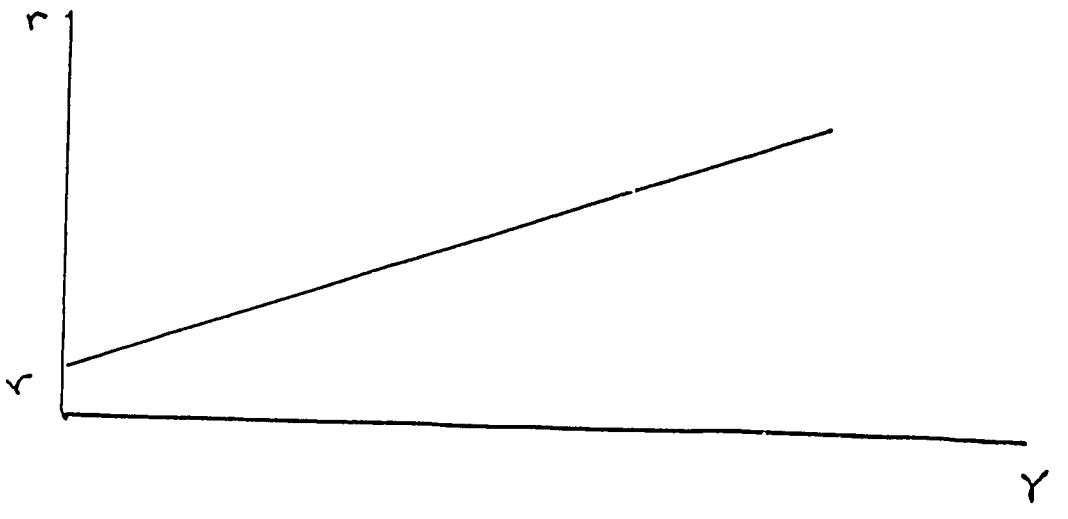


Figure I-3 a:
Growth Effects of Financial Sector Taxation

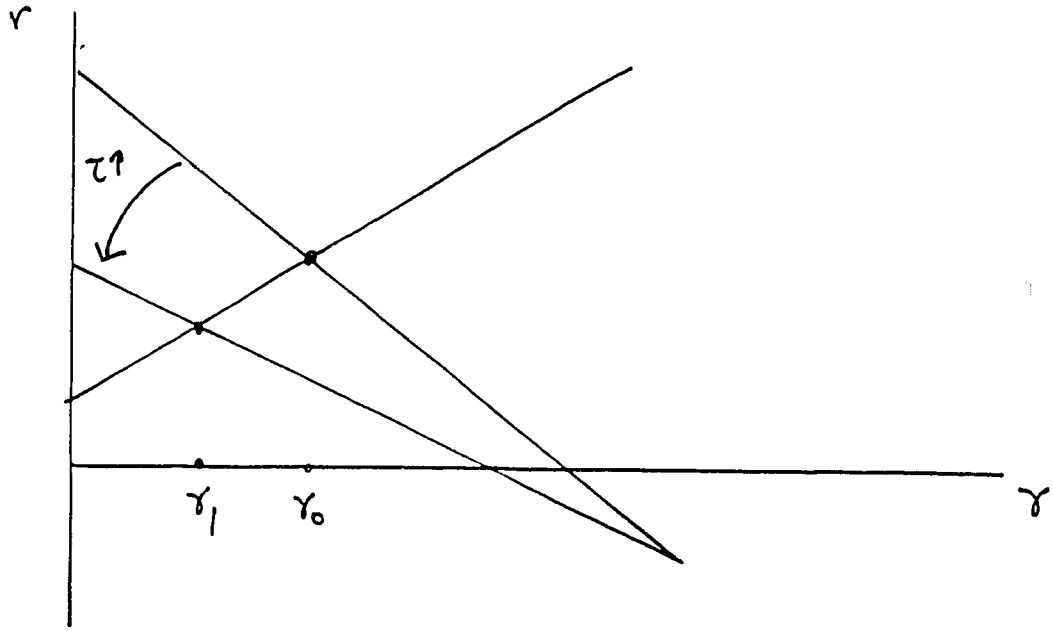


Figure I-3 b:
Growth Effects of Financial Sector Distortions
(Loan Size Restriction)

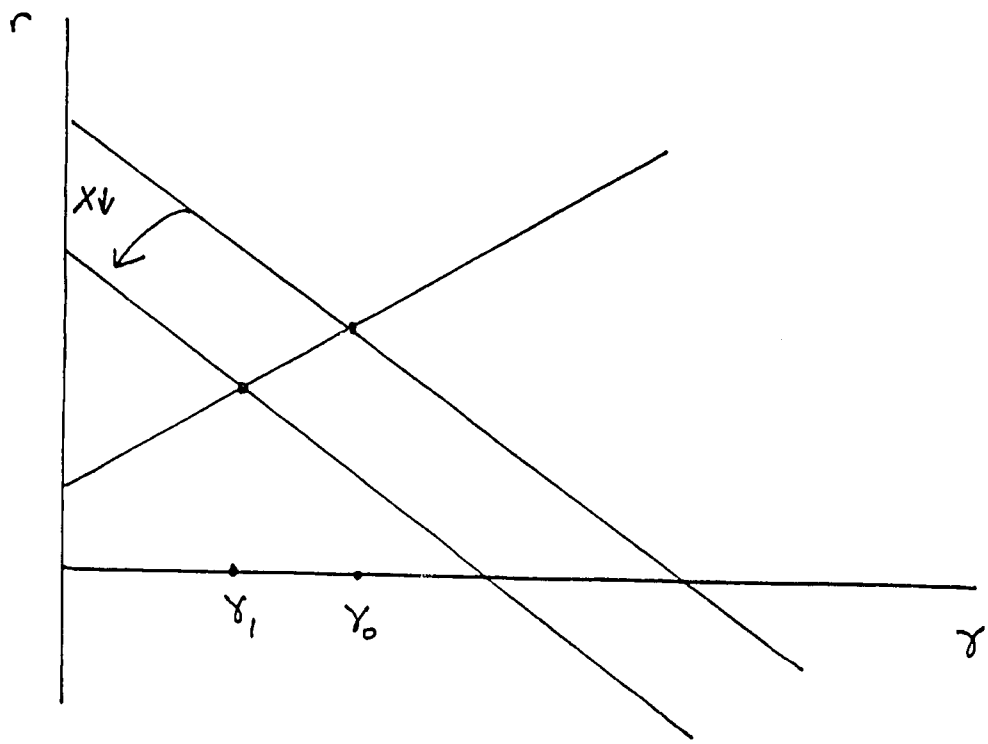


Figure II-1:

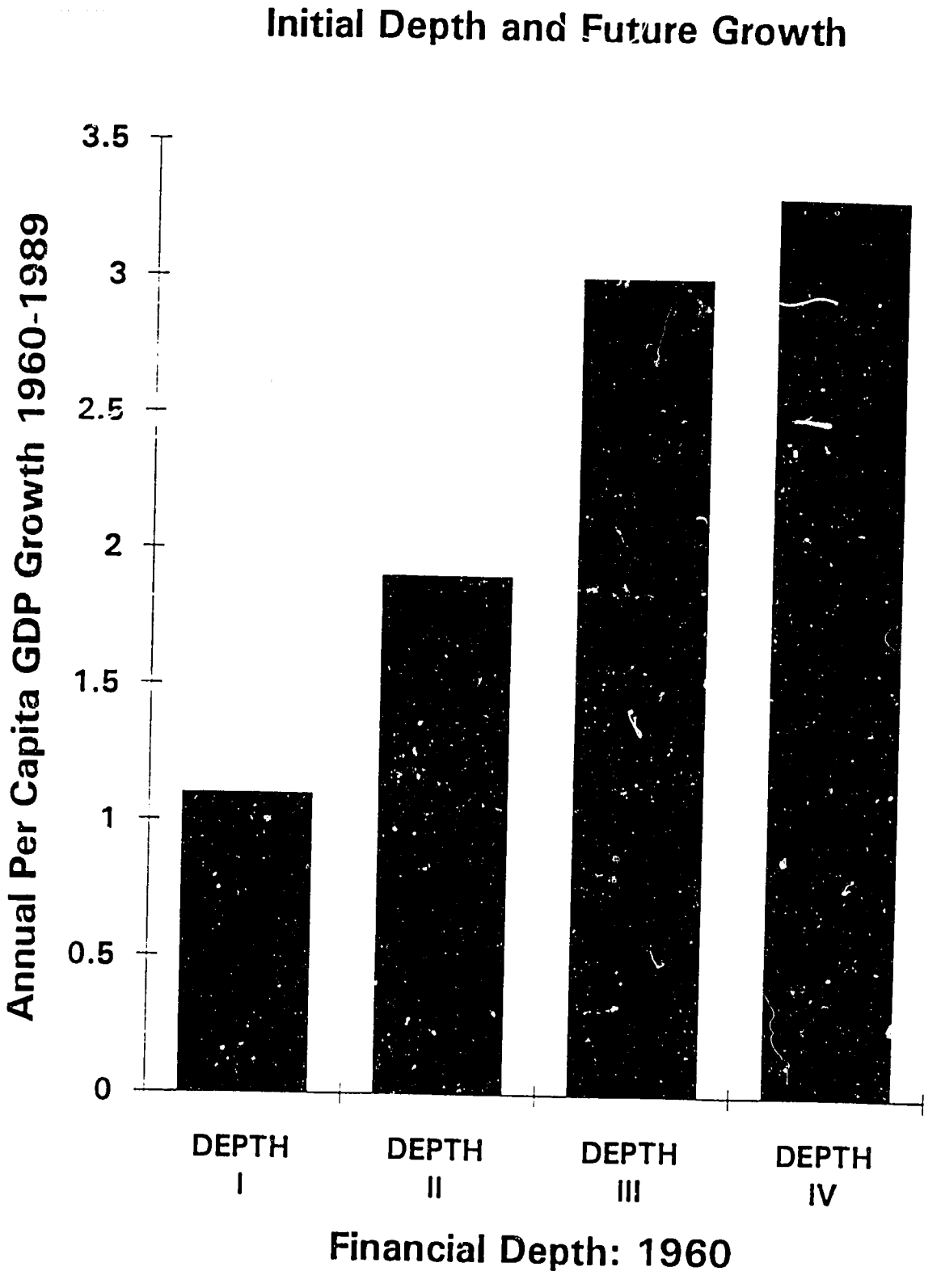

Initial Depth and Future Growth
Annual Per Capita GDP Growth 1960-1989
3.5
3
2.5
2
1.5
1
0.5
0
DEPTH I
DEPTH II
DEPTH III
DEPTH IV
Financial Depth: 1960

Figure II-2

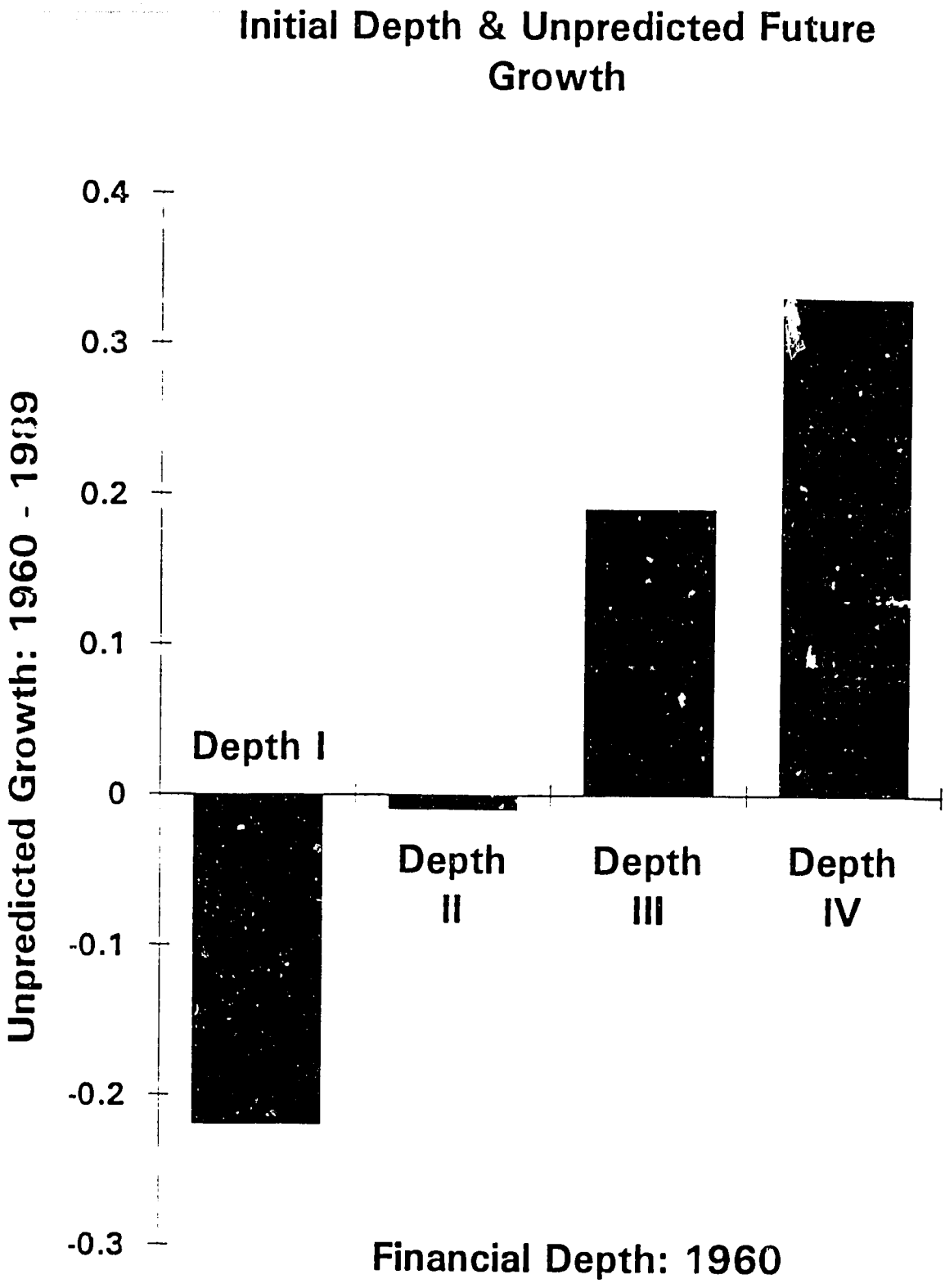

Initial Depth & Unpredicted Future Growth
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
Unpredicted Growth: 1960 - 1989
Depth I
Depth II
Depth III
Depth IV
Financial Depth: 1960

Figure II-3:

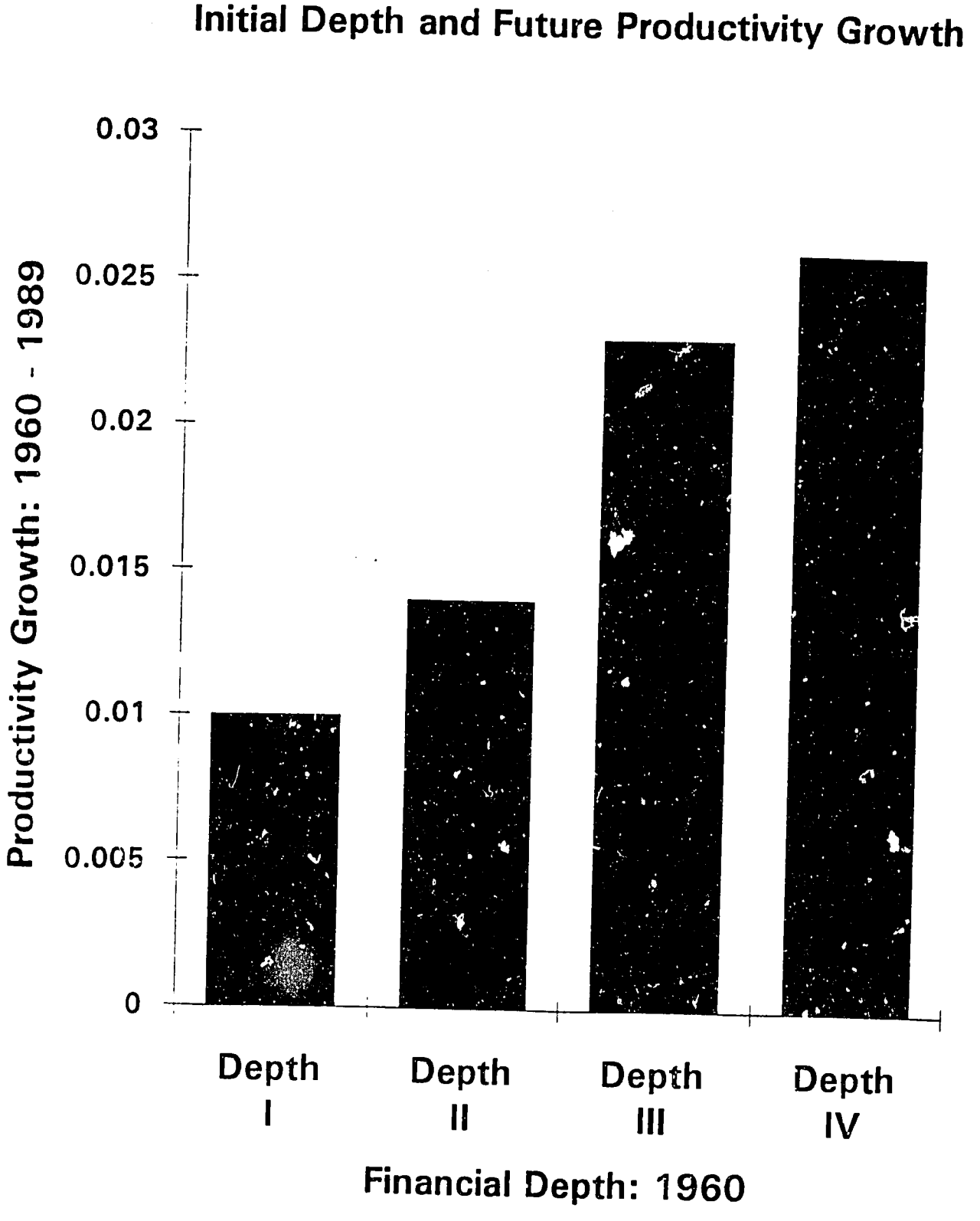

Initial Depth and Future Productivity Growth
Productivity Growth: 1960 - 1989
0.03
0.025
0.02
0.015
0.01
0.005
0
Depth I
Depth II
Depth III
Depth IV
Financial Depth: 1960

Figure II-4

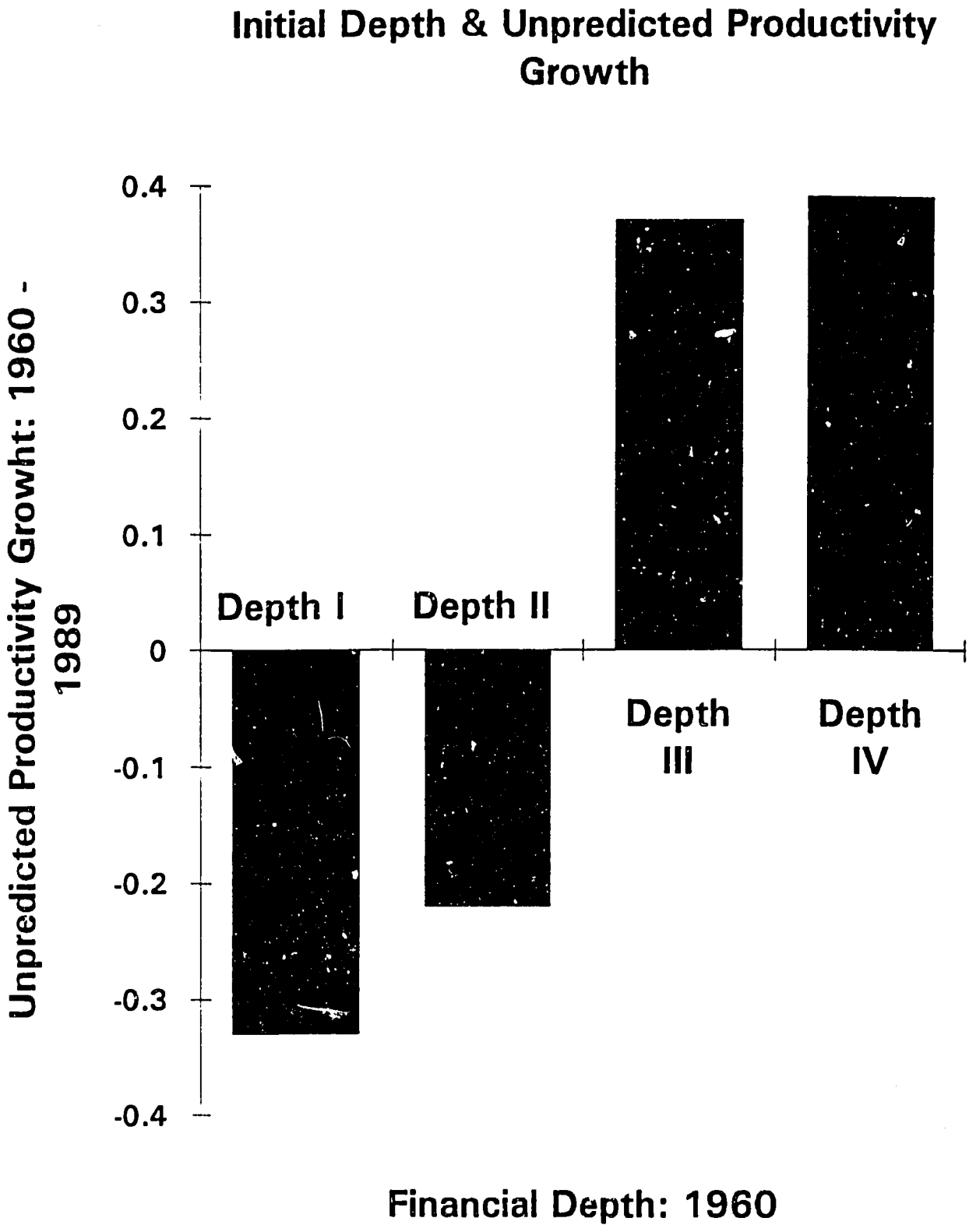

Initial Depth & Unpredicted Productivity Growth
Unpredicted Productivity Growwht: 1960 - 1989
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
Depth I
Depth II
Depth III
Depth IV
Financial Depth: 1960

Figure II-5:

KOREA 1960-89

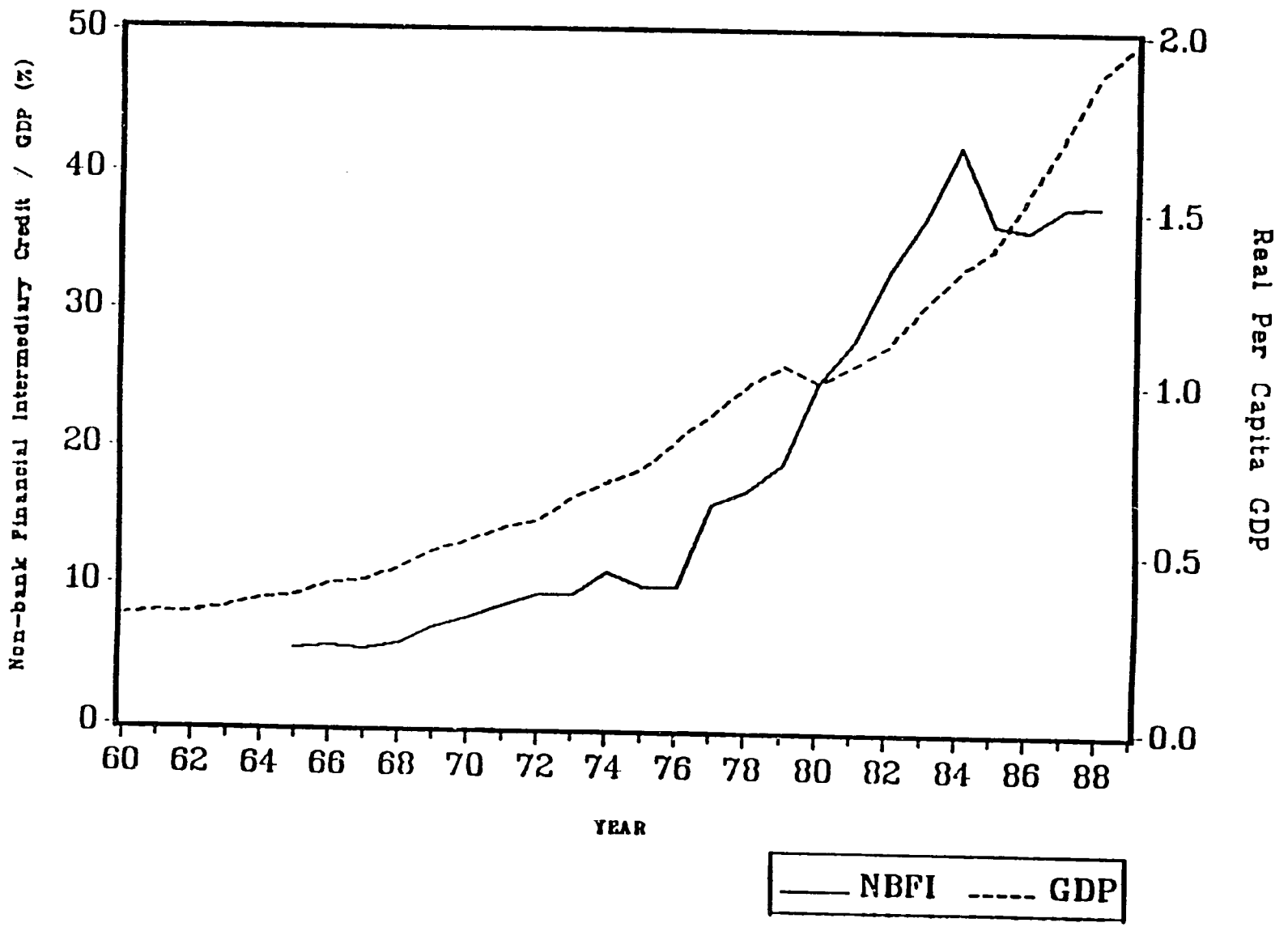


Figure II-6

KOREA 1960-89

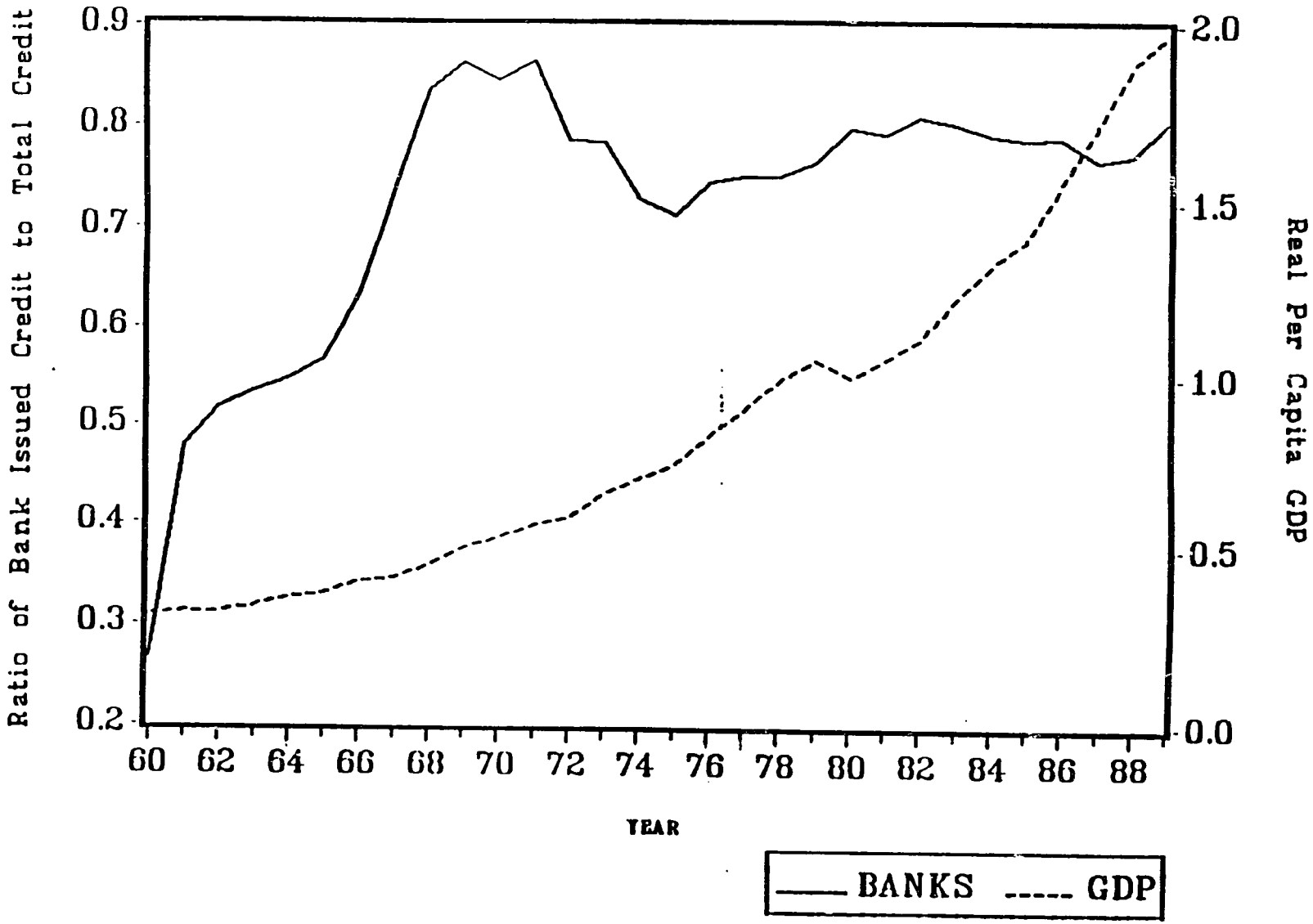


Figure II-7:

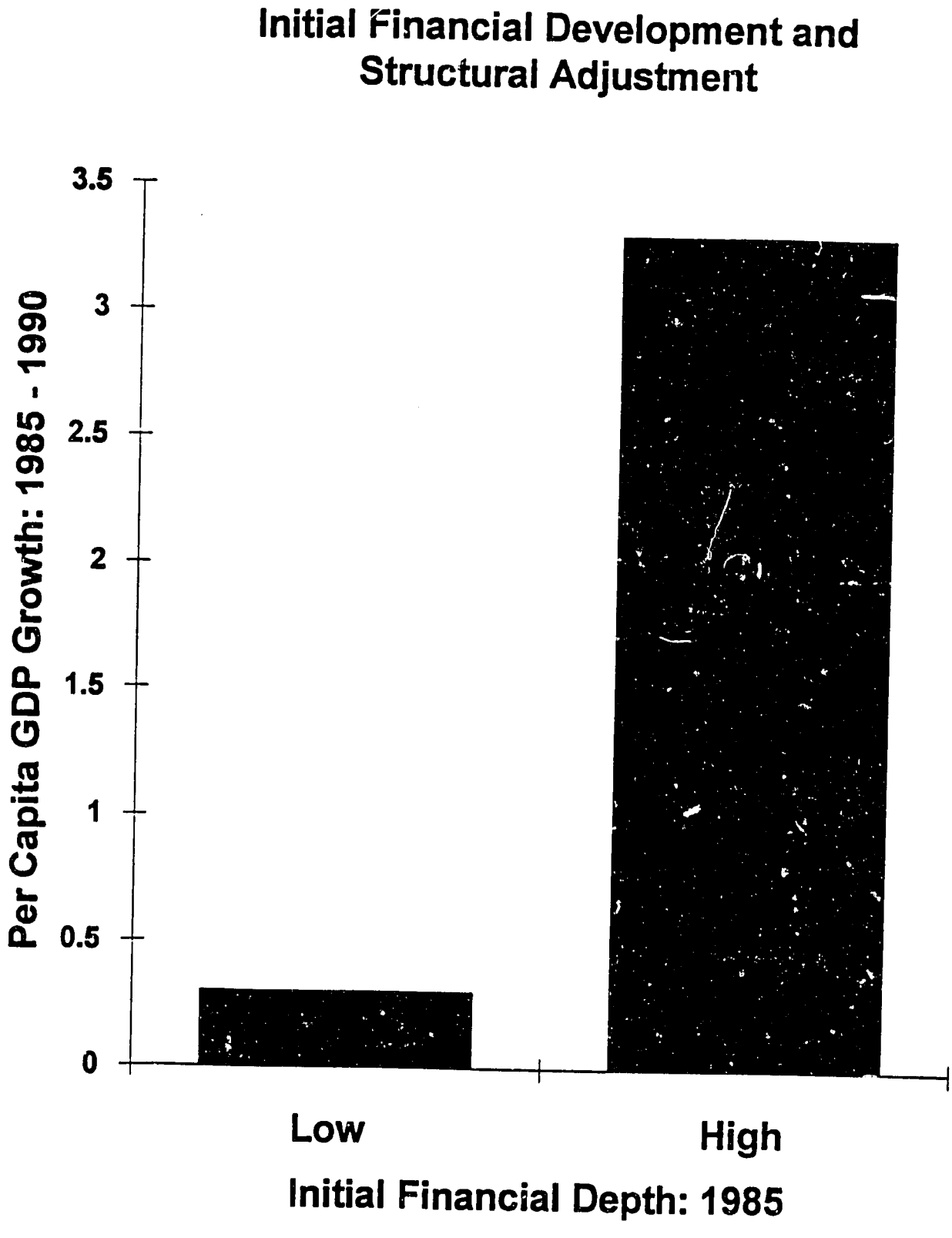

Initial Financial Development and
Structural Adjustment
Per Capita GDP Growth: 1985 - 1990
3.5
3
2.5
2
1.5
1
0.5
0
Low
High
Initial Financial Depth: 1985

Figure II-8

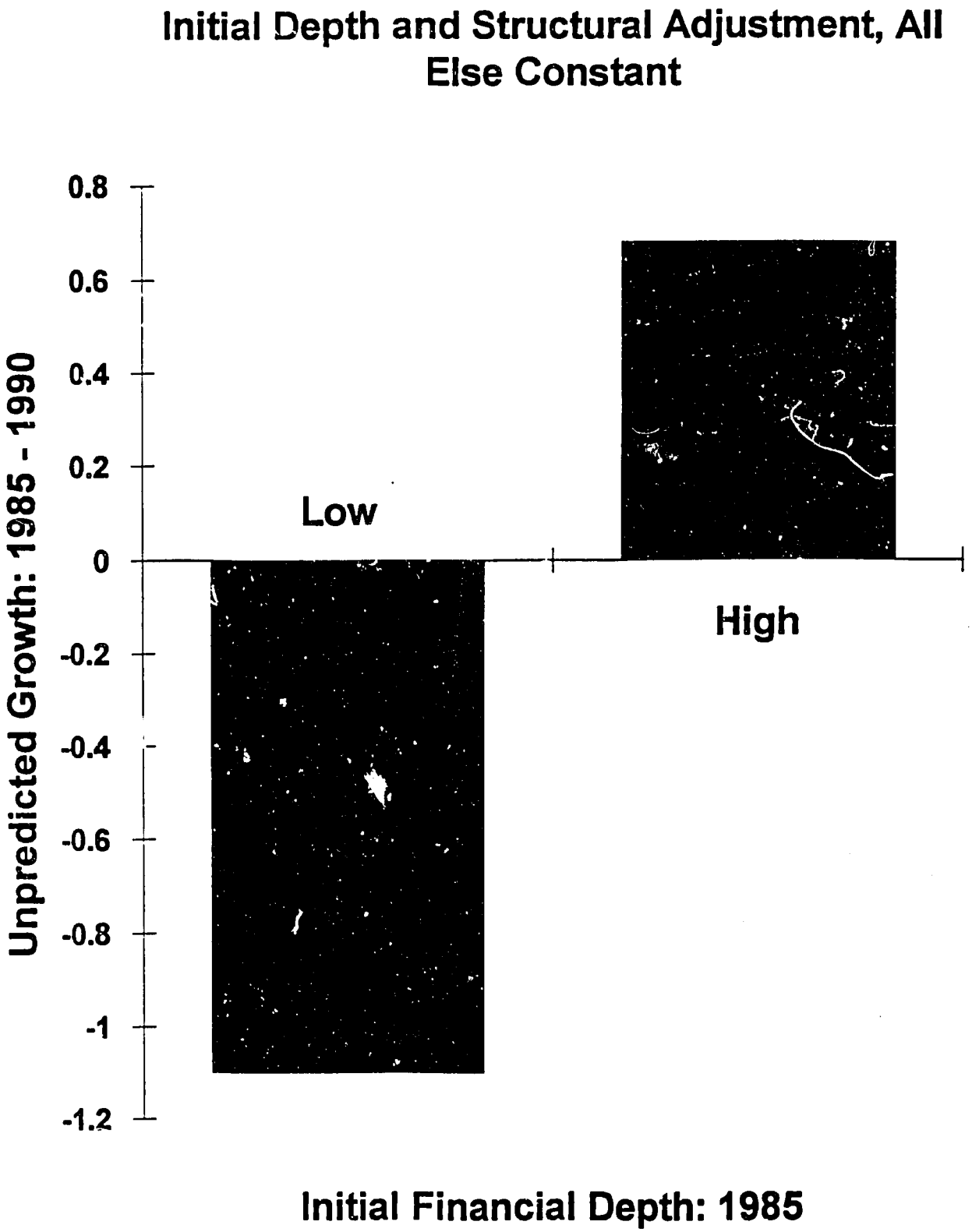

Initial Depth and Structural Adjustment, All Else Constant
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
Unpredicted Growth: 1985 - 1990
Low
High
Initial Financial Depth: 1985

Figure II-9:

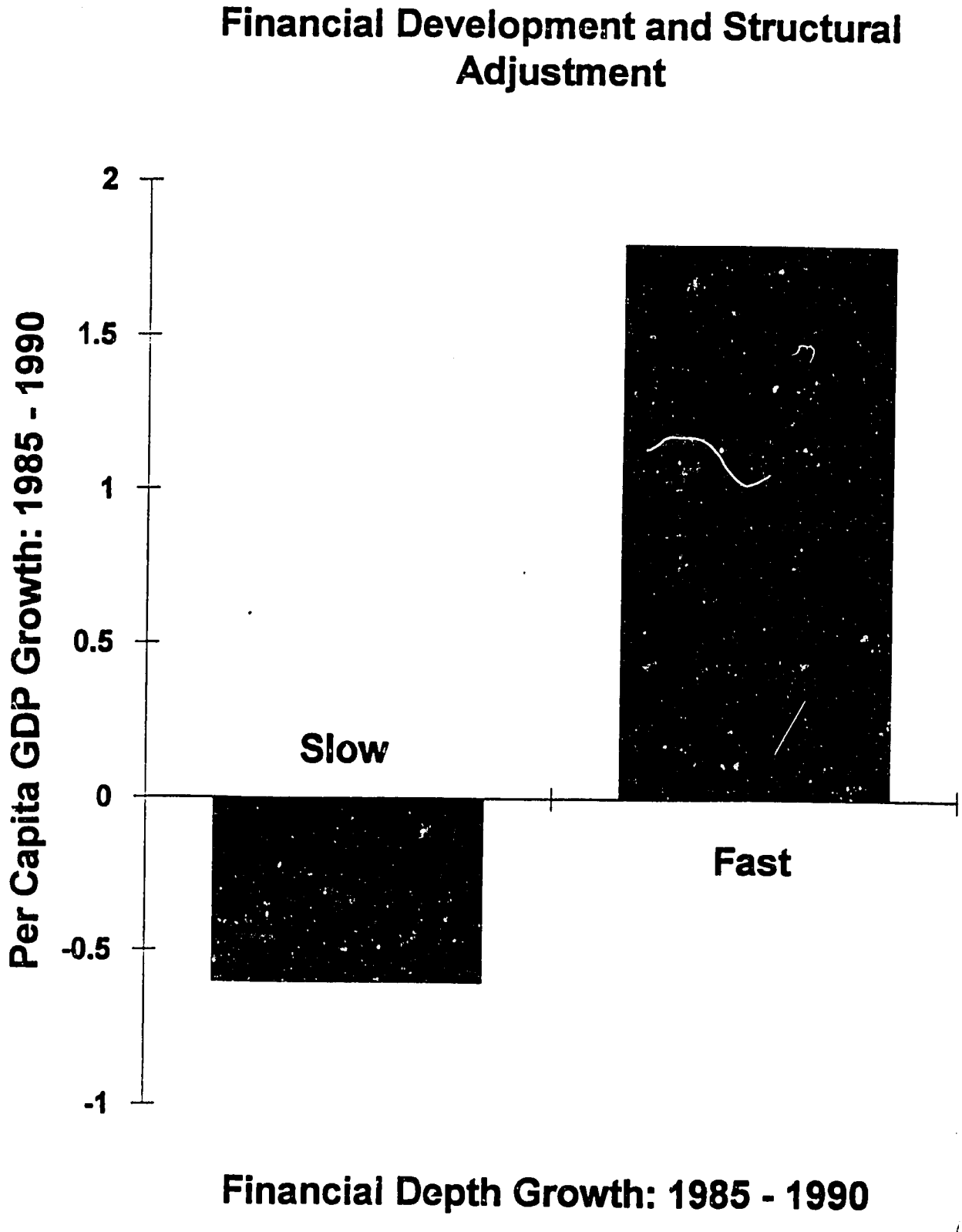
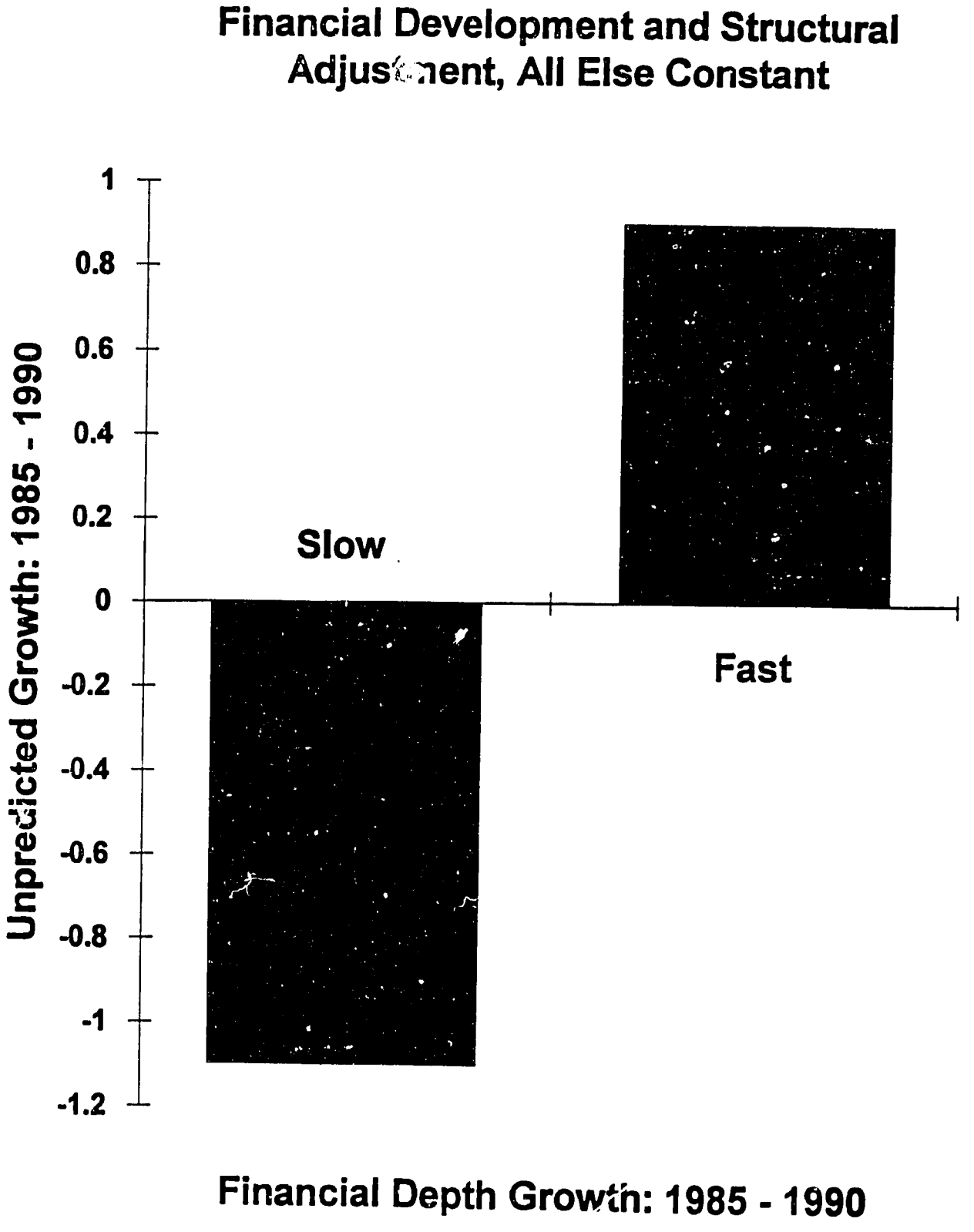

Financial Development and Structural Adjustment
Per Capita GDP Growth: 1985 - 1990
2
1.5
1
0.5
0
-0.5
-1
Slow
Fast
Financial Depth Growth: 1985 - 1990

Figure II-10:


Financial Development and Structural Adjustment, All Else Constant
Unpredicted Growth: 1985 - 1990
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
Slow
Fast
Financial Depth Growth: 1985 - 1990