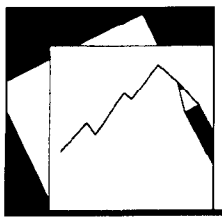
WP/03/24



IMF Working Paper

Financial Infrastructure, Group Interests, and Capital Accumulation

Theory, Evidence, and Policy

Biagio Bossone, Sandeep Mahajan and Farah Zahir

INTERNATIONAL MONETARY FUND

 WP/03/24

IMF Working Paper

Office of the Executive Director

Financial Infrastructure, Group Interests, and Capital Accumulation: Theory, Evidence, and Policy

Prepared by Biagio Bossone, Sandeep Mahajan, and Farah Zahir[1]

Authorized for distribution by Pier Carlo Padoan

January 2003

Abstract

This study presents a theory of *financial infrastructure* - or the set of rules, institutions, and systems within which agents carry out financial transactions. It investigates the effects of financial infrastructure development on financial architecture and real capital accumulation, taking into account financial-sector special interests. It shows that a more developed infrastructure promotes financial market growth, reduces the scope of traditional banking, and helps investors make more efficient investment decisions. The theory presented explains why traditional banking predominates in the early stages of economic development and becomes relatively less important as the economy develops, and why banks may retard financial sector development. The study provides evidence in support of its predictions.

JEL Classification Numbers: G1; G2; O16

Keywords: Banks; Nonbank financial intermediation; Financial infrastructure; Group interest; Information; Knowledge; Transaction costs

Author's E-Mail Address: Bbossone@imf.org, Smahajan@Worldbank.org, Fzahir@Worldbank.org

---

[1] Biagio Bossone is Advisor to the Executive Director of the IMF for Albania, Greece, Italy, Malta, Portugal, San Marino and Timor-Leste, and is associated with the Banca d'Italia. Sandeep Mahajan is Economist, Economic and Policy Unit, PREM, World Bank. Farah Zahir is Research Analyst, PREM South Asia, World Bank. The authors wish to thank R. Flood, P. Padoan, A. Sarr, L. B. Schumacher, and H. Q. Tran for their helpful comments and suggestions, and T. Beck for providing them with data sources. The opinions expressed in the text are the authors' only, and do not necessarily coincide with those of the individuals and institutions named above.

Contents Page

I. INTRODUCTION

Over the last decade, research has offered ample evidence of the positive effect of financial development on economic growth.[2] Recent studies have focused on the effects of law and financial regulation on output growth, showing the existence of robust empirical evidence in support of strong causal links.[3] Research has also found that the structure, or architecture, of the financial system (e.g., types of intermediaries and contracts used) affects the capital structure and the financing decisions of non-financial companies (see Section IV).

We believe that a satisfactory understanding of the relationship between finance and economic development requires a theory of how the complex of rules, institutions, and systems within which firms and households plan, negotiate, and perform financial transactions (what we hereafter refer to as *financial infrastructure*) affect both the economy's financial architecture and its process of real capital formation.[4]

Thus, this study investigates the effects of financial infrastructure on financial architecture and real capital accumulation, taking into account the interaction between infrastructure development and financial sector special interests. The study shows that a more developed financial infrastructure promotes the growth of financial markets, reduces the role of traditional banking activities (i.e., deposit taking and lending), enables investors to

---

[2] A recent study, based on long-term cross-country data, is the one by Rousseau and Sylla (2001). See also the recent work by Beck et al. (2000). For a review of the relevant works in this area, see Kahn and Senhadji (2000). Levine (1997) provides a comprehensive understanding of the finance-growth relationship. Demirgüç-Kunt and Levine (2001) provide a broad cross-country assessment of the ties between financial structure - the mix of financial instruments, institutions, and markets in a given economy - and economic growth.

[3] Levine, Loayza and Beck (2000) review the empirical literature and provide new corroborating evidence. They conclude that: "legal and regulatory changes that strengthen creditor rights, contract enforcement, and accounting practices boost financial intermediary development with positive repercussions on economic growth" (p. 36). Beckaert, Campbell, and Lundblad (2001) find across different specifications that equity market liberalizations are associated with significant real economic growth. Similarly, Fuchs-Schündlen and Funke (2001) show that stock market liberalization is associated with an increase in the growth of both real private-sector investment and real GDP per capita, and show that the benefits of liberalization are higher in countries that have improved their institutional framework prior to liberalization.

[4] Our definition of financial infrastructure includes:

- Legal and regulatory frameworks (including enforcement and conflict resolution mechanisms, and bankruptcy codes);
- Supervision, accounting, and auditing (i.e., rules, systems, practices, and professions);
- Financial corporate governance rules and institutions;
- Information infrastructure (i.e., public registries, public statistics, laws and rules on disclosure, credit bureaus, communications networks, rating agencies, financial information specialists, and financial and industry analysts);
- Clearing, settlement, and exchange systems (i.e., technology platforms, networks, and rules and standards); and
- Liquidity and safety net facilities.

make more efficient investment decisions, and leads to more knowledge-intensive capital accumulation.

These results offer an explanation of why traditional banking predominates in the early stages of economic development, becomes relatively less important as the economy develops, and may act as a retarding factor in financial sector development. The study also presents empirical evidence in support of its theoretical findings on a cross-country basis.

The study features the following innovations:

i. It presents a (choice-theoretic) model of how changes in financial infrastructure affect the investors' resource allocation decisions;

ii. It portrays financial infrastructure development as a process responding to market incentives and agent preferences;

iii. It explores the links between the supply of new infrastructure, government policy, and political-economy factors; and

iv. It explains how the development of financial infrastructure affects the architecture of the financial sector.

The remainder of the study is organized as follows. Section II draws the main stylized facts underpinning the interaction between financial infrastructure, banks, and financial markets across economic development. Section III presents a general-equilibrium model of an economy with investors/consumers, banks, the financial market, financial infrastructure, and information service provision. The model shows how resource allocation changes with innovations in information provision, and investigates how equilibrium asset allocations and prices vary in response to changes in the supply of financial infrastructural services. Section IV contrasts these results with those of the main contributions to the literature on financial architecture. Section V reports preliminary evidence in support of the study's predictions, and Section VI concludes and draws policy implications.

II. Financial Infrastructure and Incentives for Finance

A. Banks and Underdeveloped Financial Infrastructure

In our theory, banks act as devices to tie human capital with real (illiquid) assets (Diamond and Rajan 1998, 1999). They possess specific talents to collect the maximal value of loans to firms, and raise deposits from individual investors to whom they credibly commit to pass on (part of) the rents they expect to collect from their borrowers. This theory of banks is consistent with viewing them as agents specialized in attenuating asset-substitution and moral hazard (Boot and Thakor, 1997), as delegated monitors of ex post cash flow (Diamond 1984), and as agents with specialized technologies to induce repayment from debtors (see below).

We argue that such comparative advantage of banks is large when the economy's financial infrastructure is weak, or absent, since nonbank investors face transaction and information costs higher than what banks can achieve through their direct relationships with the borrowers, and through the incentives incorporated in their deposit and loan contracts.[5] This is especially the case in early stages of economic development, where low levels of wealth and income limit the participation of individuals to the nonbank segment of the financial system. We hold that at such stages banks *constitute* the economy's financial infrastructure that bridges across investors and fund users, since the provision of key financial infrastructural services is cost-effectively embedded in their specific intermediation function (Box 1).

BOX 1. SPECIAL SKILLS OF BANKS

With pervasive informational asymmetries in the economy, banks can be seen as cost-effective coalitions possessing specialized technologies to select best loans and protect their value. In particular, banking technologies are specialized to:

- Identify creditworthy borrowers
- Induce borrowers to select sound projects
- Monitor project implementation
- Minimize asset substitution and moral hazard from borrowers
- Ensure repayments from borrowers.

Due to their long-lasting relationships with client firms and the accumulated knowledge of their clients' specific businesses, banks can also:

- Influence the behavior of the borrower
- Expedite (industrial and financial) restructuring of weak client firms
- Facilitate ownership transfers of client firms to new entrepreneurs
- Help identify new managers for client firms
- Maximize the asset liquidation value of bankrupt client firms.

Through relationships, banks can accomplish such tasks on behalf of their depositor clientele at lower costs than is feasible for individual investors and nonbank intermediaries operating in the absence of apposite financial infrastructure.

Thus, until financial infrastructure develops into a complex of functions *disembodied* from bank production, banks make up for much of the needed financial infrastructural services, and provide such services in return for quasi-monopolistic rents through exclusive relationships with borrowers. As an example, when public information on firms is deficient or of poor quality: only banks are in a position to know the creditworthiness of borrowing firms; lesser funding opportunities are available to firms outside of the relationship with their

[5] To our knowledge, Gerschenrkon (1962) originated the idea – recently entertained by Rajan and Zingales (1998) – whereby banks are better placed to protect creditor rights when regulatory and contractual enforcement institutions are weak. In such circumstances, small investors are deterred from investing in the stock market for fear of being exploited by opportunistic and better-informed traders, and feel that their money is better protected if it is kept with banks.

banks; and banks are best positioned to extract rents from the firms.[6] To be sure, in such an environment borrowers, too, gain significant benefits from stable and protected relationships with the banks.[7]

In an environment with opaque information and poor enforcement of rules, bank relationships and bank (deposit and loan) contracts minimize information and transaction costs to the ultimate investors and borrowers: depositors need only to satisfy themselves with the reputation, liquidity, and safety of their banks, while they leave to the banks the cost and risk involved in extracting rents from individual borrowers. Banks, on the other hand, select borrowers and write contracts to ensure safe and stable returns on their loans, while they surrender to the borrowers the after-interest profit they are able to get from their activity.[8] Finally, borrowers have the opportunity to access funding at prices and conditions that would not be feasible through nonbank finance.

With this incentive structure, banks lend to firms that have large tangible (collateralizable) assets and that are specialized in activities with traditional (better known) production technologies. The asset liquidation value of such type of firms is easier to assess than for firms with more sophisticated technologies.[9] This enables banks to reduce the risk of moral hazard and asset substitution from borrowers.

B. Banks and Developed Financial Infrastructure

The development of financial infrastructure (disembodied from banks) alters the incentive structure for finance. Information ceases to be confined within exclusive investor-borrower relationships; the value of the firms becomes known to the market at large; and alternative financing opportunities become available outside of the relationships.

---

[6] A few other examples: institutional mechanisms to enforce contracts may be lacking, but banks have considerable leverage on borrowers (ultimately by mobilizing the collateral against their loans), which they use to induce borrowers to pay their dues. This leverage is supported by incentives if it is costly for the borrowers to exit the relationship with their bank and to start new credit relationships. Also, although accounting and disclosure rules may not be in place, or cannot be duly enforced, banks can use their direct access to the borrowers' books and business operations to get the information needed to assess credit statuses. Banks may as well issue credible threats to liquidate the borrowers' assets (sometime notwithstanding legal-system inefficiencies). Moreover, banks can set up in-house facilities to supplement the lack of public registries and of markets for asset valuation (such as for real estate property or used industrial plants).

[7] See Petersen and Rajan (1995), Allen and Gale (1999), Rajan and Zingales (1999a, 2000), and Boot (2000).

[8] Bank contracts can be shown to be optimal financial arrangements that, on the one hand, save on creditor's costs of monitoring states of nature throughout the life of the contracts and, on the other hand, give borrowers an incentive to minimize the risk of default and discourage them from hiding their true business performance (see Gale and Hellwig, 1985).

[9] Aside from the limited opportunities for diversification offered by economies early in development, the high cost of setting up and managing relationships with borrowers limits the banks' capacity to diversify their assets. This leads them to protect their portfolio by reducing the variability of return from individual projects through fixed-nominal debt contracts including collateral and liquidation clauses.

This change in incentives reduces the value of the relationships. The same result obtains when fund-users' compliance with rules and contracts is enforced by nonbank institutions, lowering banks' comparative advantage in rent extraction from borrowers.

The development of disembodied financial infrastructure makes a wider range of risk-sharing instruments available and attractive to investors, provides them with better information on alternative investment options, and enables them to invest more in new knowledge-intensive ventures. As well, the drop in information and communication costs and the diffusion of reputable market evaluation services facilitate the access to the market of new companies with new ideas and businesses.

As a result, traditional banks stand to lose from the development of disembodied infrastructure. Our theory assumes that the larger the rents that banks extract from their traditional (deposit-taking and loan-making) activity, the stronger the resistance of the banking industry to financial sector reforms aimed at developing financial infrastructure.[10] Similarly, attempts to develop financial infrastructure are likely to encounter stronger opposition in economies where banks dominate the financial sector and where the banking industry is more concentrated.

In fact, traditional banks might not be alone in this rent-protecting activity. Their client firms, too, who are typically involved in more traditional industrial activities, may share a similar interest if relationship (bank) finance reduces the risk of competition from new market entrants and hence the pressure on themselves to innovate.

The political-economy dimension of our theory is a special case of the "interest group" theory of financial development, proposed by Rajan and Zingales (1999b, 2000), whereby financial development is resisted and delayed by well established economic constituencies (people or firms), which expect to receive proportionately fewer benefits from financial sector reform.

To summarize: in our theory, the development of financial infrastructure has four implications. First, it promotes financial market growth and reduces the incentives for traditional banking. Second, it helps investors to select more efficient investment opportunities (with respect to risk/return considerations). Third, it induces capital accumulation in activities that incorporate relatively more intangibles and feature higher knowledge-intensity. Fourth, it is likely to be challenged by interest groups facing rent losses.

III. THEORY

This section introduces the model of the economy that we use to investigate the role of financial infrastructure, describes the agents operating in the economy, and draws a

[10] Boot and Thakor (1997) make this point, but note that this type of institutional resistance requires a coordinated action from banks.

number of theoretical results on the relationship between the development of financial infrastructure, changes in financial architecture, and real capital formation.

C. The Economy

The model portrays a developing economy with five types of agents: investors, firms, information producers, banks, and a nonprofit provider of non-information financial infrastructural services. As shown later in the study, the developmental aspect that interests us in this context is captured by the financial sector efficiency-gap separating the economy under consideration from a hypothetical fully competitive and developed benchmark-economy. The main features of the economic agents are the following:

Investors

The representative investor is a risk-averse, rational individual who lives for two periods, periods 1 and 2. She enters the economy with a real resource endowment, invests her endowment in period 1, and consumes in period 2. The investor allocates her endowment between alternative, competing financial assets with a view to maximizing intertemporal consumption utility.

Firms

The representative firm is a risk-neutral, profit-maximizing enterprise using two types of physical capital to produce output. The first type incorporates a traditional, well-known, constant-return technology, characterized by a large component of tangible assets, producing a standard output, and earning a sure rate of profit. The second type of capital is knowledge-intensive, features increasing returns to scale, incorporates a large component of intangibles, generates a nonstandard output, and earns a potentially higher but also riskier rate of profit than does the first type. The firm uses either type of capital (or combinations thereof), depending exclusively on the source of finances it receives:[11] bank loans go only into traditional technology, while direct finances from investors fund sophisticated technology exclusively. There is no cross-subsidization across the two capital types. The type of capital financed (and the related type of output produced) is thus determined by the investor preferences. The investor buys the firm's stock. The ownership of each firm is dispersed across a large number of investors.

Banks

The representative bank raises deposits from the investors and lends them to the firm; it does not invest in the company stock. The bank pays interest on deposits, incurs operational costs to produce its loans, and earns interest on its lending. Operational costs originate from generating specialized information on firms and from managing the lending relationship. The bank's special skills and resources reduce its (unit) operational cost below what it would cost to individual investors to lend directly to the firm; thus, the net return on bank lending is always higher than on individual (unintermediated) lending. Banks earn

[11] One could as well assume distinct firms with different types of capital and production process.

positive excess (monopolistic) rents, whereas their counterparties in the benchmark economy operate in a competitive environment and earn zero excess rents.

Information producers

There is one representative profit-maximizing information producer who has a comparative advantage over individual investors in the production of financial information.[12] The information produced and sold by the information producer concerns the financial and economic reputation of individual firms and the nature, profitability, and risk of their projects. Such information (which later will be formalized as an array of additive bits of knowledge) is incorporated in *information packages* that are sold to the investors at a profit-making price.

Providers of (non-information) financial infrastructural services

Non-information financial infrastructural services (disembodied from bank production) are provided by a nonprofit collective agent.[13] Examples of such services in the context of our model are network services, organized exchange mechanisms, or regulatory and supervisory systems. Their supply is assumed to be determined by public choices resulting from the interaction/conflict of group interests emerging from the financial community (investors and banks). The development of more efficient infrastructure lowers the cost of completing transactions involving the exchange of financial contracts, thus increasing investor welfare and providing the investors with greater incentives to participate in capital markets. Consequently, the investors push for a higher level of (disembodied) infrastructural services while the banking sector, if it fears rent losses, pushes for a lower level.[14] The new infrastructure generated by the collective agent is determined both by the impact on investor welfare and bank rents and by the importance placed by the collective agent on investor welfare relative to bank rents.[15] In our model, banks earn quasi-monopolistic rents from

---

[12] Here, the representative producer of information represents a wide range of financial service providers for whom information production and sale is an important component of business. Such financial services firms include rating agencies, market analysts, accounting firms, financial newsletters, etc.

[13] In modern market economies, more and more frequently policymakers promote financial infrastructure development by engaging the private sector. As a result, many financial infrastructural services are supplied by for-profit firms or by private industry groups, operating under government regulation and supervision (e.g., payment and securities clearing/settlement services, or market oversight and auditing activities). Our choice to assume a non-profit provider reflects, in the developmental context of this study, the idea of a *collective* agent who takes decisions to innovate financial infrastructure based on social cost-benefit considerations.

[14] This study abstracts from considerations concerning the ownership structure of the banking sector. In particular, issues of state vs. private ownership, which ostensibly characterize banking in developing countries, are omitted. However, the argument can be made that, if anything, state ownership of banks strengthens the barriers against financial reform, owing to the very same factor underpinning this study, namely, rent protection. The difference is that, while private banks seek to protect their quasi-monopolistic financial profits, state banks may have an interest in protecting *political* rents, including by preserving the access to easy financing from state owned enterprises or politically connected parties.

[15] The model thus incorporates a political-economy factor bearing developmental implications, in that the supply of new infrastructure capacity reflects government preferences, as influenced by group interests (specifically, in our model, by the strength with which the banking sector defends its quasi-monopolistic rents). As noted, one may expect that the larger the rents of the banks, the stronger the resistance from the banking

traditional banking activities and force the development of disembodied infrastructure to lag behind the developed-economy benchmark.

There are three assets in the economy:

1. *Equity shares*: these are issued by the firms, are market-valued and information-intensive, pay a random return, and are costly to trade;

2. *Deposit claims* (on the banks): these are fixed nominal value contracts, do not require information and transaction costs, and carry a nonrandom interest rate (lower than the expected return on stock);

3. *Loans*: these are fixed nominal value contracts extended by the banks to the firms, they are nonmarketable and earn a nonrandom return that is higher than the deposit rate plus operational cost, but lower than the ex ante return on stock.

D. Agent Choices

The agents described in the previous section are faced with the following choices.

Investor's choice

Let the investor's utility function be:

(1) $E\{-exp(-aW_2)\}$

where W_2 is the investor's period 2 wealth and a her absolute risk aversion.

At the beginning of period 1, the investor is given an option by the monopolistic information producers to buy an information package (IP) at price P_I, or not. This choice by the investor then determines her information set, I_L, in the later part of the period when she allocates her wealth across assets.

Assume that the investor invests a fraction α of her period 1 endowment, net of the expenditure on information, on the risky asset and fraction $1-\alpha$ in a safe bank deposit. Assume that $\alpha \geq 0$: no short sales are permitted. Then the investor's period 2 wealth may be written as

(2) $W_2 = \alpha (W_1 - P_I Q)(R^* - t) + (1- \alpha)(W_1 - P_I Q)r,\ Q = 0,1$

where t is the transaction cost of buying each unit of the stock, R^* is the random return on every dollar invested in stocks, r is the return on a dollar of bank deposits, Q is the number of

---

sector to financial infrastructure development. In this respect, market concentration, too, may be an important factor to the extent that a highly concentrated market generates extra rents for banks and reduces the coalition costs for them to coordinate action against government policies undesirable to them. We shall return to this political-economy issue below in this section and in Section VII.

IPs that the investors buys at price P_I. The transaction cost decreases with the level of financial infrastructure. Assume that the returns on the risky asset are generated as

(3) $R^* = \sum^n_{i=1} e^*_i$

where the e^*_is are stochastic variables reflecting the impact of the individual (technological and business) components of the underlying investment on its rate of return. The realized value of the e^*_i in period 2 is denoted e_i. n is the total number of e^*_i's. Prior to buying information, the investor has only a belief about the distributional properties of the e^*_i's in Eq. (3). The investor believes that the e^*_i's are multi-normally distributed with

(a) $E(e^*_i) = \mu$, $i = 1,...,n$

(b) $cov(e^*_i, e^*_j) = 0$, unless $i = j$

(c) $var(e^*_i) = \sigma^2$

(This structure is tractable and helps us present results. It could be generalized without changing the qualitative results.) Since the investor's decision on whether or not to buy the IP affects her decision regarding portfolio allocation later in the period, the problem can be solved recursively by solving it first for α, the portfolio optimization problem, and then using the functional value of α back in the utility function to determine the optimal choice regarding buying information. The optimal choice of information purchase is then used in the functional value of α to obtain the optimal value of α. Later in period, 1 the investor maximizes her utility given in Eq. (1), subject to her budget constraint given in Eq. (2), or the investor maximizes

(4) $\underset{\alpha}{\text{Max}}\, E_L\{-exp(-a(\alpha\,(W_1 - P_IQ)(R^* - t) + (1- \alpha\,)(W_1 - P_IQ)r)\}$

by choosing α, where E_L is the expectations operator conditioned on the information set I_L available later in period 1. I_L, therefore, is determined by the choice of Q early in period 1.

Given the rule that for a normally distributed random variable ε, $E(exp[\varepsilon]) = exp[E(\varepsilon) - var(\varepsilon)/2]$, Eq. (4) can also be written as

(5) $\underset{\alpha}{\text{Max}}\, -exp(-a(\alpha(W_1 - P_IQ)(\,E(R^*|I_L) - t) + (1- \alpha)(W_1 - P_IQ)r) + \alpha^2\,\alpha^2(W_1-P_IQ)^2 Var(R^*|I_L)/2)$

where $E(R^*|I_L)$ is the expected value of the random return R^*, conditional on the information set acquired. This optimization gives

(6) $\alpha = max\{[E(R^*|I_L) - r - t]/[aVar(R^*|I_L)(W_1 - P_IQ)], 0\}$

The investor, thus, prefers stocks to deposits the higher are the expected relative return on stocks and the lower are the transaction cost of buying stocks, her risk aversion, and the variance of the random return on stocks.

The functional value of α can then be used in Eq. (6) to determine whether or not she chooses to buy the IP from the information producer. Mahajan and Sweeney (2001) show that the investor will choose to buy the IP if and only if

(7) $a \leq ln(n/(n - q))/2P_I$,

where q is the number of e^*_i's whose actual realized value is perfectly predicted in the IP. More specifically, the IP contains a set of knowledge bits q_i's ($i=1,...,q$), each of which perfectly identifies one e_i.

Assume that the quality of the information package is high enough, and its price is low enough, that $Q = 1$ and Eq. (7) holds true. Then,

(8) $E(R^*|I_L) = E(\sum_1^q e_i) + (n - q)\,\mu$; $Var(R^*|I_L) = (n - q)\sigma^2$

Eq. 6 may then be rewritten as:

(6a) $\alpha = max\{[E(\sum_1^q e_i) + (n - q)\mu - r - t]/[a(n - q)\sigma^2(W_1 - P_IQ)], 0\}$

Note that higher information contained in the IP does not necessarily imply higher allocation toward stocks. The impact of the information on allocation works through two channels. First, more information lowers the variance on stock returns that the investor faces; this induces the investor to increase her allocation toward the risky stock. Second, additional information reveals the true values of some e_i's that were previously unknown, thus affecting the expected returns on the stock. Since the change in expected returns can go either way, the net impact of more information on asset allocation is ambiguous.[16] If the additional information reveals a higher value for the e_i's than their expected values, then, to the extent that an increase in q allows the agents to evaluate with more precision the expected return on alternative technologies, more information facilitates the financing of more knowledge-intensive investment technologies.[17]

Information producer's choice

Since the information producers is a profit-maximizer, he will choose the highest price that the investor is willing to pay for given IP quality. This implies from Eq. (7)

$P_I = ln(n/(n - q))/2a$

---

[16] It will always be the case, however, that better information will make the portfolio allocation more efficient, that is, for a given level of risk, the expected returns from the revised portfolio will be higher.

[17] Better quality information could also induce higher allocation toward stocks by reducing the adverse selection problem caused by informational asymmetries between stock-owners and the management of the firms issuing the stocks. Adverse selection typically leads to a drop in the quality of firms issuing equity (with high-return, low-risk firms opting to drop out). Under certain conditions, this may result in equity rationing – where excess demand for stocks is not matched by an increase in the price of stocks – and lower expected returns (see Myers and Majluf (1984), and Hellmann and Stiglitz (2000)).

The only way for the information producer to raise his price is by improving the quality of the IP, that is, by increasing q. Assume that the cost of increasing q is $c(q)$ and that the marginal cost $c'(q)$ is steeper than the increasing function $P_I^{m}'(q)$: $c' > 0, c'' > 0$. Then, the optimization problem for the monopolistic information producer with respect to choosing the optimal q may be written as

$$(9) \qquad \underset{q}{Max}[P_I - c(q), or \frac{1}{2a}\ln(\frac{n}{n-q}) - c(q)]$$

This gives

$$(10) \quad q^m = n - 1/[2ac'(q^m)]$$

and

$$(11) \quad P_I^m = ln[2nac'(q^m)]/2a$$

where superscript m signifies monopoly equilibrium. From Eq. (10), and using the assumptions about the slope of the cost curve, q^m increases with a decrease in the marginal cost of producing information ($c'(q^m)$), and increases in the risk aversion of the investor (a), and n, the number of e_i's. Similarly, from Eq. (11) and the assumptions on the cost curve, the price of one unit of the IP, P_I^m, increases in q and n and decreases in the marginal cost of producing information and the risk aversion of the investor.

Bank's choice:

Since each investor allocates $D = (1-\alpha)(W_1 - P_IQ)$ to deposits, the total demand for deposits faced by the bank is (using Eqs. (6), (8), (10), and (11))

$$(12) \quad D = \{1 - [E(\sum_1^q e_i) + (1/(2ac'))\mu - r - t]/[(1/(2nc'))\sigma^2 (W_1 - ln(2nac')/2a)]\}(W_1 - ln(2nac')/2a)$$

Note that a higher transaction cost favors allocation to bank deposits.

As specified earlier in this section, the bank earns a known return of θ on each unit of its loans, pays a fixed return of r on each unit of deposits, and carries operational cost h to process each unit of deposit. Then, the bank's profit function may be written as $\Pi = D(\theta - r - h)$. Using the functional value of D from Eq. (12), the bank's optimization problem can be written as

$$(13) \quad \underset{r}{Max}\,\Pi^B = \{1 - [E(\sum_1^q e_i) + (1/(2ac'))\mu - r - t]/[(1/(2c'))\sigma^2 (W_1 - ln(2nac')/2a)]\}(W_1 - ln(2nac')]/2a)(\theta - r - h)$$

$$s.t. \qquad r \geq 0$$

Solving this yields the optimal interest rate on lending

$$(14) \quad r^B = \{\theta - h + E(\sum_i^q e_i) + [1/(2ac'))\mu - t - (W_1 - ln(2nac')/2a)(1/(2c')]\sigma^2\}/2$$

where superscript B signifies an optimal value for the bank.

Collective agency's choice

Financial infrastructure (disembodied from bank production) is supplied by a non-profit collective agent (*CA*) with the purpose to facilitate financial transactions. All else being equal, the development of financial infrastructure lowers the transaction costs of trading risky assets. The *CA* determines the supply of infrastructure (or, equivalently, the level of transaction costs t) with a view to maximizing social welfare by identifying the optimal mix of banking and nonbank finance.[18] The *CA*, therefore, has to balance the positive effect of a lower t on the investor portfolio returns with the negative effect on bank rents.

E. Results

Let $t^{CA} = t_0 - g^{CA}$, where t^{CA} is the equilibrium transaction cost and g^{CA} is the reduction in the transaction cost in period 1: g^{CA} reflects the political pressures from the bank and the investor groups. Assume that $g^{CA} \geq 0$; i.e. there is no depletion in the infrastructure. Therefore, g^{CA} is the choice variable for the *CA* that determines the optimal transaction cost facing investors. t_0 reflects the existing level of financial infrastructure and is thus independent of political pressures.

The investor would clearly like to see a higher g, while the bank would like to see a lower g. In fact, the optimal transaction cost for the investor would be the one holding in developed economies with the most efficient financial infrastructures in the world.[19]

---

[18] The literature on financial system architecture and recent evidence emphasize the complementarities between banking and nonbank financial intermediation. Complementarities have been variously explained in the literature, see for instance Corrigan (1982, 2000), Fama (1985), Diamond (1991), Merton (1993), Boot (2000), and Bossone (2001a, 2001b)). Seward (1990) shows that, with multiple classes of financial claimants characterized by different information capital, efficiency is improved if the economy provides both banking and capital market services. Demirgüç-Kunt and Levine (1996) and, more recently, Levine (2000), and Demirgüç-Kunt and Levine (2001) find evidence of strong complementarities between bank and capital-market financing in affecting economic growth. Evidence showing that banks supply capital markets with valuable information is reported by James (1987), Slovin, Sushka and Hudson (1988), Lummer and McConnell (1989), and Biller, Flannery and Garfinkel (1995).

[19] We assume that policymakers seek to move the economy's infrastructure closer to the developed-economy benchmark. In practice, their success depends on the relative power of economic groups with conflicting interests. In particular, policymakers can be expected to meet resistance from banks trying to fend off rent-dissipating infrastructural changes. On the other hand, in pursuing infrastructure development, policymakers cannot neglect the impact of their policies on the stability of the banking system, so that they have to be cautious in taking actions that may significantly weaken bank rents. We shall return to this issue in Section VI.

Therefore, the optimal transaction cost from the investor's perspective would be

(15) $t^I = t^d$ *or* $g^I = t_0 - t^d$

where $t^d < t^0$ is the transaction cost investors face in the most sophisticated financial markets in the world. Superscript *I* stands for investor.

On the other hand, the optimal t for the bank, t^B, is the one for which $g = 0$, such that there is no improvement in financial infrastructure.[20] This implies that

(16) $t^B = t_0$

Also, from Eqs (15) and (16), $t^I \leq t^B$. Assume that the optimal transaction cost, t^{CA}, equals t_0 minus some linear combination of t^I and t^B, to account for partial accommodation of the political pressures emanating from both the investor and the bank groups. Then,

(17) $t^{CA} = t_0 - \beta(t_0 - t^d)$

where $\beta \in (0,1)$ is the weight placed by the *CA* on the investor's benefit, and $1-\beta$ is the weight placed on bank rents. In other words, the closer β is to 1 (0), the stronger (weaker) is the *CA*'s preference for investor welfare or, equivalently, for nonbank finance and, symmetrically, the weaker (stronger) is the *CA*'s preference for banking.

A word on the β-parameter is in order. It intends to capture the political-economy factors discussed earlier in this study. Governments may have different preferences as to the economy's optimal financial architecture. Some governments look forward to an economy with a complete set of financial markets, institutions, and products, open to innovation and innovative business, and featuring high information transparency, strong competition, openness to foreign institutions, and low transaction costs. Others may want the financial system to be closed and protected, possibly amenable to large state-interference. Others yet may believe in bank-dominated systems, less exposed to (what they perceive to be) much too erratic and unstable capital markets, and inclined to support the existing set of industries and activities.

Government preferences may not be neutral with respect to specific interest groups (e.g., banks, industrialists, institutional investors, or public-opinion coalitions) whose rent-position is likely to vary significantly with the type of financial architecture prevailing in the economy. In fact, governments themselves can be the expression of one or a number of such groups, and democratic governments are called upon to take the interests of each group in due consideration when designing financial sector policies. The β-parameter, therefore, ideally reflects the composition of the forces at play in the society and the way they translate into collective action choices. Lacking a theory for the endogenous determination of β

[20] Assuming that there are no complementarities between the banking and the nonbanking sectors.

(which might be a subject for future research), we take β in our model to be determined exogenously and to vary in way that reflects changes in the balance of the social forces.[21] Note in eq. (17) that the higher is β, the lower is the equilibrium transaction cost t^{CA}. When used in Eq. (14), the value of t^{CA} gives

$$(18)\quad r^{CA} = \{\theta - h + E(\sum_1^q e_i) + (1/(2ac'))\mu - [t_0 - \beta(t_0 - t^d)] - [W_1 - \ln(2nac')/2a](1/(2c'))\sigma^2\}/2$$

which shows that a stronger *CA*'s preference for nonbank finance (β) and a larger improvement in financial infrastructure ($t_0 - t^d$) require a higher optimal interest rate on bank borrowing. The interest rate increases also with θ, the return that the bank gets on each unit it lends to the firm, and the variance of stock returns, and decreases with W_1, the investor's wealth endowment, the bank's operational cost (h), and the initial level of infrastructure (t_0).

The net impact of the marginal cost of producing information on the interest rate is ambiguous. A fall in the marginal cost results in an increase in the equilibrium quality of the IP being produced and impacts the interest rate via three channels. First, it affects the net expected returns from a unit investment in the stock, $E(\sum_1^q e_i) + (1/(2ac'))\mu$, the direction of the impact is ambiguous and depends on the values revealed for the e_i's. Second, it results in an increase in the price of the IP, $\ln(2nac')/2a$, which tends to increase the interest rate. Third, it results in a decrease in the variance of the stock return, $1/(2ac'))\sigma^2$, which tends to increase the interest rate. Overall, the net impact of the three channels is ambiguous. Similarly, the investor's risk aversion (a) has an ambiguous impact on the equilibrium interest rate. An increase in a affects the equilibrium interest rate via two mutually offsetting channels: it reduces the quality of information contained in the IP that the investor gets and also lowers the equilibrium price she pays for the IP. Since the impact of the quality of the IP on the interest rate is ambiguous, so is the net impact of a change in risk aversion.

Furthermore, using the optimal values of r^{CA} and t^{CA} in Eq. (6a) yields

$$(19)\quad \alpha^{CA} = [E(\sum_1^q e_i) + (1/(2ac'))\mu - [t_0 - \beta(t_0 - t^d)] -$$
$$[\theta - h - (W_1 - \ln(2nac')/2a)(1/(2c'))\sigma^2]]/[2a(1/c')\sigma^2 (W_1 - \ln(2nac')/2a)]$$

which shows that the incentive to invest in the stock market (α^{CA}) increases with: the *CA*'s preference for nonbank finance (β); the improvement in financial infrastructure ($t_0 - t^d$); the inefficiency of the banking sector (equivalent to an increase in the bank operating cost h);

---

[21] One way to endogenize β could be by proxying the power of each group with the return (in terms of utility or rents) that each group extracts from changing the infrastructure. Doing this would, for instance, show that infrastructure development would be more easily attained at times when bank rents are low, that is, when the banking system is weak and in difficulty. This is not far from reality in as much as major financial sector reforms are typically carried out after crisis events that weaken the banking sector and, hence, its power to resist reforms. Yet, the full endogenization of β might defy its very concept, which, as noted, should not reflect group interests exclusively but, importantly, the (political) vision expressed by the public sector as to how the country and its institutions should develop. In this respect, an element of exogeneity should be retained in the determination of β.

and investor wealth (W_1). This last result contrasts with the standard prediction of optimal portfolio theory, whereby the allocation to risky assets is independent of wealth endowment.[22] Also contrary to standard results, the risk aversion of the investor (a) has an ambiguous effect on the allocation toward the stock, as does the marginal cost of producing information. This is because an increase in both these parameters results in higher equilibrium levels of information contained in the IP, and the net impact of more information on allocation toward the stock is ambiguous.

The equilibrium profit function for the bank may be written as

$$(20)\quad \Pi^{CA} = \{ W_1 - ln(2nac')/2a - [E(\textstyle\sum_1^q e_i) + (1/(2ac'))\mu - r^{CA} - [t^0 - \beta(t^0 - t^d)]]/[(1/(2c'))\sigma^2]\}(\theta - r^{CA} - h)$$

Eq. (20) shows that equilibrium profit decreases with: the *CA*'s preference for nonbank finance (β); the improvement in financial infrastructure ($t_0 - t^d$); and its operational cost (h). On the other hand, bank profit increases with investor wealth (W_1). Due to the reasons mentioned above for r^{CA}, the impact of the investor's risk aversion (a) and the marginal cost of producing information (c') on the Bank's profit is ambiguous.

The ex ante equilibrium welfare function, U^{CA}, for the investor/consumer can be written as (from Eq. (5)):

$$(21)\quad U^{CA} = -exp(-[E(\textstyle\sum_1^q e_i) + (1/[2ac')\mu - r^{CA} - t^{CA}]^2/[2(1/[2ac')\sigma^2] + (W_1 - ln(2nac')/2a)\, r^{CA}/[(1/[2ac')\sigma^2])$$

This last equation shows that investor welfare increases with: an increase in the *CA*'s preference for nonbank finance (β); an improvement in the financial infrastructure ($t_0 - t^d$); an increase in the bank's fixed rate of return on its investment (θ); an increase in the efficiency of the banking sector (equivalent to a reduction in bank operating cost h); and a reduction in the variance of stock returns (σ^2) and the marginal cost of producing information (c').

F. Graphical Interpretation

The results of the model are represented graphically in Chart I. As the level of infrastructure T increases (lower horizontal axis), the demand for X increases to W_1, the demand for D decreases to 0 (left vertical axis), bank rents go to their minimum (right

[22] Although this result is not particularly useful in the context of this study, we still would like to emphasize its general interest. In particular, it may suggest that as the economy's agents reach a certain minimum wealth threshold, they may find it convenient (or feasible) to participate in the financial market. A recent, excellent paper by Townsend and Ueda (2001) studies analytically the dynamic relationship between initial wealth, financial deepening, economic growth, and wealth accumulation and distribution, and simulates the relationship statistically for the Thai economy with very illustrative results.

vertical axis), and capital becomes more knowledge-intensive (higher horizontal axis). The diagonal, straight-line crossing the chart represents the substitutability between X and D in financial portfolios. Equilibrium portfolio allocations can only hold at points along such line.

Schedules $\Pi(\cdot,\cdot)$ represent bank rents as determined by the level of financial infrastructure and bank cost efficiency. The lower schedule reflects the larger rents corresponding to higher levels of cost efficiency, or to lower operational costs ($H>h$), for given levels of infrastructure. General equilibrium is reached at the intersections of the bank-rent schedules and the investor portfolio line: with efficiency given at h, for instance, efficient banks maximize their rents at T_2, subject to investors' equilibrium allocation choices X_2 and D_2. With equilibrium allocations equalizing the returns on the different financial assets, the cost of funding investment varies inversely with the level of infrastructure.

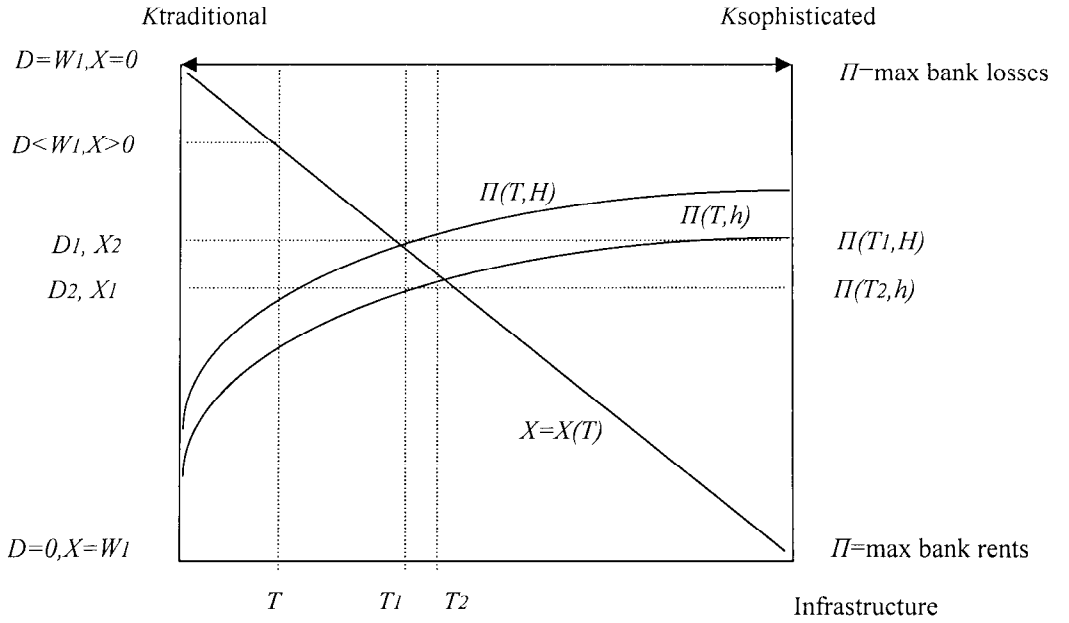


CHART 1. FINANCIAL INFRASTRUCTURE, FINANCIAL PORTFOLIOS, CAPITAL ACCUMULATION, AND BANK RENTS

At a lower level of infrastructure, say T, the economy is characterized by: a relatively higher level of deposits (and lending), higher bank rents (a higher cost of funding), less equity financing, and more traditional production technologies. Attempts to improve the infrastructure meet resistance from banks, due to their (expected) rent losses.

From the policy standpoint, the development of infrastructure can be separated in two steps: *i)* from T to T_1 along $\Pi(\cdot,\cdot)$, and *ii)* from T_1 to T_2 across the two Π-schedules. To ease bank resistance to step *i)*, banks could be compensated for the rent loss. At the same time, undertaking policies to increase banking sector efficiency would help in attenuating resistance, since banks would achieve higher profitability. We shall discuss both these steps in Section VI.

IV. Relation to the Literature

Our results generalize those of previous studies focusing on the impact of financial architecture (e.g., types of intermediaries and contracts used) on the capital structure and the financing decisions of non-financial companies.[23] Boot and Thakor (1995) found that financial innovation (and better real decisions of firms) in a universal banking system is stochastically lower than in a financial system where commercial banks and investment banks are functionally separated. In a subsequent study they showed that, as the financial system develops, market-based finance grows relative to bank finance and supports industries with more complex technologies: a more advanced capital market leads to higher productivity and output growth by financing superior physical capital and more knowledge-intensive human capital (Boot and Thakor, 1997). Likewise, Allen (1993) and Allen and Gale (1999) argued that financial markets are better positioned to promote new industries when information is sparse and there is diversity of opinions. The predictions above are supported by empirical evidence.[24]

Our results relate very importantly to those of two major contributions cited above. The first is by Boot and Thakor (1997), where the emergence of banks and financial markets is derived from agents' primitives (including the types of agent and the individual endowments of wealth and information) and is driven by preferences. On the one hand, banks form out of coalitions of agents who choose to specialize in monitoring borrowers in order to deter asset substitution and moral hazard, while financial markets result from agents choosing to acquire information about firms and to trade independently. On the other hand, borrowers with relatively higher credit quality indicators prefer to access financial markets, while those with relatively low credit quality indicators opt for bank financing. This has real effects in that bank financing is directed more toward traditional investments, whereas markets experiment more easily with innovative technologies.

The other contribution is by Allen and Gale (1999). They show that markets have considerable advantages in situations with new industry start ups, where there are different types of risk and multiple possible outcomes, hard data are typically scarce, potential financial providers have different priors, and their opinions diverge widely. In particular,

---

[23] For a discussion of these issues, see Thakor (1996), and Rajan and Zingales (1999a).

[24] Hoshi, Kashyap, and Scharfstein (1990a, 1990b) observe that industries dependent on bank finance tend to be physical capital-intensive, smokestack industries. Carlin and Mayer (1998) find that equity-financed industries tend to grow faster, carry out more R&D, and employ higher skilled workers in countries with relatively better accounting standards. They also find that better accounting standards explain the tendency of equity-financed industries to invest more in intangibles, and that bank-financed industries grow more slowly and undertake less R&D in countries with developed financial infrastructure. Beck, Levine and Loyaza (2000) confirm that the development of financial intermediation exerts a large and positive impact on growth through *better*, rather than *more*, capital accumulation. Allen (1993) and Allen and Gale (1999) use their framework to explain the importance of financial markets to support innovative industries both in the United Kingdom and the United States in the 19th century, the U.S. post-Industrial revolution in the 20th century, and the current technology revolution in the United States.

Allen and Gale show that markets work well when people disagree because the expected payoff of (informed) investors is high and only those people who are optimistic end up investing. They also show that a lower cost of information raises the investors' preference for nonbank finance relative to banks.

Our work adds to the results of these two studies in a number of respects. Beyond Booth and Thakor, it shows that the level of development of financial infrastructure may change the investor's relative preferences between banks and markets, and may therefore alter over time the architecture of the financial system. This helps us to better understand why banks tend to dominate finance early in development, while they become less important as financial infrastructure develops. Also, to the extent that financial markets and technological innovation require advanced financial infrastructure, our theory introduces the demand and supply of financial infrastructural services, including a role for collective choices in the event that market failures hinder the spontaneous supply of such services. Finally, as infrastructure affects the economy's preferences on bank vs. nonbank finance, with obvious implications for rents of different financial industries, our theory naturally leads to political-economy considerations and related public policy strategy issues.

As regards the Allen-Gale results, our work goes beyond them, too, in that it specifies the structure of the information supplied to the investors and uses such information as a conveyor of knowledge relevant to the investment considered. As a result, more information may either induce or discourage specific investment financing decisions, depending on what the transferred knowledge actually reveals about the projects considered. Also, all else being equal, more information encourages relatively more sophisticated investments because it provides more/better knowledge of the various investment components and improves decision-making and, more importantly, because investors (unbound by bank contracts; see Section II.A) have incentives to reap higher returns from investing in more productive projects. Finally, our work endogenizes information production and, therefore, incorporates a dynamic (developmental) dimension within the financial architecture of the economy that is not featured in the Allen-Gale model.

V. EMPIRICAL EVIDENCE

Our theory suggests that the development of financial infrastructure:

a) Supports the development of capital markets;
b) Supports the accumulation of knowledge-intensive industrial capital;
c) Reduces rents in the banking sector; and
d) May be resisted by the banking sector.

Tables 1-3 offer some cross-country evidence in support of these theoretical predictions.[25]

[25] These results are only suggestive. Their legitimacy is valid only to the extent that they are consistent with the theoretical predictions made by our model. Rigorous and more extensive empirical work to test the validity of our theoretical framework may offer a potentially interesting area for future research.

TABLE 1. CAPITAL MARKET DEVELOPMENT AND FINANCIAL INFRASTRUCTURE

	Independent Variables →	Constant	Inflation Variability	Financial Infrastructure	GNP per-capita (current US$)	Average Yrs of Edu	No. of Obs.	R^2	Adj. R^2
	Dependent Variable ↓								
Reg. 1	Stock Mkt Capitalization/GDP	0.53	-0.01				61	0.08	0.06
		(7.4)***	(-2.22)**						
Reg 1'	Stock Mkt Capitalization/GDP	0.09	-0.01	0.04			61	0.39	0.36
		(0.94)	(-0.95)	(5.4)***					
Reg 1"	Stock Mkt Capitalization/GDP	0.49	-0.01	0.05	-0.06		61	0.40	0.37
		(1.33)	(-1.3)	(4.72)***	(-1.12)				
Reg 1"'	Stock Mkt Capitalization/GDP	0.22	-0.01	0.05		-0.03	58	0.39	0.35
		(1.21)	(-0.99)	(4.58)***		(-0.96)			
Reg 2	Stock Mkt Turnover/GDP	0.50	-0.01				61	0.05	0.04
		(8.13)***	(-1.83)*						
Reg 2'	Stock Mkt Turnover/GDP	0.32	-0.01	0.02			61	0.12	0.09
		(3.08)***	(-1.16)	(2.13)**					
Reg 2"	Stock Mkt Turnover/GDP	-0.01	0.00	0.01	0.05		61	0.13	0.09
		(-0.02)	(-0.75)	(0.94)	(0.90)				
Reg 2"'	Stock Mkt Turnover/GDP	0.16	-0.01	0.01		0.03	58	0.14	0.09
		(0.84)	(-0.94)	(0.83)		(1.17)			
Reg 3	Stock Mkt Value Traded/GDP	0.26	-0.009				62	0.08	0.07
		(6.18)***	(-2.29)**						
Reg 3'	Stock Mkt Value Traded/GDP	-0.010	-0.003137	0.03			62	0.41	0.39
		(-0.16)	(-0.99)	(5.69)***					
Reg 3"	Stock Mkt Value Traded/GDP	-0.140	-0.002366	0.02	0.02		62	0.41	0.38
		(-0.64)	(-0.69)	(3.74)***	(0.62)				
Reg 3"	Stock Mkt Value Traded/GDP	-0.11	-0.002	0.02		0.02	59	0.41	0.38
		(-1.01)	(-0.71)	(3.6)***		(1.06)			
Reg 4	(Stk Mkt Cap. + Bond Mkt Cap.)/GDP	0.68	-0.02				62	0.11	0.09
		(8.14)	(-2.69)***						
Reg 4'	(Stk Mkt Cap + Bond Mkt Cap)/GDP	0.07	-0.01	0.06			62	0.52	0.50
		(0.66)	(-1.34)	(7.1)***					
Reg 4"	(Stk Mkt Cap + Bond Mkt Cap)/GDP	0.06	-0.01	0.06	0.00		62	0.52	0.49
		(0.16)	(-1.23)	(5.15)***	(0.02)				
Reg 4'	(Stk Mkt Cap + Bond Mkt Cap)/GDP	0.03	-0.01	0.06		0.00	59	0.51	0.49
		(0.15)	(-1.15)	(5.15)***		(0.15)			
Reg 5	(Stk Mkt Cap + Bond Mkt Cap)/Priv Credit	1.27	-0.002				61	0.00	-0.02
		(6.9)	(-0.15)						
Reg 5'	(Stk Mkt Cap + Bond Mkt Cap)/Priv Credit	0.41	0.01	0.08			61	0.18	0.15
		(1.41)	(0.96)	(3.6)***					
Reg 5"	(Stk Mkt Cap + Bond Mkt Cap)/Priv Credit	1.82	0.01	0.11	-0.20		61	0.21	0.17
		(1.72)*	(0.42)	(3.57)***	(-1.39)				
Reg 5'	(Stk Mkt Cap + Bond Mkt Cap)/Priv Credit	0.56	0.01	0.08		-0.03	59	0.17	0.13
		(1.07)	(0.86)	(2.85)***		(-0.33)			

Numbers in parantheses are the respective t statistics
The superscripts *, **, *** indicate that the coefficient is significant at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 1 shows results of regressions of a number of measures of capital market development (taken from Beck, Demirgüç-Kunt, and Levine, 1999) on a measure of financial infrastructure, human capital (proxied by average years of schooling), level of economic development (proxied by GNP per capita), and inflation variability (used as a proxy for conduciveness of the macro-policy climate) for a large sample of industrial and developing countries (see Appendix II).[26] [27]

[26] To measure financial infrastructure, we created a synthetic indicator averaging for each country across scores on individual financial infrastructure and institutional components. These include bureaucratic delays, bureaucratic efficiency, creditor rights, shareholder rights, accounting standards, and contract enforcement. See Appendix I for an explanation of each individual indicator, score method used, and information sources.

[27] Inflation variability for each country has been calculated as the standard deviation of yearly CPI inflation from its 1990-95 average.

In most cases, when inflation variability is used as the only regressor, inflation variability is seen to affect capital market development negatively and significantly. However, when the financial infrastructure measure is added to the regression, in all cases the inflation variability measure becomes insignificant, while financial infrastructure has a strong positive and significant impact on capital market development: the adjusted R^2 increases considerably with the addition of the infrastructure variable. The proxies for human capital and level of development do not appear to have a significant impact on capital market development in the presence of the financial infrastructure variable as a regressor. Therefore, these results strongly support our theoretical prediction that the more developed is the financial infrastructure in a country, the stronger the incentive it provides for the development of capital markets.

TABLE 2. FINANCIAL INFRASTRUCTURE AND BANK STRENGTH

	Independent Variables →	Constant	Inflation Variability	Financial Infrastructure	log (GNPpc)	(Net Interest margin)*(Conc. Ratio)	Concentration ratio	No. of Obs.	R^2	Adj. R^2
	Dependent Variable ↓									
Reg 6	Infrastructure	-11.62			2.58	-11.95		65	0.43	0.41
		(-2.84)***			(5.5)***	(-2.8)**				
Reg 7	Net Interest Margin	-0.02					0.32	60	0.09	0.08
		(-0.21)					(2.45)**			
Reg 7'	Net Interest Margin	0.16		-0.01			0.25	60	0.32	0.30
		(2.0)*		(-4.41)***			(2.22)**			
Reg 8	Deposit Money Bank Assets/GDP	0.70	-0.02					62	0.22	0.21
		(13.6)***	(-4.1)***							
Reg 8'	Deposit Money Bank Assets/GDP	0.43	-0.01	0.03				62	0.41	0.39
		(5.4)***	(-3.2)***	(4.4)***						
Reg 9	Priv Credit by Deposit Money Banks/ GDP	0.57	-0.02					62	0.20	0.19
		(12.8)***	(-3.91)***							
Reg 9'	Priv Credit by Deposit Money Banks/ GDP	0.34	-0.01	0.02				62	0.40	0.38
		(5.06)***	(-2.98)***	(4.3)***						

Table 2 presents regression results that reflect the relationship between financial infrastructure and the strength of the banking sector across a large sample of industrial and developing countries (see Apendix II). The latter is proxied by the product of net interest margins times the level of banking sector concentration (both drawn from Beck, Demirgüç-Kunt and Levine, 1999).[28] In the theoretical framework, we predicted that the causality between banking sector profitability and level of infrastructure development runs both ways. On the one hand, we had shown that the more profitable the banking sector is and the more cohesive it is, the stronger will be its resistance to infrastructure development.

Regression 6 in Table 2 supports this hypothesis: financial infrastructure is positively correlated with per capita GNP but is negatively and significantly correlated with a proxy for the level of monopoly power in the banking sector (net interest margin times concentration ratio in the banking sector). On the other hand, the theoretical model also predicted that a

[28] Low margins and low concentration indicate suggest low market power and vice versa. The use of a product variable allows for more information to be conveyed by the indicator.

more developed financial infrastructure would erode the banking sector's comparative advantage and hence lower its profit margin. This hypothesis, too, is supported by the results in Regressions 7 and 7'. Results of Regressions 8-9' show that the size of the banking sector is adversely affected by macro-policy uncertainty but is positively affected by the level of financial infrastructure: the latter result supports the works showing important complementarities between banking and capital markets.

In Table 3 we present results in support of our theoretical prediction that development of financial infrastructure stimulates investment toward knowledge-intensive sectors, resulting in relatively faster growth in these sectors and also more investment in innovation and knowledge generation as a result. Knowledge indicators and data are drawn from OECD (1999) and for OECD countries only. Regression 10 shows that relative performance of knowledge-intensive industries is adversely affected by macro-policy uncertainty and GNP per capita (the latter is somewhat counterintuitive) and positively affected by financial infrastructure development. Regressions 11-12' show that the investment toward R&D falls with macro-policy uncertainty and rises with financial infrastructure development.

TABLE 3. FINANCIAL INFRASTRUCTURE AND KNOWLEDGE-INTENSITY

	Independent Variables ⟶	Constant	Inflation Variability	Financial Infrastructure	log (GNPpc)	No. of Obs.	R^2	Adj. R^2
	Dependent Variable ↓							
Reg 10	Growth in Knowl.-based Indust. - Gr. Of Business Sector	10.52674 (2.23)**	-0.142768 (-1.83)*	0.13515 (2.39)**	-1.169694 (-2.19)**	25	0.22	0.11
Reg 11	Gross domestic exp.on R&D (% of GDP)	1.97 (10.62)***	-0.11 (-2.65)**			26	0.23	0.19
Reg 11'	Gross domestic exp.on R&D (% of GDP)	0.84 (1.91)**	-0.09 (-2.48)**	0.08 (2.77)**		26	0.42	0.37
Reg 12	Business Enterprise R&D (% of dom prod. of Industry)	1.60 (7.66)***	-0.10 (-2.16)**			31	0.16	0.13
Reg 12'	Business Enterprise R&D (% of dom prod. of Industry)	0.48 (0.93)	-0.08 (-1.93)*	0.08 (2.35)**		31	0.33	0.27

Numbers in parantheses are the respective t statistics
The superscripts *, **, *** indicate that the coefficient is significant at the 10 percent, 5 percent, and 1 percent levels respectively.

VI. POLICY IMPLICATIONS AND CONCLUSION

The theory presented in this study and the preliminary results from the empirical analysis reported in Section V suggest that the development of financial infrastructure plays a key role in promoting nonbank financial intermediation and, more generally, in shaping the relationship between finance and economic development.

Incumbent banks (and their client firms) may have an interest in resisting infrastructure development in the attempt to defend their rents obtained from traditional activities. Their resistance may hamper the supply of new infrastructure, retard the development of modern domestic financial markets and, ultimately, slow down the evolution of industrial capital toward more knowledge-intensive and productive forms.

Underlying these conclusions is that the benefits of infrastructure development are widespread across the society, while its costs are concentrated in a relatively small social segment. This implies that, up to the point where the welfare losses from inadequate infrastructure become serious and visible, thereby making reform inevitable, the cost to garner support around a developmental action exceeds the cost for the incumbent banks to coalesce against it and organize an effective resistance.[29]

The reform programs aimed to develop financial infrastructure - especially where banks dominate domestic finance – should therefore be designed so as to minimize bank resistance. A number of general policy indications can be identified to this end, although of course each reform program must be adapted to the specific financial sector for which it is intended. First, as noted earlier, in modern financial systems, traditional banking performs key functions that are complementary to those carried out by financial markets and intermediaries. Thus, while traditional banking business tends to consolidate as the financial system develops, it remains strong at its core and continues to generate attractive rents for the banks that perform those functions efficiently (Bossone, 2001b). It is crucial then that, when reformers resolve to modernize the financial infrastructure of the economy, they ensure also that strong market entry/exit rules be in place to regulate the banking business, which allow only sound banks to compete for rents while penalizing banks responsible for untoward behavior (if necessary, by excluding them from the market). This solution would *protect* bank rents from falling below normal, it would discourage banks with better business prospects from joining weaker banks in anti-reform coalitions, and would induce them, instead, to align their interest with that of the reformers.

Second, the *protection* of bank rents can be attained by allowing banks to broaden their scope of activity beyond their traditional business boundaries, provided that they fully comply with the regulations covering their new operations. This solution would enable banks to offset rent losses from infrastructure development by exploiting new business opportunities, including the provision of infrastructural services. This solution has the advantage that it may win the consensus on the reform program of the most entrepreneurial banks, which can now expect to make profits from entering new markets and to benefit themselves from better financial infrastructure.

Third, while intervening on the infrastructure, reformers should open the domestic banking market to (sound) foreign banks. This may turn out to be a decisive factor in trying to pre-empt or break anti-reform coalitions, since foreigners are strangers to (and uninterested in) local interest networks, and aim instead to gain market shares and profits

---

[29] As experience shows, crisis situations - such as in the event of major financial shocks - present reformers with unique opportunities to enact reform measures that would not be considered in normal times. This is because the costs of the crisis are at their peak and visible, and the incumbent institutions are (politically and financially) too weak to form effective anti-reform coalitions. Experience shows, however, that the time window for reformers to act upon is not indefinite: as time elapses from the hot days of the crisis, anti-reform constituencies gain new strength and re-consolidate their forces around their interests.

through competition. Foreign entry gives to the largest and most viable domestic firms an access to alternative sources of funds, drive bank rents down from quasi-monopolistic levels, and remove the very purpose for domestic banks to resist the reform (Rajan and Zingales, 2000). This solution also would induce the healthiest of banks to adapt to a more competitive environment, thus facilitating endogenous change. Finally, foreign banks may directly influence the development of domestic financial infrastructure by importing operational and managerial practices designed for more developed markets. They may improve, for example, some key infrastructural components as clearing and settlement services, information provision and disclosure standards, financial contract design, and risk management techniques.

While the first two recommendations amount to preventing banks' anti-reform actions by compensating them for their potential rent losses, the third recommendation implies a shift in the efficiency level of the domestic banking industry toward international standards (see Section IV).[30] Interestingly, reforming the financial sector with a view to supporting financial market development requires more efficient banks. This conclusion re-emphasizes the importance of the observed complementarities between banks and financial markets and suggests that, in redesigning the financial architecture of the economy, policymakers should be aware of the need to strengthen the domestic banking system in parallel with their effort to develop financial infrastructure.

There are other important steps that policymakers can take. They can improve the incentives for a market for information to develop (Bossone and Promisel, 1998). For instance, tightening transparency standards and introducing regulation that rewarded (penalized) more (less) transparent financial institutions would create a demand and a supply for quality financial information and, with it, a potential market for specialized information producers. The government itself could provide some information services directly (although at some point it could let the private sector take over the initiative), or it could disseminate information on bank credit risk collected in its banking supervisory capacity and establish a centralized registry. Information on bank credit risk would provide basic inputs for more analytical assessments by specialized institutions. It would also make possible for credit rating agencies to assess smaller firms that usually do not get rated, thus enabling these firms to have access to financial services otherwise unavailable to them. Furthermore, the government could support the training of professionals in the business of financial information (accountants, auditors, market survey specialists, IT experts. Lastly, the government could compile and disseminate statistical information necessary for more advanced risk-management technologies.

Finally, policymakers can actively seek to use the public media to build domestic consensus on their reform program. Through various forms and forums, they should repeatedly explain to the public the reasons for modernizing the financial infrastructure in

---

[30] In terms of Chart 1, Section IV, the first two recommendations would have the economy move T to T_1 along $\Pi(\cdot,\cdot)$, while the third recommendation implies a shift from T_1 to T_2 across the two Π-schedules.

such sensitive areas as, say, law and transparency. They should publicly assess the benefits and the costs of doing so, and illustrate the steps needed to get there. This would not only help coalesce the support of those in society who benefit from an improved financial infrastructure but also publicly identify groups that oppose reforms and reveal their vested interest in doing so.

DEFINITIONS OF THE FINANCIAL INFRASTRUCTURE VARIABLES USED IN THE STUDY

This appendix defines the variables used in this study to measure the development of financial infrastructure across countries and reports the sources used. Note that next to the name of each variable reference is indicated to the study where the variable was originally used for purposes of empirical analysis.

Bureaucratic delays (La Porta, 1998)
Reflects the level of red tape. Low ratings indicate lower levels of red tape in the bureaucracy of the country. Scale from 0 to 10. The index is published three times per year. The data is the average of the years between 1972 and 1995 and the. Source: *Business Environmental Risk Intelligence's Operation Risk Index.*

Bureaucratic efficiency(La Porta, 1997)
Measures the speed and efficiency of the civil service including processing customs clearances, foreign exchange remittances and similar applications. Scored 0-4, with higher scores for greater efficiency. Source: *Business Environment Risk Intelligence*

Creditor rights (La Porta, 1997)
This index aggregates different creditor rights. The index is formed by adding 1 when (1) the country imposes restrictions, such as creditors' consent or minimum dividends to file for reorganization; (2) secured creditors are able to gain possession of their security once the reorganization petition has been approved (no automatic stay); (3) secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and (4) the debtor does not retain the administration of its property pending the resolution of the reorganization. The index ranges from zero to four (0-4). Source: *Bankruptcy and Reorganization Laws.*

Shareholder rights (Knack and Keefer, 1995)
The index is formed by adding 1 when (1) the country allows shareholders to mail their proxy vote; (2) shareholders are not required to deposit their shares prior to the General Shareholders' Meeting; (3) cumulative voting is allowed; (4) an oppressed-minorities mechanism is in place; and (5) when the minimum percentage of share capital that entitles a shareholder to call for an Extraordinary Shareholders' Meeting is less than or equal to 10% (the sample median). The index ranges from 0 to 5. Source: *Company Law or Commercial Code.*

Accounting standards (La Porta, 1998)
Created by examining and rating companies' 1990 annual report on their inclusion or omission of 90 items. These items fall into seven categories (general information, income statements, balance sheets, funds flow statement, accounting standards, stock data, and special items). A minimum of three companies in each country were studied. The companies represent a cross section of various industry groups; industrial companies represented

70 percent, and financial companies represented the remaining 30 percent. Source: *International Accounting and Auditing Trends,* Center for International Financial Analysis and Research.

Contract Enforceability (La Porta, 1998)
Measures the relative degree to which contractual agreements are honored and complications presented by language and mentality differences. Scored 0-4, with higher scores for greater enforceability.

LIST OF COUNTRIES USED IN THE REGRESSION ANALYSIS (TABLES 1-2)

Argentina
Australia
Austria
Bahrain
Bangladesh
Belgium
Botswana
Brazil
Bulgaria
Canada
Chile
China
Colombia
Costa Rica
Czech Republic
Denmark
Ecuador
Egypt, Arab Rep.
Finland
France
Germany
Ghana
Greece
Honduras
Hungary
India
Indonesia
Iran, Islamic Rep.
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kenya
Korea, Rep.
Kuwait
Latvia
Lithuania
Malaysia
Mexico

Morocco
Namibia
Netherlands
New Zealand
Nigeria
Norway
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Russian Federation
Singapore
Slovak Republic
Slovenia
South Africa
Spain
Sri Lanka
Swaziland
Sweden
Switzerland
Thailand
Tunisia
Turkey
United Kingdom
United States
Uruguay
Venezuela, RB
Zambia
Zimbabwe

REFERENCES

Allen, F. (1992), "Stock Markets and Resource Allocation," in *Capital Markets and Financial Intermediation*, edited by C. Mayer and X. Vives (Cambridge, UK: Cambridge University Press), pp. 81–107.

Allen, F. and D. Gale (1999), *Comparing Financial Systems* (Cambridge, Massachusetts: MIT Press).

Beck, T., A. Demirgüç-Kunt, and R. Levine, (1999), "A New Database on Financial Development and Structure," Financial Sector Discussion Paper No. 2, September (Washington DC: World Bank).

Beck, T., R. Levine and N. Loyaza (2000), "Finance and the Sources of Growth," *Journal of Financial Economics*, 58, pp. 261–300.

Beckaert, G., R. H. Campbell and C. Lundblad (2001), "Emerging Equity Markets and Economic Development," *Journal of Development Economics*, 66, pp. 465–504.

Biller, M. T., M. J. Flannery and J. A. Garfinkel (1995), "The Effect of Lender Identity on a Borrowing Firm's Equity Return," *Journal of Finance*, 50, pp. 699–718.

Boot, A. W. A. (2000), "Relationship Banking: What Do We Know?" *Journal of Financial Intermediation*, 9, pp. 7–25.

Boot, A. W. A. and A. Thakor (1997), "Financial System Architecture," *Review of Financial Studies*, Vol. 10, No. 3, Fall, pp. 693–733.

Bossone, B. (2001a, "*Circuit* Theory of Banking and Finance," *Journal of Banking and Finance*, Vol. 25, No. 5, pp. 857–90.

_____ (2001b), "Do Banks Have a Future? A Study on Banking and Finance As We Move Into the Third Millennium," *Journal and Banking and Finance*, 25, pp. 2239–2276.

_____, and L. Promisel (1998), *Strengthening Financial Systems in Developing Countries. The Case for Incentive-Based Financial Sector Reforms* (Washington D.C.: World Bank).

Carlin, W., and C. Mayer (1998), "Finance, Investment and Growth," unpublished (London: University College).

Corrigan, E. G., (1982), *Are Banks Special?*, Annual Report Essay (Minneapolis: Federal Reserve Bank of Minneapolis).

Corrigan, E. G. (2000), *Are Banks Special? A Revisitation*, The Region (Special Issue 2000) (Minneapolis: Federal Reserve Bank of Minneapolis).

Demirgüç-Kunt, A., and R. Levine (1996), "Stock Markets, Corporate Finance, and Economic Growth: An Overview," *World Bank Economic Review*, Vol. 10, No. 2, May, pp. 191–223.

_____ (eds.) (2001), *Financial Structure and Economic Growth. A Cross-Country Comparison of Banks, Markets, and Development* (Cambridge, Massachusetts: MIT Press).

Diamond, D. W. (1984), "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51, pp. 393–414.

_____ (1991), "Monitoring and Reputation: The Choice Between Bank Loans and Privately Placed Debt," *Journal of Political Economy*, 99, pp. 689–721.

_____, and R. G. Rajan (1998), "Liquidity Risk, Liquidity Creation and Financial Fragility: A Theory of Banking," NBER Working Paper No. W7430, December. (Cambridge, Massachusetts: National Bureau of Economic Research).

_____ (1999), "A Theory of Bank Capital," NBER Working Paper No. W7431, December. (Cambridge, Massachusetts: National Bureau of Economic Research).

Easterly, W., and R. Levine (1997), "Africa's Growth Tragedy: Policies and Ethnic Divisions," *Quarterly Journal of Economics*, Nov., 112, pp. 1203–1250.

Fuchs-Schnündeln, and N. Funke (2001), "Stock market Liberalizations: Financial and Macroeconomic Implications," IMF Working Paper WP/01/193 (Washington D.C.: International Monetary Fund).

Gale, D., and M. Hellwig (1985), "Incentive-Compatible Debt Contracts: The One-Period Problem," *Review of Economic Studies*, 52, October, pp. 647–663.

Gerschnkron, A. (1962), *Economic Backwardness in Historical Perspectives, A Book of Essays* (Cambridge, Massachusetts: Harvard University Press).

Hellmann, T., and J. Stiglitz (2000), "Credit and Equity Rationing in Markets with Adverse Selection," *European Economic Review*, 44, pp. 281–304.

Hoshi, T., A. Kashyap, and D. Scharfstein (1990a), "The Role of Banks in Reducing the Cost of Financial Distress," *Journal of Financial Economics*, 27, pp. 67–88.

_____ (1990b), "Bank Monitoring and Investment: Evidence From the Changing Structure of Japanese Corporate Banking Relationships," in *Asymmetric Information, Corporate Finance and Investment*, edited by R. G. Hubbard (Chicago: University of Chicago).

James, C. (1987), "Some Evidence on the Uniqueness of Bank Loans," *Journal of Financial Economics*, 19, pp. 217–35.

Khan, M., and A. S. Senhadji (2000), "Financial Development and Economic Growth: An Overview," IMF Working Paper WP/00/209 (Washington D.C.: International Monetary Fund).

Knack, S. and P. Keefer (1995), "Institutions and Economic Performance: Cross Country Tests Using Alternative Institutional Measures," *Economics and Politics*, Vol. 7, No.3, pp. 27–28.

La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. W. Vishny (1997), "Legal Determinants of External Finance," *Journal of Finance*, Vol. 52, Issue 3, pp. 1131–50.

_____ (1998), "Law and Finance," *Journal of Political Economy*, Vol. 106, No.6, pp. 113–55.

Levine, R. (1997), "Financial Development and Economic Growth: Views and Agenda", *Journal of Economic Literature*, Vol. 35, June, pp. 668–726.

Levine, R. (2000), "Bank-Based or Market-Based Financial Systems: Which is Better?", January, unpublished (University of Minnesota).

Levine, R., N. Loayza, and T. Beck (2000), "Financial Intermediation and Growth: Causality and Causes," *Journal of Monetary Economics*, 46, pp. 31–77.

Lummer, S. L., and J. J. McConell (1989), "Further Evidence on the Bank Lending Process and the Capital-Market Response to Bank Loan Agreement," *Journal of Financial Economics*, 79, pp. 113–34.

Mahajan, S., and R. J. Sweeney (2001), "Strategic Choices of Quality, Differentiation and Pricing in Financial Services," *Journal of Banking and Finance*, 25, pp. 1447–1473.

Merton, R. C. (1993), "Operation and Regulation in Financial Intermediation: A Functional Perspective," in *Operation and Regulation of Financial Markets*, edited by P. Englund (Sweden: The Economic Council), pp. 17–68.

Myers, S., and N. Majluf (1984), "Corporate Financing and Investment Decisions When Firms have Information that Investors Do Not Have", *Journal of Financial Economics*, 13, pp. 187–221.

OECD (1999), *OECD Science, Technology and Industry Scoreboard: 1999 Benchmarking Knowledge-Based Economies* (Paris: Organisation for Economic Co-Operation and Development.

Petersen, M., and R. Rajan (1995), "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics*, 110, pp. 495–543.

Rajan, R. G., and L. Zingales (1998), "Finance Dependence and Growth", *American Economic Review*, June, Vol. 88, No. 3, pp. 559–86.

_____ (1999a), "Financial Systems, Industrial Structure, and Growth," prepared for the Symposium on the International Competitiveness of the Swedish Financial Industry organized by the Bank of Sweden Tercentenary Foundation.

_____ (1999b), "The Politics of Financial Development," prepared for the Symposium on the International Competitiveness of the Swedish Financial Industry organized by the Bank of Sweden Tercentenary Foundation.

_____ (2000), "The Great Reversals: The Politics of Financial Development in the 20th Century," NBER Working Paper 8178, March (Cambridge, Massachusetts: National Bureau of Economic Research).

Rousseau, P. L., and R. E. Sylla (2001), "Financial Systems, Economic Growth, and Globalization," in M. D. Bordo, A. M. Taylor and J. G. Williamson (eds.), *Globalization in Historical Perspective* (Chicago: The University of Chicago Press).

Seward, J. K. (1990), "Corporate Financial Policy and the Theory of Financial Intermediation," *Journal of Finance*, 45, pp. 351–77.

Slovin, M. B., M. E. Sushka, and C. D. Hudson (1988), "Corporate Commercial Paper, Note Issuance Facilities, and Shareholder Wealth", *Journal of International Money and Finance*, 7, pp. 289–302.

Thakor, A. (1996), "The Design of Financial Systems: An Overview", *Journal of Banking and Finance*, 20, pp. 917–948.

Townsend, R. M., and K. Ueda (2001), "Transitional Growth with Increasing Inequality and Financial Deepening," IMF Working Paper WP/01/108 (Washington D.C.: International Monetary Fund).