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FINANCIAL STRUCTURE AND ECONOMIC DEVELOPMENT

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ABSTRACT

An important challenge to economists is to explain how financial contracts and institutions affect economic growth while simultaneously explaining how economic development elicits the creation and modification of an economy's financial structure. This paper addresses one side of this inherently two-sided issue. The paper shows how risk, transactions costs, and economies of scale in information gathering and resource coordination create incentives for the emergence of commonly observed financial institutions and contracts and how the resulting financial structure influences the steady state growth rate of per capita output. Policy can affect growth directly by altering investment incentives and indirectly by changing the incentives underlying the creation of financial structures.

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I. INTRODUCTION

Raymond Goldsmith and others have empirically documented the rough parallelism between the evolution of financial markets and economic development.[2] While not incontrovertible, evidence suggests that as real income rises, the ratio of financial institutions' assets to GNP grows and the distribution of financial assets among financial institutions changes. Given these observations, a satisfactory theory of the relationship between financial market evolution and economic development needs to explain how per capita output growth and technological change elicit the creation and modification of financial arrangements while simultaneously explaining how the evolving financial structure alters the incentives and decisions of individuals in ways that change the economy's growth rate. Unfortunately, the profession is years away from such a unified theory.

This paper's purpose is to improve our understanding of how specific financial institutions affect the growth rate of per capita output. In studying the relationship between financial structure and economic development, the paper extends and links two literatures. The endogenous growth literature examines how economic incentives, production opportunities,

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1. The author is a staff economist in the International Finance Division. The views expressed in this paper are solely the responsibility of the author and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System, or other members of its staff. I would like to thank M. Carkovic, J. Coleman, D. Henderson, W. Helkie, D. Howard, E. Leeper and seminar participants at the Federal Reserve Board and the World Bank for helpful comments. This paper could not have been written without the help of David Gordon.

2. See Cameron 1967; Goldsmith 1969; the World Bank 1989, and Gelb 1989.

and policies lead individuals to make decisions that generate technological innovation and long-run growth. The literature on financial structures studies the emergence of financial contracts and intermediaries as optimal responses to particular assumptions regarding the structure of risk and the costs of acquiring information.[3] This paper constructs a model in which agents create financial arrangements that mitigate risk and information costs and make investment decisions that determine the rate of technological progress and per capita growth. Most importantly, this paper demonstrates how the emerging financial arrangements alter investment incentives in ways that change steady state per capita growth rates. Unfortunately, there is no avenue via which growth can alter financial arrangements; the paper does not explain why countries at different levels of economic development choose different financial structures.

The model includes a variety of forces found in the endogenous growth literature. As in Romer (1990), per capita output growth only occurs if agents invest a sufficient amount in projects that augment human capital and stimulate technological innovation. The critical inputs into human capital and technology production are physical resources [King and Rebelo 1990] and group interactions [Lucas 1988]. In particular, I assume that productivity growth occurs in "firms," where groups of people invent, innovate, and produce together in a two period production process [Prescott and Boyd 1987]. Furthermore, I assume that physical resources invested in firms are subject to an externality [Levine 1990]: the average quantity of resources maintained in

3. On growth see Romer 1986, 1990; and Lucas 1988. On finance see Gertler's 1988 review. On linking the literatures see Bencivenga and Smith 1988, Greenwald and Stiglitz 1989, Jovanovic and Greenwood 1990, and Levine 1990.

firms during production increases the human capital of each worker independently of that individual's own investment of resources.

The externality associated with capital in firms has two implications. First, if an individual removes physical resources after one period, the rate of human capital accumulation of remaining members declines; therefore, the rate of technological progress slows. Since economic growth is inextricably linked to human capital accumulation and technological innovation, premature removal of firm capital slows growth. Second, the production externality implies that the fraction of resources allocated to firms in a competitive equilibrium is less than the socially optimal level.

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 encourage the creation of commonly observed financial contracts and institutions. In the model, firm managers recognize production externalities, but it is difficult to convey this information to individuals and mobilize resources to exploit the firm's productive capabilities. Although identifying externalities and mobilizing resources may be prohibitively expensive for any individual, an institution - perhaps resembling an investment bank - may find it profitable to undertake the coordination costs associated with internalizing production externalities. Such an institution would encourage firm investment and accelerate growth.

A second characteristic of the model that generates a positive welfare role for financial contracts is liquidity risk. As in Diamond and Dybvig (1983), agents choose how much to invest in firms that produce and distribute profits in two periods and how much to invest in a less profitable but liquid asset that pays off in one period. The liquid asset does not enhance human capital or technology and, therefore, does not contribute to growth. After making decisions, some individuals receive a privately observed liquidity shock: they discover that they need to consume their wealth before firms complete production and distribute profits. Even though the premature liquidation value of firm capital is small, agents receiving these shocks remove their capital from firms. If liquidity shocks were publicly verifiable, standard insurance contracts would eliminate the liquidity risk faced by individuals. Since liquidity shocks are not publicly observable, alternative financial contracts may arise to mitigate liquidity risk.

This paper discusses three financial structures that may emerge to cope with liquidity risk and, in so doing, influence the economy's growth rate. They resemble stock markets, banks, and mutual funds. Stock markets reduce liquidity risk by allowing agents who receive liquidity shocks to sell their shares in firms. Investors not plagued by liquidity shocks purchase firm shares with liquid assets because firms enjoy a higher expected rate of return than liquid assets. Banks and mutual funds mitigate liquidity risk by issuing demand deposits or equity, pooling the savings of individuals, and investing in a manner that shares risk.[4] Banks and mutual funds require fewer transactions than stock markets. By managing liquidity risk, these financial arrangements tend to encourage firm investment and eliminate the premature liquidation of firm capital in response to liquidity shocks.

In analyzing financial institutions that manage liquidity risk, this paper confronts a fundamental problem associated with models using the Diamond and Dybvig (1983) preference structure to generate liquidity risk. Diamond and Dybvig argue that banks can offer deposits that reproduce the equilibrium that would exist if liquidity shocks were publicly observable. Jacklin

4. That mutual funds offer equity while banks offer demand deposits has implications for their susceptibility to panics that are discussed below.

(1987), however, demonstrates that the Diamond and Dybvig solution is not incentive compatible. This paper derives a bank deposit return structure that ameliorates risk and produces an incentive compatible equilibrium.

A third feature of the model that encourages the creation of financial contracts is productivity risk. Otherwise identical firms are subject to productivity shocks in the last period of production. This productivity risk discourages investors from investing in firms. Stock markets, banks, and mutual funds, however, allow individuals to invest either directly or indirectly in many firms and diversify away idiosyncratic risk. This diversification raises the fraction of resources invested in firms and accelerates the rate of human capital production.

The financial structures that arise - stock markets, banks, mutual funds, and investment banks - affect growth by improving the efficiency with which resources are used, not by increasing the savings rate.[5] This efficiency effect operates through two channels. First, financial markets increase the fraction of resources allocated to firms, so that human capital and technology grow faster. Stock markets, banks, and mutual funds can raise firm investment by reducing liquidity and productivity risk. Investment banks encourage firm investment by allowing investors to internalize production externalities. A second channel through which financial arrangements affect growth is by eliminating the premature liquidation of firm capital. This increases the externality associated with human capital production, and the economy grows faster. Stock markets, banks, and mutual funds eliminate capital liquidation by managing liquidity risk.

5. This is an attractive feature since Diaz-Alejandro 1985, Gelb 1989, and Dornbusch and Reynoso 1989 find that financial liberalization is correlated with investment efficiency not the aggregate savings rates.

An important finding is that financial institutions that specialize in research and resource mobilization may act in concert with financial intermediaries that focus on risk management to provide a broad range of financial services. For example, banks together with investment banks reduce risk and transactions costs while internalizing production externalities.

Although this paper does not focus on policy, imposing different public policies on the model generates different financial arrangements and different per capita growth rates. Thus, given policies towards financial markets, this paper helps explain three empirical findings that have not been previously reconciled within the context of a single model: across countries and over time within individual countries there exist (1) startling differences in per capita growth rates with little tendency for convergence; (2) positive correlations between the size of financial systems as a fraction of GNP and per capita growth rates; and (3) positive correlations between measures of investment efficiency and the relative sizes of financial systems.[6]

6. These regularities are debatable. Romer 1989, Barro 1989, Summers, Heston, and Kravis 1984, and Abramowitz 1986 show that per capita growth rates are not converging, but Baumol 1986 argues that within income groups growth rates are converging. See Easterly and Wetzel's 1989 literature review.

II. THE MODEL ECONOMY

This section presents an endogenous growth model. Growth is endogenous in the sense that given preferences and production opportunities agents make decisions that fully determine the steady state growth rate of per capita output. Incentives for financial contracts and institutions to arise are generated by the Diamond and Dybvig (1983) preference structure that creates liquidity risk, productivity shocks that create productivity risk, economies of scale in information gathering and resource mobilization, and transactions costs. Later sections study the emergence and functioning of financial institutions and the effects of these institutions on growth.

A. Preferences and Endowments

Agents live for three periods with a countable infinity of agents born every other period.[7] All young agents have the utility function

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

The coefficient of relative risk aversion is $\gamma + 1$, and c_i is consumption at age i. Since agents do not care about age one consumption, they save all first period income. Institutional arrangements, therefore, cannot alter the age one savings rate. They can only alter the composition of savings.

7. This structure is used to avoid certain inter-generational issues that would greatly complicate the analysis. This restriction could also be made by making specific assumptions about the production function or by specifying a simple proportional bequest function.

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

$$(2) \qquad \phi = \begin{cases} 0 & \text{with probability} \quad 1-\pi \\ 1 & \text{with probability} \quad \pi. \end{cases}$$

ϕ is the only form of risk. Since the distribution of ϕ is known, there is no aggregate risk: $(1-\pi)$ of each generation are type $\phi=0$ and π are type $\phi=1$.

The preference and risk structure defined by (1) and (2) imply that agents are concerned about the ability to consume their wealth at age two. This is the "desire for liquidity." Since each individual's "type" is random, there is "liquidity risk." If each individual's type were publicly observable, standard insurance contracts tied to the observation of one's type would eliminate liquidity risk. Since types are not publicly verifiable, alternative financial arrangements may arise.

There are three goods: a consumption good, a capital good, and human capital. Human capital is a non-tradable factor of production representing the knowledge, expertise, and skills embodied in individuals. Romer (1990) distinguishes technology - the instructions for combining raw materials into goods - from human capital - the ability to follow instructions and create new instructions. In this paper, the distinction is unimportant because of the specific production processes that I study. I assume that legal or technical considerations imply that newly invented technologies are only useful to the firms that create those new plans. Using Romer's (1990) terminology, firm-created technology is perfectly excludable and therefore economically indistinguishable from rival goods such as human capital. Thus, I will use the terms technology and human capital interchangeably in referring to intangible inputs such as knowledge, skills, and production plans.

B. Intertemporal Opportunities: Storage

There are two ways of transferring goods intertemporally. After working for age three entrepreneurs at age one and receiving wage w_t, agents may store (at zero depreciation) some fraction of these goods until period t+1.

C. Intertemporal Opportunities: Firm Production

The second way of transferring goods intertemporally is to engage in production. Individuals can invest time and wage earnings in "firms." During the first stage of firm production, individuals invent new production processes and improve human capital skills. In the second stage, firm members hire age one workers and produce consumption goods subject to a firm specific productivity shock. Since production occurs in t+2, only age three individuals can receive firm profits.

Firm production is illiquid: removal of one's investment before production occurs yields a low return of x consumption goods per investment, where x is less than the return from the storage technology (x<1). Thus, type $\phi=0$ agents regret their initial investment because they must prematurely remove their resources from the firm at age two.

1. Stage One: Human Capital Production

As in Prescott and Boyd (1987), human capital production requires that a group of agents work together for two periods. More specifically, an individual's accumulation of human capital depends positively on (1) interactions with other individuals; (2) the amount of resources invested by the individual; and (3) the average amount of physical resources invested and maintained in the group for two periods. The first input captures the belief that interacting with other people is an important aspect of innovation, invention, and the general improvement of productive skills [see: Lucas 1988]. The second input states that the more resources devoted to the accumulation of human capital by an individual the greater the amount of human capital received by that individual. Input three states that the average amount of resources invested by 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. First, there may be a public good externality associated with resources within a firm. Second, a member who benefits from her own investment will, via her interactions with other members, influence the human capital of others. Finally there may be a time-savings effect that stimulates innovation. For example, the resources invested by one individual may allow that individual to interact more with other members. This enhances the human capital of other members independently of their own investments.

The human capital production function of a representative firm member is

$$(3) \quad h_{t+2} = H\bar{\tilde{W}}^{\delta}_{t+2}(qw_t)^{\epsilon}, \qquad 1 < \delta, \epsilon < 0,$$

where H is a constant, qw_t is the quantity of resources invested by the representative agent, and $\tilde{W}_{t+2}$ is the quantity of resources per entrepreneur maintained in the firm between t and t+2: $\tilde{W}_{t+2} = (1-\bar{\alpha}^f)(\bar{q}\bar{w}_t)/\pi$, where $\bar{\alpha}^f$ is the average fraction of resources removed from firms at t+1, $\bar{q}\bar{w}_t$ is the average amount of resources per entrepreneur invested in period t, and π is the fraction of initial members remaining in period t+2.

2. Stage two: Consumption Goods Production

After groups of agents - "firms" - have acquired human capital skills, they hire age one individuals to produce consumption goods (y):

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

where L_{t+2} is age one labor units hired per entrepreneur in t+2 and $\tilde{\eta}_t$ is a firm specific shock with an expected value of one.[8] h_{t+2} is the level of human capital per entrepreneur at t+2. To focus on the role of human capital in development, this paper abstracts from physical factor accumulation in consumption goods production.[9] In terms of the standard neoclassical growth model, the term, h_{t+2}, is the level of "technology." In contrast to the standard neoclassical growth model, the evolution of technology in this model is the direct result of the decisions of maximizing agents.

The labor market is competitive, and labor is supplied inelastically. Age one labor receives a wage equal to its expected marginal product,

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

8. Formally, for each firm indexed by j, $\tilde{\eta}_t^j$ is drawn from the distribution function $G[\eta_t^j]$ on a compact interval $[\underline{\eta}, \bar{\eta}]$, where $\underline{\eta} > 1 - \theta$, and where $E[\eta] = \int \eta dG(\eta) = 1$.

9. Physical capital is, however, a crucial element in human capital production, and the model can be easily extended to include capital in the production of consumption goods without altering the results, e.g., think of h as a composite human/physical capital good. Also, while physical resource accumulation is undeniably important for development, empirical evidence suggests that changes in measurable factor inputs such as capital and labor are able to account for considerably less than half of the observed growth rates in per capita output over the past one hundred years [Maddison 1987].

The return to each age three entrepreneur in firm j is therefore

$$(6) \quad r^j_{t+2} = [\tilde{\eta}^j_{t+2} + \theta - 1]\, h_{t+2} L^{1-\theta}_{t+2}$$

Thus, the level of human capital positively influences the production of consumption goods, the wage rate, and the return to entrepreneurs.

D. Information Structure and Transactions Costs

The economic environment studied in this paper provides four motivations for financial structures to emerge. First, individuals face uncertain liquidity needs that are not verifiable. Thus, insurance contracts cannot eliminate liquidity risk, and alternative financial arrangements may arise. Second, firm specific shocks create an incentive for financial contracts that help agents diversify against productivity risk.

A third element of the model's informational structure that can elicit the creation of financial intermediaries is the cost associated with identifying and exploiting production externalities. Let the cost of identifying externalities in a firm and coordinating resources accordingly be proportional to the average amount of resources invested in firms: $Z\bar{q}\bar{w}_t$, where Z is chosen such that no single individual undertakes this activity. Although prohibitively costly for an individual, a group of agents - a designated researcher/mobilizer - may find it worthwhile to research production processes and mobilize resources to internalize production externalities. The cost of these activities may then be shared by a large number of individuals.

Finally, I assume that there are costs associated with financial transactions. More specifically, agents are permitted to conduct free financial transactions on two occasions.[10] Additional trips to the asset market are taxed at a rate of τ per trip. Intermediaries may arise that reduce the number of asset transactions and economize on transactions costs.

III. FINANCIAL AUTARKY AND OMNISCIENT SOCIAL PLANNING

This section compares two benchmark financial arrangements. The first is autarky: the economy does not have financial contracts or intermediaries. The financially autarkic economy demonstrates the workings of the model so that the emergence of financial arrangements can be usefully studied in later sections. The second benchmark arrangement is an omniscient social planner: the planner can at zero cost verify agents' types and internalize production externalities. Given the information available to the social planner, the planner can minimize liquidity risk, productivity risk, and transactions costs while fully exploiting production opportunities by investing for all individuals. Although the planner violates the informational restrictions of the model, the planning equilibrium serves as a useful "ideal" and exemplifies the ways in which financial arrangements can improve on financial autarky.[11]

A. Financial Autarky

1. Trading

Consider a representative agent born at time t. During the first period of life, he supplies time to a firm, receives wage w_t, and makes an investment decision (q). He invests the proportion q of his wealth [qw_t] in a illiquid,

10. As will become clear, choosing two is unimportant for the results.

11. Haubrich and King 1984 use a similar approach.

firm and the proportion (1-q) of his wealth $[(1-q)w_t]$ in the storage technology. The initial firm investment is counted as one asset transaction.

At age two, ϕ is realized. The fraction π of the generation receives $\phi=0$ and therefore does not value age three consumption. These type 0 agents regret having invested in the firm. They consume their wealth at age two: stored goods $[(1-q)w_t]$ plus the premature "liquidation" value of firm capital $[xqw_t]$. This liquidation is counted as a second asset transaction. Since all type 0 agents liquidate firm capital, the fraction of resources removed from firms $(\bar{\alpha}^f)$ equals the fraction of the population that are type 0 $(1-\pi)$. Thus, the average quantity of physical resources maintained firms for two periods $(\bar{W}_{t+2})$ is lower than it would be if capital were not removed from firms. Because of the physical resource externality, type 0 agents unintentionally reduce the rate of human capital accumulation of remaining members.

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

Note that at age two, $(1-\pi)$ of the population regrets having invested in the firm [type 0 agents] and π of the population regret having stored goods [type 1 agents]. Thus, there is a positive welfare role for financial arrangements that insure agents.

2. Equilibrium

A representative agent born at t solves the problem

$$(7)\quad \max_{q} E_{\tilde{\eta}}\left(-\frac{(1-\pi)[qw_t x+(1-q)w_t)]^{-\gamma}}{\gamma}-\frac{\pi[(\tilde{\eta}^{j}_{t+2}+\theta-1)H\bar{W}^{\delta}_{t+2}(qw_t)^{\epsilon}L^{1-\theta}_{t+2}+(1-q)w_t]^{-\gamma}}{\gamma}\right),$$

where $E_{\tilde{\eta}}$ is the expected value operator with respect to the distribution on $\tilde{\eta}$. Since only π of a generation become entrepreneurs and L_t is age one labor per entrepreneur, $L_t = 1/\pi$. Also, in this economy, all type 0 agents prematurely remove firm capital so that $\bar{\alpha}^f = 1-\pi$. Thus, in equilibrium,

$$(8)\quad L_t^{1-\theta} = \pi^{\theta-1} = \psi, \quad \text{and} \quad \bar{W}_{t+2} = (1-\bar{\alpha}^f)(\bar{q}\bar{w})/\pi = w_t q.$$

The first order condition after substituting (8) and assuming $\epsilon + \delta = 1$ is[12]

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

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. There is a solution to (9) where $0 \le q \le 1$ if $\pi\epsilon\theta H\psi > 1 > x > 0$, and x can be set close to zero. This condition merely requires that the expected return from firm investment is greater than the return to liquid assets which in turn is

12. Steady state per capita growth can occur as long as $\epsilon + \delta \geq 1$. Making this an equality allows one to solve for a closed form solution.

greater than the premature liquidation value of firm capital.[13]

Assume that $\pi\epsilon\theta H\psi > 1 > x > 0$ and re-write (9)

$$(10)\quad \frac{(1-\pi)[x - 1]}{[xq + 1(1-q)]^{1+\gamma}} + \pi\frac{[\epsilon\theta H\psi - 1]}{[\theta H\psi q + 1(1-q)]^{1+\gamma}} + $$

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

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

To examine the factors determining the investment decision (q) first assume that the productivity shock has zero variance ($\tilde{\eta}^j = 1$ for all j), which implies that the covariance term in (10) is zero, and solve for q.

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

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

13. If the return from liquid assets is higher than the expected return from firms, then there would be no firm investment. If, on the other hand, the liquidation value of firm capital is higher than the return from liquid assets, then no agent invests in liquid assets. Thus, if $\pi\epsilon\theta H\psi > 1 > x$ does not hold, a relatively uninteresting corner solution results.

internalized by individuals (ϵ).[14] Finally, the greater the degree of relative risk aversion (γ), the lower is the amount invested in firms

Now let the variance of the productivity shock be greater than zero, so that the covariance term in (10) is negative, not zero. Note that the summation of the first two terms in (10) varies inversely with q. Therefore, if the variance of $\tilde{\eta}$ increases, the absolute value of the covariance term increases, so that q must fall to satisfy condition (10). The economic implication of this finding is that the variance of the productivity shock discourages risk averse investors from investing firms. Consequently, a market that allows investors to diversify against productivity shocks will induce individuals to invest more in firms.

3. Per Capita Growth

Since in equilibrium $y_t = \psi h_t$, the two period growth rate is

$$g_y = y_{t+2}/y_t = h_{t+2}/h_t = \frac{H\tilde{W}^{\delta}_{t+2}(qw_t)^{\epsilon}}{h_t}$$

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

$$(12) \quad g_y = H[(1-\theta)\pi^{\theta}]q = H\rho q = H\rho\left[\frac{1(\lambda-1)}{(R-1) + \lambda(1-x)}\right].$$

14. The term ϵ arises because agents do not internalize fully the effects of investing in firms [see: equation 3]. This model incorporates the notion that individuals perceive diminishing marginal returns to firm investment. If instead individuals see themselves as buying a share of final firm output proportional to their own investments,then the return to firm investment is $H\theta\psi\tilde{W}_{t+2}(qw/\bar{q}\bar{w})$. The results under this specification can be obtained from this paper by setting ϵ to 1.

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

4. <u>Discussion</u>

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. Since all age one income is saved, the form of savings along with productive efficiency are the key determinants of growth.

The fraction $1-\pi$ of the population removes its capital from firms after one period. Because of the production externality, premature removal of firm capital reduces the rate of human capital production of remaining firm members and slows the economy's growth rate. An institution or market that minimizes premature liquidation may increase the economy's growth rate.

B. <u>Omniscient Social Planning</u>

An omniscient social planner could deal with the four motivations for financial contracts that exist in this model: liquidity risk, productivity risk, information and coordination costs associated with production externalities, and transactions costs. I assume that the planner can observe each individual's type, so that the planner can write optimal insurance contracts. Furthermore, since the planner coordinates investment for all individuals, the planner internalizes production externalities and invests in a large number of firms to eliminate idiosyncratic productivity risk. Finally, the planner minimizes asset transactions by keeping them to two per person: relinquishing resources to the planner and retrieving goods later.

1. Trading

An agent born at supplies labor to a firm, receives wage w_t, and reliquishes these resources to the planner. At age two, his type is revealed. If type 0, he retrieves consumption goods. If type 1, he continues working in the firm and receives consumption goods at age three.

Since the omniscient social planner invests resources for the entire community, he perceives the firm production function $H\left[\frac{(1-\bar{\alpha}^f)}{\pi}\right]^{\delta} qw\, L_{t+2}^{1-\theta}$. Since there are only two asset transactions in the planner economy - giving and receiving resources from the social planner - there are no transactions costs. Thus, the social planner maximizes expected utility for the representative agent, and the resulting resource allocation is pareto optimal.

2. Equilibrium

A preliminary proposition will simplify the solution. Let $R^* = \theta\psi H\pi^{-\delta}$,

Proposition 1: If $\pi R^* > 1 > x$, then:
(i) no resources are prematurely liquidated; and
(ii) all stored goods are distributed to type 0 agents.

Proof: See Appendix A.

The major implication of Proposition 1 is that resources are not prematurely removed from firms, $\bar{\alpha}^f = 0$.[15] This implies that the rate of human capital accumulation occurring within firms will be higher for any given initial investment than in the financially autarkic economy. Formally, $\hat{W} = \bar{q}\bar{w}/\pi$, so that $R^* > R$ by $\pi^{-\delta}$.

15. The condition for Proposition 1 to hold requires that the expected return from increasing firm investment is larger than that from storing more goods which in turn is larger than the liquidation return. If the return from storage were higher than that from the firm, then there would be no firm investment. If the liquidation return were higher than the storage return, then no agent would invest in the liquid asset. Thus, if the condition does not hold, a relatively uninteresting corner solution results.

Thus, assuming $\pi R^* > 1 > x$, the social planner solves the problem

$$(13) \quad \max_{q^*} \; -\left(\frac{1-\pi}{\gamma}\right)\left(\frac{(1-q)^* w_t}{1-\pi}\right)^{-\gamma} - \left(\frac{\pi}{\gamma}\right)[\theta H(\pi^{-\delta})q^* w_t \, L_{t+2}^{1-\theta}]^{-\gamma}.$$

Solving and using the equilibrium conditions yields

$$(14) \quad q^* = \beta/(1+\beta), \quad \text{where} \quad \beta = \left[\frac{\pi}{(1-\pi)}\right]^{\frac{1}{1+\gamma}} \left[\frac{1}{(1-\pi)R^*}\right]^{\frac{\gamma}{1+\gamma}}.$$

The fraction of society's resources invested in firms, q^*, depends positively on the expected rate of return πR^*. If the physical return climbs (R^* rises) or if the probability distribution shifts toward type 1 (π rises), q^* rises. Also, as risk aversion, γ, ascends, q^* falls. Finally, note that only type 0 agents want to withdraw after one period. This is demonstrated in Appendix A and follows directly from Bencivenga and Smith (1988).

3. Growth: Omniscient Social Planner

The two period growth rate in the social planner economy is

$$(15) \quad g_y^* = H[(1-\theta)\pi^\theta]\pi^{-\delta}q^* = H\rho\pi^{-\delta}q^* = H\rho\pi^{-\delta}\frac{\beta}{1+\beta}.$$

In comparing the growth rate of the economy with an omniscient social planner with the growth rate of the economy in financial autarky, there are two channels through which the informational advantages of the planner can influence growth. The first channel is the waste-reduction channel that arises because of the planner's ability to manage liquidity risk. The planner pools and invests resources such that no resources are prematurely removed from human-capital-augmenting firms. Because of externalities, this improves the productivity of firms. Thus, even if $q = q^*$, the planner growth rate is greater than the financial autarky growth rate because the rate of human capital accumulation is higher by $\pi^{-\delta}$, $\bar{W}^* > \bar{W}$. Since human capital and technology are the sources of per capita growth in this model, omniscient social planning increases economic growth by enhancing productive efficiency.

The second channel is the allocation channel. The more resources devoted to firms, the higher is the economy's growth rate. The planner affects resource allocation in three ways. By reducing the liquidity and productivity risk associated with firm investment, the planner economy devotes a larger fraction of resources to firms than in the financially autarkic economy if agents are sufficiently risk averse.[16] The omniscient social planner also encourages growth by internalizing externalities. Ceteris paribus, internalizing the positive externalities associated with firm investment implies that a larger fraction of resources are allocated to firms and economic growth is more rapid.

4. Discussion

By definition, the omniscient social planning equilibrium is pareto optimal. The planner costlessly pools the economy's resources, verifies agents' types, and exploits production externalities. Thus, the planner

16. From equations (11) and (14), $q^* > q$ if γ is sufficiently large (or small). To see this, note that the omniscient social planner increases the expected return of being type 0 because, ceteris paribus, $\frac{(1-q)w_t}{1-\pi} > (1-q)w_t$, but social planning also increases the expected return of being a type 1 agent because $\bar{W}$ is higher. Thus, the change in the relative rates of return in conjunction with agents' risk aversion determines whether the planner increases or reduces the fraction of resources devoted to the firm.

optimally invests the economy's resources. Furthermore, the planner achieves the pareto optimal allocation with a minimum of transactions. The remainder of this paper explores financial arrangements that may arise endogenously to cope with risk, production externalities, and transactions costs.

IV. STOCK MARKETS

This section shows how the emergence of a "stock market" can mitigate liquidity and productivity risk and influence resource allocation, growth, and welfare. The incentives for stock markets to form are straightforward. First, agents would like to diversify their investments to minimize productivity risk. Stock market allow individual investors to hold a diversified portfolio that eliminates idiosyncratic productivity risk. Second, when a generation turns age two, type 1 agents would like to trade their stored goods for more claims on high-return firms that pay off in period 3, and type 0 agents would like to sell their claims on future firm output for goods in period two. Stock markets allow type 0 and type 1 agents to trade. Stock markets reduce liquidity risk because agents know that they can sell their claims to period 3 output for more than the liquidation value of firm investment if they turn-out to be type 0.[17]

While reducing risk, stock markets eliminate the premature withdrawal of resources from firms and may also increase the fraction of resources devoted to firms. These effects accelerate the rate of human capital accumulation and

17. Trading could go on strictly in firms. But, public stock markets may provide a cheaper and less disruptive mechanism for satisfying liquidity requirements and diversifying portfolios.

per capita output growth. The stock market does not allow individual entrepreneurs to internalize production externalities.

There are, however, transactions costs associated with stock market trading. The fraction $(1-\pi)$ of the population go to the market twice while the fraction π go to the market three times. Thus, expected transactions costs for the representative agent is $\pi\tau$.

A. The Model with Stock Markets

1. Trading, a Preliminary Proposition, and the Maximization Problem

Stock market transactions take place in the first part of each period and other activities occur in the second part. During age one, agents create and distribute shares of firms. At age two, agents learn their types. The resulting heterogeneity creates an incentive for stock transactions.

At age two, agents know the amount of claims each has on period three consumption goods and the quantity of consumption goods stored from period one. Type 0 agents will sell their claims to period three consumption goods as long as they receive a rate of 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 is less than one.

Let P equal the period two stock market price of claims to period three goods. A rational expectations equilibrium involves (i) finding agents' optimal consumption/investment decisions in period two, given P and period one decisions; (ii) finding a P that clears the market in period two, given period one decisions; (iii) finding the optimal period one investment allocation decision, q, given P; and (iv) requiring period one market equilibrium.

Before characterizing the equilibrium, a result worth establishing is

<u>Proposition 2</u>: if $\epsilon\pi R^{*} > 1 > x$, then:
(i) then no resources are prematurely liquidated; and
(ii) all stored goods are consumed by type 0 agents.

<u>Proof</u>: See Levine 1990.

Proposition 2 establishes that as long as the expected return of firm investment is larger than the storage return which is in turn larger than the liquidation return, no resources will be prematurely liquidated and all stored goods are consumed by agents that do not value period three consumption.[18]

Assuming that $\epsilon\pi R^{*} > 1 > x$ and agents hold a diversified portfolio, agents choose q to maximize expected utility:

$$(16)\quad \max_{q} \; -\left(\frac{1-\pi}{\gamma}\right)\left[(1-q)w_t + P\pi\theta\psi H\bar{W}^{\delta}_{t+2}(qw_t)^{\epsilon}\right]^{-\gamma}$$

$$-\left(\frac{\pi}{\gamma}\right)\left[\pi\theta\psi H\bar{W}^{\delta}_{t+2}(qw_t)^{\epsilon} + \frac{(1-q)w_t}{P} - \tau\right]^{-\gamma}.$$

If transactions costs are large enough, agents will choose not to use the stock market, and the economy returns to financial autarky. Thus, public policies that raise transactions costs could reduce stock market activity.

Solving (16) yields

$$(17)\quad \epsilon\pi R^{*}P = 1.$$

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18. As above, an uninteresting corner solution arises if $\epsilon\pi R^{*} > 1 > x$ does not hold. Furthermore, agents voluntarily relinquish their ability to liquidate resources. Thus, agents have a vertical supply curve of claims to period three consumption goods in period 2 [see: Levine 1990].

2. <u>The Investment Allocation decision</u>: q^s

To solve for the stock market investment allocation decision, conjecture that $P = \dfrac{(1-\bar{q}^s)}{(1-\pi)R^*\bar{q}^s}$, substitute into (17), and solve for q^s,

$$(18)\quad q^s = \frac{\epsilon\pi}{1-\pi+\epsilon\pi}.$$ [19]

The stock market investment decision q^s does not depend on agents' risk aversion. This arises because an individual faces a fixed price for claims on period three consumption goods in terms of period two goods (P). Consequently, individuals perceive an <u>unchangeable</u> difference between consumption when $\phi = 0$, or 1, i.e., a change in q by any individual does not affect the proportion of consumption in the two states.[20] This result is different from the planning equilibrium because the planner recognizes that alterations in q change the relative consumption of type 1 and type 0 agents.

Note from (11) and (18) that there are parameterizations of the model such that without a stock market there is no firm investment, but the emergence of stock markets changes incentives sufficiently so that individuals invest in firms. Thus, policies that stymie the evolution of capital markets may retard technological innovation and economic progress.

19. This q and P are a rational expectations equilibrium. Proposition 2 demonstrates that this P clears the market in period 2 and also identifies the optimal consumption/investment decision of type 0 and 1 agents in period 2. The investment decision, q, is optimal given P from the solution to (16), and substitution demonstrates that this P and q clear the market in period two.

20. Thus, in equilibrium, individual portfolio choice is indeterminate. But, market equilibrium requires that a "representative agent" hold q^s.

B. Growth: Stock Markets

The two period per capita growth rate in the stock market economy is

$$(19) \quad g_y^s = H\rho\pi^{-\delta}q^s = H\rho\pi^{-\delta}\frac{\epsilon\pi}{1-\pi+\epsilon\pi} .$$

As in the omniscient social planner economy, stock markets improve the efficiency of firms by eliminating the premature liquidation of firm resources. The maintenance of more resources in firms increases the rate of human capital production and technological innovation.

Stock markets can also accelerate growth by reducing liquidity and productivity risk and encouraging firm investment. If agents are sufficiently risk averse, stock markets imply a higher q than in the financially autarkic economy and the planning economy.[21]

Stock markets alone do not allow investors to internalize production externalities. Furthermore, stock markets require more transactions than in the autarkic or planning economies. The next section discusses financial institutions that may arise to cope with transactions costs and informational problems associated with exploiting production externalities.

21. If, however, the social planner does not internalize production externalities, then the stock market economy unambiguously devotes a higher fraction of resources to firms.

IV. DEMAND DEPOSIT BANKS: DIAMOND/DYBVIG BANKS AND OTHER BANKS

In an influential paper, Diamond and Dybvig (1983) propose demand deposit issuing banks as an endogenous institutional response to liquidity risk. They demonstrate that banks can offer returns to individuals that achieve the optimal risk sharing allocation of resources, i.e., the returns offered by Diamond/Dybvig banks generate the same allocation of resources as when agent's types are publicly observable and insurable. Jacklin (1987), however, shows that the returns offered by Diamond/Dybvig banks are not incentive compatible unless severe restrictions are imposed on the trading of private agents. In particular, given that other individuals have joined banks, each individual would choose not to join a bank; Diamond/Dybvig banks cannot coexist with stock markets or in any environment in which individuals can invest directly in the economy's production opportunities.

This section verifies that banks offering Diamond/Dybvig type returns - returns designed to produce the optimal risk sharing allocation of resources - are subject to Jacklin's (1987) critique within the context of this paper's growth model. But, the section goes on to show that a revised set of bank deposit returns can be offered to agents that is incentive compatible. Although this incentive compatible banking equilibrium does not reproduce the optimal risk sharing equilibrium of an omniscient social planner, this paper's banking equilibrium is superior in expected utility terms to financial autarky without imposing severe trading restrictions.[22]

22. As in Diamond and Dybvig 1983, bank runs occur if agents lose confidence in bank solvency. However, Jacklin 1987 shows that mutual funds can mimic the banking equilibrium without subjecting themselves to "runs." Since recasting this section using equity-issuing mutual funds does not change the results, I ignore bank run equilibria except for a brief discussion.

A. <u>The Model with Diamond/Dybvig Banks</u>:

1. <u>Trading and Two Preliminary Propositions</u>

Banks take deposits from age one individuals and invest directly in the storage technology and a diversified set of firms. A demand deposit is defined as a contract that requires an initial investment at age one and promises a return per investment of r^1 at age two or r^2 at age 3, at the discretion of the depositor. These returns are conditional on bank solvency. I assume that the bank is liquidated after two periods so that any resources not distributed after one period are included in the return r^2. If r^1 is greater than 1, demand deposits offer a degree of insurance against being type 0. Agents in this economy make two asset transactions: depositing and withdrawing funds from banks. Therefore there are no transactions costs.

I will first derive the return structure and resource allocation implied by Diamond/Dybvig type banks. A proposition simplifies the derivation.

<u>Proposition 3</u>: If $\epsilon\pi R^* > 1 > x$, then:
(i) no resources are prematurely liquidated; and
(ii) all stored goods are distributed to type 0 agents as r^1.

<u>Proof</u>: Straightforward given the proof of Proposition 1 in Appendix A

Banks are owned by depositors and maximize expected utility of the representative depositor. The resulting resource allocation <u>is</u>, by definition, a constrained social optimum, constrained by the inability of banks to internalize production externalities.

2. The Investment Allocation Decision

Given Proposition 3, banks solve the problem

$$\max_{q} \; - \left(\frac{1-\pi}{\gamma}\right)\left(\frac{(1-q)w_t}{1-\pi}\right)^{-\gamma} - \left(\frac{\pi}{\gamma}\right)[\theta H\bar{W}^{\delta}_{t+2}(qw_t)^{\epsilon} L^{1-\theta}_{t+2}]^{-\gamma}.$$

Solving for the Diamond/Dybvig investment allocation decision, q^{dd},

$$(20) \quad q^{dd} = \beta^{dd}/(1+\beta^{dd}), \quad \text{where} \quad \beta^{dd} = \left[\frac{\epsilon\pi}{(1-\pi)}\right]^{\frac{1}{1+\gamma}} \left[\frac{1}{(1-\pi)R^*}\right]^{\frac{\gamma}{1+\gamma}}.$$

The Diamond/Dybvig banking investment allocation decision, q^{dd}, is very similar to the omniscient social planner's investment allocation decision. The only difference is that the planner internalizes production externalities. Formally, $\beta > \beta^{dd}$ because β^{dd} includes ϵ in the first term so that $q^* > q^{dd}$.

3. Growth with Diamond/Dybvig Banks

The two period growth rate in the banking economy is

$$(21) \quad g^{dd}_y = H[(1-\theta)\pi^{\theta}]\pi^{-\delta}q^{dd} = H\rho\pi^{-\delta}q^{dd} = H\rho\pi^{-\delta}\frac{\beta^{dd}}{1+\beta^{dd}}.$$

The Diamond/Dybvig bank produces a per capita growth rate very similar to the omniscient social planner. By coping with liquidity risk, the Diamond/Dybvig bank eliminates the premature liquidation of firm capital. Bank also encourages firm investment above the financially autarkic solution if agents are sufficiently risk averse because banks reduce liquidity and productivity risk. And, with Diamond/Dybvig banks, agents only make two transactions: deposit and withdrawal. Again, the difference between Diamond/Dybvig banks and the social planner is that the planner invests a larger fraction of resources in firms because he internalizes externalities.

B. <u>Bank Runs</u>

In a bank run, agents panic and withdraw their funds after one period. The bank has insufficient liquid funds to satisfy the demand because it invested assuming that only type 0 agents would withdraw after one period. Consequently, banks liquidate firm investment. The quantity of resources (per agent) available to banks after one period is $[(1-q) + qx] < 1$. Thus, in a bank run, banks are forced to liquidate <u>all</u> firm investment so that economic growth stops and the mean level of consumption is less than one, i.e., the bank run equilibrium is worse than financial autarky. As mentioned above, bank runs can be avoided with mutual funds [See: Jacklin 1987].

C. <u>Incentive Compatibility</u>

Thus far, this section has implicitly assumed that individuals can <u>only</u> buy demand deposits. I now show that if agents can invest in firms and sell their shares to other agents that the optimal risk sharing equilibrium is infeasible, i.e., it is no longer a Nash equilibrium.

Jacklin (1987) shows that given (1) the return structure offered by Diamond-Dybvig banks (r^1 and r^2) and (2) the ability of individuals to invest directly in firms, each individual has no incentive to deposit savings in a bank. Consider an individual trying to decide whether or not to deposit savings in a bank. If he invests in a bank, anticipated consumption is:

$r^1 w_t = \frac{(1-q^{dd})w_t}{1-\pi}$ if he is type 0; and $r^2 w_t = R^* q^{dd} w_t$ if he is type 1. Consider an alternative investment strategy: invest everything in a diversified portfolio of firms. If he is a type 1, he consumes $R^* w_t$, which is greater than r^2. If he turns out to be type 0, he sells his shares to individuals with bank deposits for $r^1 w_t / q^{dd} = \frac{(1-q^{dd})w_t}{q^{dd}(1-\pi)}$,[23] which is greater than r^1. Thus, whether he is type 1 or type 0, he is better off not joining the bank and investing everything in firms. Put differently, stock markets are incompatible with Diamond/Dybvig banks.

To prevent this result, restrictions need to be imposed on trading, or there needs to be a change in the return structure of bank deposits. Changing the return structure of banks circumvents this incentive incompatibility problem at the cost of not achieving optimal risk sharing.

D. Equilibrium with Demand Deposit Issuing Banks[24]

Banks that offer returns designed to achieve the the optimal risk sharing resource allocation do not produce an incentive compatible equilibrium. This subsection shows how alterations in the returns offered to depositors can produce an incentive compatible equilibrium that improves the welfare of agents above the financially autarkic equilibrium or the stock market equilibrium. The equilibrium is the same as the stock market economy except that demand deposit issuing banks reduce transactions costs.

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23. In this example, an ex post type 1 bank depositor has the choice of "investing" r^1 and receiving $r^2 = R^b q^b$ next period or using r^1 to purchase R^b. The price of R^b that makes him indifferent is r^1/q^b.

24. David Gordon provided very helpful guidance on this section.

1. An Incentive Compatible Return Structure

Instead of offering the Diamond/Dybvig return structure of

$$r^1 = \frac{(1-\bar{q}^{dd})}{1-\pi} = \frac{1}{1+\beta^{dd}} \quad \text{and} \quad r^2 = R^* q^{dd} = R^* \frac{\beta^{dd}}{1+\beta^{dd}} \text{ to depositors,}$$

let banks offer depositors $r^1 = \dfrac{1}{1-\pi+\epsilon\pi}$ and $r^2 = \dfrac{R^*\epsilon\pi}{1-\pi+\epsilon\pi}$. These returns are equal to the equilibrium returns in the stock market economy 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 stock market economy π percent of the population transact three times. Thus, agents prefer the banking equilibrium to stock markets.

Furthermore, the returns offered by this bank are not subject to Jacklin's (1987) critique described above. To see why, recall that in the stock market economy individual agents 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. The banks, by offering the same returns, simply mimic stock markets. The reduced transactions costs accrue to type 1 agents as a non-distortionary benefit.

2. Growth and Discussion

This banking equilibrium is attractive for a number of reasons. Demand deposit issuing banks are ubiquitous financial institutions that account for a large fraction of financial intermediation. It is therefore comforting to discover that the type of financial contracts commonly issued by banks may help improve risk sharing and resource allocation in an incentive compatible equilibrium. Furthermore, the banking equilibrium involves no premature liquidation of firm capital, reduces transactions costs, and eliminates the need to self-finance projects. Thus, even within a simple model, financial intermediation can be a pivotal input into economic activity.

Agents in the banking economy have a higher expected utility level than agents in the stock market economy because banks reduce the required number of transactions. Nonetheless, the banking equilibrium yields the same investment allocation, q, and the same per capita growth rate as in the stock market economy. Neither of these financial arrangements, however, allows economic decision makers to internalize production externalities.

V. INVESTMENT BANKS: DELEGATED RESEARCHERS/MOBILIZERS

Individuals would invest more in firms if they could internalize firm externalities into their investment decisions. The costs associated with researching firms and mobilizing resources to exploit externalities, however, are prohibitively expensive for any single individual. A delegated researcher/mobilizer, however, may form to perform these tasks. I call these institutions "investment banks." Investment banks research the production processes of firms, identify externalities, and mobilize resources to take full advantage of these opportunities. In performing these tasks, investment banks raise the fraction of funds allocated to long-run projects, accelerate economic growth, and improve welfare.

A. Equilibrium

The cost of identifying externalities and coordinating resources are proportional to average firm resources: $Z\bar{q}\bar{w}_t$, where Z is large enough such that no individual undertakes the job. Since the number of people in society is large, groups of agents might perform these activities and charge individuals and/or firms. The cost per individual would then be negligible.

I will demonstrate the role of investment banks within an economy that has already created demand deposit issuing banks. Combining these two financial institutions shows how the combination of banks and investment banks move the economy from a financially autarkic equilibrium to an equilibrium approaching the omniscient social planning equilibrium. Since banks offering incentive compatible deposit returns mimic stock market returns except for transactions costs, finding the investment allocation decision in an economy with banks and investment banks involves solving the following problem:[25]

$$(22)\quad \max_{q} \; -\left(\frac{1-\pi}{\gamma}\right)\left[(1-q)w_t + P\pi R^* q w_t\right]^{-\gamma} \; - \left(\frac{\pi}{\gamma}\right)\left[\pi R^* q w_t + \frac{(1-q)w_t}{P}\right]^{-\gamma}.$$

Solving yields

$$(23)\quad q^{bi} = \pi,$$

where the superscript "bi" has been added to designate the investment allocation decision with banks and investment banks.

B. Discussion

The bank/investment bank economy devotes a larger fraction of resources to firms than the financially autarkic economy, the stock market economy, the banking economy, or the omniscient social planner economy: $q^{bi} > q$, q^s, q^b, or

25. Note the similarities with the stock market problem (16). Here externalities are internalized and $\tau=0$ because banks require two transactions.

q^*. By fully internalizing externalities, the investment bank encourages firm investment. Furthermore, the reduction in risk actually encourages firm investment beyond the socially optimal level of the social planner.

In addition to devoting the highest fraction of resources to firms, the bank/investment bank equilibrium does not involve premature liquidation of resources or transactions costs. This implies that the economy in which banks and investment banks have emerged will enjoy the fastest per capita growth rate. The bank/investment bank economy grows faster than the planner economy because the planner is able to account completely for agents' risk aversion.

Before concluding, two points should be emphasized. First, the operations of investment banks and banks complement one another. Banks reduce liquidity risk and transactions costs while investment banks help investors internalize production externalities. These functions eliminate the premature liquidation of firms resources and increase the fraction of resources devoted to firms. Thus, the combination of investment banks and deposit banks enhance technological advancement and economic growth. Second, since the savings rate is trivially set to one, financial arrangements can only affect growth by improving the allocation of savings or the productivity of firms. This conforms with empirical findings by Diaz-Alejandro (1985), Gelb (1989), and Dornbusch and Reynoso (1989).

VI. SUMMARY

An important challenge to financial economists is to explain how financial contracts and institutions affect economic growth while simultaneously explaining how economic development elicits the creation and modification of financial arrangements. This paper addresses one side of this inherently two sided issue. I show how liquidity risk, productivity risk, transactions costs, and economies of scale in information gathering and resource coordination create incentives for the emergence of commonly observed financial institutions and contracts and how the resulting financial structure influences the steady state growth rate of real per capita output. In this model, public policy can affect growth directly and indirectly. By directly altering investment incentives, policy affects the economy's growth rate. By changing the incentives underlying the creation of specific financial arrangements, policy alters the financial structure and, therefore, indirectly affects investment and growth.

The firm is the protagonist in this model. In a process that takes two periods, firms augment human capital, create technology, and produce goods. Growth occurs when society invests and maintains a sufficient amount of resources in firms. Increases in the fraction of resources allocated to firms or decreases in the premature removal of resources from firms accelerate the growth rate of real per capita output. Since there are costs associated with internalizing production externalities in firms, firm investment is "too" low and growth "too" slow in the absence of financial institutions.

The paper examines four reasons for the emergence of financial contracts and institutions: liquidity risk, productivity risk, economies of scale in information gathering and resource mobilization, and transactions costs. Financial structures that mitigate risk make firm investment more attractive by providing partial insurance against liquidity shocks and allowing agents to hold diversified portfolios against idiosyncratic productivity shocks. In addition, liquidity risk management eliminates the premature liquidation of firm capital which accelerates technological change. Thus, financial structures that manage risk, like stock market, banks and mutual funds, tend to increase investment in firms and the efficiency of firms. Also, banks and mutual funds require fewer transactions than stock markets.

Financial structures may also arise to exploit economies of scale in information gathering and resource mobilization. In the model, internalizing production externalities is prohibitively costly for individuals. A group of agents, however, may find it worthwhile to research production processes, identify externalities, and mobilize resources accordingly. This delegated researcher/mobilizer, or investment bank, accelerates the economy's growth rate by allocating more resources to firms. Importantly, a combination of financial institutions - for example banks and investment banks - can have the biggest impact on growth and welfare by mitigating risk, reducing transactions costs, internalizing production externalities, and eliminating the premature liquidation of firm capital. In so doing, they improve the allocation of resources and the productivity of firms. The result is higher growth and welfare.

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APPENDIX A

Proof of Proposition 1:

For simplicity set $w_t = 1$ and let

r_1 = return to person withdrawing after 1 period,

r_2 = return to person withdrawing after 2 period,

α^{ℓ} = proportion of the liquid asset liquidated after 1 period,

α^{f} = proportion of firm investment liquidated after 1 period.

The resource constraints facing the omniscient social planner are

(A1) $$r_1 = \frac{\alpha^{\ell}(1-q) + \alpha^{f}qx}{1-\pi}, \text{ and}$$

(A2) $$r_2 = (1-\alpha^{f})^{\delta}R^{*}q + \frac{(1-\alpha^{\ell})(1-q)}{\pi}.$$

Consider moving from a situation in which $\alpha^f > 0$ to a new situation designated by "^" where $\hat{\alpha}^f = 0$. Since q represents the proportion of savings held in illiquid form and α^f represents the proportion of those illiquid assets liquidated in period 2, $q\alpha^f$ signifies the reduction in illiquid assets as a fraction of total savings if α^f changes to $\hat{\alpha}^f = 0$. Thus,

$$(1-\hat{q}) = (1-q) + q\alpha^f; \qquad \hat{q} = q - q\alpha^f; \qquad \hat{\alpha}^{\ell} = 1 - (1-\alpha^{\ell})(1-q)/(1-\hat{q})$$

this implies that in (A1), the numerator of the right-hand-side falls by $\alpha^f qx$ and rises by $[1 - (1-\alpha^{\ell})(1-q)/1-\hat{q})](1-\hat{q}) - \alpha^{\ell}(1-q)$, which equals $\alpha^f q$. Since $1 > x$, $\hat{r}_1 > r_1$. In (A2), moving from an $\alpha^f > 0$ to an $\hat{\alpha}^f = 0$ implies no change in r_2, i.e., $\hat{r}_2 = r_2$. Since $\hat{r}_1 > r_1$ and $\hat{r}_2 = r_2$, $\alpha^f > 0$ is inconsistent with optimality.

Now, let $\alpha^{\ell} < 1$ with $\alpha^{f} = 0$ and consider a new situation designated by "^" where $\hat{\alpha}^{\ell} > \alpha^{\ell}$. By definition

$$(1-\hat{q}) = [\alpha^{\ell}/\hat{\alpha}^{\ell}](1-q); \quad \text{and} \quad \hat{q} = q + [1 - \alpha^{\ell}/\hat{\alpha}^{\ell}](1-q).$$

Thus, from (A1) with $\alpha^{f} = 0$, $\hat{r}_1 = r_1$.

From (A2),

$$\partial r_2 = (\pi R^* - 1)[1 - \alpha^{\ell}/\hat{\alpha}^{\ell}](1-q)/\pi.$$

Moving from α^{ℓ} to $\hat{\alpha}^{\ell}$, expected consumption rises if $\pi R^* > 1$. If $\pi R^* > 1$, then $\alpha^{\ell} < 1$ cannot be optimal, so that $\alpha^{\ell} = 1$ and $r_2 = R^* q$.

<u>Withdrawing After One Period:</u>

If one withdraws after 1 period, consumption is $r_1 = \dfrac{(1-q)}{1-\pi}$ and $r_2 = R^* q$ if one withdraws after two. Thus, type 1 agents want to withdraw after 2 periods if

$$R^* \frac{\beta}{1+\beta} > \left(\frac{1}{1-\pi}\right) \left(\frac{1}{1+\beta}\right)$$

Substituting for β this expression is equivalent to

$$\pi R^* > n.$$

Thus, agents with $\phi = 1$ do not withdraw after one period.

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