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Financial Structures and Economic Development

Ross Levine

This paper constructs a model that captures the two-way nature of the relationship between financial and economic development — and allows societies at different levels of economic development and with different policies to choose different financial services.

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Levine constructs a model that captures the two-way nature of the relationship between financial and economic development — and allows societies at different levels of economic development and with different policies to choose different financial services.

In this model, various types of financial contracts and institutions arise in response to the economic environment. Incentives for financial structures to emerge are generated by liquidity and productivity risk, the costs of gathering information and mobilizing resources, and the costs of financial transactions. The emergence and development of financial arrangements in response to the economic environment can alter investment decisions and per capita growth rates — while the level of per capita income helps determine the *types* of financial services a particular society chooses to develop and use.

Levine not only reconciles more empirical regularities than past theoretical studies have done, but highlights the role of public policies on financial activities. Policy has important implications for the rate of economic growth, the level of financial development, and the types of institutions providing financial services.

Levine's model also predicts that per capita growth rates should be related to the types of financial services provided by the financial sector. Thus, the most common empirical measure of financial development — the overall size of the financial system — may not appropriately capture fundamental features of financial development.

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TABLE OF CONTENTS

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I. Non-Technical Summary

A. Motivation

Although a large and growing literature documents some aspects of the relationship between the evolution of financial markets and economic development,[1] economic theory has not yet been able to explain many of these empirical regularities within the context of a single model. Existing empirical evidence suggests at least five stylized facts concerning the linkages between financial development and long-run growth:

- As real income rises the ratio of financial institutions' assets to GNP tends to grow;
- Periods of rapid economic growth tend to be accompanied by above-average rates of growth in the ratio of financial institutions' assets to GNP;
- Rapid growth tends to occur in countries where the financial system is already large;
- The distribution of financial assets among financial intermediaries tends to change in a common pattern as per capita income rises: central banks typically become less important as income per capita rises, while deposit banks grow in importance over an initial range of income, and then other financial intermediaries, mutual funds, pension funds, etc., surge in importance; but
- Countries at similar income levels display noticeable differences in the distribution of assets across specific financial intermediaries, e.g., deposit banks compose a much larger share of the financial system in France than in the United Kingdom, while contractual savings institutions are relatively more important in the U.K.

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[1] See Goldsmith (1969), Gertler and Rose (1991), King and Levine (1991), Roubini and Sala-i-Martin (1991), and the World Bank (1989).

These observations suggest that a satisfactory theory of the relationship between financial market evolution and economic growth needs to explain how economic growth elicits the creation and modification of financial arrangements while simultaneously explaining how the evolving financial structure alters the incentives of individuals in ways that change the economy's growth rate. This paper helps reconcile theory with the empirical evidence.

B. The Literature and This Paper's Contribution

Recent theoretical papers by Bencivenga and Smith (1991), Levine (1991), and Roubini and Sala-i-Martin (1991) have contributed to our understanding of how financial markets affect growth,[2] but a common problem with these models is that there is no channel through which economic growth can stimulate changes in financial markets. In Greenwood and Jovanovic (1990), however, the level of income per capita helps determine membership in an information-processing intermediary that in turn improves investment decisions and economic growth.

One shortcoming with all of these models, however, is that agents are either completely isolated from financial arrangements, or they participate in the totality of financial services available within the context of the specific models. Across countries, however, we see financial markets providing a continuum of services. Apparently, economies choose the types of financial services that they require and can afford given the policies and legal structures of the economy.

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[2] Bencivenga and Smith (1991) construct a model in which a bank that pools all of an economy's resources invests more efficiently than if individuals make their own investment decisions. Levine (1991) shows how productivity and liquidity risk may induce equity markets to arise and explores how the resultant market allocates risk and alters investment incentives in ways that change steady state growth rates. Roubini and Sala-i-Martin (1991) assume that financial services increase economic efficiency, and then explore the interactions between financial repression, economic growth, and tax evasion.

This paper constructs a model in which various types of financial contracts and institutions arise in response to the economic environment. Incentives for financial structures to arise are generated by liquidity and productivity risk, information gathering and resource mobilization costs, and financial transactions costs. The emergence and development of financial arrangements in response to the economic environment can alter investment decisions and per capita growth rates, while the level of per capita income helps determine the types of financial services that society chooses to construct and use. Thus, not only does this paper capture the two-way nature of the relationship between financial and economic development, it also allows for societies at different levels of economic development and with different policies to choose different financial services. Thus, this paper helps reconcile the five stylized facts listed above.

C. Intuition Underlying the Model

The model is built on the foundations of both the "endogenous growth" literature, which studies how economic incentives, production opportunities, and policies prompt individuals to make investment decisions that determine the rate of economic growth, and the "endogenous financial structures" literature, which studies the emergence of financial services in response to risk and information costs.[3]

In this paper, per capita output growth only occurs if agents invest a sufficient amount of resources in projects that augment human capital and stimulate technological innovation. The critical inputs into human capital and technology production are physical resources and group

[3] The endogenous growth literature is most closely associated with the work of Romer (1986, 1990), Lucas (1988), and Rebelo (1991). On the endogenous financial structures literature see Townsend (1978, 1979), Diamond and Dybvig (1983), Diamond (1984), and the review by Gertler (1988).

interactions. Intuitively, the model captures the notion that human interactions are a crucial aspect of inventing new technologies, improving production processes, and augmenting human capital skills. Similarly, physical capital can expedite technological innovation and improvements in human capital.

These human-capital-augmenting and technology-producing interactions occur in "firms," where groups of agents invent, innovate, and produce together in a two period production process. The intuition behind the two period process is that it takes a "long time" to learn to communicate with colleagues, discover areas of comparative advantage, and then improve production techniques and human capital skills. Furthermore, I assume that physical resources invested in firms are subject to an externality: the average quantity of resources maintained in firms during the two period production process increases the human capital of each worker independently of that individual's own investment of resources. The *ideas* underlying this externality are that (1) there may be a public good characteristic associated with resources within a "firm", i.e., if I bring a better computer to work, others can use it when I'm not using it and thereby improve their own skills; (2) a firm member who benefits from his own additional capital investment will, via interactions with other firm members, positively influence the human capital of others even though they did not invest more capital; and (3) there may be a time-saving aspect of physical capital investment that promotes more human interactions, i.e., capital resources invested by one individual may allow that individual to interact more with other firm members. The physical capital externality implies that an individual who prematurely removes his capital after one period slows the rate of human capital accumulation of remaining firm members and, thereby, slows economic growth.

In addition to specifying an environment in which per capita growth may emerge as the result of private investment decisions, the model has characteristics that motivate the creation of commonly observed financial services. Agents may invest in illiquid firms that are subject to productivity shocks, or in liquid but less profitable assets that pay-off in one period. The liquid asset does not enhance human capital or technology and, therefore, does not contribute to growth. Firms are termed illiquid because premature removal of one's capital before firms complete production yields a low return. After making investment decisions, some individuals receive privately observed liquidity shocks whereby they discover that they need to consume their wealth before firms complete the two period production process. This liquidity risk along with firm productivity risk may discourage firm investment. Consequently, financial contracts and institutions may arise to enhance the liquidity associated with investing in firms and allow investors to diversify against productivity shocks.

Another element of the model that can elicit the creation of financial intermediaries is the cost associated with identifying and exploiting profitable investment opportunities. The paper assumes that there are research costs associated with identifying which firms are good and which firms have less profitable futures. Similarly, the paper assumes that it is costly to mobilize resources for firms. These costs include setting up organizations, communicating with clients, keeping accounts, enforcing contracts, and certifying the viability and profitability of relatively unknown firms. An intermediary that identifies worthy projects for investors and mobilizes resources for firms could improve resource allocation and accelerate economic growth. The costs to providing some financial services, however, may be too high for many investors to pay and therefore unprofitable for financial intermediaries to provide. I examine a simple cost

structure, such that individual investors have to pay a fee each period to purchase financial intermediary services. This cost structure implies that the level of income per capita helps determine the types of financial services constructed and used by economies. Put differently, growth can influence the types financial services found in an economy by making the provision of financial services profitable and the purchase of these services affordable.

The financial structures that may arise in this model - depending on policy, transactions costs, and the level of income per capita - affect growth via two channels. First, financial services can increase the fraction of resources devoted to long-run endeavors that augment human capital and technology. Specifically, financial structures can raise the fraction of resources devoted to firms by reducing the liquidity and productivity risk associated with firms, by providing investors with better information about firms, and by mobilizing capital resources for firms. A second channel via which financial arrangements may affect growth is by eliminating the premature liquidation of firm capital. Financial structures can eliminate premature capital liquidation by allowing investors that receive liquidity shocks and require access to their assets quickly to trade - either directly through equity markets or indirectly through financial intermediaries - with individuals that do not require quick access to their assets. In this way, investors requiring quick access to their wealth do not prematurely liquidate firm capital. Because of the physical resource externality in firm production, premature liquidation of firm capital reduces the rate of human capital augmentation and technological advancement occurring within firms. Financial structures that eliminate premature capital liquidation improve the productive efficiency of firms for any level of initial firm investment,

and the economy grows faster. Thus, financial services can accelerate growth by (1) improving the allocation of capital and (2) enhancing the productivity of firms.

D. Policy and Empirical Predictions

This paper helps explain the five stylized facts presented above and also makes empirical predictions that can be studied in future research. In this paper, financial development and economic growth occur simultaneously. Financial services promote efficient resource mobilization and allocation and can eliminate costly disruptions to the production process. These services encourage economic growth. Similarly, increases in per capita income make more sophisticated types of financial services affordable. Thus, economic growth stimulates financial development in this model, so that growing economies will choose more advanced forms of financial services as they develop. In addition, the model contains threshold levels of income, such that when a country passes these discrete income levels, more sophisticated types of financial services become affordable and the country grows faster. Thus, the model takes some steps toward explaining the observation first made by Goldsmith (1969) that periods of rapid economic growth are accompanied by rapid financial development.

Public policy toward financial services has important implications in this model for the rate of economic growth, the level of financial development, and the types of institutions providing financial services. Taxing or impeding financial intermediaries in this model reduces the rate of economic growth and stymies financial development. In addition, public policies that indirectly raise the costs of evaluating firms and coordinating capital financing for firms will also retard the development and restrict the functioning of financial intermediaries that improve the

efficiency with which society allocates resources and produces goods. Thus, an inefficient legal system, poor accounting standards, macroeconomic instability, and poor regulatory institutions may thwart both financial and economic development. This paper does not, however, explore reasons why authorities choose to tax and repress financial intermediaries. This optimal tax question is examined by Roubini and Sala-i-Martin (1991) and Bencivenga and Smith (1990).

Public policies may also influence the types of financial institutions that provide financial services. For example, taxes on equity transactions or distortionary taxes on capital gains could restrict stock market participation and encourage banks, informal financial houses, and financial divisions of corporations to provide financial services. Similarly, directed credit policies, interest rate controls, and distortionary taxation of debt could reduce the effectiveness of banks and encourage the formation of other types of financial intermediaries. Thus, policy will not only help in determining whether or not financial services are provided, policy may also importantly shape the types of financial structures that arise to manage risk, reduce transactions costs, and mobilize and allocate resources.

An important prediction from the model is that per capita growth rates are related to the types of financial services provided by the financial sector: financial structures that manage liquidity and productivity risk, reduce transactions costs, and augment the information content of investment decisions increase the efficient allocation of resources, the productivity of firms, and therefore economic growth. Thus, the most common empirical measure of financial development - the overall size of the financial system - may not appropriately capture fundamental features of financial development. This paper suggests that empirical work should focus on developing indicators of the provision of financial services, not simply measuring the

size of the financial system. Some preliminary results in King and Levine (1991) suggest that this distinction is empirically important.

The remainder of this paper provides a fairly rigorous treatment of what has been discussed in this non-technical summary. The next section describes the endogenous growth model and the incentives generating financial services. Section III studies the emergence of financial structures that enhance firm liquidity, allow agents to diversify against productivity risk, and lower financial transactions costs. In addition, the section evaluates the implications of these financial services and public policy on resource allocation and growth. This section emphasizes the role that financial services can play in economic development. It does not focus on the precise institutional forms that may arise in different countries to perform these services. The section does, however, discuss how public policy can shape the types of institutions that provide financial services. Section IV examines the emergence of financial intermediaries that research production processes, identify and verify externalities, and mobilize resources to exploit profitable opportunities. The role and implications of policy are also discussed. Section V concludes.

II. The Model

This section presents an endogenous growth model based on Levine (1991). Liquidity risk, productivity risk, information gathering and resource mobilization costs, and financial transactions costs generate a demand for financial services. In addition, the level of income per capita may affect the affordability and provision of financial services. Later sections study (1) the emergence of financial contracts, markets, and institutions, (2) the resultant effects of financial arrangements on steady state growth, and (3) the manner in which economic growth can affect the emergence of different financial intermediaries.

A. *Preferences and Endowments*

The economy consists of an infinite sequence of agents that live for three periods. There is no population growth; in each period, indexed by t=0,1,2,..., a continuum of identical agents of measure one is born with the utility function

$$u(c_1, c_2, c_3) = -\frac{[c_2 + \varphi c_3]^{-\gamma}}{\gamma}, \quad \text{where } \gamma > 0. \tag{1}$$

Consumption at age i is c_i, and the coefficient of relative risk aversion is $\gamma+1$. Since agents do not value age 1 consumption, they save all age 1 income.

The agent-specific, privately observed random variable φ is revealed at the start of the second period of life, and has the probability distribution

$$\varphi = \begin{array}{l} 0 \text{ with probability } 1-\pi \\ 1 \text{ with probability } \pi \end{array} . \qquad (2)$$

The preference and risk structure defined by equations (1) and (2) imply that agents care about the ability to consume their wealth at age 2 because they may receive $\varphi=0$ and therefore not value age 3 consumption. Consequently, there is a "desire for liquidity." The uncertainty associated with being a "type 0" ($\varphi=0$) is "liquidity risk." If each individual's type were publicly observable, standard insurance contracts contingent on each agent's type would eliminate liquidity risk. Since types are not publicly verifiable, alternative financial arrangements may arise to mitigate liquidity risk.

Age 1 agents are endowed with one unit of labor that they supply inelastically to firms.

B. *Technology*

Each period, groups of agents - "firms" - produce a commodity that can be used as capital, consumed immediately, or stored and consumed in the next period.

Production is a two-stage, two-period process. During the first stage, individuals invent production processes and improve human capital.[3] During the second stage, firms produce commodities.

Formally, an agent born at t works for age 3 entrepreneurs, receives wage w_t, stores (1-q) of her earnings until t+1, and invests the fraction q of age 1 income (qw_t) in a firm. The human capital augmentation function is

$$h_{t+2} = H\underline{W}_{t+2}^{\delta}(qw_t)^{e}, \qquad 1<\delta,\ e<0, \tag{3}$$

where h is human capital, H is a constant, qw_t is the quantity of resources invested in the firm by the individual, and $\underline{W}_{t+2}$ is the average quantity of resources per entrepreneur maintained in the firm between t and t+2. Specifically, $\underline{W}_{t+2} = (1-\alpha)(\underline{qw}_t)/\pi$, where α is the average fraction of resources removed from the firm at t+1, $\underline{qw}_t$ are average resources per entrepreneur invested in period t, and π is the fraction of initial members remaining in t+2.

Human capital acquisition requires that agents interact for two periods [Prescott and Boyd 1987]. The *rate* of human capital acquisition for an individual depends positively on (1) the amount of resources invested by the individual [King and Rebelo 1990] and (2) the average

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[3] Human capital is a non-tradable factor of production representing the knowledge and skills embodied in individuals. Although Romer (1990) distinguishes technology - the instructions for combining raw materials into goods - from human capital - the ability to follow instructions and create new instructions, this distinction is unimportant in this paper because I assume that legal or technical restrictions imply that invented technologies are only useful to the firms that create those plans. Using Romer's terminology, firm-created technology is perfectly excludable and therefore economically indistinguishable from rival goods such as human capital. Thus, I will use the terms human capital and technology interchangeably.

amount of physical resources maintained in the firm for two periods [Levine 1991]. This last input states that the average amount of resources in the firm positively affects the human capital of each individual member independently of that individual's own investment. This physical resource externality may be the result of a number of effects: (1) there may be a public good externality associated with resources within a firm; (2) a member who benefits from his own investment will, via interactions with other members, influence the human capital of others; (3) resources invested by one individual may allow that individual to interact more with other firm members. The externality implies that investment is socially sub-optimal. If a financial intermediary could coordinate investment, it would internalize the production externality and increase firm investment.

In the second stage of firm production, age 3 firm members with human capital - "entrepreneurs" - hire age 1 workers to produce consumption goods (y):

$$y_{t+2}=\tilde{\eta}_{t+2}h_{t+2}L_{t+2}^{1-\theta}, \quad 0<\theta<1, \tag{4}$$

where L_{t+2} is age 1 labor units hired per entrepreneur in t+2 and η_{t+2} is a firm specific shock with an expected value of one.[4] The level of human capital per entrepreneur at t+2 is h_{t+2}. In relation to the standard neoclassical growth model, h_{t+2} is technology, but in this paper, the evolution of technology is the result of the decisions of maximizing agents.

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[4] For each firm η is drawn from a distribution function on a compact interval, such that $\min\{\eta\} > 1 - \theta$, and the expected value of η equals 1.

Only age 3 agents receive firm profits because production requires two periods. Removal of one's capital after one period yields a low gross return of x consumption goods per initial investment good, where x is less than the return from the storage technology (i.e., $x < 1$). Thus, firm investment is illiquid.

The labor market is competitive, so that labor is paid its expected marginal product,

$$w_{t+2} = (1-\theta)\, h_{t+2} L_{t+2}^{-\theta}. \tag{5}$$

Thus, the return to each entrepreneur in firm j is

$$r_{t+2}^{j} = [\tilde{\eta}_{t+2}^{j} + \theta - 1]\, h_{t+2} L_{t+2}^{1-\theta}. \tag{6}$$

Equation (4), (5), and (6) demonstrate that human capital positively influences production, wages, and the return to capital.

C. *Information and Transactions Costs*

The economic environment studied in this paper has four characteristics that motivate the creation of financial structures. First, individuals face uncertain liquidity needs. Consequently, financial contracts and institutions may arise that allow individuals to reduce liquidity risk. Second, firm specific productivity shocks create an incentive for financial structures that help agents diversify against productivity risk. Third, there are costs associated with financial

transactions. Thus, intermediaries may arise that reduce the number of transactions. For simplicity, I assume that agents can conduct two free asset transactions; additional transactions cost τ per trip. As will become clear, allowing two free transactions is unimportant for the results.

A fourth element of the model's informational structure that can elicit the creation of financial intermediaries is the cost associated with identifying and exploiting profitable investment opportunities. The model contains an externality associated with physical capital in the creation of human capital and technology. The externality implies that firm investment is socially sub-optimal. An intermediary that identifies profitable opportunities and coordinates investment for a firm could internalize the production externality and improve resource allocation. This activity, however, is costly.

I examine a simple cost structure that creates an important relationship between financial structure and economic growth. I assume that there is a cost (Z) each period associated with researching firms and identifying externalities. Any individual or agency can acquire this information about all of the productive processes in the economy for Z. An intermediary that collects information for a large number of investors can reduce the research costs per investor by spreading the fixed costs over many investors. Thus, there is an incentive for intermediaries to perform researching activities for many individuals. In addition, I assume that there are costs associated with mobilizing resources from many individuals and coordinating financing to exploit profitable projects.[5] Specifically, mobilization costs are equal to a constant amount (ζ) per

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[5] As discussed by Townsend (1983), these costs may be associated with setting up organizations, communicating with clients, keeping accounts, and writing and enforcing contracts. In addition, Booth and Smith (1986) argue that financial intermediaries certify the viability and profitability of relatively unknown firms. The costs involved in obtaining this information and effectively

investor from whom the intermediary collects funds, or put differently, each investor must pay ζ to receive researcher/mobilizer services in a competitive equilibrium. Thus, researcher/mobilizer services cost less in richer countries in per capita income terms. Consequently, the level of economic development helps determine the type of financial structures constructed and used by an economy.

D. Trading under Financial Autarky

This section examines the model without financial services. Consider an agent born at time t. During the first period of life, she supplies time to a firm, receives wage w_t, and makes an investment decision (q). She invests the proportion q of her earnings (qw_t) in an illiquid firm and stores the remainder (1-q). The initial firm investment is one asset transaction.

At age 2, agents learn their types (φ). The fraction $1-\pi$ of the generation receives $\varphi = 0$ and therefore does not value period 3 consumption. These type 0 agents regret having invested in the firm. They consume their wealth at age 2: stored good $[(1-q)w_t]$ plus the premature "liquidation" value of the capital they invested in the firm $[xqw_t]$. This liquidation is counted as a second asset transaction. Since all type 0's liquidate firm capital, the fraction of resources removed from firms (α) equals the fraction of the population that are type 0 ($1-\pi$). Thus, the average quantity of resources maintained in firms for two periods (W_{t+2}) is lower than it would be if capital were not removed from firms prematurely. Because of the externality, type 0 agents unintentionally reduce the rate of human capital accumulation of remaining members.

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communicating this information to investors could be substantial.

Type 1 agents value age 3 consumption and regret having stored goods at age 1 because firms have a higher expected rate of return than storage. They do not prematurely liquidate capital and consume only their stored goods at age 2: $[(1-q)w_t]$. At age three, type 1 agents complete stage one of firm production, having developed skills and patents. They hire age 1 labor, produce goods subject to a productivity shock, pay labor, and distribute any profits to remaining partners based on their initial investments. Thus, type 1 agents consume r^j_{t+2} at age 3. The distribution of profits is a second asset transaction.

Note that at age 2, $(1-\pi)$ of the population regrets having invested in the firm [type 0 agents], and π of the population regrets having stored goods [type 1 agents]. Thus, there is a positive role for financial markets and institutions that allow these two types to trade directly or indirectly.

E. Equilibrium under Financial Autarky

A representative agent born at t chooses q to solve the problem

$$\max E \; -\frac{(1-\pi)\,[qw_t x + (1-q)\,w_t]^{-\gamma}}{\gamma} - \frac{\pi\,[(1-q)\,w_t + (\tilde{\eta}^{j}_{t+2}+\theta-1)\,H W^{\delta}_{t+2}\,(qw)^{\epsilon}\,\cdot\,{}^{1-\theta}_{2}]^{-\gamma}}{\gamma}, \tag{7}$$

where E is the expected value operator. Since π of a generation become entrepreneurs and L_t is age 1 labor per entrepreneur, $L_t = 1/\pi$. Under financial autarky, all type 0 agents prematurely remove firm capital, so that $\alpha = 1-\pi$. Thus, in equilibrium

$$L_t^{1-\theta} = \pi^{\theta-1} = \psi, \quad W_{t+2} = (1-\alpha)\,(qw)/\pi = w_t q. \tag{8}$$

The first order condition after substituting (8) and assuming $\epsilon + \delta = 1$ is[6]

$$\frac{(1-\pi)\,[x-1]}{[xq+(1-q)]^{1+\gamma}} + \pi E_{\tilde{\eta}} \left\{ \frac{[(\tilde{\eta}+\theta-1)\,\epsilon H\psi - 1]}{[(\tilde{\eta}+\theta-1)\,H\psi q + (1-q)]^{1+\gamma}} \right\} = 0. \tag{9}$$

[6] This makes it easy to solve for a closed form solution.

The first term in (9) is the increment to utility if q is marginally increased given that the agent is type 0. The second term is the expected increment to utility if q is marginally increased given that the agent is type 1.[7]

Re-write (9)

$$\frac{(1-\pi)\,[x-1]}{[xq+(1-q)]^{1+\gamma}} + \pi\frac{[\epsilon\theta H\psi-1]}{[\theta H\psi q+(1-q)]^{1+\gamma}} + \pi Cov\left\{[\tilde{\eta}+\theta-1]\,\epsilon H\psi-1],\ \frac{1}{[(\tilde{\eta}+\theta-1)H\psi q+(1-q)]^{1+\gamma}}\right\}=0. \quad (10)$$

Contingent on the agent being type 1, the last term is the covariance between the expected return to marginally increasing firm investment and the marginal utility of consumption. This covariance is always negative.

The first result is that financial contracts or institutions that allow investors to hold diversified portfolios will induce individuals to invest more in firms. To see this, note that the summation of the first two terms in (10) varies inversely with q. Since the covariance is negative and becomes more negative as the variance of the productivity shock increases, q - the fraction of income devoted to firm investment - must fall as the variance of the productivity shock increases. The economic intuition is that the variance of the productivity shock discourages risk averse investors from investing in firms. Consequently, financial structures that allow investors to diversify against productivity shocks will induce more firm investment.

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[7] Since I assumed that the expected return from firm investment is greater than that of storage which is greater than the premature liquidation value of firm capital ($\pi\epsilon\theta H\psi > 1 > x > 0$), there is a solution to (9) where $0 \leq q \leq 1$.

F. Investment and Growth under Financial Autarky

Having established the influence of productivity risk on investment, let the variance of the productivity shock equal zero. Solving (10) yields

$$q = \frac{\lambda - 1}{(R-1) + \lambda(1-x)}, \quad \text{where} \quad \lambda = \left\{ \frac{\pi(\epsilon R - 1)}{(1-\pi)(1-x)} \right\}^{\frac{1}{1+\gamma}}, \quad R = H\theta\psi. \quad (11)$$

The fraction of resources allocated to firms depends positively on the share of output going to entrepreneurs (θ), the rate of human capital accumulation (H), labor per entrepreneur (ψ), the liquidation value of firm investment (x), the probability of being type 1 (π), and the fraction of marginal returns internalized by the individual (ϵ). Also, the greater the degree of risk aversion (γ), the lower is the amount invested in firms because there is liquidity risk associated with firm investment.

The two period growth rate is

$$g_y = y_{t+2}/y_t = h_{t+2}/h_t = \frac{HW_{t+2}^{\delta}(qw_t)^{\theta}}{h_t}. \qquad (12)$$

Substituting equilibrium values and letting $A = H(1-\theta)\pi^{\theta}$,

$$g_y = Aq = A\left[\frac{1(\lambda-1)}{(R-1)+\lambda(1-x)}\right]. \qquad (13)$$

Per capita growth is tied to human capital accumulation: the faster the rate of human capital accumulation, the faster is the growth rate of per capita output.

G. Discussion

The larger the fraction of resources devoted to firms, the higher is the economy's growth rate. Thus, incentives for firm investment increase growth; disincentives discourage it. Productivity risk discourages firm investment and thereby lowers growth. Financial contracts and institutions that allow agents to hold diversified portfolios reduce productivity risk, encourage firm investment, and expedite per capita growth. Similarly, financial arrangements that ameliorate liquidity risk can stimulate firm investment and economic growth. Furthermore, financial intermediaries that allow investors to internalize production externalities would further

raise the fraction of resources allocated to firms, augmenting the rate of human capital creation and accelerating per capita income growth.

In addition to the fraction of resources allocated to firms being an important determinant of growth, the economy's growth rate is also a function of firm productivity. The fraction $1-\pi$ of the population removes its capital from firms after one period. Because of the production externality, premature capital liquidation reduces the rate of human capital accumulation of remaining firm members and slows economic growth. An institution or market that minimizes premature capital liquidation would increase economic growth for any firm investment rate by improving productive efficiency.

III. Risk and Transactions Costs:

Equity Markets and Simple Financial Intermediaries

This section examines the emergence of equity markets and simple financial intermediaries that mitigate liquidity and productivity risk. In mitigating risk, these financial structures alter investment decisions and improve the efficiency of firm production. The incentives for equity markets and financial intermediaries to form are straightforward: agents would like to hold diversified portfolios that eliminate their exposure to idiosyncratic productivity risk; and investors would like to hold assets that are liquid, so that they do not receive a low return when they require early access to their wealth. Equity markets and simple financial intermediaries allow investors to hold diversified portfolios. In addition, they increase

the liquidity of firm investment by - explicitly in the case of equity markets and implicitly in the case of intermediaries - allowing agents with different liquidity needs to trade.

While reducing liquidity risk, equity markets and simple financial intermediaries eliminate the premature withdrawal of resources from firms. This increases firm efficiency and accelerates growth. Furthermore, when agents are sufficiently risk averse, the reduction in productivity and liquidity risk increases the fraction of resources devoted to firms which further speeds growth.

There are, however, transactions costs associated with equity transactions. The fraction $[1-\pi]$ of the population goes to the market twice, while the fraction π goes three times. Thus, expected transactions costs at age 1 are $\pi\tau$. The intermediaries introduced in this section reduce transactions costs. The intermediaries are termed "simple" because they do not improve the informational content manifest in society's investment decisions. More sophisticated financial intermediaries are studied in the next section.

It should also be emphasized that this paper focuses on the provision of financial services, not on explicitly characterizing the institutions that provide financial services. Thus, while the presentation is done in the context of equity markets and deposit taking financial intermediaries, this paper says little about the precise form of contracts and institutions. I do, however, discuss how different looking institutional structures could provide similar financial services and also describe how public policy may shape the existence and form of financial institutions.

A. Trading and the Emergence of Equity Markets

Financial transactions take place in the first part of each period and other activities occur in the second part. During age 1, agents create firms and distribute shares. At age 2, agents learn their types. The resulting heterogeneity creates an incentive for financial transactions.

At age 2, agents know the amount of claims each has on period three consumption goods and the quantity of consumption goods stored from period 1. Let P equal the period 2 price of claims to period 3 goods, i.e., how many stored goods one has to pay for a claim to a period 3 good. Type 0 agents will sell their claims to period 3 consumption goods as long as they receive a return at least equal to the liquidation value of their firm investment, x. Type 1 agents will purchase period three consumption goods with their stored goods as long as the price of period three consumption goods in terms of stored consumption goods (P) is less than one.

The solution is greatly simplified by establishing the following result:

Proposition 1: if $\epsilon\pi R^* > 1 > x$, *where* $R^* = R\pi^{-\delta}$, *then*
(i) No resources are prematurely removed from firms; and
(ii) all stored goods are consumed by type 0 agents.

Proof: *See Levine 1991.*

Proposition 1 states that as long as the expected return from firm investment ($\epsilon\pi R^*$) is greater than the storage return (1) which is in turn larger than the liquidation return (x), no resources will be prematurely liquidated and all stored goods are consumed by agents that do not value period 3 consumption.[8]

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[8] If the condition for Proposition 1 is violated a relatively uninteresting corner solution results: if the return from storage is higher than expected firm returns, there would be no firm investment. If the premature liquidation return is higher than storage, there would be no storage.

The major implication of Proposition 1 is that no firm capital is prematurely liquidated; thus $(1-\alpha) = 1$, so that $W_{t+2} = w_t q^*/\pi$. This implies that the rate of human capital accumulation will be higher for any given investment rate than in the financially autarkic economy.

Assuming that agents hold diversified portfolios, agents choose q^* to maximize expected utility, where the superscript "*" is used to designate the investment allocation decision with equity markets:

$$\begin{aligned} \max \quad & -\left[\frac{1-\pi}{\gamma}\right]\left[(1-q^*)w_t + P\pi\theta\psi H W^{\delta}_{t+2}(q^* w_t)^e\right]^{-\gamma} \\ & -\left[\frac{\pi}{\gamma}\right]\left[\pi\theta\psi H W^{\delta}_{t+2}(q^* w_t)^e + \frac{(1-q^*)w_t}{P} - \tau\right]^{-\gamma}. \end{aligned} \tag{14}$$

If transactions costs are sufficiently large, agents will choose not to create and use equity markets; the economy will resort to the financially autarkic equilibrium studied in Section I. Thus, public policies that raise transactions costs could inhibit the formation and functioning of capital markets.[9]

The intuition behind the proof in Levine (1991) is straightforward: (1) if agents expect capital to be liquidated, the expected price of period 3 goods in period 2 (P) must be so low that all agents would increase the fraction of goods stored (until no goods are prematurely liquidated); (2) if at age 1 agents expect to consume stored goods even if they are type 1, the price of period 3 goods in terms of period 2 goods must be so high that agents would store less goods (until no stored goods are consumed by type 1 agents). Thus, the requirement of a rational expectations equilibrium yields Proposition 1.

[9] Levine (1991) studies the implications of income taxes, corporate taxes, capital gains taxes, and consumption taxes on the provision of financial services and the rate of per capita output growth.

B. The Investment Decision and Growth with Equity Markets

Taking the first condition of (14) and simplifying yields

$$e\pi R^{*}P = 1. \tag{15}$$

To solve for q^{*} conjecture that

$$P = \frac{(1-q^{*})}{(1-\pi)R^{*}q^{*}}, \tag{16}$$

substitute (16) into (15) to obtain q^{*}

$$q^{*} = \frac{e\pi}{1-\pi+e\pi}. \tag{17}$$

Levine (1991) formally demonstrates that this q^{*} and P represent a rational expectations equilibrium.[10]

Equation (17) specifies the fraction of resources devoted to firm investment when society chooses to create equity markets. In comparing the investment decision in the presence of equity

[10] To see this is a rational expectations equilibrium note that (1) Proposition 1 establishes that this P clears the equity market in period 2 given period 1 investment decisions; (2) Proposition 1 establishes the optimal consumption/investment decision of type 0 and 1 agents in period 2, which are consitent with this P and q^{*} combination; (3) the investment decision, q^{*}, is optimal given P and the first order condition from (14); and (4) substitution demonstrates that this P and q clear the market in period one. Satisfaction of these conditions represent a rational expectations equilibrium.

markets (17) with the investment decision in the absence of equity markets (11), note that there are parameterizations of the model such that without equity markets no firm investment occurs, but the emergence of equity markets alone changes incentives sufficiently, so that individuals invest in firms and the economy grows. Thus, policies that stymie the evolution of capital markets may retard technological innovation, human capital augmentation, and economic growth.

The per capita growth rate of the economy is

$$\begin{aligned} g_y^* &= A\pi^{-\delta}q^* \\ &= A^*q^* \\ &= A^*\frac{\epsilon\pi}{1-\pi+\epsilon\pi}. \end{aligned} \tag{18}$$

Equations (17) and (18) demonstrate the two channels through which the emergence of equity markets can stimulate growth. The first channel is enhanced productive efficiency. By allowing agents to manage liquidity risk, equity markets eliminate the premature removal of capital from firms. The maintenance of more resources in firms increases the rate of human capital accumulation because of the physical resource externality in human capital production. The faster rate of human capital augmentation enhances firm productivity and the rate of per capita income growth. Thus, even if $q = q^*$, the growth rate with equity markets is greater than under financial autarky, i.e., $A^* > A$ by $\pi^{-\delta}$.

The second channel through which equity markets can affect growth is the allocation channel. By reducing the liquidity and productivity risk associated with firm investment, equity markets can increase the fraction of resources devoted to firms over the financially autarkic

allocation. The larger the fraction of resources devoted to firms, the higher is the economy's growth rate.

Equity markets do not, however, allow investors to internalize production externalities into their investment decisions. Furthermore, equity markets require more transactions than in financial autarky.

C. "Simple" Financial Intermediaries

This section shows how financial intermediaries can reduce transactions costs. These intermediaries may issue demand deposits and make loans, or issue equity and purchase ownership claims, or have a mixture of financial instruments as assets and liabilities. Although I will model these intermediaries as deposit taking institutions, this paper does not examine the differences between debt and equity contracts,[11] and many institutional forms could provide financial services that manage liquidity and productivity risk and reduce transactions costs.

Intermediaries take deposits from age 1 individuals and invest directly in the storage technology and a diversified portfoiio of firms.[12] A demand deposit is defined as contract that requires an initial investment at age 1 and promises a return of r^1 at age 2 or r^2 at age 3 at the discretion of the depositor. Let intermediaries offer depositors

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[11] See Townsend (1979), Stiglitz (1989), and Seward (1990).

[12] The storage technology may be viewed as "reserves" and investment in firms may be in the form of loans.

$$r^1 = \frac{1}{1-\pi+\epsilon\pi}; \qquad r^2 = \frac{R^*\epsilon\pi}{1-\pi+\epsilon\pi}. \tag{19}$$

These return are equal to the equilibrium returns in the presence of equity markets except that r^2 is greater in this banking economy by τ because transactions costs are lower. Each agent only conducts two transactions: deposit and withdrawal. In the equity market equilibrium π percent of the population transact three times.

In mimicking equity markets, these simple financial intermediaries choose the same allocation of resources, q^*. Thus, emergence of these simple intermediaries has the same fundamental influences on productive efficiency, investment decisions, and growth as does the emergence of equity markets: firm capital is not prematurely liquidated, and reduced productivity and liquidity risk enhance firm investment. Agents in the simple banking economy, however, have a higher expected level of utility than agents in the equity market economy because intermediaries lower the number of transactions. Neither of these financial structures, however, allows economic decision makers to internalize production externalities.

Different public policies may play an important role in determining the types of institutions that perform financial services across economies. Directed credit policies, interest rate controls, and taxes on financial intermediaries could impede the ability of intermediaries to invest optimally and thereby discourage development of financial institutions. In this case, equity markets may play a more prominent role in allowing investors to pool and trade risk. Similarly, taxes on equity transactions or capital gains could restrict participation in stock markets. Under these conditions, banks, mutual funds, informal finance houses, and even the

financial divisions of large corporations may play key roles in providing financial services. Thus, policy will not only help in determining whether or not financial services are provided, public policies may importantly shape the type of financial structures that arise to allocate risk and reduce transactions costs.

Before concluding, it should be noted that this subsection's equilibrium allocation of resources is incentive compatible, unlike the banking allocations in Diamond and Dybvig (1983) and Bencivenga and Smith (1991). In those papers, each individual would prefer to invest directly in firms rather than in financial intermediaries, i.e., individuals would not join intermediaries unless they were forced to join.[13] In this paper with no policy distortions, individuals voluntarily forgo equity market transactions and join intermediaries. To see why, recall that in the equity market economy individuals rationally expect a given price, P, for claims to period 3 goods. This P implies a specific set of returns. Given these returns, investors choose a specific investment allocation. Intermediaries in this subsection simply mimic the investment allocation of equity markets. Thus, given the reduced transactions costs, agents choose to join intermediaries and the savings in transactions costs accrue to type 1 agents as a non-distortionary benefit.

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[13] See Jacklin (1987) or Levine (1990) for more detailed treatments. Note that if agents are forced to deposit their savings in a financial intermediary that maximizes the utility of the representative depositor, expected utility is higher than that with equity markets or with intermediaries where membership is voluntary. See Levine (1990).

IV. Financial Intermediaries: Researcher/Mobilizer

Individuals would invest more in firms if they could internalize firm externalities into their decisions, but there are costs associated with researching projects, identifying externalities, publicly certifying "good" projects and conveying this information to investors, and then mobilizing resources from individual investors. Although it would be prohibitively costly for each individual to perform these activities, financial intermediaries may form to research production processes and mobilize resources to take full advantage of profitable production opportunities. These research, certification, mobilization, and coordination functions are similar to the types of activities conducted by investment banks, venture capitalists, and commercial banks.[14]

A. Costs, Trading, and Equilibrium

As described in Section I, the cost of researching firms and identifying externalities is Z. Therefore, an intermediary that collects funds from many investors can effectively reduce the research costs to zero *per investor*. In addition, there are costs associated with mobilizing resources and coordinating financing to exploit profitable projects. Specifically, it costs the researcher/mobilizer ζ per investor. Since I assume the market for financial services is competitive, the profits from financial intermediation must be zero in equilibrium. Thus, financial intermediaries charge ζ per investor in equilibrium. Individuals, however, may not find it worthwhile to purchase researcher/mobilizer services. If the extra return generated by

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[14] On the certification role that financial intermediaries may play when relatively unknown firms try to raise capital in a world with asymmetric information see Booth and Smith (1986) and Megginson and Weiss (1991). On the monitoring role of financial intermediaries see Diamond (1984).

these services does not sufficiently compensate for the cost of purchasing these services, agents will not purchase the financial services offered by researcher/mobilizers and researcher/mobilizers will not form to provide these financial services.

For simplicity, I examine the situation in which financial structures already exist that allow agents to both diversify portfolios and manage liquidity risk such that there is no premature capital liquidation. In this case, investors have the choice of whether to use or not use researcher/mobilizer intermediaries. Formally, investors can choose to forgo researcher/mobilizer services, so that utility equals

$$V^* = \max \; -\left[\frac{1-\pi}{\gamma}\right]\left[(1-q)\,w_t + P\pi\theta\psi H W_{t+2}^{\delta}(qw_t)^{\varepsilon}\right]^{-\gamma} - \left[\frac{\pi}{\gamma}\right]\left[\pi\theta\psi H W_{t+2}^{\delta}(qw_t)^{\varepsilon} + \frac{(1-q)\,w_t}{P}\right]^{-\gamma}. \tag{20}$$

Or, investors can purchase researcher/mobilizer services from financial intermediaries and obtain a higher returns by investing in firms via these financial intermediaries. In this case, agents maximize expected utility

$$V^{**} = \max \; -\left(\frac{1-\pi}{\gamma}\right)\left[(1-q)\,w_t + P\pi R^* q w_t - \zeta\right]^{-\gamma} - \left(\frac{\pi}{\gamma}\right)\left[\pi R^* q w_t + \frac{(1-q)\,w_t}{P} - \zeta\right]^{-\gamma}, \tag{21}$$

where the superscript "**" designates values for an economy that chooses to create research/mobilizer financial intermediaries.

Before characterizing the equilibrium, Proposition 2 will simplify the analysis.

Proposition 2: *For a given purchase price of researcher/mobilizer activities, ζ, there is a threshold level of income, $\hat{w}$, such that when income is above the threshold level, $w > \hat{w}$, agents choose to purchase researcher/mobilizer activities because $V^{**} > V^{*}$.*

Proof: *Since (i) $V^{**} > V^{*}$ when $\zeta = 0$; and (ii) $V^{**} - V^{*}$ is continuous and increasing in w, then for any constant $\zeta > 0$ there is a $\hat{w}$ where $V^{**}(\hat{w}) = V^{*}(\hat{w})$, so that for $w > \hat{w}$, $V^{**}(w) > V^{*}(w)$.*

Proposition 2 establishes that the level of per capita income can help in determining the types of financial services provided by financial intermediaries. If per capita income is sufficiently high, agents choose to purchase complex financial services that involve researching firms, certifying the existence of worthy projects, and mobilizing resources to exploit fully investment opportunities. In economies where per capita income is not sufficiently high, agents find that the additional returns generated by these financial services are not worth the cost.

It should also be pointed out that public policies may affect the cost of financial intermediation and thereby affect the rate of economic growth. If public policies directly or indirectly raise the cost of evaluating firms and coordinating financing for firms, this could retard the development of financial intermediaries that improve the efficiency with which society allocates resources. Thus, the model predicts that restrictive financial policies can lower productive efficiency and the rate of economic growth.

Having established Proposition 2, we can solve for the equilibrium investment allocation decision and per capita growth rate in an economy that chooses to create and use financial

intermediaries that provide researcher/mobilizer services. Let $w > \hat{w}$, so that agents maximize the problem in equation (21). The investment decision is

$$q^{**} = \pi, \tag{22}$$

and growth is

$$\begin{aligned} g_y^{**} &= A^* q^{**} \\ &= A^* \pi . \end{aligned} \tag{23}$$

B. Discussion

The economy where a financial intermediary arises that substantially augments the informational content of investment decisions grows faster than economies where these "complex" financial intermediaries do not arise. This occurs because researcher/mobilizer intermediaries induce a larger fraction of resources to be invested in human capital augmenting firms, i.e., $q^{**} > q^{*}$ and $q^{**} > q$. By internalizing externalities, the financial intermediary encourages investment in firms that enhance technology and improve human capital. Since the analysis of this "complex" financial intermediary was assumed to occur in the presence of financial structures that minimize liquidity and productivity risk, no firm capital is prematurely liquidated and productivity risk does not discourage investors from investing in firms.

An important finding is that financial development can be a function of the level of income per capita. Thus, this model partly captures the two-sided nature of the relationship

between finance and growth: the emergence and development of financial contracts and institutions alters investment incentives and firm production processes in ways that change per capita growth rates; and the level of economic development helps in determining the types of financial arrangements that society chooses to construct and use.[15] One empirical prediction that emerges from the analysis is that economies that pass a threshold level of income per capita will choose more sophisticated financial arrangements and therefore grow faster.

The model also predicts that per capita growth rates are related to the types of financial services provided by the financial sector: financial structures that manage liquidity and productivity risk, reduce transactions costs, and augment the information content of investment decisions increase the efficient allocation of resource, the productivity of firms, and economic growth. Thus, common empirical measures of the overall size of the financial system may not appropriately capture fundamental features of financial development. This paper suggests that empirical work should focus on developing indicators of the provision of financial services, not simply measuring the size of the financial system or any particular financial institution.

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[15] Different costs structures for acquiring information and mobilizing resources would produce different results. For example, let the cost of identifying externalities and coordinating resources be proportional to per capita income, $z\underline{w}_t$. The justification might be that in richer, more complicated economies, the total costs of identifying and mobilizing resources are larger. Thus, at a cost of $z\underline{w}_t$ an individual or agency can identify externalities and collect resources from individuals to exploit these externalities in period t. By sharing the cost of performing researcher/mobilizer activities among many investors, these agencies allow society to identify and exploit fully the most profitable projects. Under this cost structure, the formation of delegated researcher/mobilizers is independent of income per capita.

V. Conclusion

An important challenge to economists is to explain how financial contracts and institutions affect economic growth while simultaneously explaining how economic growth elicits the creation and modification of financial arrangements. This paper examines the relationship between the evolution of financial services and long-run economic growth. Liquidity risk, productivity risk, transactions costs, and information gathering and resource coordination costs create incentives for the emergence of financial contracts and institutions. The level of income per capita, public policies, and legal codes determine the provision of financial services and the types of financial structures that provide these services. The resultant financial structures can alter investment incentives, such that the steady state growth rate of per capita output increases. In addition, the model formally demonstrates that the purchase and use of financial services is not necessarily "all-or-nothing." From the broad spectrum of available financial services, economies choose to construct and use financial contracts and institutions given the level of income per capita, public policies, and legal structures.

Growth occurs in this model when society invests and maintains a sufficient amount of resources in firms that augment human capital, create technology, and produce goods. Increases in the fraction of resources allocated to firms or decreases in the premature liquidation of firm capital accelerate economic growth. Financial structures that mitigate liquidity and productivity risk make firm investment more attractive. In addition, liquidity risk management eliminates the premature liquidation of firm capital which accelerates technological change. Thus, financial structures that allow agents to reduce liquidity and productivity risk can increase economic growth by increasing the fraction of resources invested in firms and enhancing the efficiency of

firms. Financial structures that identify production externalities and mobilize resources to more fully exploit profitable projects can further enhance growth by raising the proportion of resources devoted to human capital augmenting endeavors.

Taking policies toward financial markets as given exogenously, this paper can help explain a number of empirical regularities that have not been previously reconciled within the context of a single optimizing model. In this model, different policies toward financial activities can yield different steady-state growth rates; these policy differences can explain the positive correlation between per capita output growth and various measures of financial market activity; and different financial market policies can simultaneously explain why economies will tend to choose more sophisticated financial services as per capita income rises, but why policy and legal differences may cause the form of the financial institutions providing those services to differ across countries with similar per capita incomes. The focus on financial services in this paper suggests a new emphasis for empirical investigations. The analysis predicts that it is the provision of specific financial services that will be related to long-run growth, not necessarily the size of the financial system or of any particular financial institution.

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