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WORLD BANK ECONOMIC REVIEW

Volume 10 Number 2

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The Coevolution of the Real and Financial Sectors in the Growth Process
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THE WORLD BANK ECONOMIC REVIEW

Volume 10 May 1996 Number 2

A SYMPOSIUM ISSUE ON STOCK MARKETS AND ECONOMIC DEVELOPMENT

THIS SYMPOSIUM ISSUE draws on papers presented at the World Bank Conference on Stock Markets, Corporate Finance, and Economic Growth, held in Washington, D.C., February 16–17, 1995. The articles in the symposium were refereed in the usual way. The Editorial Board invited the conference organizers, Aslı Demirgüç-Kunt and Ross Levine, to write the introduction to the symposium.

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Stock Markets, Corporate Finance, and Economic Growth: An Overview

Aslı Demirgüç-Kunt and Ross Levine

World stock markets are booming, and emerging markets compose a disproportionately large amount of this boom. Over the past ten years, world stock market capitalization rose from $4.7 trillion to $15.2 trillion, and emerging market capitalization jumped from less than 4 to 13 percent of total world capitalization.[1] Trading in emerging markets also surged: the value of shares traded on emerging markets climbed from less than 3 percent of the $1.6 trillion world total in 1985 to 17 percent of the $9.6 trillion worth of shares traded on all of the world's exchanges in 1994. Furthermore, emerging markets have become more integrated with world capital markets. International investors have noticed and participated in this rapid development of emerging stock markets. Most notably, portfolio flows of equity investment to emerging markets soared to $39 billion in 1995 from a mere $0.1 billion in 1985.

The rapid development of emerging stock markets has also attracted the attention of academics and policymakers. Recent research has focused on the benefits for investors of holding a globally diversified portfolio and the benefits for countries of removing barriers to international capital flows (see, for example, *The World Bank Economic Review* January 1995 issue on stock markets). On the policy front, many countries have reformed their laws and regulations and removed capital controls and other barriers to attract foreign portfolio flows. While analysts have studied emerging stock markets, economists need to acquire more information to understand the linkages between the functioning of stock markets and economic development. The six articles in this symposium contribute to this knowledge by exploring the role of stock markets in economic development.[2]

The research presented here focuses on four issues. First, it constructs more measures or criteria of stock market development than any previous study. It compares liquidity, concentration, volatility, institutional development, and international integration across forty-four industrial and developing countries from

1. One trillion is equal to 1,000 billion.

2. These articles were originally prepared for the World Bank Conference on Stock Markets, Corporate Finance, and Economic Growth, held in Washington, D.C., February 16–17, 1995.

Aslı Demirgüç-Kunt and Ross Levine are with the Policy Research Department at the World Bank. This research was funded by World Bank research grant RPO 678-37. The authors acknowledge Mary Shirley's valuable comments.

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1976 to 1993. Besides identifying general characteristics of these measures and defining stock market development empirically, these data facilitate further research into the relationship between stock market development and financial intermediaries, corporate finance decisions, and economic growth. These measures, ranked for each country, can be used for intercountry comparisons of the level of stock market development. In addition, the data provide a basis for gauging the success of capital market development projects using objective criteria.

Second, with these new data the research investigates the relationships between stock markets and financial intermediaries. Although bankers in many countries may worry that stock markets will steal business, the evidence points to the contrary. Countries with better-developed stock markets also have better-developed banks and nonbank financial intermediaries—such as finance companies, mutual funds, investment companies, brokerage houses, and pension funds—and countries with weak stock markets tend to have weak financial intermediaries. Thus, stock market development goes hand-in-hand with other aspects of financial development.

Third, the research analyzes the relationship between stock market development and long-run economic growth. New theoretical work shows how stock markets might boost long-run economic growth, and new empirical evidence supports this view. Specifically, the level of stock market development does a good job of predicting future economic growth. This aspect is important for the World Bank and policymakers in developing countries because it means that in many countries capital market reforms should be high on the reform agenda.

Fourth, the research studies the ties between stock market development and financing choices of firms. Surprisingly, this important issue has never been previously investigated. Researchers find that in many countries, improvement in the functioning of the stock market produces a higher debt-equity ratio in firms. While stock market development naturally implies greater use of equity markets in raising capital, it also stimulates greater use of bank finance, so corporate debt-to-equity ratios actually rise. Thus, for these countries, stock markets and banks are not substitute sources of corporate finance; stock market development actually tends to increase the quantity of bank loans. Complementing these empirical findings, the research also starts to build a theoretical framework for understanding the interactions among banks, equity markets, and corporate decisions.

This overview puts this research in context and reviews the main results of the study. Section I provides a brief review of the role of stock markets in economic development and documents the evolution of debt and equity markets during the growth process. Section II defines stock market development and presents summary data on the codevelopment of financial intermediaries and stock markets. Section III presents evidence on the effect of stock market development on economic growth. Section IV summarizes the empirical results on

how stock market development affects firm financing decisions. Section V concludes by discussing policy implications.

I. Stock Markets and Economic Development

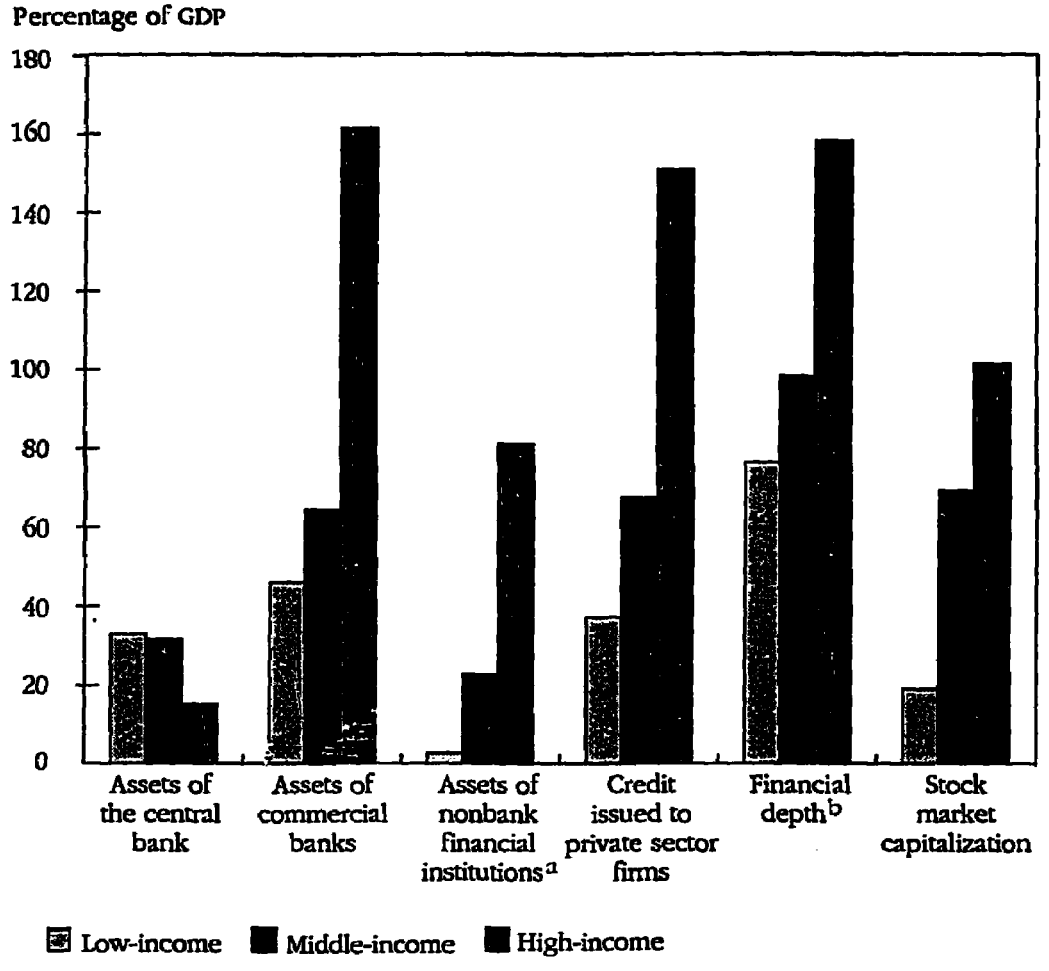
This section introduces and motivates the analysis of the role of stock markets in corporate financing decisions and economic development, and presents new information on the codevelopment of financial intermediaries and stock markets. Early observations by Gurley and Shaw (1955, 1960) and Goldsmith (1969) indicate that as economies develop, self-financed capital investment first gives way to bank-intermediated debt finance and later to the emergence of equity markets as an additional instrument for raising external funds. Financial structure—the mix of financial intermediaries and markets—changes as countries develop, as illustrated by differences in financial structure across countries and across time for individual countries.

Figure 1 illustrates how the financial structure of economies varies with their income. Moving from poorer to richer economies, commercial banks and nonbank financial institutions grow in importance, while the role of the central bank diminishes. Furthermore, the financial system allocates more credit to the private sector as a share of GDP in richer countries; and richer countries tend to have larger overall financial systems and stock markets as percentages of GDP than poorer countries.

Figure 2 shows how financial structure evolves over time. The data support Gurley and Shaw's view that at low levels of development commercial banks are the dominant financial institutions. As economies grow, however, specialized financial intermediaries and equity markets develop and prosper. Figure 2 traces the same set of low-, middle-, and high-income economies through time. The low-income economies had virtually no stock market activity or nonbank institutions in the 1970s. By 1990, however, both nonbanks and stock markets began to develop. The financial systems in middle- and high-income economies have evolved according to a similar pattern. The middle- and high-income economies are simply ahead of the low-income group.

Countries follow a financial development path that is not without its anomalies. Many differences in financial structure exist across countries at similar stages of economic development. For example, in the United Kingdom the assets of commercial banks composed 65 percent of financial system assets in 1990, but this figure was almost 80 percent in Germany. Similarly, the assets of nonbanks were 15 percent of the financial system assets in Germany, but they were over 30 percent in the United Kingdom. These anomalies apply to developing countries, too. In 1990 the share of nonbank assets in total financial assets was 18 percent in Malaysia and 28 percent in the Republic of Korea; private insurance and pension assets were 30 percent of financial assets in Chile and only 3 percent in Mexico. Thus, although there is a general trend involving financial structure and the level of GDP per capita,

Figure 1. *Financial Structure in Low-, Middle-, and High-Income Economies, 1990*



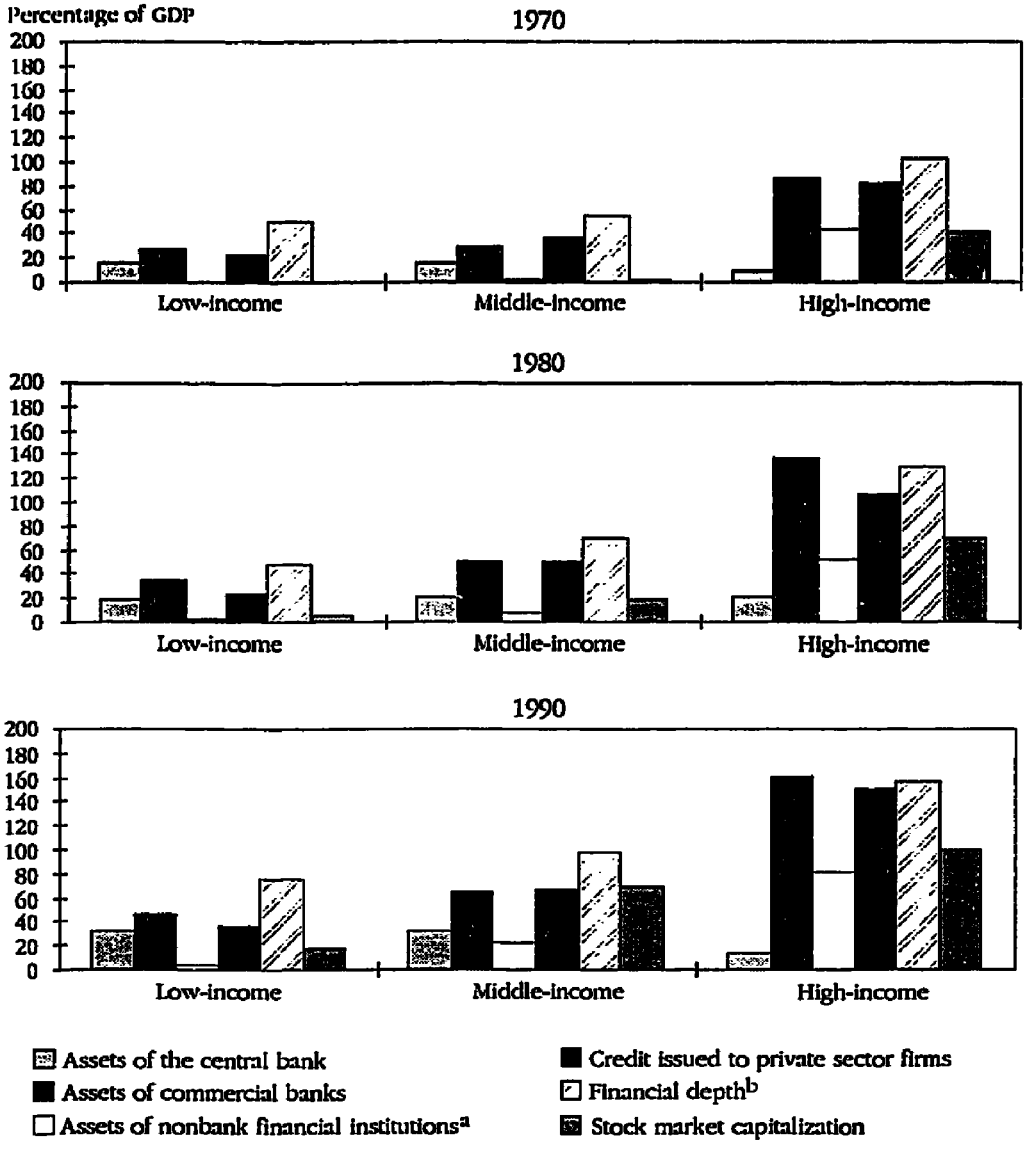
Note: The data are for twelve low-income economies (Bangladesh, Egypt, Ghana, Guyana, India, Indonesia, Kenya, Nigeria, Pakistan, Zaire, Zambia, and Zimbabwe), twenty-two middle-income economies (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Greece, Guatemala, Jamaica, the Republic of Korea, Malaysia, Mexico, Paraguay, the Philippines, Taiwan (China), Thailand, Tunisia, Turkey, Uruguay, and Venezuela), and fourteen high-income economies (Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Singapore, Spain, Sweden, the United Kingdom, and the United States). In 1990, low-income economies had an average GDP per capita of $490; middle-income economies, $2,740; and high-income economies, $20,457.

a. Nonbank financial institutions include insurance companies, pension funds, mutual funds, brokerage houses, and investment banks.

b. Financial depth is measured by currency held outside financial institutions plus demand deposits and interest-bearing liabilities of banks and nonbank financial intermediaries (M3 money supply).

Source: IMF (various issues) and individual country reports by central banks, banking commissions, and stock exchanges.

Figure 2. *Evolution of Financial Structure in Low-, Middle-, and High-Income Economies, 1970, 1980, and 1990*



Note: The data are for twelve low-income economies (Bangladesh, Egypt, Ghana, Guyana, India, Indonesia, Kenya, Nigeria, Pakistan, Zaire, Zambia, and Zimbabwe), twenty-two middle-income economies (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Greece, Guatemala, Jamaica, the Republic of Korea, Malaysia, Mexico, Paraguay, the Philippines, Taiwan (China), Thailand, Tunisia, Turkey, Uruguay, and Venezuela), and fourteen high-income economies (Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Singapore, Spain, Sweden, the United Kingdom, and the United States). Average GDP per capita for low-income economies was $200 in 1970, $430 in 1980, and $490 in 1990; for middle-income economies it was $510 in 1970, $1,980 in 1980, and $2,740 in 1990; and for high-income economies it was $3,048 in 1970, $10,616 in 1980, and $20,457 in 1990.

a. Nonbank financial institutions include insurance companies, pension funds, mutual funds, brokerage houses, and investment banks.

b. Financial depth is measured by currency held outside financial institutions plus demand deposits and interest-bearing liabilities of banks and nonbank financial intermediaries (M3 money supply).

Source: IMF (various issues) and individual country reports by central banks, banking commissions, and stock exchanges.

there are exceptions and differences within the categories presented in figures 1 and 2.

Research on Financial Intermediaries

Although financial structure evolves with economic development and stock market development is a part of this evolution, research on the ties between financial development and economic growth focuses almost exclusively on financial intermediaries. Empirically, as illustrated in figure 1, central and commercial banks compose the vast majority of the financial systems of developing countries. Thus, development economists have focused on the ties between banks and economic growth. Moreover, statistics on central and commercial banks are readily available, but there were few data on stock markets in developing countries until recently.

Theoretical reasons also underlie the profession's focus on financial intermediaries (see Gertler 1988; Levine 1996a, 1996b; Mishkin, forthcoming; and Stiglitz 1994). As argued by Diamond (1984), Stiglitz and Weiss (1981), and others, banks and other financial intermediaries have important advantages over securities markets in reducing the information asymmetries that produce adverse selection problems and in ameliorating the inefficiencies created by information differences. For example, information asymmetries may create an adverse selection problem in securities markets (Akerlof 1970; Greenwald, Stiglitz, and Weiss 1984; and Myers and Majluf 1984). If potential investors cannot distinguish high-quality from low-quality firms, then outside purchasers of securities will only pay a price that reflects the average value of firms issuing securities. This average price may be attractive to low-quality firms but unattractive to high-quality firms, so that the latter will not want to issue securities at going prices. Thus, some theories emphasize the importance of financial intermediaries and the weakness of security markets in effectively allocating capital.

The research on the ties between financial intermediation and growth has produced useful information. Using data on thirty-five countries from 1860 to 1963 (when available), Goldsmith (1969) found that (a) the size of financial intermediaries as a share of GDP tends to rise with per capita income and (b) when a country grows faster than normal, the ratio of financial system assets to GDP also tends to experience above-average growth. McKinnon (1973) argued that appropriate financial sector reforms expedite growth-inducing financial development. More recently, King and Levine (1993a, 1993b) have examined the empirical ties between financial intermediation and long-run economic growth using data on eighty countries from 1960 to 1989. The major findings from this research are that, after controlling for many other factors associated with long-run growth, the level of financial intermediary development is strongly linked to long-run growth and finance does not simply follow economic growth. The predetermined component of financial development is a good predictor of future economic growth. King and Levine (1993a, 1993b) use instrumental variables and other techniques to show that the strong link between financial development

and the rate of long-run economic growth does not merely reflect contemporaneous shocks that affect both financial development and economic growth.

Although existing evidence suggests that well-developed financial intermediaries assist economic development, there is little evidence on the role of stock markets in economic growth. This empirical gap is notable because the data suggest that stock markets are an integral part of financial development. Thus, to have a comprehensive view of the ties between financial and economic development, the profession must conceptually and empirically explore the relationship between the functioning of equity markets and economic growth more fully than it has.

The Role of Stock Markets in Economic Growth

Although stock market development is a common feature of financial and economic development, many analysts view stock markets in developing countries as "casinos" that have little positive—and potentially a large negative—impact on economic growth. Other analysts argue that, because not much corporate investment is financed through the issuance of equity (Mayer 1988), stock markets are unimportant for economic growth. Various conceptual arguments emphasize the potentially positive, neutral, or even negative implications of stock market development for economic growth.

As shown by Levine (1991) and Bencivenga, Smith, and Starr (this issue), stock markets may affect economic activity through the creation of liquidity. Many profitable investments require a long-term commitment of capital, but investors are often reluctant to relinquish control of their savings for long periods. Liquid equity markets make investment less risky and more attractive because they allow savers to acquire an asset—equity—and to sell it quickly and cheaply if they need access to their savings or want to alter their portfolios. At the same time, companies enjoy permanent access to capital raised through equity issues. By facilitating longer-term, more profitable investments, liquid markets improve the allocation of capital and enhance prospects for long-term economic growth. Further, by making investment less risky and more profitable, stock market liquidity can also lead to more savings and investment. Investors will come if they can leave.

The critical role of financial market liquidity in affecting the efficiency of physical production enjoys historical support. According to Hicks (1969), new technological inventions did not ignite the industrial revolution in England in the eighteenth century. Most of the innovations that characterized the early phases of the industrial revolution had been invented much earlier. Rather, more liquid financial markets made it possible to develop projects that required large capital injections for long periods before the projects ultimately yielded profits. Without liquid capital markets, savers would have been less willing to invest in the large, long-term projects that characterized the industrial revolution; "the industrial revolution therefore had to wait for the financial revolution," as Bencivenga, Smith, and Starr note on page 243.

There are alternative views about the effect of liquidity on long-term economic growth, however. Increased liquidity can deter growth through at least three channels. First, by increasing the returns to investment, greater stock market liquidity may reduce saving rates through income and substitution effects. If saving rates fall enough and if there is an externality attached to capital accumulation, greater stock market liquidity could slow economic growth. Second, by reducing the uncertainty associated with investment, greater stock market liquidity may reduce saving rates because of the ambiguous effects of uncertainty on savings. While less uncertainty makes an investment more attractive to risk-averse agents, less uncertainty also lowers demand for precautionary savings. Thus, the ultimate impact of lower uncertainty on saving rates, produced by greater stock market liquidity, is uncertain. Third, stock market liquidity may adversely affect corporate governance. Very liquid markets may encourage investor myopia. Because more liquid markets make it easy for dissatisfied investors to sell quickly, liquid markets may weaken investors' commitment and reduce investors' incentives to exert corporate control by overseeing managers and monitoring firm performance and potential. According to this view, enhanced stock market liquidity may actually hurt economic growth.

Risk diversification through internationally integrated stock markets is another vehicle through which stock markets can affect economic growth. Because high-return projects also tend to be comparatively risky, stock markets that facilitate risk diversification encourage a shift to higher-return projects (Obstfeld 1994). Thus, better-functioning, more internationally integrated stock markets boost economic growth by shifting society's savings into higher-return investments, all else being equal. But, all else is not necessarily equal. As noted above, greater risk sharing—a reduction in uncertainty—can reduce the need for precautionary saving, reduce saving rates, and thereby retard economic growth. As a result, theory is ambiguous about the ultimate effects of greater risk sharing through internationally integrated stock markets on economic growth.

Stock markets may also affect incentives for investors to acquire information about firms. Larger, more liquid markets make it easier for an investor who has obtained information about a firm to trade at posted prices. Thus, the investor can make money before the information becomes widely available and prices change (Kyle 1984). If investors can profit from obtaining information, they will be more likely to research and monitor firms. To the extent that larger, more liquid stock markets increase incentives to research firms, the improved information will improve resource allocation and accelerate economic growth. By contrast, Stiglitz (1985, 1994) argues that developed stock markets quickly reveal information through price changes. This quick public revelation creates a free-rider problem; it reduces incentives for investors to expend lots of resources in obtaining information about firms because investors can get this information by observing prices.

Finally, stock markets may impact economic growth through changes in incentives for corporate control. As noted above, greater stock market liquidity may generate investor myopia and diffuse ownership that reduce incentives for investors to monitor carefully (Shleifer and Vishny 1995). A countervailing argument is that stock markets that accurately value firms improve the efficacy of tying manager compensation to stock: if stock prices rise, both the managers and the owners benefit, so that managers will have incentives to maximize firm value (Jensen and Murphy 1990). Thus, well-developed stock markets can help align the interests of owners and managers and thereby spur efficient resource allocation and economic growth.

II. Stock Market Development and Financial Intermediaries: Stylized Facts

What is the conceptual definition of stock market development? How can stock market development be empirically measured? Theory does not provide a unique concept of stock market development to guide empirical research. Existing models suggest that stock market development is a multifaceted concept, involving issues of market size, market liquidity, and integration with world capital markets.

Numerous papers test whether emerging stock markets are integrated into the world markets (Errunza and Losq 1989; Bekaert 1995; Buckberg 1995; Harvey 1995; and Tesar and Werner 1995). To examine whether integration is important for economic development requires country-specific measures of the degree of integration. If markets are financially integrated, capital should flow across borders to equalize the price of risk. However, if the markets are not integrated, possibly because of capital controls or other barriers, then the price of risk may differ across markets. Korajczyk (this issue) estimates deviations from the law of one price of risk using the International Arbitrage Pricing Model (IAPM). He finds that market segmentation is larger for emerging markets than developed markets. Also, market segmentation decreases through time for many countries, suggesting a reduction in the barriers to capital flows.

Using Korajczyk's measure of market integration, as well as measures of stock market size, liquidity, volatility, concentration, and institutional development for forty-four developed and emerging markets from 1986 to 1993, Demirgüç-Kunt and Levine (this issue) find that large markets tend to be less volatile, more liquid, and less concentrated in a few stocks than smaller markets. In addition, internationally integrated markets tend to be less volatile. Furthermore, institutionally developed markets with strong information disclosure laws, international accounting standards, and unrestricted capital flows have larger, more liquid markets. Another finding of the article is that Indonesia, Turkey, Portugal, and Venezuela have experienced explosive stock market development. The fact that all four countries liberalized restrictions on portfolio and dividend flows

hints at the importance of policy in affecting stock market development. Levine and Zervos (1995), for example, show that countries which liberalized restrictions on capital and dividend flows showed a marked improvement in the functioning of their stock exchanges.

Levine and Zervos (1995) explore the effects of liberalization of capital controls. They identify fourteen countries that significantly reduced barriers to international capital and dividend flows in the 1980s. They show that these countries enjoyed rapid improvements in the functioning of their stock markets following liberalization. Table 1 summarizes these results. Interestingly, while the results in the table suggest that stock return volatility rises immediately following capital control liberalization, the analysis by Demirgüç-Kunt and Levine implies that, in the long term, stock return volatility is lower in countries with more open capital markets.

Demirgüç-Kunt and Levine also examine the interaction between stock market development and financial intermediaries. They find that as countries grow and reach middle income (about $2,000 per capita in 1990), stock markets and nonbank financial intermediaries develop rapidly. As stock markets and nonbanks grow in importance, banks represent a correspondingly smaller share of the overall financial system. However, the ratio of bank assets to GDP continues to grow as stock markets and nonbanks prosper.

After constructing individual measures of bank, nonbank, and financial system development, Demirgüç-Kunt and Levine also construct aggregate indexes of financial intermediary development based on the individual measures of bank and nonbank development. They find that across countries the level of stock

Table 1. *Changes in Stock Market Variables after Capital Market Liberalization in Fourteen Countries in the 1980s*

Country	*Size*	*Liquidity*	*Volatility*
Argentina	increase	increase	increase
Brazil	no change	no change	increase
Chile	no change	increase	no change
Colombia	no change	increase	increase
India	increase	increase	increase
Jordan	no change	increase	no change
Korea, Rep. of	no change	increase	no change
Malaysia	no change	no change	—
Pakistan	increase	increase	increase
Philippines	no change	increase	no change
Portugal	increase	increase	—
Thailand	no change	increase	increase
Turkey	increase	increase	—
Venezuela	no change	increase	increase

— Not available.

Note: Size represents the market capitalization to GDP; liquidity is the stock market turnover or total value traded to GDP; and volatility is the twelve-month rolling standard deviation estimate based on market returns.

Source: Levine and Zervos (1995).

market development is positively correlated with the development of financial intermediaries. Thus, stock markets and financial institutions are generally complements; they grow simultaneously.

III. Stock Market Development and Long-Run Economic Growth

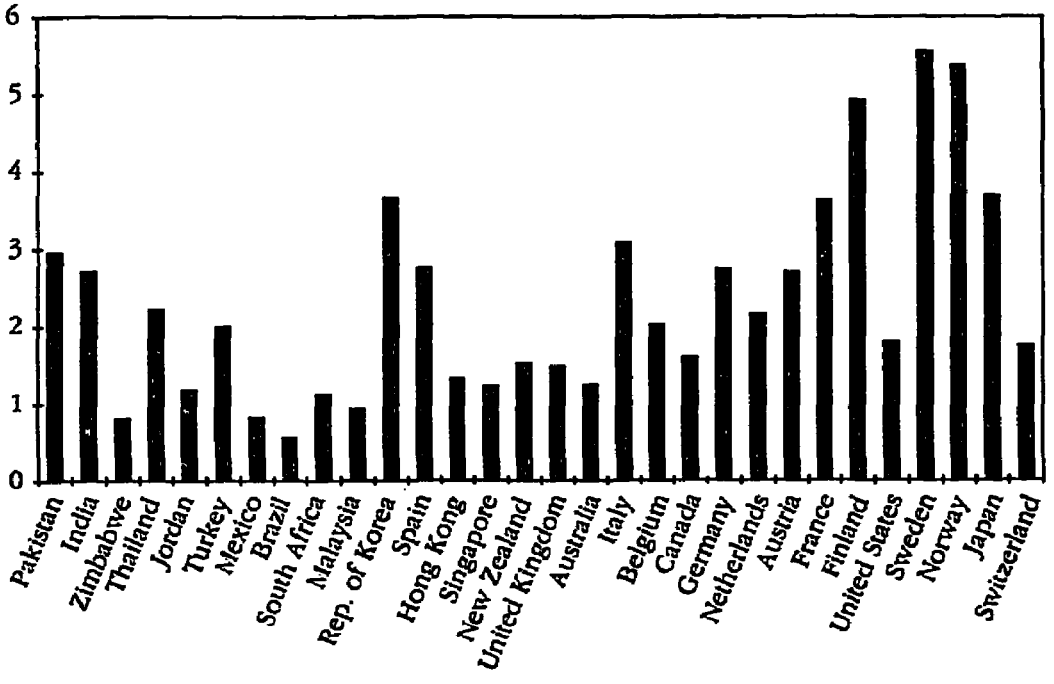
Levine and Zervos (this issue) examine the empirical relationship between measures of stock market development and long-run growth rates. They construct aggregate indexes of overall stock market development that combine information on stock market size, liquidity, and international integration. Levine and Zervos use instrumental variables procedures and control for many other variables associated with economic growth to assess the strength of the empirical relationship between economic growth and stock market development (see also Levine and Renelt 1992). After controlling for the initial level of GDP per capita, initial investment in human capital, political stability, the level of banking development, and measures of monetary, fiscal, and exchange rate policy, the predetermined component of stock market development remains positively and significantly correlated with long-run economic growth.

The strong correlation between overall stock market development and long-run economic growth seems economically important. For example, the coefficients indicate that if Brazil and Mexico (in the middle of the sample in terms of stock market development) had had the same level of stock market development as Malaysia (in the top third of the sample), then Brazil and Mexico would have enjoyed 1.6 percent faster per capita growth each year. Although these types of conceptual experiments should be viewed with caution, this illustration suggests a potentially large economic relationship between stock market development and economic growth. Much work remains, but the results are consistent with theories and historical analyses that imply a positive relationship between stock market development and economic performance. Haber (1991), for example, documents the positive impact of capital market development and capital market reform on competition and industrialization using evidence from Brazil, Mexico, and the United States during the nineteenth and early twentieth centuries.

IV. Stock Market Development and the Financing Decisions of Firms

Finance theory suggests that firms decide which securities to issue—debt or equity—on the basis of taxes and other market imperfections (see Harris and Raviv 1991 and Demirgüç-Kunt 1992 for a review of the literature). Although Rajan and Zingales (1994) and Demirgüç-Kunt and Maksimovic (1994) study international differences in capital structures, they analyze the impact of firm characteristics on financing choices of firms within individual countries. However, differences among firms can explain only part of the great cross-country variation in firm debt-equity ratios (see figure 3).

Figure 3. *Average Total Firm Debt-Equity Ratios for Thirty Economies, 1980–91*



Note: Economies are ranked according to their 1991 GDP per capita, from lowest (Pakistan) to highest (Switzerland).
Source: IFC's Corporate Finance Data Base and Global Vantage Data Base.

The existing literature overlooks an important factor influencing financing choices of firms: the level of stock market development. For the first time in the research, Demirgüç-Kunt and Maksimovic (this issue) empirically explore the effect of financial market development, particularly stock market development, on financing choices of firms. Looking at a sample of thirty industrial and developing economies, they observe that the effect of stock market development on firm debt-equity ratios depends on the initial level of stock market development. Firms in countries with underdeveloped stock markets first increase their debt-equity ratios as their stock markets develop. Thus, not only do they issue new equity, but they also borrow more. This relationship changes as stock markets develop. Firms in countries with relatively developed stock markets substitute equity for debt as stock markets develop further. These findings are consistent with the view that at early stages of market development, improvement in stock market functioning tends to improve information quality, monitoring, and corporate control, such that these improvements induce creditors to lend more. For these firms, debt and equity finance are complementary.

Boyd and Smith (this issue) develop a theoretical framework that helps explain important aspects of the Demirgüç-Kunt and Maksimovic findings on corporate finance and financial market development. Boyd and Smith construct a model in which firms finance capital accumulation externally through a combination of debt and equity, and in which the level of development of debt and equity markets interacts with physical capital investment decisions. The model predicts that as an economy moves along its growth path, the use of more specialized and complex technologies will become more common. This will lead to a rise in the relative cost of monitoring, so that firms will reduce their investments in projects with high returns and high monitoring costs. Because these investments are generally associated with debt, the model predicts that richer countries tend to use more equity and less debt finance. In the model, plausible parameter values suggest that at low levels of economic development, agents do not use equity markets. However, savers and firms begin to use stock markets once the economy attains a critical level of real per capita income. Furthermore, the Boyd and Smith model suggests that stock markets and banks may act as complements rather than as substitute sources of capital.

V. Conclusions and Policy Implications

Recognizing the importance of financial services for economic development, the World Bank in the 1980s began devoting an increasing effort toward (a) improving the financial systems of countries to stimulate economic development and (b) coping with financial crises that threaten economic prosperity. Throughout this period, the World Bank mostly focused on banking systems—removing interest rate controls, reducing government involvement in credit allocation, minimizing taxation of financial intermediaries, managing bank insolvencies, and training bank managers and supervisors. More recently, World Bank programs have stressed the development of capital markets in general and stock markets in particular. The research presented in this symposium seeks to substantively boost knowledge of the relationship between stock markets and economic development to thereby improve policy advice.

The project findings are being released at a time when emerging markets, formerly the darling of international investors, have taken a beating in the wake of the steep devaluation of the Mexican peso and the subsequent economic crisis in that country. As a result, some economists are reconsidering the extent to which developing countries should rely on the highly liquid investments that stock markets typically attract. Although the research presented here was largely completed before recent events in Mexico, the findings suggest that Mexico's experience should not cause countries to adopt more restrictive policies toward international capital flows. As noted above, Levine and Zervos (1995) show that countries which reduce barriers to international capital flows enjoy rapid improvements in the functioning of their stock markets. Although stock return volatility may rise in the short term following capital control liberalization, coun-

tries that are more open to international capital flows tend to have less volatile markets in the long run than those with tighter capital controls, as shown by Demirgüç-Kunt and Levine.

Although the research contained in this symposium sheds light on the role of stock markets in economic development, the articles do not study individual country cases, or analyze when countries are ready for stock market development. For information on specific country experiences with stock market development, see El-Erian and Kumar (1995), Claessens (1995), and Morgenstern (1995). For comparisons of market trading and information systems in developing countries, see Glen (1995).

It is not clear that every country needs its own active stock market. Theory and evidence do suggest that countries benefit from easy access to well-functioning stock markets where residents and domestic firms can buy, sell, and issue securities. However, the geographical location of the market is not necessarily important. In other words, there is little reason to believe, for example, that California would grow faster if the New York Stock Exchange moved to Los Angeles. Thus, future research could examine the effects of the cross-listing and cross-trading of shares.

Finally, the research in this symposium does not suggest that policymakers should push stock market development. The available information suggests that policymakers should remove impediments to stock markets, such as tax, legal, and regulatory barriers. But no strong evidence supports interventionist policies, such as tax incentives, that artificially boost stock market size and activity. Future research could focus more on what policies appropriately facilitate healthy stock market development.

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Equity Markets, Transactions Costs, and Capital Accumulation: An Illustration

Valerie R. Bencivenga, Bruce D. Smith, and Ross M. Starr

Poorly developed equity markets inhibit the transfer of capital ownership. Moreover, the costs of transacting in equity markets affect not just the level of investment, but the kinds of investments that are undertaken. Once equity markets allow the ownership of capital to be transferred economically, reductions in costs tend to favor the use of longer-maturity investments. When there is a relationship between the maturity of an investment and its productivity, transactions cost reductions are conducive to observing certain kinds of increases in productive efficiency. This article analyzes savings, investment, and consumption decisions by using an overlapping generations model with two-period-lived agents. The analysis allows for several technologies for converting current output into future capital that vary by productivity and maturity, and it makes ownership of capital costly to transfer. A reduction in transactions costs will typically alter the composition of savings and investment, and have potentially complicated consequences for capital accumulation and steady-state output.

There is a close—if imperfect—relationship between the effectiveness of an economy's capital markets and its level of real development.[1] Financial markets provide liquidity (Bencivenga and Smith 1991; Levine 1991), promote the acquisition and dissemination of information (Diamond 1984; Boyd and Prescott 1986; Williamson 1986; Greenwood and Jovanovic 1990), and permit agents to increase specialization (Cooley and Smith 1992). And yet, although a literature exists pursuing the contributions of each of these functions to increasing real activity, surprisingly little of that literature provides predictions about how the volume of activity in financial markets is related to the level or efficiency of an economy's productive activity. Indeed, surprisingly little research has investigated

1. For documentation of this claim in historical and modern development contexts, see Cameron (1967) and McKinnon (1973), and Shaw (1973), respectively. For quantitative analyses of the experiences of a variety of economies, see Goldsmith (1969), Antje and Jovanovic (1992), or King and Levine (1993a, 1993b).

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the relation between an economy's efficiency in performing financial transactions and its efficiency in performing physical production. We pursue this relation in some detail. In the process, we also discuss how an economy's volume of financial transactions and its level of real activity are related.

In addition, we analyze why the connections between the development of an economy's financial markets and its level of real development, although close, are not perfect. Many prominent examples of successful growth—such as the Republic of Korea and Taiwan (China)—have experienced their success despite heavily regulated financial systems. And, all too often, attempts by governments to stimulate the development of financial markets in developing economies have been (apparently) counterproductive (for examples, see Galbis 1979, van Wijnbergen 1985, Diaz-Alejandro 1985, Khatkhate 1988, and Fry 1988). Why should this be the case if financial market development is, typically, conducive to real development? We also investigate this issue.

Section I sets the context of the article by discussing the importance of financial markets and transactions costs. Section II lays out the model economy we employ, and section III describes the nature of trade and transactions costs and sets out the conditions of a steady-state competitive equilibrium. Section IV examines how the level of transactions costs affects the choice of investment technology, the rate of return on savings, capital accumulation and output, steady-state welfare, and the volume of equity market activity when transactions costs represent true resource costs. Section V reconsiders these issues when transactions costs represent pure transfers. Section VI presents some final thoughts on issues that could be addressed in more complicated versions of this framework.

I. Financial Markets and Transactions Costs

We draw on two fairly fundamental insights. One is that the most productive capital investments often require the commitment of large amounts of funds for substantial periods, with investors facing relatively long times to payout (Bohm-Bawerk 1891). The other is that investors are unlikely to commit funds to such investments in the absence of well-functioning capital markets that can provide them with liquidity. The second point was made quite forcefully by Hicks (1969) in discussing the question of what made the industrial revolution revolutionary.

Hicks (1969) argued that the industrial revolution was not the consequence (or, at least, not the immediate consequence) of a set of new technological innovations, because most of the innovations that were exploited in the early phases of the industrial revolution had occurred some time earlier. Rather, according to Hicks, what was new was that the implementation of these particular innovations on an economical scale required that investments of large magnitude be made in highly illiquid and activity-specific capital for long periods. This would not have been possible in the absence of financial markets to provide liquidity. Thus, technological innovation by itself was insufficient to stimulate growth; another precondition for the implementation of new technologies was the exist-

ence of liquid capital markets. The industrial revolution therefore had to wait for the financial revolution—a term applied by Dickson (1967) to the rapid development of English financial markets in the first half of the eighteenth century—before it could occur. According to Hicks,

> What happened in the Industrial Revolution . . . is that the range of fixed capital goods that were used in production . . . began noticeably to increase. . . . But fixed capital is sunk; it is embodied in a particular form, from which it can only gradually . . . be released. In order that people should be willing . . . to sink large amounts of capital, . . . it is the availability of liquid funds which is crucial. This condition was satisfied in England . . . by the first half of the eighteenth century. . . . The liquid asset was there, as it would not have been even a few years earlier. (Hicks 1969: 143–45).

In our view, Hicks asserted that individual investors face two important timing decisions with respect to their capital investments: the time to payout (or maturity) of the investment and its holding period. In poorly developed equity markets, the transfer of capital ownership is inhibited, and an individual investor will face a time to payout and a holding period that are identical. As Hicks argued, these conditions would prevent an array of investments from being undertaken. However, once equity markets allow the ownership of capital to be transferred economically, individuals can separate decisions involving the maturity of an investment from the length of time they will hold it themselves. Hence, equity markets permit investors to choose a maturity of investment that maximizes yield, and at the same time to choose a holding period to satisfy the desired timing of their own transactions. The maturity of an investment is no longer held hostage to the desired liquidation dates of wealth-holders.

These observations imply that the costs of transacting in equity markets are of great importance for affecting not just the level of investment, but the kinds of investments that occur. Which kinds of investments appear economical will depend not just on their productivities, but on the cost of transferring ownership of them, if necessary. Thus, the efficiency of an economy's financial system (measured by the costs of transacting in equity markets) has implications for the choice of which investments are undertaken. The issue of which investments are undertaken, in equilibrium, affects the productivity of investment, as well as capital formation. Moreover, as we will show, far-reaching implications arise from the relationship among the costs of transacting in capital markets, the choice of investment, and the composition of wealth-holding between existing equity claims and the initiation of new capital investment. These implications permit us to make some observations about why the association between financial market development and real development is not a perfect one.

In order to discuss the relationship among capital market efficiency (transactions costs), productive efficiency, and the composition of investment, we employ essentially the simplest model we can imagine. Many details of this model are generalized in Bencivenga, Smith, and Starr (1994, 1995, 1996). Savings,

investment, and consumption decisions are undertaken in an overlapping generations model with two-period-lived agents. In order to trivialize savings, labor supply, and production decisions, both preferences and the technology for producing final goods are assumed to be linear. The innovations of the analysis—which we highlight by heavily simplifying all other aspects of the model—are the presence of several technologies for converting current output into future capital and the fact that ownership of capital is costly to transfer. The first feature allows us to address the issue of the equilibrium choice of investment technology emphasized by Bohm-Bawerk and Hicks; the second allows us to index the effectiveness of an economy's capital markets by the costs of transacting in them.

In practice, some transactions costs represent a real social loss of resources, and others represent simple transfers between agents (for example, rents accruing to brokers or market makers, or taxes paid to the government). In previous research (Bencivenga, Smith, and Starr 1994, 1995, 1996), we have investigated transactions costs in secondary capital markets that represent a genuine resource loss, and examined their consequences for the determination of saving, investment, the composition of the capital stock, and asset pricing. We reconsider these issues here as well, using a particularly simple model designed to highlight the economic mechanisms at work. These simplifications permit us to obtain particularly sharp conclusions about the consequences of changes in the level of transactions costs.

When transactions costs involve real resource losses, it is immediate, in this context, that reductions in transactions costs raise steady-state welfare. What does this observation imply about the desirability of imposing charges on, or subsidizing, secondary market transactions? To answer this question, we need to consider the situation where transactions costs represent pure fees or rents. An analysis of this issue goes beyond that in Bencivenga, Smith, and Starr (1994, 1995, 1996). In the case in which transactions costs represent pure fees or rents, such costs introduce a wedge between the buying and selling prices of capital. The structure of transactions costs still affects the composition of savings and investment, as in Bencivenga, Smith, and Starr (1994, 1995, 1996), and also has implications for the productivity of investment. On the basis of these implications from the efficiency effects of the pricing structure of transactions costs, we analyze how the pricing structure for financial transactions affects the allocative efficiency of the financial system.

Since agents are two-period lived, the use of technologies with more than one gestation period requires the ownership of immature capital to be transferred in capital resale—or equity—markets. For simplicity, we assume a proportional transactions cost structure in these markets. Agents will decide which investment technologies to use on the basis of their yields—at currently prevailing prices—net of transactions costs. Since transactions costs have a greater effect on the net-of-transactions-cost yields of longer-maturity investments (these investments are resold more times, and hence are more transactions intensive), high transactions costs imply that the equilibrium maturity of investments will

be relatively short (in order to economize on capital resale). As argued by Bohm-Bawerk and Hicks, this is likely to imply that the investments made are relatively unproductive.

We then investigate the consequences of (exogenous) reductions in transactions costs for steady-state equilibria. For the reasons we have described, transactions cost reductions tend to favor the use of longer-maturity investments, and hence are conducive to certain kinds of increases in productive efficiency. Reductions in transactions costs also necessarily raise the net-of-transactions-costs rates of return on (all) investments, and these reductions therefore raise the equilibrium rate of return on savings. However, transactions cost reductions have potentially complicated consequences for capital accumulation and steady-state output.

If transactions costs represent real resource costs, their reduction has two effects. First, such a reduction raises the—net-of-transactions-cost—productivity of all investment technologies. If the composition of investment remained constant, this effect would necessarily increase capital formation and steady-state output. However, the composition of wealth-holding—much less the equilibrium choice of investment technology—will not typically remain constant with an increase in the efficiency of equity markets. Such changes make the ownership of already-existing equity more attractive, other things being equal, and they can cause some fraction of agents' wealth to be transferred away from the initiation of new capital investment and into the ownership of existing equity. This effect is detrimental to capital formation and production. Moreover, as it turns out, either effect can dominate. We describe when each situation does dominate, and hence when increasing the efficiency of equity markets is and is not conducive to capital accumulation. Thus we can not only describe why equity market conditions are important determinants of both productive efficiency and real activity, but also why the relationship between equity market conditions and real development is an imperfect one. In particular, in analyzing the effects of an improvement in the functioning of equity markets, it is necessary to be fully cognizant of how such an improvement will affect the composition of wealth-holding.

We are also able to examine how the level of transactions costs affects the volume of financial market activity and steady-state welfare. We consider two polar cases: (a) transactions costs represent real resource costs, and (b) transactions costs are pure transfers (such as fees or rents to brokers or market makers or, possibly, taxes paid to the government). It is clear that, as a practical matter, a great deal of time and physical resources are devoted to the process of undertaking financial transactions. However, there are also additions to—or subtractions from—transactions costs that represent pure transfers between economic agents. For example, governments often subsidize the formation of exchanges or the transfer of funds. These types of activities represent actual transactions subsidies. By the same token, there are often taxes on financial transactions, and some prominent economists have even proposed that these taxes should be in-

creased. Such taxes or subsidies very clearly represent pure transfers. However, other types of transfers may occur. For example, it is not uncommon for some agents to obtain the monopoly rights to the provision of certain financial services. The existence of such monopoly power can result in rents accruing to the providers of these services. Such rents, which may themselves be regulated, are again pure transfers between agents.

Whether transactions costs represent either pure resource losses or pure transfers, a reduction in transactions costs increases the volume of equity market activity. However, since a transactions cost reduction may or may not lead to increased output levels, an increase in the volume of financial market activity can be, but need not be, associated with an increase in the level of real activity. In addition, when transactions costs represent genuine resource losses, their reduction necessarily leads to higher steady-state welfare. This result would need to be qualified in more general models, like those of Bencivenga, Smith, and Starr (1994, 1996).

The conclusion for resource losses must be substantially modified, however, if transactions costs simply represent transfers. Here transactions cost reductions may either raise or lower steady-state welfare. In particular, it is possible that an economy can undertake a socially excessive volume of financial market transactions. In this case, it will be desirable to raise the fees associated with equity market activity. This situation is particularly likely to occur in economies that have low real interest rates but large transactions volumes.

The case in which the transactions costs borne by individuals represent a genuine social resource loss seems to correspond to the situation envisioned by Hicks (1969), a situation that has been previously analyzed by Bencivenga, Smith, and Starr (1994, 1995, 1996). However, an alternative view of transactions costs in financial markets has often been put forward. In this view, many financial market transactions are purely speculative; they simply rearrange the ownership of existing capital without affecting its allocation in production. Under this view, if such transactions are costly, they are socially wasteful. Arguments of this type led Keynes (1964: 159) to conclude that "it is usually agreed that casinos should, in the public interest, be inaccessible and expensive. And perhaps the same is true of stock exchanges." Similar reasoning about currency markets led Tobin (1994) to propose the taxation of currency transactions. Attempts to artificially increase the costs of transacting, as proposed by Keynes and Tobin, clearly represent transactions costs to individuals, but not social costs. The formulation in section V allows what we believe is the first formal analysis of the effects of transactions costs of this type. In particular, we describe conditions under which Keynes's and Tobin's arguments have merit, as well as conditions under which they do not.

II. The Model

In this section we describe what we believe is the simplest model that can be used to illustrate the issues we have just discussed. This model confronts both

households and producers with what are essentially trivial decisions, and in so doing, it permits us to focus on what seems to us the most central issue: how transactions costs in equity markets affect the composition of savings and investment, and—through those channels—capital accumulation.

We consider a two-period-lived, overlapping generations model with production. Time is indexed by $t = 1, 2, \ldots$, and in each period a new young generation is born with N identical members. (Note that we are abstracting both from heterogeneity and population growth, a simplification that reduces notational requirements.) Each agent is endowed with one unit of labor when young, which is supplied inelastically, and all agents are retired when old. No agents other than the initial old are endowed with capital or consumption goods at any date.

In each period there is a single consumption good produced, which can either be eaten or converted into capital. We assume that all agents care only about old-period consumption, which we denote simply by c. We thus abstract from any interesting labor supply or savings decisions on the part of households. Each agent will save their entire young-period income at each date.

The consumption good is produced according to a constant-returns-to-scale, in fact a linear, technology using capital and labor as inputs. Thus, a firm employing K_t units of capital and L_t units of labor at t can produce

$$F(K_t,L_t) = aK_t + bL_t$$

units of the final good. The use of a linear technology confronts the firm with an essentially trivial decision regarding the choice of factor inputs.

Capital is also produced from the final good using a set of linear capital investment technologies. We assume that there are J such technologies, indexed by $j = 1, \ldots, J$. These technologies differ along two dimensions, productivity and gestation period. In particular, one unit of the final good invested in technology j at t yields $R_j > 0$ units of capital (gross of transactions costs) at $t + j$. Thus j represents the gestation length of capital investments in the technology with that index, and R_j represents the (gross) productivity of that technology.

We assume further that if K_t denotes the total capital stock available at t, K_t is simply the sum of maturing capital investments produced through all technologies. Thus, more specifically, all capital—produced by any investment technology—is perfectly substitutable as an input in final goods production. (The assumption that all capital, however produced, is perfectly substitutable in production is relaxed by Bencivenga, Smith, and Starr 1994.) Our assumptions here on capital production technologies imply that capital investments are completely unproductive until they mature. This can be thought of as an Austrian model of investment. It is possible to alter the analysis so as to allow all capital investments to mature in one period but at the same time have capital produced using different technologies with different productive lifetimes. This, however, is a more complicated model, and we do not pursue it here.

Since agents are two-period lived, the use of any investment technology with $j > 1$ requires owners of capital in process (CIP) to transfer ownership of it in equity markets. This is true of CIP in all periods prior to maturity, so that ownership of CIP is transferred through a sequence of holders in equity—or capital resale—markets. We are interested in considering how the costs of transacting in these markets affect capital accumulation and per capita income, the equilibrium return on savings, the equilibrium choice of capital production technologies, and welfare in a steady-state equilibrium.

For simplicity, we assume a proportional transactions costs structure confronting agents who operate in equity markets. Our specific assumption is that transferring ownership of one unit of CIP produced using technology j that has been in process for h periods (that is, which is $j - h$ periods from maturity), consumes $\alpha^{j,h}$ units of CIP. Thus, after a sale of one unit of type (j, h) CIP, $1 - \alpha^{j,h}$ units remain. Under this specification, transactions costs represent a pure resource loss. We consider below the alternative case in which transactions costs represent a pure transfer to market makers (or a tax paid to the government).

Finally, we assume that when CIP matures it is used in the production process and then depreciates completely. This assumption allows us to abstract from the existence of resale markets for mature—as opposed to maturing—capital.

Trade

Three kinds of transactions occur in this economy: capital and labor are rented in competitive factor markets, final output is bought and sold, and agents trade ownership of CIP in competitive equity markets. We focus on transactions costs in equity markets and otherwise keep the model as close to standard as possible (see Diamond 1965 and Azariadis 1992, ch. 13). Therefore, we assume that there are no costs associated with transactions in output or factor markets. We also focus throughout on steady-state equilibria. We therefore omit time subscripts wherever possible.

Let w denote the (steady-state value of) the real wage rate, and let r denote the rental rate on capital. In a competitive economy, factor prices will equal marginal products of the appropriate factor, so that

$$r = a \tag{1}$$

$$w = b. \tag{2}$$

Each young agent earns the wage income w, all of which is saved. Let S denote savings by a representative young agent, measured in units of CIP. The only decision confronting such an agent is how to allocate savings among various alternative assets; the available assets are type j CIP ($j = 1, \ldots, J$) of vintage h ($h = 1, \ldots, j-1$). Mature capital is simply rented to firms. Since there are no transactions costs in factor markets, this amounts to assuming that $\alpha^{j,j} = 0$ ($j = 1, \ldots, J$).

Let $S^{j,h}$ denote the amount of type j CIP that is h periods old acquired by a representative agent. Then, for example, $S^{j,0}$ represents the amount of newly initiated investment in technology j, and $S^{j,j-1}$ is the amount of type j CIP acquired that will mature in one period. Similarly, let $P^{j,h}$ be the price—in units of current consumption—of one unit of technology j CIP that is h periods old. Since one unit of the final good invested in technology j at any date becomes one unit of technology j CIP (by choice of units), $P^{j,0} = 1$. Moreover, mature CIP is simply capital, which is rented to firms. As one unit of technology j CIP yields R_j units of rentable capital on maturity, $P^{j,j} = rR_j$ must hold. That is, the price of mature CIP is simply the rental value of the associated capital. For $j > 1$ and $0 < h < j$, $P^{j,h}$ must be determined.

Without loss of generality, we can assume that transactions costs are borne by sellers of CIP. Then, since each agent consumes only when old, the budget constraints confronting an individual agent are

$$\sum_{j=1}^{J} \sum_{h=0}^{j-1} P^{j,h} S^{j,h} \leq w \tag{3}$$

$$c \leq \sum_{j=1}^{J} \sum_{h=0}^{j-1} P^{j,h+1} S^{j,h} (1 - \alpha^{j,h+1}). \tag{4}$$

Equation 3 imposes that the value of asset purchases does not exceed savings, and equation 4 asserts that old-age consumption is funded by the net-of-transactions-cost proceeds of asset sales. We also impose nonnegative asset holdings (no short sales) for all types of assets. Note that while agents take the transactions costs parameters $\alpha^{j,h}$ as given, the total quantity of transactions costs incurred is a choice variable that responds not just to the values $\alpha^{j,h}$ but to asset prices as well.

Agents here care only about the rates of return received on assets, since our model contains no motive for diversification. Thus, all assets actually held in equilibrium must bear a common (gross) rate of return, net of transactions costs, which we denote by γ. If technology j is actively used in a steady-state equilibrium, then technology j CIP of all possible times to maturity must be held by some agent. Thus, for all $h = 0, \ldots, j-1$, the gross rate of return on type (j, h) CIP must equal γ. In other words, then, if technology j is active in a steady-state equilibrium,

$$\gamma = (1 - \alpha^{j,h+1}) P^{j,h+1} / P^{j,h} \tag{5}$$

for all $h = 0, \ldots, j-1$.

When rates of return on all capital investments in use are equated, each young agent is indifferent to the composition of his portfolio. The aggregate composition of investment will, nevertheless, be determinate, as we will see shortly.

Long-Maturity Investments

The assumption that agents are two-period lived implies that the number of times any investment changes hands is simply its gestation length minus 1. As a consequence, long-maturity investments are traded more times than short-maturity investments. Although this is a necessary consequence of our assumptions on agents' life cycles, we believe that it captures a feature that is generally true of reality.

A more general but much more complicated formulation would allow for longer-lived agents who make endogenous choices about the holding periods for each of their investments. These holding periods would typically depend on the patterns of agents' incomes and expenditures, as well as on the structure of transactions costs. Indeed, we could additionally add the feature that agents' incomes and expenditures are subject to some uncertainty. In this case, the occurrence of various shocks would motivate asset market transactions that agents could not perfectly predict in advance.

In either of these more realistic (and hence complex) formulations, we would expect agents to have determinate asset demand functions. These demand functions would, however, necessarily depend on the structure of transactions costs. So long as transactions costs are greatest for assets of longer maturities, reductions in transactions costs will be conducive to the transfer of savings from shorter- to longer-maturity instruments. It is this transfer that is central to our results. We therefore do not believe that the introduction of uncertainty or of richer life-cycle savings behavior into the analysis would tend to alter our main conclusions.

III. Steady-State Equilibrium

In order to describe the steady-state equilibrium capital stock, output level, and rate of return on savings, we need to know two things: first, which capital production technology (or technologies) will be in use in such an equilibrium; second, how savings will be divided among CIP of different gestation periods in this technology.

The Equilibrium Choice of Investment Technology

As intuition might suggest—and as Bencivenga, Smith, and Starr (1995, 1996) show formally—in equilibrium the capital production technology or technologies in use maximize the internal rate of return on investment, net of transactions costs. An investment of one unit in technology j at t yields $\tilde{R}_j$ units of capital at $t + j$, net of transactions costs, where

$$\tilde{R}_j \equiv R_j \prod_{h=0}^{j-1} (1 - \alpha^{j,h+1}). \tag{6}$$

This capital is then rented at its competitive rental rate, r. With this "point input, point output" technology, the internal rate of return on technology j is

$(r\tilde{R}_j)^{1/j}$. The equilibrium choice of capital production technology—in steady state—is that which maximizes this internal rate of return. Thus, if j^* is the equilibrium choice of capital production technology,

$$j^* = \arg\max_j [(a\tilde{R}_j)^{1/j}]. \tag{7}$$

We assume throughout that j^* is unique, which will generically be the case.

The equilibrium rate of return on savings is equal to the internal rate of return on the equilibrium capital production technology. Therefore, in equilibrium,

$$\gamma = (a\tilde{R}_{j^*})^{1/j^*} \tag{8}$$

holds.

To summarize, in choosing which technology to use, agents care only about the internal rate of return on investments, net of transactions costs. The costs of transacting in equity markets influence the equilibrium capital production technology through their influence on this rate of return. After characterizing the remaining aspects of an equilibrium, we will pursue the implications of this observation.

The Capital Stock and the Composition of Savings

The equilibrium level of the capital stock—as well as, by implication, the equilibrium level of output—depends very heavily on how savings is allocated between existing, but not yet mature, CIP and the initiation of new capital investment. Purchases of the former represent equity holdings so, in effect, the division of young people's saving between equity and new investment determines the steady-state capital stock.

Let $\theta^{j,h}$ denote the fraction of per capita saving (of young people) invested in purchasing technology j CIP of vintage h.[2] In a steady state, $\theta^{j,h} = 0$ holds for all technologies that do not maximize the internal rate of return on investment. Thus, only $\theta^{j^*,h} > 0$ holds. We now consider the equilibrium value of these weights.

Since $\theta^{j^*,h}$ is a fraction of total savings in the form of type (j^*, h) CIP,

$$\sum_{j=1}^{J} \sum_{h=0}^{j-1} \theta^{j,h} = \sum_{h=0}^{j^*-1} \theta^{j^*,h} = 1 \tag{9}$$

must hold. In addition, the market for type (j^*, h) CIP must clear at each date. The demand for such CIP is the fraction of savings invested in this form, $\theta^{j^*,h}$, times savings, w, divided by the price of type (j^*, h) CIP. In other words, the demand for such CIP is given by $\theta^{j^*,h}\, w/P^{j^*,h}$.[3] The supply of type (j^*, h) CIP is the amount of new capital investments in technology j^* initiated h periods ago, less

2. If all households were behaving identically, $\theta^{j,h} \equiv P^{j,h} S^{j,h}/w$ would hold.

3. Notice that $\theta^{j^*,h}\, w$ gives the value, in real terms, of the demand for type (j^*,h) CIP. Division by $P^{j^*,h}$ converts this demand into units of CIP.

the amount of CIP consumed by the transactions technology in the interim. Thus, the supply of type (j^*, h) CIP equals

$$\theta^{j^*,0} w \prod_{t=0}^{h-1} (1-\alpha^{j^*,t+1}) / P^{j^*,0} = \theta^{j^*,0} w \prod_{t=0}^{h-1} (1-\alpha^{j^*,t+1}),$$

since $1 - \prod_{t=0}^{h-1} (1-\alpha^{j^*,t+1})$ of the initial CIP created has been lost in the transactions process. The market for type (j^*, h) CIP clears, then, if

$$\theta^{j^*,h} w = P^{j^*,h} \theta^{j^*,0} w \prod_{t=0}^{h-1} (1-\alpha^{j^*,t+1}). \tag{10}$$

We now observe that

$$P^{j^*,h} = P^{j^*,0}(P^{j^*,h}/P^{j^*,h-1})(P^{j^*,h-1}/P^{j^*,h-2})\ldots(P^{j^*,1}/P^{j^*,0}) = (\gamma)^h / \prod_{t=0}^{h-1} (1-\alpha^{j^*,t+1}). \tag{11}$$

Substituting equation 11 into equation 10, we obtain

$$\theta^{j^*,h} = (\gamma)^h \theta^{j^*,0}. \tag{12}$$

Loosely speaking, equation 12 asserts that the demand for (and the supply of) CIP of increasing maturity grows at the rate of interest. This is necessary in order for all vintages of CIP to bear a net-of-transactions-cost rate of return equal to the equilibrium interest rate.

Equations 9 and 12 imply that

$$\theta^{j^*,0} = (1-\gamma) / [1-(\gamma)^{j^*}]. \tag{13}$$

In view of equation 8, equations 12 and 13 imply that the composition of savings is determined entirely by the internal rate of return on investments in the equilibrium capital production technology. In particular, equation 13 describes how this rate of return determines the amount of new capital investment, and equation 12 governs how the remainder of agents' savings are allocated to the purchase of already-existing CIP in equity markets.

The internal rate of return on savings depends on two factors: the marginal product of capital (a), and the net-of-transactions-cost productivity of the equilibrium investment technology $(\tilde{R}_{j^*})$. We now investigate how changes in $\tilde{R}_{j^*}$ influence capital accumulation.

Let k denote the per capita capital stock in a steady-state equilibrium. Then

$$k = \tilde{R}_{j^*} \theta^{j^*,0} w. \tag{14}$$

Equation 14 simply notes that the steady-state equilibrium capital stock (per capita) equals the per capita initiation of new capital investments j^* periods earlier $(\theta^{j^*,0} w)$, times the amount of capital produced, per unit invested, net of

transactions costs $(\tilde{R}_{j^*})$. The linearity of final goods production implies that $w = b$. Equation 13 implies that $\theta^{j^*,0}$ depends entirely on γ, which in turn is the internal rate of return on technology j^*. Finally, which technology maximizes the internal rate of return depends on the productivities of the capital investment technologies, net of transactions costs. Thus, ultimately, the net-of-transactions-cost productivities of the various investment technologies, that is the values $\{\tilde{R}_j\}$, fully determine the steady-state capital stock. Later we will explore how the structure of transactions costs affects capital formation. Before doing so, however, we will characterize the equilibrium value of equity market activity.

Equity Market Activity

The real value of equity market transactions in each period—in per capita terms—is per capita saving less the real value of new capital investments initiated. In particular, all savings—other than what goes into new capital investments—is used to purchase existing CIP in equity markets. Thus, the real value of net purchases in equity markets is given by $w(1 - \theta^{j^*,0})$. As before, this quantity is largely determined by the structure of transactions costs.

IV. The Effects of Changes in Transactions Costs

To investigate how changes in the level of transactions costs affect all aspects of a steady-state equilibrium, it is convenient to have a simple representation of transactions costs. To that end, we henceforth assume a constant proportional transactions cost structure:

$$\alpha^{j,h} = \alpha \in (0,1); \quad h \neq 0, j. \tag{15}$$

Consistent with our earlier discussion, we assume that there are no costs associated with capital rental or with the initiation of new capital investment. Thus we impose $\alpha^{j,0} = \alpha^{j,j} = 0$, for all j. Under these assumptions,

$$\tilde{R}_j = R_j(1-\alpha)^{j-1} \tag{16}$$

holds for all j.

Our assumptions imply that a reduction in transactions costs has the largest proportional effect on $\tilde{R}_j$ for those investments with the longest maturities. The notion that transactions costs are most significant for long-maturity assets is certainly consistent with casual observation. For instance, *The Wall Street Journal* of July 23, 1993, reported a bid/ask spread on three-month treasury bills of the previous day equal to 0.005 percent of price. For a thirty-year treasury bond, this spread was 0.062 percent of price, but for a thirty-year treasury strip (a pure discount instrument, equivalent to a long-term bill), the spread was 0.7 percent of price. Thus, transactions costs vary by a factor of 100 with maturity

alone, despite the fact that these observations ignore the obvious likelihood that a long-term instrument will be rolled over many more times during its lifetime than a short-term instrument.

Given the specification of transactions costs in equation 15, technology j has a higher internal rate of return than technology $j-1$ if and only if

$$1-\alpha \geq a(R_{j-1})^j/(R_j)^{j-1} \tag{17}$$

is satisfied. Therefore, for a given set of technological parameters a and $(R_1, R_2, \ldots, R_J)$, the level of the transactions cost parameter α determines which technology will be in use. Long-gestation technologies—which may intrinsically be highly productive—are also transactions intensive; that is, their ownership must be transferred many times. This will only be economical if transactions costs are sufficiently low.

To put some structure on the parameters $(R_1, R_2, \ldots, R_J)$, we henceforth assume that

$$(R_j)^{j+1}/(R_{j+1})^j > (R_{j-1})^j/(R_j)^{j-1} \tag{18}$$

holds for all $j \geq 2$. The conditions imposed in expression 18 are essentially technical: they guarantee that, for each capital production technology, some value of α exists at which that technology maximizes the internal rate of return to investment, net of transactions costs. We comment later on what happens if the assumption in 18 is relaxed.

Expression 18 is compatible with a variety of different configurations of the values $(R_1, R_2, \ldots, R_J)$. For example, if $J = 3$, setting $(R_1, R_2, R_3) = (2, 1, 1/3)$ satisfies expression 18, as does setting $(R_1, R_2, R_3) = (1/3, 1, 2)$.

The Dependence of Equilibrium Values on Transactions Costs

Here we consider how exogenous changes in the transactions cost parameter α affect (a) the steady-state capital stock, (b) the rate of return on savings, and (c) the volume of activity in equity markets. In order to analyze these issues, we need to begin with the effect of α on the equilibrium maturity of capital investments, j^*.

Suppose first that

$$1-\alpha < a(R_1)^2/R_2 \tag{19}$$

holds. Then expressions 17 and 18 imply that $j^* = 1$; in other words, transactions costs are so high that technology 1—which requires no transactions—maximizes the internal rate of return on investments, net of transactions costs. In this case, there is no equity market activity, and $\theta^{1,0} = 1$. The equilibrium per capita capital stock (see equation 14) is $k = R_1 b$, and the equilibrium return on savings is $R_1 a$.

Small reductions in α—and, more specifically, reductions that leave expression 19 satisfied—do not change the equilibrium choice of capital production technology. Hence, there continues to be no equity market activity, and both the capital stock and the real return on savings are unaffected.

Suppose that α is now reduced enough so that expression 19 ceases to hold and, instead,

$$a(R_2)^3/(R_3)^2 > 1 - \alpha > a(R_1)^2/R_2 \tag{20}$$

is satisfied. For this lower level of transactions costs, expressions 17 and 18 imply that $j^* = 2$: transactions costs are now low enough for agents to view making longer-gestation investments that require some resale as economical. The equilibrium rate of return on savings is $[aR_2(1-\alpha)]^{0.5}$; expression 20 guarantees that this return exceeds aR_1. Hence, the lower level of transactions costs has resulted in a higher equilibrium rate of return on savings.

Once $j^* = 2$ holds, it must be the case that $\theta^{2,1} > 0$ also obtains. In particular, agents must sell ownership claims in CIP that is not yet mature. As a consequence, $\theta^{2,0} < 1$. Thus, activity in equity markets diverts some saving away from capital formation. Indeed, the steady-state capital stock is now $k = R_2(1-\alpha)\,\theta^{2,0}b$. If $R_2(1-\alpha) > R_1$ holds, the reduction in transactions costs has two competing effects on the capital stock. First, the net-of-transactions-costs productivity of investment has risen [$R_2(1-\alpha) > R_1$ holds], which is conducive to increased capital formation. However $\theta^{2,0} < \theta^{1,0} = 1$ also holds, so that some savings has been transferred from the initiation of new capital investment to the purchase of existing equity. Which effect dominates?

The answer depends on the magnitude of α. Equation 13 implies that

$$\theta^{2,0} = \{1 + [aR_2(1-\alpha)]^{0.5}\}^{-1}.$$

Hence, $R_2(1-\alpha)\,\theta^{2,0} \geq R_1$ holds if and only if

$$R_2(1-\alpha)/\{1 + [aR_2(1-\alpha)]^{0.5}\} \geq R_1. \tag{21}$$

If equation 21 holds, transactions costs are low enough so that the use of technology 2 actually leads to a higher steady-state capital stock than the exclusive use of technology 1. In this case, reductions in transactions costs (that is, more-efficient capital markets) lead to a higher long-run level of real activity. However, if equation 21 fails—as is perfectly compatible with expression 20 being satisfied—then lower transactions costs divert enough saving away from capital formation into equity so that the long-run capital stock and the level of real activity are actually reduced. Thus to summarize, reductions in transactions costs that raise the equilibrium gestation period of capital investment must increase the real return on saving and the volume of equity market activity. How-

ever, the latter fact implies that long-run real activity may fall as a result of an increase in the efficiency of equity markets.

Once transactions costs are low enough to satisfy expression 20, further reductions in α that leave expression 20 satisfied have very unambiguous effects. The internal rate of return on investments (net of transactions costs) rises as transactions costs fall. The same is true for the value of equity market activity. It is also straightforward to show that $R_2(1-\alpha)\,\theta^{2,0}$ is increased by such a reduction in transactions costs; as transactions costs fall, the steady-state capital stock and level of real activity necessarily increase.

Even further reductions in α can cause expression 20 to be violated, and

$$a(R_3)^4/(R_4)^3 > 1-\alpha > a(R_2)^3/(R_3)^2 \tag{22}$$

to hold. Here expressions 17 and 18 imply that $j^* = 3$. The effects of such a transition are exactly analogous to those of a transition from $j^* = 1$ to $j^* = 2$. The steady-state rate of return on savings must rise, as a reduction in transactions costs raises the internal rate of return (net of transactions costs) on all investment technologies. The volume of equity market activity also rises, or, in other words, $\theta^{3,0} < \theta^{2,0}$ necessarily holds.[4] The steady-state capital stock is given by $k = R_3(1-\alpha)^2\,\theta^{3,0}b$. If $R_3(1-\alpha)^2 > R_2(1-\alpha)$, then again the implications for the capital stock are ambiguous. The reduction in transactions costs is itself conducive to capital formation, but, as before, savings are diverted away from initiation of new capital investment into the purchase of existing equity. For transactions cost levels that make technology 3 just marginally preferred to technology 2, the latter effect must dominate. The former effect may dominate for yet lower levels of transactions costs.

As long as α satisfies expression 22, further reductions in α raise the internal rate of return on investment, increase the level of equity market activity, and raise $R_3(1-\alpha)^2\,\theta^{3,0}$. Thus, the steady-state capital stock rises with reductions in the costs of financial transactions.

As α is reduced further, the equilibrium maturity of capital investments can continue to rise, and all of the factors we have noted previously will come into play. However, if $1 > a(R_{J-1})^J/(R_J)^{J-1}$ holds, low enough transactions costs imply that $j^* = J$. Here further reductions in transactions costs cannot raise the gestation period of investments, and therefore necessarily increase the capital stock. Although the increase in equity market activity means that less savings is being placed in new capital investment, this effect never dominates the increased efficiency of capital markets as long as j^* is unaltered.

When reductions in transactions costs increase j^*, however, they result in discrete increases in the volume of equity market activity.[5] Thus, even though the net-of-transactions-cost productivity of all capital investment technologies

4. See Bencivenga, Smith, and Starr (1996) for a formal proof of this assertion.

5. Under the assumptions made here, j^* is nonincreasing in α. This result does not depend on any of the current simplifying assumptions. See Bencivenga, Smith, and Starr (1996) for a more general treatment.

rises, enough savings can be diverted away from new capital investment so that lower transactions costs are actually—over some range—detrimental to capital formation.

Admittedly, this result has been obtained by imposing a variety of assumptions, for example the condition on the parameters $(R_1, R_2, \ldots, R_J)$ stated in expression 18. However, the same conclusions survive when many of our assumptions are generalized. For example, if expression 18 is relaxed for some capital production technologies, it will still be true that the equilibrium maturity length of capital investments is nonincreasing with transactions costs, and that reductions in transactions costs necessarily raise the rate of return on savings and increase the volume of equity market activity. The primary consequence of relaxing expression 18 is merely that, when expression 18 fails, some capital investment technologies could never be used in a steady-state equilibrium. Indeed, if expression 18 fails to hold for all capital production technologies, then either $j^* = 1$ or $j^* = J$ must hold. The former will obtain for high enough transactions costs and the latter will obtain for low enough transactions costs.

Steady-State Welfare

All young agents save their young-period wage, which, under our assumptions, is independent of the capital stock. These agents then consume their interest income, so that steady-state welfare is proportional to the rate of return on savings. Transactions cost reductions always increase the internal rate of return on savings, net of transactions costs, and hence always raise this rate of return. Thus, transactions cost reductions necessarily increase steady-state welfare.[6]

V. Transactions Costs as Pure Rents

In this section we analyze the same set of issues we did earlier under the assumption that transactions costs represent pure fees paid to a broker, a market maker, or the government. Thus, although the fees associated with transactions represent costs to equity market participants, these fees no longer represent a social resource loss. For simplicity, we assume that the fees collected are simply rebated to old agents as a lump sum; we can think of this as corresponding to a situation where all old agents are given equal shares in a brokerage firm or where the government rebates the revenue it collects as a lump sum.

The assumption that resources collected in the form of fees or taxes are rebated to old agents prevents a transfer of the proceeds from those who bear these costs—by assumption, sellers (or old agents)—to those who do not—by assumption, buyers (or young agents). A transfer of resources from old to young agents would, under our assumptions, raise the aggregate savings rate and, in and of itself, constitute a stimulus to capital formation. Instead, we wish to isolate the effects of transactions costs alone. Therefore we rebate the proceeds

6. This assertion would not hold so generally if the wage rate depended on the capital stock. See Bencivenga, Smith, and Starr (1996).

of fee or tax collections to those who pay the fees or taxes. Given our preference assumptions, the result is that savings patterns are unaltered by the existence of fees or taxes.

If the transactions fees we analyze are interpreted as payments received by a broker or market-maker, we assume that none of the labor of these agents is diverted away from goods production when young. This reinforces the notion that there are (in this section) no social resource costs associated with the transactions process. If the fees paid are received by the government, then it is permissible to think of them as negative, a situation corresponding to that in which the government subsidizes activity in capital markets. Many developing country governments do act to subsidize the formation of equity markets (Fry 1988); we analyze the consequences of this activity in this section.

As we did in the previous section, we assume that there is a constant fee $\alpha \leq 1$ levied on transactions. (We no longer impose $\alpha \geq 0$.) We also assume—in consonance with our earlier formulation—that there are no fees associated with the initiation of new capital investments, or with transactions in factor markets. Thus, $\alpha^{j,0} = \alpha^{j,j} = 0$, for all j.

Steady-State Equilibrium Conditions

The fact that transactions costs may not represent a social resource loss does not affect most of the steady-state equilibrium conditions. Indeed, these remain as above, with two exceptions. First, since transactions costs no longer consume capital, equation 14 must be replaced by

$$k = R_{j^*}\, \theta^{j^*,0} b. \tag{23}$$

Second, transactions costs no longer erode the supply of CIP. Thus, equation 10 is supplanted by the condition

$$\theta^{j^*,h}\, P^{j^*,h} = \theta^{j^*,0}; \quad h = 0, \ldots, j^* - 1. \tag{24}$$

Note that equations 11 and 24 imply that

$$\theta^{j^*,h} = \theta^{j^*,0}\, [\gamma/(1-\alpha)]^h; \quad h = 0, 1, \ldots, j^* - 1. \tag{25}$$

Equation 25 is equation 12, corrected for the fact that transactions costs now represent a transfer between agents, rather than a social resource loss. Equations 9 and 25 now determine $\theta^{j^*,0}$, and equation 23 gives the steady-state equilibrium capital stock.

As before, technology j bears a higher internal rate of return than technology $j-1$ if and only if equation 17 is satisfied. Thus, the level of transactions costs determines the equilibrium choice of investment technology, as well as the internal rate of return on savings. From equations 9 and 25, the internal rate of return on savings determines the fraction of savings going into the initiation of

new capital investment ($\theta^{j^*,0}$), which in turn determines the steady-state capital stock (k). Note that when transactions costs do not represent social resource costs, they affect the steady-state capital stock and output level only through their effects on the equilibrium maturity of capital investment (j^*) and the portfolio weight ($\theta^{j^*,0}$) attached to new capital investment.

We now wish to investigate how the steady-state capital stock, as well as other equilibrium quantities, vary with the transactions cost parameter α. To simplify the exposition, we focus on the case $J = 2$. When there are only two technologies for producing capital, equation 17 implies that $j^* = 2$ holds if and only if

$$1 - \alpha \geq a(R_1)^2/R_2. \tag{26}$$

Equation 26 describes how the equilibrium choice of capital production technology varies with α.

When equation 26 fails, $j^* = 1$ holds, as does $\theta^{1,0} = 1$. Equation 23 implies that $k = bR_1$. When equation 26 holds, $j^* = 2$, and equations 9 and 25 imply that

$$\theta^{2,0} = \{1 + [aR_2/(1 - \alpha)]^{0.5}\}^{-1}. \tag{27}$$

In this case, equations 23 and 27 determine k.

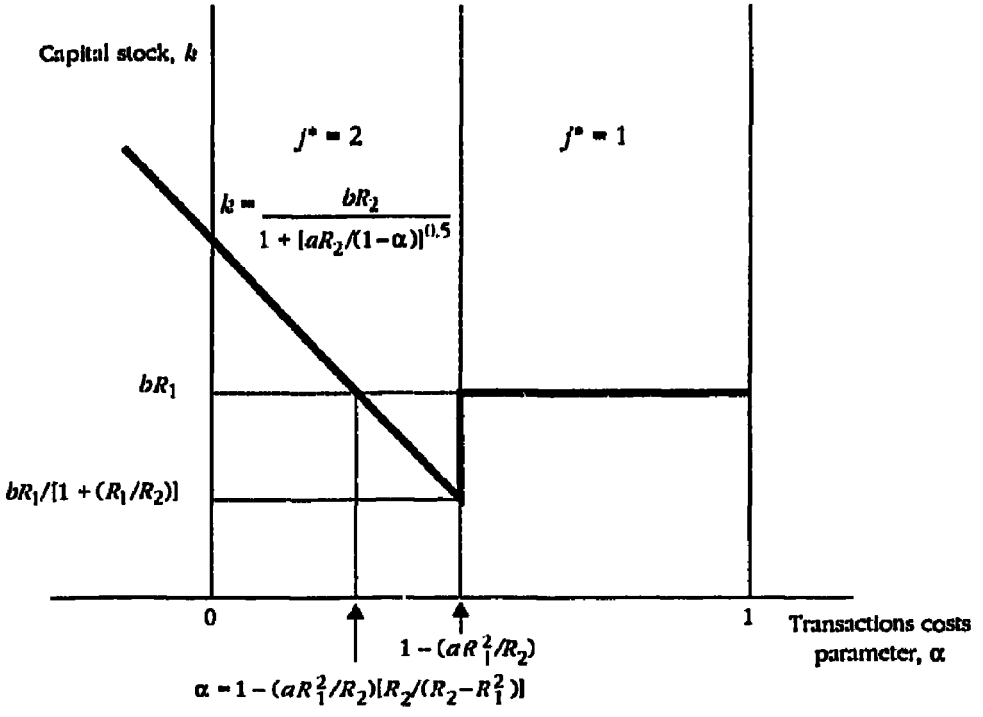
Evidently, for all values of α violating equation 26, the steady-state capital stock is independent of the level of transactions costs, there is no equity market activity, and the rate of return on savings is simply aR_1. When α satisfies equation 26, by contrast, $j^* = 2$ holds. Now we can see that $\theta^{2,0} < 1$, so that equity markets are active, and that $\theta^{2,0}$ is decreasing in α. Thus, when transactions costs are pure fees, a reduction in transactions costs raises the fraction of savings invested in the initiation of new capital investments. As is apparent from equation 23, reductions in transactions costs—once equation 26 is satisfied—necessarily raise the steady-state capital stock.

However, as $(1 - \alpha)$ transits from being just below $a(R_1)^2/R_2$ to being just above it, the economy moves from a situation with $\theta^{1,0} = 1$ to a situation with $\theta^{2,0} < 1$. Hence, transitions in the equilibrium choice of investment technology will be associated with diversions of savings away from investment and, as before, it is possible to show that if technology 2 is only slightly preferred to technology 1, the steady-state capital stock will be smaller than it could be if technology 1 were in use. Figure 1 depicts the steady-state relationship between k and α. The steady-state equilibrium capital stock with $j^* = 2$ is no less than that with $j^* = 1$ if and only if

$$\alpha \leq 1 - (aR_1^2/R_2)\,[R_2/(R_2 - R_1)]^2 < 1 - (aR_1^2/R_2). \tag{28}$$

Expression 28 describes how low α must be in order for the use of technology 2 not to be associated with a reduction in the steady-state equilibrium capital stock.

Figure 1. *The Steady-State Relationship between the Capital Stock and the Transactions Costs Parameter*



Note: At low transactions costs, long-gestation investment technologies are used. The lower the transactions costs (for $j^* = 2$), the higher the capital stock. However, for transactions costs just below those that make technology 1 preferred to technology 2, the capital stock is lower than it would be with $j^* = 1$. When $\alpha > 1-(aR_1^2/R_2)$, $j^* = 1$. When $\alpha < 1-(aR_1^2/R_2)$, $j^* = 2$. Here k is decreasing in α.

Steady-State Welfare

We want to know how the choice of α, which might reflect a conscious policy decision, affects the level of steady-state welfare. The analysis of this issue requires the consideration of two factors. First, since the real wage rate is just b, and since all young-period income is saved, one component of old-period consumption is simply γb. Moreover, since $\gamma = \max\{aR_1, [aR_2(1-\alpha)]^{0.5}\}$, the choice of a transactions fee can affect γ. Second, the choice of α can affect the lump-sum transfer received by old agents. Recall that the real value of financial transactions per capita is given by $b(1-\theta^{j^*,0})$. In addition, all agents pay a fee of α per transaction, with transactions measured in real terms. Thus, the transfer received by an old agent in real terms is given by $\alpha b(1-\theta^{j^*,0})$, and steady-state welfare is then

$$U = b\max\{aR_1, [aR_2(1-\alpha)]^{0.5}\} + \alpha b(1-\theta^{j^*,0}).$$

If $j^* = 1$, that is, if $\alpha > 1-(aR_1^2/R_2)$, then no financial transactions occur, $\theta^{j^*,0} = \theta^{1,0} = 1$, and steady-state utility is just $U_1 = baR_1$. Alternatively, if $j^* = 2$, some

financial transactions occur (as described by equation 27), and transactions fees are paid. The net result is that steady-state welfare is described by the expression

$$(29) \qquad U_2(\alpha) \equiv b[aR_2(1-\alpha)]^{0.5} + \alpha b(1 - 1/(1 + [aR_2/(1-\alpha)]^{0.5})) = b(aR_2)^{0.5}\{1 + [aR_2(1-\alpha)]^{0.5}\}/\{(1-\alpha)^{0.5} + (aR_2)^{0.5}\}.$$

It is straightforward but tedious to show that steady-state welfare is increasing in the cost of transacting—that is, $U_2'(\alpha) \geq 0$ holds—if and only if the internal rate of return on technology 2 is lower than the steady-state rate of growth (that is, $aR_2 \leq 1$ holds). When the latter condition is satisfied, higher transactions fees actually lead to higher steady-state welfare levels, so long as any secondary market transactions are undertaken. (Such transactions will be undertaken if and only if $1 - \alpha > aR_1^2/R_2$.) Such a result should be intuitive, since higher transactions costs in this case discourage low-return investments. In particular, then, if $j^* = 2$ and $aR_2 < 1$ hold, there is a socially excessive volume of equity market activity. It is therefore desirable to reduce the amount of this activity, as argued by Keynes and Tobin. However, there remains the issue of whether it is desirable to drive the level of financial transactions to zero, which requires setting $\alpha > 1 - (aR_1^2/R_2)$. At levels of α this high, $j^* = 1$, and there are no financial market transactions.

We now describe when it is and is not desirable to eliminate secondary capital markets in the case $aR_2 < 1$. We then show what happens when the internal rate of return on technology 2 exceeds the steady-state growth rate, which obtains when $aR_2 > 1$.

CASE 1: $aR_2 < 1$. In this case, $U_2(\alpha)$ is maximized by setting $\alpha = 1 - (aR_1^2/R_2)$; this is the largest value of α consistent with $j^* = 2$. Evaluating equation 29 at this value of α yields

$$(30) \qquad U_2[1 - (aR_1^2/R_2)] = b(1 + aR_1)/[1 + (R_1/R_2)].$$

Then $U_2[1 - (aR_1^2/R_2)] \geq U_1 = baR_1$ holds if and only if

$$(31) \qquad 1 \geq aR_1^2/R_2,$$

or, that is, if and only if the value of α that maximizes steady-state welfare with $j^* = 2$ is positive. Thus, if $aR_2 < 1$ and equation 31 holds, steady-state welfare is maximized by setting $\alpha = 1 - (aR_1^2/R_2) \geq 0$, or, in other words, by setting fees as high as possible without eliminating secondary capital markets. In particular, when $aR_2 < 1$ and equation 31 holds, there is a socially excessive volume of transactions because capital is overaccumulated, in the standard Diamond (1965) sense. It is then attractive from a policy perspective to reduce capital formation, which can be done by increasing transactions fees (see figure 1). However, tech-

nology 2 still has a higher internal rate of return than technology 1, and hence it should be used. Secondary capital markets are therefore required.

When $aR_2 < 1$ and equation 31 fails, the use of technology 2 is socially inefficient in and of itself. Agents can be induced to use the more efficient technology by taxing equity market activity at a high enough rate and, indeed, one which eliminates this activity altogether.

When $aR_2 < 1$ holds, and if technology 2 is in use when $\alpha = 0$, our analysis indicates that there will be a socially excessive amount of financial market activity. Under these conditions, the arguments made by Keynes and Tobin for taxing this activity would have merit.

We might note that the context in which this situation arises is somewhat unconventional. The internal rate of return to physical investment is negative, but investment is still attractive because it represents the principal private means of saving. An implication of this observation is that there is, socially speaking, oversaving, which can be partially corrected by taxing financial transactions.

CASE 2: $aR_2 > 1$. When $aR_2 > 1$ holds, $U_2(\alpha)$ is decreasing in α, and is therefore maximized by setting α arbitrarily small. From equation 29,

$$\lim_{\alpha \to -\infty} U_2(\alpha) = baR_2.$$

If $R_2 > R_1$, then steady-state welfare maximization dictates setting $j^* = 2$, and maximally subsidizing equity market activity. In particular, technology 2 is more productive than technology 1, and incentives should be created to use it as intensively as possible. If, instead, $R_1 > R_2$ holds, it is technology 1 that is socially most productive. In this event, transactions fees should be set high enough to discourage secondary market activity, along with the use of technology 2. That outcome can be attained, as in case 1, by setting $\alpha > 1 - (aR_1^2/R_2)$. Note that the case for taxing secondary market activity need not rely on either technology's having a particularly low internal rate of return.

SUMMARY. As the examples just given indicate, it can be desirable to either subsidize or heavily tax agents transacting in equity markets. It will be optimal to confront agents undertaking such transactions with relatively heavy fees when $aR_2 < 1$ or, in other words, when the internal rate of return on technology 2 (at a zero transactions cost level) is lower than the real growth rate of the economy. It will also be optimal to impose high fees in these markets when $aR_2 > 1$ and $R_1 > R_2$ both hold. Thus, even if the internal rate of return on technology 2 exceeds the rate of growth (with no transactions costs), it is undesirable to use technology 2 if it is less productive than technology 1. By contrast, when $aR_2 > 1$ (the internal rate of return on technology 2 exceeds the growth rate) and $R_2 > R_1$ (technology 2 is more productive than technology 1), there is good reason to subsidize equity market activity.

These observations suggest a criterion for determining when it is desirable to tax (or raise the costs faced by) equity market participants. A socially excessive volume of financial market transactions is undertaken in economies with relatively high levels of equity market activity ($j^* = 2$, so that $\theta^{2,0} < 1$), and with real interest rates (gross of transactions costs) lower than the long-run real rate of growth of the economy ($aR_2 < 1$).

VI. Some Final Thoughts

How does the efficiency of an economy's capital resale or equity markets—as measured by the costs of transacting in them—affect the economy's efficiency in producing physical capital and, through this channel, final goods and services? In order to propose an answer to this question, we have followed Hicks (1969) in emphasizing the role of equity markets in providing liquidity to holders of long-lived and inherently illiquid capital. As the efficiency of an economy's capital markets increases (that is, as transactions costs fall), the general effect is to cause agents to make longer-term, and hence more transactions-intensive, investments. The result is a higher rate of return on savings, as well as a change in its composition. These general equilibrium effects on the composition of savings cause agents to hold more of their wealth in the form of existing equity claims and to invest less in the initiation of new capital investments. As a result, a reduction in the resource losses suffered in the transactions process can cause the capital stock either to rise or to fall, and we have described conditions under which each situation will obtain. However, a general point that bears emphasis is that a reduction in transactions costs will typically alter the composition of savings and investment, and that any analysis of the consequences of such changes must take these effects into account.

It has also often been proposed that a significant fraction of financial market transactions are socially unproductive, and that transactions taxes should be imposed to reduce the level of financial market activity. We have put forward a criterion for verifying when such taxes might be imposed, and we have indicated that to tax financial market transactions when long-gestation investments are relatively productive and when real interest rates are relatively high is not desirable.

One topic that we have not addressed is the role for financial intermediation in the kind of environment we have considered. If intermediation does not allow transactions to be undertaken at a lower cost, then clearly it has no role here. However, if intermediaries can issue liabilities that are traded more cheaply than their underlying assets, then clearly there can be a role for banks. These banks would hold relatively illiquid, long-maturity assets, and would issue relatively liquid, short-maturity liabilities. This is obviously a natural function of banks. The integration of financial intermediaries into the analysis is an important topic for future investigation.

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A Measure of Stock Market Integration for Developed and Emerging Markets

Robert A. Korajczyk

A wide array of official capital controls across countries makes it difficult to perform cross-sectional analysis of the effects of market segmentation. This article constructs a measure of deviations from capital market integration that can be consistently applied across countries. It measures the deviations of asset returns from an equilibrium model of returns constructed assuming market integration. Applying the measure to stock returns from twenty-four national markets indicates that market segmentation tends to be much larger for emerging markets than for developed markets, and that the measure tends to decrease over time. Along several dimensions, the proposed measure yields results that are consistent with reasonable priors about the relations between effective integration and explicit capital controls, capital market development, and economic growth.

In financially integrated markets, capital should flow across borders in order to ensure that the price of risk—the compensation investors receive for bearing risk—is equalized across assets. Conversely, if capital controls or other forces prevent free movement of capital across borders, then it is likely that different economies will demand different levels of compensation for risk. In some markets, direct measures of the severity of capital controls are available. For example, some countries have dual classes of common equity. Restricted equity can be held only by domestic residents, but unrestricted equity can be held by both domestic and foreign investors. The price differential between restricted and unrestricted shares that have identical payoffs is a direct measure of the effects of capital controls (Hietala 1989; Bailey and Jagtiani 1994). Similarly, differences between official and black market exchange rates, between official and offshore interest rates, or between the market price and the net asset value of closed-end country mutual funds can be used to measure the effects of capital controls (Bonser-Neal and others 1990).

A difficulty arises when attempting intercountry comparisons of the severity of capital controls because different countries may have different mechanisms

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for restricting capital movements. For example, a country that prohibits all foreign investment does not have unrestricted shares whose prices can be compared to restricted shares. In addition, countries without any formal restrictions against foreign investment will not have restricted shares trading. Although the former case is ostensibly one of segmented markets and the latter case is one of integrated markets, there may be methods by which investors circumvent the restrictions in the former case, and there may be informal barriers that lead to actual segmentation in the latter case (such as less stringent accounting standards or insider trading regulations).

Given the difficulty of directly comparing the effects of the wide array of official capital controls across countries, a measure of deviations from capital market integration that can be consistently applied across countries is important for cross-sectional analyses of the effects of market segmentation. The approach taken here is to measure deviations from integration by measuring the deviations of asset returns from an equilibrium model of returns constructed assuming market integration.

Testing the law of one price (LOP) in financial markets requires a model that identifies the type of risk that is important to investors. The model used here is the International Arbitrage Pricing Theory (IAPT). An advantage of an approach that relies on asset prices or returns is that effective barriers to capital flows, regardless of their source, should lead to actual deviations from LOP. Statutory barriers to capital flows that are ineffective should not lead to pricing deviations. Ostensibly free markets with large nonstatutory barriers (such as large differentials in information costs) should exhibit pricing deviations.

A disadvantage of the IAPT approach is that it relies on a particular specification of the asset pricing model. If the asset pricing model is incorrect, then pricing errors will be observed even when markets are integrated. Also, regime shifts, such as those that would occur when an economy moves from being segmented to integrated, will lead to changes in the asset pricing relation and to large short-term measured deviations from LOP.

The next section contains a brief description of the asset pricing model. Section II relates pricing errors to the existence of deviations from the law of one price induced by market segmentation. Section III discusses estimation of pricing errors. Section IV addresses the effects of regime shifts. Section V describes the data. The techniques used to construct factor-mimicking portfolios are described in section VI. The empirical measures of deviations from the law of one price are described in section VII. Section VIII presents conclusions and suggestions for future work.

I. The Multifactor Asset Pricing Model

The logic behind the Arbitrage Pricing Theory (APT; Ross 1976) and international extensions (Ross and Walsh 1983; Solnik 1983; Levine 1989; and Clyman,

Edelson, and Hiller 1991) is that there are a small number of risks that are common to most assets, for which investors command risk premiums. Risk that is specific to one asset (or a small set of assets) is diversifiable and, therefore, investors do not demand compensation for this risk.

The Case without Diversifiable Risk

The arbitrage argument can be most easily illustrated in the case where there is no diversifiable, or idiosyncratic, risk. Assume that the realized returns on securities are given by the following linear factor model:

$$r_{j,t} = \mu_{j,t} + b_{j,1}\delta_{1,t} + \ldots + b_{j,k}\delta_{k,t} \tag{1}$$

where $r_{j,t}$ denotes realized returns on asset j at time t, $b_{j,i}$ is the sensitivity of asset j to the ith common source of risk, $\delta_{i,t}$ is the realization of risk factor i in period t, and $\mu_{j,t} = E_{t-1}(r_{j,t})$ is the expected return on asset j. In this case where there is no asset-specific risk, there could be a riskless, costless arbitrage opportunity unless:[1]

$$\mu_{j,t} = \lambda_{0,t} + b_{j,1}\lambda_{1,t} + \ldots + b_{j,k}\lambda_{k,t} \tag{2}$$

where $\lambda_{0,t}$ is the return on a riskless asset and $\lambda_{i,t}$ is the risk premium on the ith source of risk. More generally, expected returns could be expressed as

$$\mu_{j,t} = \alpha_j + \lambda_{0,t} + b_{j,1}\lambda_{1,t} + \ldots + b_{j,k}\lambda_{k,t} \tag{3}$$

where α_j represents the pricing error, or deviation of expected returns from the predictions of the multifactor asset pricing model.

In this case, α_j must equal zero for all j so that no arbitrage opportunities are possible. Let $\boldsymbol{\mu}' = (\mu_{1,t}, \mu_{2,t}, \ldots \mu_{n,t})$, $\boldsymbol{\alpha}' = (\alpha_1, \alpha_2, \ldots, \alpha_n)$, $\boldsymbol{\lambda}' = (\lambda_0, \lambda_1, \ldots, \lambda_k)$, and $B = (\iota, b)$ where ι is an n-vector of ones and b is an $n \times k$ matrix whose (j, i) element is $b_{j,i}$. In matrix notation, equation 3 can be expressed as:

$$\boldsymbol{\mu} = \boldsymbol{\alpha} + B\boldsymbol{\lambda}.$$

The value of $\boldsymbol{\lambda}$ that minimizes the pricing error (in terms of minimizing the sum of squared pricing errors) is $\boldsymbol{\lambda} = (B'B)^{-1}B'\boldsymbol{\mu}$ and $\boldsymbol{\alpha} = [I - B(B'B)^{-1}B']\boldsymbol{\mu}$, where I is an $n \times n$ identity matrix. Note that $\boldsymbol{\alpha}'B = 0$, so that a portfolio formed by choosing the portfolio weight on asset i to be α_i is costless (since $\boldsymbol{\alpha}'\iota = 0$) and riskless (since $\boldsymbol{\alpha}'b = 0$, which implies that the portfolio has no exposure to the risk factors). The expected return on the portfolio is

$$\boldsymbol{\alpha}'\boldsymbol{\mu} = \boldsymbol{\alpha}'\boldsymbol{\alpha} + \boldsymbol{\alpha}'B\boldsymbol{\lambda} = \boldsymbol{\alpha}'\boldsymbol{\alpha} + 0 > 0.$$

1. This requires the assumptions that there are more assets than sources of risk ($n > k$) and that the $n \times k$ matrix of sensitivities, b—where the (j,i) element of b is $b_{j,i}$—has rank k.

Thus, this portfolio is riskless and costless and has a strictly positive return. This is an arbitrage opportunity that will be exploited. In order to avoid arbitrage opportunities, the pricing relation given by equation 2 must hold. That is, $\alpha_j = 0$ for all j in equation 3.

The Case with Diversifiable Risk

The expression for asset returns in equation 1 assumes that there are only k worldwide factors that influence all asset returns. To generalize this specification to include uncertainty that is asset specific, or diversifiable, returns will be expressed as:

$$r_{j,t} = \mu_{j,t} + b_{j,1}\delta_{1,t} + \ldots + b_{j,k}\delta_{k,t} + \varepsilon_{j,t} \tag{4}$$

where $\varepsilon_{j,t}$ is the uncertainty in asset j's returns that is not explained by the worldwide factors. Ross (1976) assumes that there are an infinite number of assets and that the asset-specific risks are uncorrelated across assets, that is, $\text{corr}(\varepsilon_{j,t}, \varepsilon_{m,t}) = 0$ for $j \neq m$. Ross notes that weaker conditions also imply that the risk embodied in the term $\varepsilon_{j,t}$ is diversifiable (Chamberlain and Rothschild 1983; Connor and Korajczyk 1993).

Because each asset has its own unique, or asset-specific, risk, it will not be possible to form riskless portfolios from a finite set of risky assets. However, an asymptotic arbitrage opportunity can be defined as one in which it is possible to construct a sequence of portfolios whose expected returns approach infinity and whose variance approaches zero as the number of assets, n, approaches infinity. The absence of such arbitrage opportunities implies that the sum of squared pricing deviations ($\alpha_1^2 + \alpha_2^2 + \ldots + \alpha_n^2$) must remain finite as n approaches infinity (Ross 1976; Huberman 1982).

The fact that the sum of squared pricing deviations must remain finite implies (in an economy with an infinite number of assets) that most of the pricing errors must be small and that equation 2 holds as an approximation for most assets:

$$\mu_{j,t} \approx \lambda_{0,t} + b_{j,1}\lambda_{1,t} + \ldots + b_{j,k}\lambda_{k,t}. \tag{5}$$

Further restrictions can be placed on the economy to get the pricing model to hold as an equality (Connor 1984; Constantinides 1989). I will assume that, under the null hypothesis of financial market integration, either such restrictions hold or the approximation is good enough to ignore the approximation error in equation 5.

II. Market Segmentation and Pricing Errors

Although the method of estimating the risk factors is described more fully later, it is useful at this juncture to point out that capital market segmentation prevents cross-market arbitrage and, therefore, prevents the prices of risk (vec-

tor λ) from being equated across markets. Capital market segmentation will lead to pricing errors relative to risk factors constructed assuming capital market integration. This is illustrated by a hypothetical world consisting of two markets (a and b) that are influenced by the same single-world factor. That is, assets in each economy satisfy a one-factor pricing model. However, because the markets are segmented, the parameters of the asset pricing model are different across markets. The expected returns on asset j in the two markets are given by

$$\mu^a_{j,t} = \lambda^a_0 + b^a_{j,1}\lambda^a_1$$

$$\mu^b_{j,t} = \lambda^b_0 + b^b_{j,1}\lambda^b_1$$

with $\lambda^a_0 \neq \lambda^b_0$ and $\lambda^a_1 \neq \lambda^b_1$. However, the implied riskless return and world factor risk premium estimated by pooling the two markets together and assuming (incorrectly) that they are integrated will be (assuming the markets are of equivalent size and have the same distribution of sensitivities) $\bar{\lambda}_0 = (\lambda^a_0 + \lambda^b_0)/2$ and $\bar{\lambda}_1 = (\lambda^a_1 + \lambda^b_1)/2$. That is, estimating an integrated model when the null is incorrect will lead to estimated risk premiums that are weighted averages of the true segmented risk premiums. This implies that for economy a, the measured pricing deviation (relative to a model estimated assuming integration) of asset j is

$$\alpha^a_j = (\lambda^a_0 - \bar{\lambda}_0) + b^a_{j,1}(\lambda^a_1 - \bar{\lambda}_1) \tag{6}$$

and for economy b, the measured pricing deviation of asset j is

$$\alpha^b_j = (\lambda^b_0 - \bar{\lambda}_0) + b^b_{j,1}(\lambda^b_1 - \bar{\lambda}_1). \tag{7}$$

Thus, the mispricing parameters, α, provide a direct measure of deviations from the LOP.

Although the example assumes a single common factor, the results extend to any number of common factors, under the assumption that the IAPT would be the appropriate pricing model in an integrated world. That is, different prices of risk for common factors will lead to nonzero alphas relative to the IAPT.

Under certain conditions, the pricing errors relative to a factor model might actually miss market segmentation. This could occur if there are local factors in one or more countries that are priced locally (because of segmentation) but not priced in other countries. In addition, market segmentation could be missed if (1) the local factors are unrelated to asset returns in the other countries (that is, the factors are not common in that the sensitivities of nonlocal assets to the local factors are zero) and (2) the local factors are included in the asset pricing model. To illustrate this situation, consider a hypothetical world consisting of two markets (a and b) that are influenced by the same single-world factor. Country b's assets are sensitive to a local factor that is priced in b but not in a. That is, assets in each economy satisfy the factor pricing models

$$\mu_j^a = \lambda_0^a + b_{j,W}^a \lambda_W$$

$$\mu_j^b = \lambda_0^b + b_{j,W}^b \lambda_W + b_{j,L}^b \lambda_L^b$$

where W and L stand for world and local factors. Here I have assumed that the two economies have the same price of risk for the world factor but different prices for the local factor. Applying a two-factor model to these economies using the world and local factors will not reveal a pricing deviation even though the nonzero price of the local factor in country b is due to market segmentation. The pricing deviation will be undetected because assets in economy a have zero sensitivity to the local factor.

Failure to reject integration in this case hinges on including the local factor in the model. If only the world factor, and not the local factor, is included in the model, then the pricing errors for country b's assets will be nonzero and should lead to a rejection of the market integration hypothesis.

An alternative approach to testing the law of one price is to estimate the price of risk for different subsets of securities and test the hypothesis that the price of risk is equal across subsets. This is done within a single country in Roll and Ross (1980), who test for the equality of the zero-beta return, λ_0, across subsets, and in Brown and Weinstein (1983), who test for the equality of all risk premiums. In an international setting, subsetting by country allows an estimate of country-specific prices of risk. This is done by Cho, Eun, and Senbet (1986); Gultekin, Gultekin, and Penati (1989); and Harvey (1991).

III. Estimation of Pricing Errors

The pricing deviations discussed in sections I and II were expressed as discrepancies between an asset's true expected return and the expected return implied by the asset pricing model. However, the ex post return on the asset is observed, not the true expected returns on the asset. From equation 4, the asset's ex post return deviates from its expected return because of shocks from the common factors and asset-specific shocks.

Let T be the number of time periods for observed asset returns; n the number of securities; r^n the $n \times T$ matrix of excess returns on the assets; F the $k \times T$ matrix of realized factors plus risk premiums $F_{i,t} = \delta_{i,t} + \lambda_{i,t}$, where $F_{i,t}$ is the excess return on the portfolio that mimics factor i in period t; b^n the $n \times k$ matrix of sensitivities, or factor loadings; and ε^n the $n \times k$ matrix of idiosyncratic (asset specific) returns. Equations 2 and 4 imply that

$$r^n = b^n F + \varepsilon^n \tag{8}$$

with $E(F\varepsilon^{n\prime}) = 0$, $E(\varepsilon^n) = 0$, and $E(\varepsilon^n \varepsilon^{n\prime}/T) = V^n$.

The assumption of a factor structure and the asset pricing theory (equations 2 and 4) imply that there is a restriction on a multivariate regression of asset

returns on a constant and the excess returns on factor-mimicking portfolios, which is embodied in equation 8. The restriction is that the intercepts are jointly equal to zero. That is, in the multivariate regression

$$r^n = \alpha^n + b^n F + \varepsilon^n \tag{9}$$

the vector of intercept terms, α^n, contains the pricing deviations. If markets are integrated and the multifactor asset pricing model describes asset expected returns, α^n should be equal to zero. However, if risks are priced differently across economies, these pricing differences will lead to nonzero values of α^n. Thus, one measure of financial integration is the size of the intercept terms in the multivariate regression (equation 9).

IV. Asset Pricing Dynamics and Regime Shifts

The theoretical pricing errors in equations 6 and 7 are derived assuming that each economy is in a steady-state segmented equilibrium each period. However, the recent trend in most markets is movement from segmented markets toward integrated markets. This trend implies that the asset pricing regimes will shift from segmented to integrated regimes and that the parameters in equation 9 are likely to change through time. In the long run, increasing integration should lead to smaller pricing errors (zero pricing errors in the limit approaching complete integration). However, in the short run, measured pricing errors might be larger as asset prices change because of the changes in asset pricing regimes. Since the movement from a completely segmented market to a completely integrated market is rarely smooth, the asset pricing dynamics during the transition phase are difficult to characterize. In particular, if market participants anticipate the liberalization from a segmented to integrated market, asset expected returns in the transition period are not likely to be set according to models that assume complete segmentation or complete integration.

The appendix contains a simple numerical example of an unanticipated regime shift. Although the numerical results are clearly dependent on the numbers picked for the example, the fact still remains that shifts across pricing regimes are likely to cause changes in the parameters (α and b) and cause large measures of mispricing in the short run. Also, these shifts in pricing should occur as shifts in regimes become anticipated. Thus, the effects of regime shifts could be spread over a longer period as the market updates its assessment of changes in capital controls. The unconditional approach in equation 9 ignores shifts in the parameters and the transition dynamics. Clearly, if the nature of pricing errors was constant through time, the full time-series sample should be used to estimate α. Given the importance of regime shifts, I investigate the behavior of estimated mispricing over a sequence of different time periods. This is an admittedly crude method of ac-

commodating nonstationarities such as regime shifts. However, it is a first step toward measuring levels of integration.

Most empirical studies of market integration assume that the level of segmentation is constant over the estimation period. A notable exception is Bekaert and Harvey (1995). They propose a regime switching model in which markets stochastically move between segmented and integrated regimes. In addition, the probability of a regime shift is allowed to change as a function of predetermined instrumental variables. Within a regime, the model assumes that assets are priced as though agents expect to be in that regime forever. Although this does not admit an investigation of the pricing effects of anticipated regime shifts, it takes seriously the fact that regime shifts happen and that the transition probabilities vary through time.

V. Data Sources and Summary Statistics

Historical monthly data on equity returns for individual stocks trading in twenty emerging markets are from the Emerging Markets Data Base provided by the International Finance Corporation (IFC). The economies covered by the data base are Argentina, Brazil, Chile, Colombia, Greece, India, Indonesia, Jordan, the Republic of Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Portugal, Taiwan (China), Thailand, Turkey, Venezuela, and Zimbabwe. The set of emerging markets is geographically diverse as well as diverse in the severity of capital controls.

The sample of developed equity markets includes stocks from Australia, Japan, the United Kingdom, and the United States. Equity data sources for the developed markets are the Centre for Research in Finance at the Australian Graduate School of Management for Australia, the Japan Securities Research Institute for Japan, the London Share Price Data Base from the London Business School for the United Kingdom, and the Center for Research in Security Prices at the University of Chicago for the United States. The sample includes all assets traded on the Australian Stock Exchange, the New York and American Stock Exchanges, the first section of the Tokyo Stock Exchange, the London Stock Exchange, and the unlisted securities market in the United Kingdom.

Monthly returns, adjusted for dividends and stock splits, are transformed into U.S. dollar returns using end-of-month exchange rates. The emerging markets exchange rates are from the IFC's Emerging Markets Data Base, and the developed markets exchange rates are from IMF (various issues). To compute excess returns, I use the U.S. Treasury Bill returns from Ibbotson Associates (1993).

Data on equity returns and shares outstanding from the IFC's Emerging Markets Data Base were screened for unusual values. Confirmations or corrections of these values were obtained from the IFC. When there is more than one exchange rate system in place within a country, the IFC attempts to obtain a free market rate either from newspapers or from IFC correspondents in each market

(see IFC 1993). There are a few instances, earlier in the sample, when the exchange rates seem too stable to be free market rates, given that black market rates seem to be varying over the same period. This does not appear to be an issue later in the sample.

Construction of the Emerging Markets Data Base began in 1981. Firms were chosen at that time on the basis of 1980 data (Errunza and Losq 1985: 562). Although such a choice poses no particular problems for returns after 1980, there may be a survivorship bias induced for the returns before 1981. That is, firms that disappeared between 1975 and 1980, for example, would not be included in the data base. An actual portfolio strategy might have included those assets in the sample. As shown in table 1, eleven of the twenty emerging markets have data prior to 1981. Errunza and Losq (1985) investigate the issue of survivorship bias in a sample of eight of these emerging markets. They apply the selection criteria to assets as of the beginning of the sample, December 1975. They find that the overlap between this sample and the actual sample in the data base is between 53 and 85 percent. Seven companies that would have been included when applying the selection criteria in 1975 were not trading on the exchanges in 1980. Errunza and Losq argue that the survivorship bias is small in the sample. Although the reported statistics about the overlap of the samples and delistings are suggestive, the extent of the survivorship bias is difficult to estimate without recreating each market's sample with a nonanticipatory inclusion rule over the period from 1975 to 1980. Even if this were done, there is another potential survivorship bias in that the initial set of emerging markets was chosen on the basis of information available in 1980. There may have been markets that would have been included in 1975 that performed poorly between 1975 and 1980 (that is, failed to emerge) and were thus not included in the sample.

Random errors in the individual stock data will clearly induce noise into the estimated mispricing parameters. More systematic errors—such as errors in the exchange rate, which influence the calculated return on all assets in a given economy, or survival biases—will tend to cause false rejection of market integration by inducing nonzero pricing errors in the factor model.

Tables 1 and 2 provide some summary statistics on the emerging markets in the sample. The IFC's Emerging Markets Data Base does not include all of the stocks traded in the emerging markets. Rather, the data base consists of a sample of stocks from each market. The stocks are chosen on the basis of trading activity, capitalization, and diversity across market sectors (see IFC 1993). On average, the stocks in the IFC sample represent 57 percent of the total capitalization of the respective markets.

As illustrated in table 1, the average number of firms ranges from 11 (Zimbabwe) to 66 (Indonesia). The capitalization (as of December 1992) of the stocks included in the data base ranges from $268 million (Zimbabwe) to $66 billion (Mexico and Korea).[2] Average monthly turnover (volume for month t divided by

2. One billion is equal to 1,000 million.

Table 1. *Summary Statistics for Emerging Markets*

Market	Beginning of sample period[a]	Average number of firms	Capitalization as of December 1992 (millions of U.S. dollars)	Trading volume as of December 1992 (millions of U.S. dollars)	Average turnover (monthly percentage)
Emerging market composite[b]	1984	590	401,998	16,535	8.79
Europe and Middle East					
Greece	1975	15	5,377	112	1.05
Jordan	1978	15	1,988	70	1.18
Portugal	1985	20	4,868	52	1.07
Turkey	1975	19	3,872	158	2.54
Latin America					
Latin America composite[b]	1984	176	135,638	3,936	3.24
Argentina	1975	23	14,293	1,112	3.41
Brazil	1975	33	23,200	803	3.40
Chile	1975	25	21,933	96	0.76
Colombia	1984	21	5,107	23	0.49
Mexico	1975	32	66,108	1,806	5.31
Venezuela	1984	14	4,997	96	2.00
Asia					
Asia composite[b]	1984	325	249,191	12,204	10.99
India	1975	36	25,365	364	6.42
Indonesia	1989	66	8,661	260	3.85
Korea, Rep. of	1975	37	66,461	6,007	8.20
Malaysia	1984	52	47,941	773	1.11
Pakistan	1984	52	3,774	33	0.86
Philippines	1984	22	8,167	84	2.13
Taiwan (China)	1984	50	60,454	3,172	23.66
Thailand	1975	17	28,368	1,877	5.38
Africa					
Nigeria	1984	18	797	1	0.05
Zimbabwe	1975	11	268	1	0.35

a. The sample begins at the end of December of the year indicated.
b. Composites are value-weighted portfolios formed from the national market indices.
Source: IFC's Emerging Markets Data Base.

the capitalization of the market in month $t-1$) for the sample period is lowest for Nigeria at 0.05 percent and highest for Taiwan (China) at 23.66 percent.

Table 2 reports some statistics for the return distributions of the IFC emerging market indexes. The average monthly rate of return in U.S. dollars is lowest for Indonesia (–1.02 percent) and highest for Argentina (5.66 percent). The variability of the index returns (standard deviation in table 2) is also quite high. Jordan has the smallest monthly standard deviation, 5.17

Table 2. *Monthly Return and Pricing Error Statistics for Emerging Markets*

Market	Monthly return (percent)			Average pricing errors, $\tilde{\theta}^b$
	Mean	Standard deviation	Autocorrelation coefficient, ρ_1[a]	
Emerging market composite[c]	1.50	6.98	0.16	
			(1.53)	
Europe and Middle East				
Greece	0.62	10.46	0.13	0.85
			(1.89)	
Jordan	0.90	5.17	0.00	2.42
			(0.00)	
Portugal	2.88	14.50	0.29	−10.43
			(2.61)	
Turkey	3.15	21.44	0.23	−4.43
			(1.97)	
Latin America				
Latin America composite[c]	2.60	11.21	0.24	
			(2.40)	
Argentina	5.66	30.00	0.05	−2.73
			(0.77)	
Brazil	1.84	17.39	0.03	−31.29
			(0.41)	
Chile	3.06	11.42	0.17	48.99
			(2.41)	
Colombia	3.64	9.28	0.49	11.01
			(4.79)	
Mexico	2.53	12.86	0.25	10.97
			(3.53)	
Venezuela	2.68	13.66	0.27	2.43
			(2.62)	
Asia				
Asia composite[c]	1.50	7.42	0.01	
			(0.13)	
India	1.68	7.86	0.08	−2.05
			(1.13)	
Indonesia	−1.02	9.40	0.28	−0.01
			(1.71)	
Korea, Rep. of	1.77	9.34	0.00	3.15
			(−0.02)	
Malaysia	1.15	7.61	0.05	2.50
			(0.51)	
Pakistan	1.79	6.70	0.25	0.22
			(2.45)	
Philippines	3.78	11.02	0.34	6.62
			(3.32)	
Taiwan (China)	2.84	15.27	0.07	1.84
			(0.72)	
Thailand	1.86	7.44	0.11	5.33
			(1.63)	
Africa				
Nigeria	0.22	10.54	0.08	[illegible]4
			(0.83)	
Zimbabwe	0.65	9.86	0.14	21.70
			(1.97)	

a. First-order autocorrelation coefficient of market index returns. *t*-statistics are in parentheses.
b. Time-series average of bias-adjusted average squared pricing errors.
c. Composites are value-weighted portfolios formed from the national market indices.
Source: IFC's Emerging Markets Data Base.

percent, while Argentina has the largest monthly standard deviation, 30 percent. By contrast, the S&P 500 portfolio has a monthly standard deviation of 4.46 percent for the period from January 1976 to December 1992 (Ibbotson Associates 1993).

VI. Construction of Factor-Mimicking Portfolios

In order to estimate the level of mispricing, α^n in equation 9, we need to have the matrix F. F contains the time series of excess returns on k portfolios whose innovations are perfectly correlated with the k sources of factor risk. In practice, these excess return portfolios need to be estimated.

To estimate the excess returns on the factor-mimicking portfolios, I use the asymptotic principal components technique of Connor and Korajczyk (1986, 1988). The asymptotic principal components procedure can easily accommodate the large number of stocks in the sample. The procedure assumes that the factor structure is as in equation 4; that the exact multifactor pricing relationship, equation 2, holds; that the conditional factor loadings, $b_{j,t}$, are constant through time for most assets; and that the cross-sectional average asset-specific variance is constant through time. Let Ω^n be the $T \times T$ matrix defined by $\Omega^n = r^{n\prime} r^n / n$ and $\hat{F}^n$ the $k \times T$ matrix of the first k eigenvectors of Ω^n (where $\hat{F}^n$ is an estimate of F, and where r^n and F are as defined in equation 8). Under the assumption that asset returns follow a k-factor model as in equation 4, Connor and Korajczyk (1986) show that $\hat{F}^n$ converges in probability to a nonsingular linear transformation of F as n goes to infinity. Because the sample of equity returns is large, I ignore the estimation error in $\hat{F}^n$. In order to use all available data in the sample, I employ an extension of the principal components technique from Connor and Korajczyk (1988), which does not require that asset returns exhibit continuous time series of returns. This method is designed to avoid a common source of survivorship bias. Although these types of factor portfolios do not fully explain the pricing of international equities, they perform well relative to common alternative models (Korajczyk and Viallet 1989).

I use the returns on all stocks from the twenty-four national stock markets to estimate the factor-mimicking portfolios. For an average month in the period from January 1976 to December 1992, 6,851 firms from the twenty-four markets have available returns.

An alternative approach to implementing international multiple factor models is to specify, ex ante, the identity of the factors. This is the approach taken in Harvey (1995a, 1995b). The factors used in those papers include the return on the proxy for the world market portfolio, the return on a portfolio of currencies, and proxies for changes in commodity and agricultural prices (Harvey 1995a) plus proxies for oil price movements, inflation, and world business cycles (Harvey 1995b). Harvey (1995a) investigates conditional as well as unconditional factor models.

VII. Empirical Measures of Deviations from the Law of One Price

As discussed in section III, the estimated IAPT pricing errors (that is, the intercepts, α, in a regression of asset returns (in excess of a riskless asset) on the excess returns of a factor-mimicking portfolio) are a measure of segmentation. The estimation treats the pricing errors as constant over the sample period even though there have been significant liberalizations of capital controls in many economies. Therefore, I estimate pricing errors over a sequence of time periods and attempt to characterize the time-series behavior of the mispricing parameters. Although it is somewhat schizophrenic to assume α is fixed for estimation but then to look at the time series of α over different sample periods, the exercise should provide some information about the behavior of pricing errors (see Foster and Nelson 1991 for an analysis of such "rolling regressions").

My approach is as follows:

1. Estimate factor-mimicking portfolios using the asymptotic principal components procedure. The asymptotic principal components procedure uses data on all of the equities traded in the twenty-four markets studied here to estimate factor-mimicking portfolios for the entire sample period.
2. For each national market, estimate equation 9 for all stocks individually over rolling eighteen-month sample periods. This estimation will yield vectors of mispricing estimates, $\hat{\alpha}_t^n$, where the time subscript denotes the sample period over which the parameters are estimated.
3. Calculate a summary measure of the mispricing for each national market.

In focusing on deviations (both positive and negative) of α from zero, a natural measure of mispricing across the assets is the average squared mispricing coefficient, $\alpha^{n\prime}\alpha^n/n$. However, the regressions provide only an estimate of α^n, $\hat{\alpha}^n$, not the true value. The average squared values of the estimates, $\hat{\alpha}^{n\prime}\hat{\alpha}^n/n$, will converge to $\alpha^{n\prime}\alpha^n/n$ plus the average squared value of the estimation error. Thus, $\hat{\alpha}^{n\prime}\hat{\alpha}^n/n$ will yield an upwardly biased estimate of $\alpha^{n\prime}\alpha^n/n$. However, the bias for asset i, $E[\hat{\alpha}_i^2 - \alpha_i^2]$, has an expected value equal to the variance of the intercept coefficient. Let v_i denote the estimated variance of the regression intercept for asset i and let the n-vector of these variances for n assets be v^n. Given v^n, an adjusted average squared pricing error can be calculated as $\hat{\theta} = \hat{\alpha}^{n\prime}\hat{\alpha}^n/n - v^{n\prime}\iota/n$, where ι is an n-vector of ones. The quantity $\hat{\theta}$ will be called the *average adjusted mispricing* for the n assets. In the empirical analysis, I use estimates, v_i, which are corrected for conditional heteroskedasticity, as in White (1980).

Under the null hypothesis that $\alpha^n = 0$, the expected value of $\hat{\theta}$ is zero. Thus, if capital markets are integrated and share the same set of pervasive risks, the average adjusted mispricing should be close to zero. This measure of mispricing should tend to be larger the more severe the barriers to free capital flows. In addition, the periods of transition from segmented to integrated markets should be associated with large average adjusted mispricing, as asset prices adjust to a different equilibrium level.

Rather than emphasize formal statistical tests, I wish to characterize the cross-sectional and time-series characteristics of the estimated mispricing and relate the behavior of the measures to changes in capital controls in the various markets. This characterization of the empirical properties of the mispricing, or market segmentation, measures should provide some sense of the forces causing the measured deviations from LOP. Average adjusted mispricing is estimated for each of the twenty-four national markets. Since the severity of capital controls is likely to vary through time, I estimate a time series of $\hat{\theta}$'s, rather than estimate each economy's adjusted mispricing for the entire sample period. The time series of $\hat{\theta}$'s is constructed by estimating $\hat{\theta}$ for each (overlapping) eighteen-month period in the sample. That is, data from January 1976 to June 1977 are used to estimate $\hat{\theta}_{6/77} = \hat{\alpha}^{n'}_{6/77}\hat{\alpha}^{n}_{6/77}/n - v^{n'}_{6/77}\iota/n$, data from February 1976 to July 1977 are used to estimate $\hat{\theta}_{7/77}$, and so on. The final period is July 1991 through December 1992. All firms are included in the sample as long as they have at least fifteen monthly observations in the subperiod.

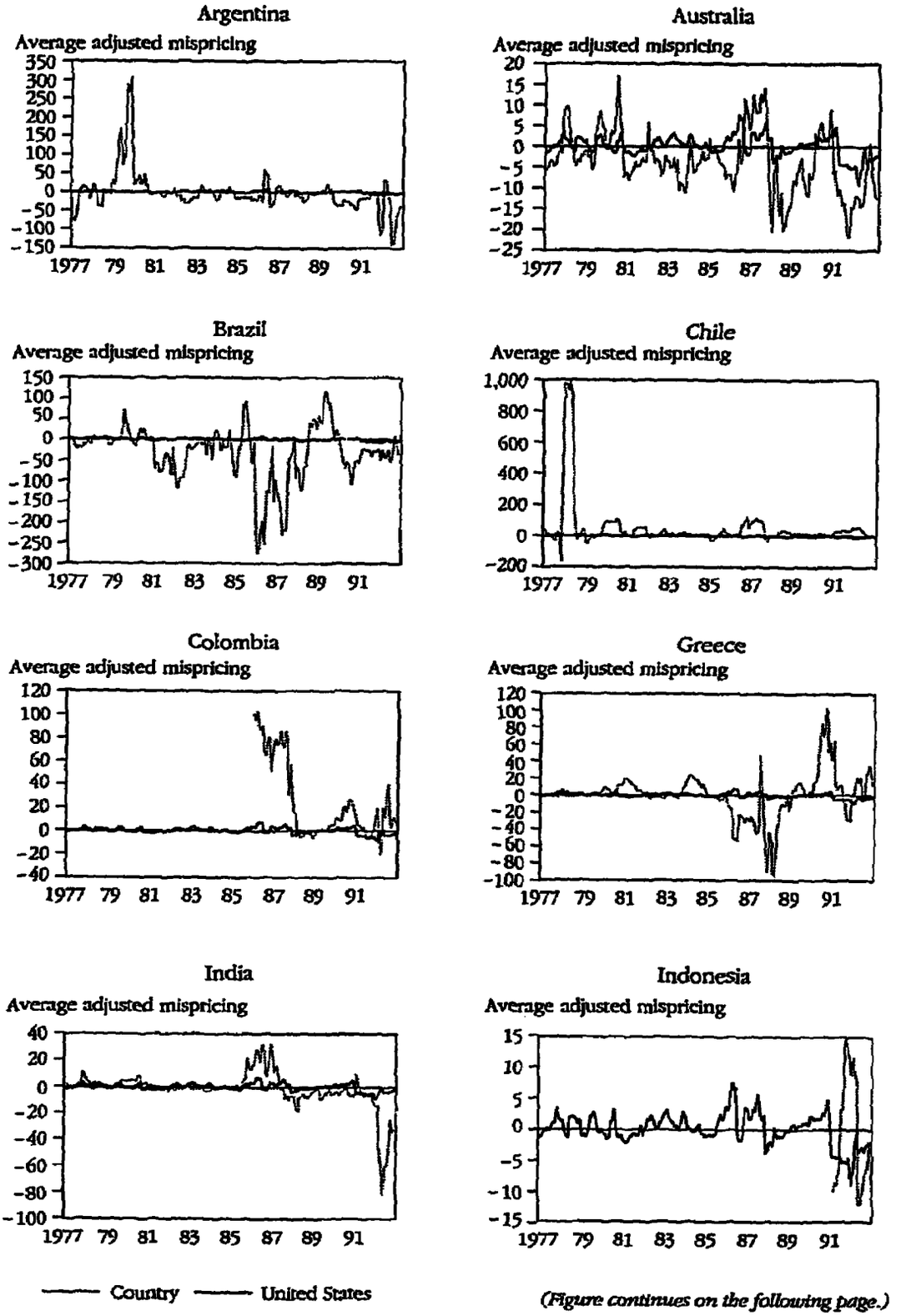
The time-series averages of the values of $\hat{\theta}_t$ are reported in table 2. The average adjusted mispricing, $\hat{\theta}_t$, is plotted for each national market in figure 1. Each graph also plots $\hat{\theta}_t$ for the United States as a reference point. The values of $\hat{\theta}_t$ for Australia, Japan, and the United Kingdom are generally small. The largest deviations from the value of zero occur for Australia, with values around –20 that occur around the 1987 stock market crash.

Argentina begins in the late 1970s with very high values of $\hat{\theta}_t$ (around 300), that decline rapidly. There is a sharp rise in $\hat{\theta}_t$ in 1986, followed by a sharp decline. The period from 1986 through 1987 coincides with increased investment by foreign institutional investors. Beginning in the autumn of 1989, there is a period in which $\hat{\theta}_t$ takes on large negative values. This latter period coincides with the beginning of a series of economic reforms in Argentina.[3] The reforms include the State Reform Law (in September 1989), which announced—among other things—various privatizations, and the New Foreign Investment Regime (in November 1989), which essentially opened the Argentine capital markets to foreign investors by eliminating restrictions on both foreign ownership (except in selected sectors) and the repatriation of capital.

The values of $\hat{\theta}_t$ for Brazil are particularly large in the period from 1985 through 1989. The largest deviations occur in 1986. This corresponds to a period in which the government announced the Cruzado Plan, which instituted strict price controls on goods, wages, and official exchange rates. There is a short-lived boom in the stock market in which the IFC index of stocks doubles (in U.S. dollar terms) in the span of two months (from February to April). The boom is followed by a decline in the IFC index of stocks to their February levels by the end of the year. Large negative values of adjusted mispricing seem to accompany liberalizations in March 1987 (approval of

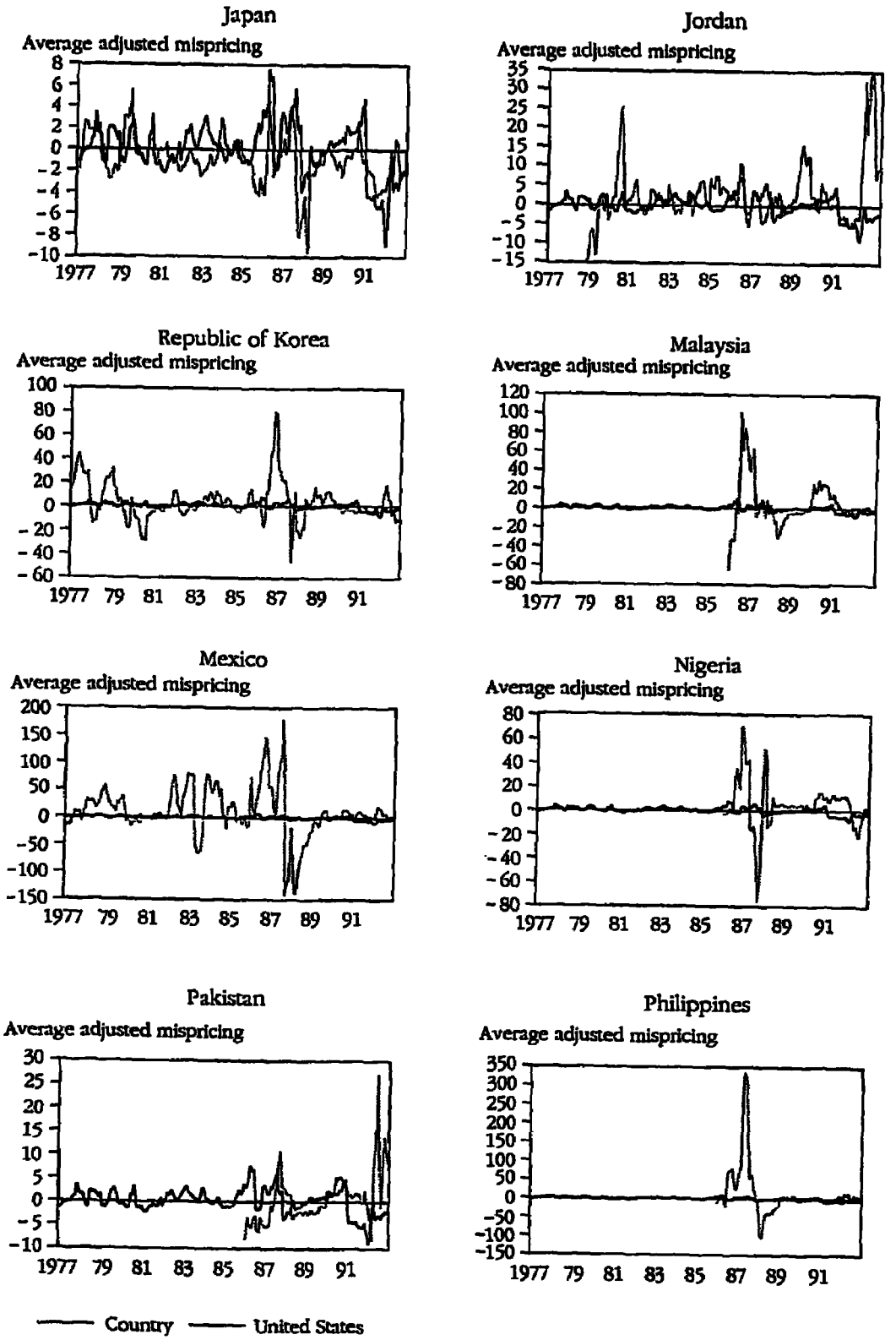
3. Sources of information on economic and political developments as well as extant capital controls in emerging markets are Chuppe and Atkin (1992), IFC (1993), Park and Van Agtmael (1993), Levine and Zervos (1994), and Bekaert (1995).

Figure 1. *Average Adjusted Mispricing, Selected Markets, June 1977 to December 1992*



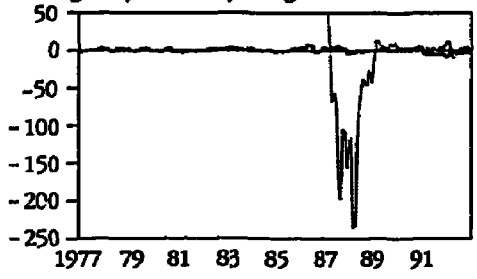
(Figure continues on the following page.)

Figure 1. *(continued)*



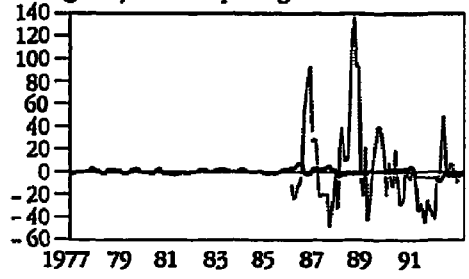
Portugal

Average adjusted mispricing



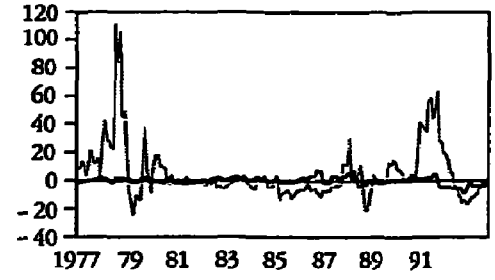
Taiwan (China)

Average adjusted mispricing



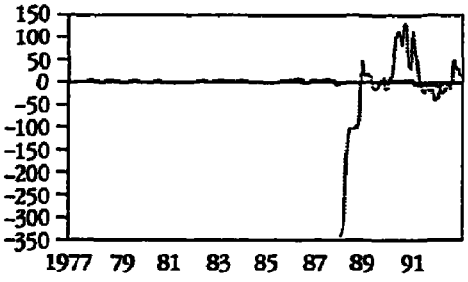
Thailand

Average adjusted mispricing



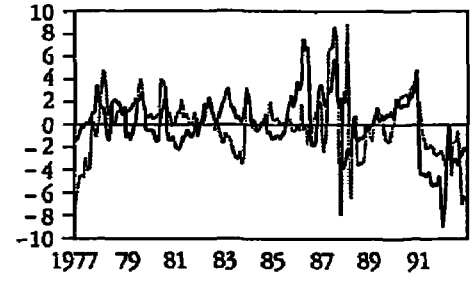
Turkey

Average adjusted mispricing



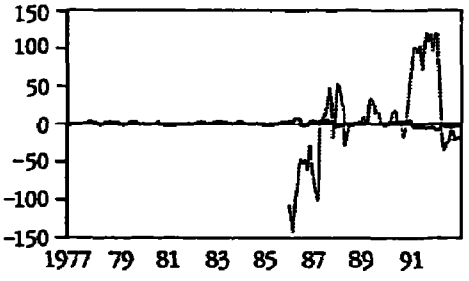
United Kingdom

Average adjusted mispricing



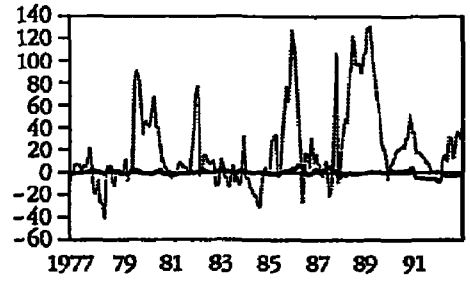
Venezuela

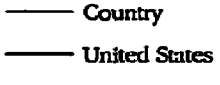
Average adjusted mispricing



Zimbabwe

Average adjusted mispricing





Source: IFC's Emerging Markets Data Base.

foreign investment trusts) and 1990 (when an interbank foreign exchange market is allowed).

Chile has extremely large values of adjusted mispricing in 1977–78. There are smaller (but still large) values of mispricing in 1981 and 1987.

Colombia shows a steady decline in $\hat{\theta}_t$ for the periods ending March 1986 through March 1988. After that, $\hat{\theta}_t$ stays relatively close to zero until late 1990. The large values of $\hat{\theta}_t$ in late 1990 and early 1991 may be associated with a move toward making the market 100 percent investable in February 1991.

The values of $\hat{\theta}_t$ are relatively close to zero for Greece until the mid-1980s. There is a large increase in mispricing in 1990. After several years of a socialist government (from 1981 to 1989) and a year in which two elections failed to produce a clear winning party, the conservative party was elected to power in April 1990. There is a 59 percent return to holding the portfolio of stocks in the IFC index in April 1990, followed by a 44 percent return in June 1990. Prices subsequently decline in late 1990.

The average adjusted mispricing values for India are generally small except from 1985 to 1987 and in 1991–92. This later period includes a balance of payments crisis in mid-1991, followed by a series of reforms phasing in full convertibility of the rupee. Restrictions on institutional investment in Indian equities were loosened in 1992. In April 1992 it was disclosed that a number of banks were illegally investing funds in the Indian equity market. The disclosure led to a sharp decline (approximately 40 percent) in the equity market.

The time-series sample for Indonesia is rather short. Because of this, it is difficult to detect particular patterns in the average adjusted mispricing.

Jordan exhibits some of the smallest absolute levels of average adjusted mispricing among the emerging markets. It also exhibits the lowest volatility and one of the lowest mean returns among the emerging markets (table 2). The largest values of adjusted mispricing occur in 1991–92.

The Korean stock market exhibits relatively small values of adjusted mispricing except in the late 1970s and the mid-1980s, in spite of the fact that there were severe restrictions on foreign investment in Korean equities. In 1981 the first of a series of funds was offered through which foreign investors could invest in Korean securities (see Chuppe and Atkin 1992). From 1985 through 1987 additional liberalization occurred. Additional Korean mutual funds were offered to international investors. In 1985, companies on the Korean stock exchange were granted authorization to raise capital in international bond markets and, as a result, gained access to equity capital through convertible bond issues. An over-the-counter market for unlisted stocks was opened in 1987. A government fund to stabilize stock prices was created in 1989 after the 1989 crash.

The Malaysian stock market shows very large levels of mispricing in 1986 and early 1987. The period through late 1986 involved extensive liberalization of restrictions on capital inflows. The large values of adjusted mispricing might be due to large capital inflows at that time, although it is difficult to infer much from the short time series.

For the Mexican stock market, the average adjusted mispricing is relatively large until 1989. From 1989 through 1992 the average pricing errors are relatively low. Before 1989, restricted shares—which could be owned by foreigners—were typically restricted to below 50 percent of a firm's equity capital. In 1989, foreigners were allowed to hold up to 100 percent of a firm's equity in most industrial sectors. A trust fund was also established in 1989 to allow foreign investors to buy (through the trust) previously restricted shares.

The Nigerian stock market was essentially closed to foreign investment throughout the sample period. The average adjusted mispricing is large and volatile in the mid-1980s. The value of $\hat{\theta}_t$ declines to approximately 0 in the late 1980s with a jump to the 7–10 range in 1991.

Pakistan has relatively small average mispricing throughout the sample period. There is a small jump in mispricing in 1991, which coincides with the lifting of restrictions on foreign investment.

The Philippines shows large values of average mispricing from 1986 to 1989. This may reflect the price effects of inflows of capital following the ouster of President Marcos. After 1989 the average mispricing is generally small.

The Portuguese stock market shows large values (first positive, then negative) of average mispricing from 1987 through 1989. This may have been caused by pricing effects of the Portuguese entry into the European Union (and the associated elimination of barriers to foreign investments) followed by the October 1987 crash. After 1989 the estimated average adjusted mispricing is relatively small.

The Taiwan (China) stock market shows generally large levels of estimated mispricing with no discernible trend, even though the period is one in which barriers to foreign investments were generally being lifted. Indirect investment was allowed through investment trust funds in 1982, with direct investment by foreign institutions following in 1991 (with a temporary halt in 1992).

Average mispricing on the Thailand stock market is generally small in the 1980s. Larger average mispricing occurs in the late 1970s and early 1990s.

The Istanbul Stock Exchange opened in 1986. The short time series of mispricing for Turkey does not show any pronounced trend, except the initial increase from very negative values.

The Zimbabwe stock market shows generally high levels of adjusted mispricing. This is consistent with the fact that the market was closed to foreign investment throughout the sample period.

VIII. Conclusions and Suggestions for Future Work

In this article I suggest a measure of the deviations from the law of one price across potentially segmented capital markets. This measure is applied to stock returns from twenty-four national markets (four developed markets and twenty emerging markets). The measure of market segmentation tends to be much larger for emerging markets than for the developed markets, a result consistent with

larger barriers to capital flows into or out of the emerging markets. The measure often tends to decrease through time, a result that is consistent with growing levels of integration. Large values of adjusted mispricing also occur around periods of economic turbulence and periods in which capital controls change significantly. Thus, the adjusted mispricing estimates measure not only the level of deviations from the LOP but also the revaluations inherent in moving from one regime to another.

Relating the proposed measure of market integration to alternative measures of integration (as in Bekaert 1995), to measures of capital market development, or to ex post measures of economic growth would be useful for highlighting the advantages and disadvantages of this measure.

Bekaert and Harvey (1995, figure 2) plot the estimated probability of being in the integrated regime. There are some interesting similarities and differences in the conclusions that could be drawn from their measure of integration and the adjusted mispricing plotted in figure 1. For example, Bekaert and Harvey (1995) show dramatic declines in the probability of India's stock market's being integrated in 1985 and 1992, corresponding to the periods in which there are large values of the adjusted mispricing parameter for India in figure 1. An example of a case in which the measures of integration seem to differ is Mexico. Bekaert and Harvey's estimate of the probability of integration is quite low in the post-1989 period. This is the period in which the adjusted mispricing estimate is the closest to zero for Mexico (figure 1). Thus, these alternative measures of market integration seem to be highlighting different aspects of the mechanism generating expected returns.

Demirgüç-Kunt and Levine (1996) investigate the cross-sectional relation between mispricing and other indicators of capital market development. They find that mispricing (without the bias adjustment) is significantly negatively correlated with the size (market capitalization) and trading volume of the respective markets and is significantly positively related to market volatility and concentration. Levine and Zervos (1994, 1995) find that the mispricing measure proposed here is negatively correlated with economic growth and that the levels of adjusted mispricing decline after liberalization of restrictions on capital flows. Thus, along several dimensions, the proposed measure of integration yields results that are consistent with reasonable priors about the relations between effective integration and explicit capital controls, capital market development, and economic growth.

APPENDIX. UNANTICIPATED ASSET PRICING REGIME SHIFTS

To illustrate the short-term effects of regime shifts, I will consider the somewhat artificial but tractable example of a market that changes unexpectedly from being completely segmented from world markets to being completely integrated. Assume that under complete segmentation the economy's assets are priced by a domestic representative consumer with time-additive utility,

$$U_t = \sum_{s=1}^{\infty} \rho^s u(c_{t+s})$$

where ρ reflects the consumer's rate of time preference, c_{t+s} is the consumer's consumption in period $t + s$, and $u(\cdot)$ is the per period utility of consumption. The pricing of assets in this multiperiod, multifactor world depends crucially on the comovements of the risk factors with the marginal utility of consumption (see Connor and Korajczyk 1989 for details). Consider the following special case: the covariances between the representative consumer's marginal utility of consumption and the risk factors are constant $E_t[\delta_{i,t+s}u'(c_{t+s})/u'(c_t)] = \gamma_i$, and assets are expected to pay one unit of consumption each period, but their actual payoff depends on the risk factors. Then asset j will have a price equal to

$$P_{j,t} = \left(\frac{\rho}{1-\rho}\right)(1 + b_{j,1}\gamma_1 + \ldots + b_{j,k}\gamma_k).$$

To make the example concrete, assume that for the closed-economy (segmented market) case there are two risk factors (a world factor and a domestic factor) that are correlated with the marginal utility of consumption; the domestic representative investor has a time-preference parameter of 0.98 (ρ = 0.98); and the covariances between the representative consumer's marginal utility of consumption and the two risk factors—$E_t[\delta_{1,t+s}u'(c_{t+s})/u'(c_t)]$ and $E_t[\delta_{2,t+s}u'(c_{t+s})/u'(c_t)]$—are −0.10 and −0.20, respectively. Asset j will have a price equal to:

$$P_{j,t} = \left(\frac{\rho}{1-\rho}\right)[1 + b_{j,1}(-0.1) + b_{j,2}(-0.20)].$$

Thus, if asset j has $b_{j,1} = 1.0$ and $b_{j,2} = 0.5$, then $P_{j,t} = 39.20$. Now assume that the market is opened to global investors and asset prices are determined by the preferences of a globally diversified representative consumer. The new parameters are ρ = 0.98, $E_t[\delta_{1,t+s}u'(c_{t+s})/u'(c_t)] = -0.10$, and $E_t[\delta_{2,t+s}u'(c_{t+s})/u'(c_t)] = 0.0$. For example, the covariance between the domestic factor and the global representative investor's marginal utility might be zero because the small economy's domestic factor risk is diversifiable across economies. The unexpected shift from a segmented to an integrated economy leads to a change in price from $39.20 to $44.10, an immediate return of 12.5 percent. If the parameter ρ were to simultaneously change from 0.98 to 0.99, the price of asset j would jump to $89.10, an immediate return of 127 percent.

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Stock Market Development and Financial Intermediaries: Stylized Facts

Asli Demirgüç-Kunt and Ross Levine

World stock markets are booming, and emerging stock markets account for a disproportionate share of this growth. Yet economists lack a common concept or measure of stock market development. This article collects and compares a broad array of indicators of stock market and financial intermediary development, using data from forty-four developing and industrial countries during the period from 1986 to 1993. The empirical results exhibit wide cross-country differences for each indicator as well as intuitively appealing correlations between various indicators. The article constructs aggregate indexes and analyzes them to document the relationship between the emergence of stock markets and the growth of financial intermediaries. It produces a set of stylized facts that facilitates and stimulates research into the links among stock markets, economic development, and corporate financing decisions.

The growth and globalization of emerging stock markets are impressive. In 1994, emerging market capitalization was $1.9 trillion, compared to $0.2 trillion in 1985. Similarly, $39 billion flowed into emerging equity markets from abroad in 1994, compared with $0.1 billion in 1985.[1] These developments have attracted the attention of academics, practitioners, and policymakers. Several studies focus on measuring the benefits of holding a globally diversified portfolio (for example, see Harvey 1995 and De Santis 1993); and many countries are reforming regulations and laws to foster capital market development and attract foreign portfolio flows. Yet, economists have neither a common concept nor a common measure of stock market development.

This article gives empirical content to the phrase "stock market development" by collecting and comparing a broader array of empirical indicators of stock market development than any previous study. Using data on forty-four developing and industrial countries from 1986 to 1993, we examine different measures of stock market size, market liquidity, market concentration, market volatility, institutional development, and integration with world capital markets. Since each indicator suffers from statistical and conceptual shortcomings, we use a variety of indicators, which provide a more accurate depiction of stock markets

1. One billion is 1,000 million; one trillion is 1,000 billion.

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than any single measure. Furthermore, stock market development—like the level of economic development—is a complex and multifaceted concept. No single measure will capture all aspects of stock market development. Thus, our goal is to produce a set of stylized facts about various indicators of stock market development that facilitates and stimulates research into the links among stock markets, economic development, and corporate financing decisions.

After describing each of the stock market development indicators, we examine the relationships among them. We find enormous cross-country variation in the stock market indicators. For example, five countries have market capitalization to gross domestic product (GDP) ratios greater than 1, and five countries have market capitalization to GDP ratios less than 0.10. We find attractive correlations among the indicators. For example, large stock markets are more liquid, less volatile, and more internationally integrated than smaller markets; countries with strong information disclosure laws, internationally accepted accounting standards, and unrestricted international capital flows tend to have larger and more liquid markets; countries with markets concentrated in a few stocks tend to have smaller, less liquid, and less internationally integrated markets; and internationally integrated markets are less volatile.

Although many stock market development indicators are significantly correlated in an intuitively plausible fashion, the individual indicators produce different country rankings. Thus, to produce an assessment of the overall level of stock market development across countries, we produce indexes of stock market development that average together the information contained in the individual indicators. Developing aggregate indexes that summarize the extent of a country's stock market development in a single figure is especially helpful for analysts who are interested in making comparisons across countries. These indexes can be used in empirical studies linking stock market development and other economic phenomena, as in Levine and Zervos (1996) and Demirgüç-Kunt and Maksimovic (1996). We find that from 1986 to 1993 the most developed stock markets in the world are in Japan, the United States, and the United Kingdom, and the most underdeveloped markets are in Colombia, Venezuela, Nigeria, and Zimbabwe. The data suggest that Hong Kong, Singapore, the Republic of Korea, Switzerland, and Malaysia have highly developed stock markets; Turkey, Greece, Argentina, and Pakistan have underdeveloped markets. Furthermore, although richer countries generally have more developed stock markets than poorer countries, many markets labeled emerging are more developed than those in France, the Netherlands, Australia, Canada, Sweden, and Norway.

We use the assortment of stock market indicators to evaluate which stock markets have been developing fastest over the last eight years. Using measures of size, liquidity, and international integration, Indonesia, Turkey, Portugal, and Venezuela stand out as the most rapidly developing markets in the world.

This article documents the relationship between the various stock market indicators and measures of financial intermediary development. Since debt and

equity are frequently viewed as alternative sources of corporate finance, stock markets and banks are sometimes viewed as alternative vehicles for financing corporate investments (see Demirgüç-Kunt and Maksimovic 1996). Consequently, we document the cross-country ties between stock market development and financial intermediary development. We use measures of the size of the banking system, the amount of credit going to private firms, the size of nonbank financial corporations, and the size of private insurance and pension companies. We find that most stock market indicators are highly correlated with the development and efficient functioning of banks, nonbank financial corporations, and private insurance companies and pension funds. Countries with well-developed stock markets tend to have well-developed financial intermediaries.

Section I presents indicators of stock market development and describes their theoretical relevance. Section II ranks countries using the different indicators of stock market development and studies the correlations among the indicators. Section III examines which countries have the fastest-developing stock markets. Section IV analyzes the links between stock market development and financial intermediary development. Section V summarizes the results.

I. Indicators of Stock Market Development

A growing theoretical literature examines the relationship between particular attributes of stock markets and both economic growth and firms' financing decisions. For example, Devereux and Smith (1994) and Obstfeld (1994) show that by facilitating risk sharing, internationally integrated stock markets affect saving decisions, the allocation of capital, and long-run economic growth rates. Greater risk diversification and liquidity have theoretically ambiguous effects on saving rates, however, because saving rates could fall sufficiently for enhanced liquidity and risk diversification to lead to slower economic growth. Levine (1991) and Bencivenga, Smith, and Starr (1996) emphasize that stock market liquidity—the ability to easily trade securities—facilitates investments in longer-run, higher-return projects that involve more transactions. On stock market size, Pagano (1993) studies the increased risk-sharing benefits of larger stock markets due to thick market externalities. Besides stock market size, liquidity, and integration with world capital markets, theorists have examined stock return volatility. For example, DeLong and others (1989) argue that excess volatility in the stock market can hinder investment, and therefore growth, although there is considerable disagreement over the existence of excess volatility in stock returns (see Shiller 1981). In terms of corporate finance, some theories link stock market functioning with firms' financing and investment decisions. Pagano (1993) models the ties between risk-diversification and corporate financing decisions, while Boyd and Smith (1996) analyze complementarities between debt and equity financing for capital investments. Yet, as Demirgüç-Kunt and Maksimovic (1996) discuss, the effect of stock market development

on firms' financing decisions is theoretically inconclusive. Thus, theory provides a rich array of channels through which stock markets—market size, liquidity, integration with world capital markets, and volatility—may be linked to economic growth and corporate financing decisions.

There is very little empirical evidence on the links among stock markets, economic development, and firms' corporate financing decisions. To facilitate empirical research, this article collects and compares a broad array of stock market indicators motivated by the above theoretical studies and constructs aggregate indexes of overall stock market development. Demirgüç-Kunt and Maksimovic (1996) and Levine and Zervos (1996) use these indexes to examine the empirical relationship among stock market development, firms' financing decisions, and long-run economic growth.

The rest of this section presents and discusses an array of stock market development indicators. We focus on indicators identified by existing theoretical studies. We describe measures of market size, market liquidity, market volatility, market concentration, asset pricing efficiency, regulatory and institutional development, and conglomerate indexes that aggregate the information contained in the individual measures. For developing countries, we use data from the International Finance Corporation's (IFC's)Emerging Markets Data Base. For industrial countries, data are from Morgan Stanley Capital International (MSCI). We also use macroeconomic data from IMF (various issues). The data cover the period from 1986 to 1993 for up to forty-four developing and industrial countries. The appendix provides details of data construction and discusses cross-country comparability issues.

Stock Market Size

The *market capitalization ratio* equals the value of listed shares divided by GDP. Analysts frequently use the ratio as a measure of stock market size. In the rest of the article, we refer to this measure as market capitalization. In terms of economic significance, the assumption behind market capitalization is that market size is positively correlated with the ability to mobilize capital and diversify risk. For example, Pagano (1993) motivates his theoretical model by observing the great variation in market capitalization and in the number of listed companies in different economies. As indicated in table 1, South Africa, Hong Kong, Malaysia, Japan, and Singapore all had market capitalization ratios greater than 1 from 1986 to 1993, while Nigeria, Argentina, Indonesia, Colombia, and Turkey all had market capitalization ratios of less than 0.10 during the same period.

We include statistics on the *number of listed companies* as an additional measure of market size. Although marginal differences in the number of listed companies are uninformative, extreme values can be useful. It is not very interesting that Australia averaged 1,184 listed companies and Canada averaged 1,118 listed companies during the period from 1986 to 1993. But the fewer than 70 listed companies for Finland and Zimbabwe suggest that these countries have very limited markets (table 1). Similarly, the fact that in Indonesia, Turkey, and Por-

tugal the number of listed companies grew at over 20 percent a year from 1986 to 1993 suggests rapid stock market development (see table 3 in section III).

Liquidity

Although economists advance many theoretical definitions of liquidity, analysts generally use the term to refer to the ability to easily buy and sell securities. Since liquidity allows investors to alter their portfolios quickly and cheaply, it makes investment less risky and facilitates longer-term, more profitable investments. Liquidity is an important attribute of stock market development because theoretically liquid markets improve the allocation of capital and enhance prospects of long-term economic growth. A comprehensive measure of liquidity would quantify all the costs associated with trading, including the time costs and uncertainty of finding a counterpart and settling the trade. Because we want to compare liquidity across countries and because data are very limited, we simply use two measures of realized stock trading.

Total value traded/GDP equals total shares traded on the stock market exchange divided by GDP. The total value traded ratio measures the organized trading of equities as a share of national output, and should therefore positively reflect liquidity on an economywide basis. Japan, Hong Kong, Malaysia, the United States, and the United Kingdom all had total value traded/GDP ratios above 0.40, while in Pakistan, Zimbabwe, Colombia, and Nigeria, the total value traded/GDP ratio was about 0.01 from 1986 to 1993. The total value traded/GDP ratio complements the market capitalization ratio. Although market capitalization may be large, there may be little trading. For example, South Africa and Chile had above-average market capitalization but below-average total value traded/GDP (table 1). Together, market capitalization and total value traded/GDP inform us about market size and liquidity.

A second measure of liquidity is the turnover ratio. *Turnover* equals the value of total shares traded divided by market capitalization. High turnover is often used as an indicator of low transactions costs. Korea and Germany (largely reflecting massive trading around reunification) had turnover ratios above 0.90, while Nigeria, Zimbabwe, and South Africa had turnover ratios below 0.05. The turnover ratio complements market capitalization. A small but active market will have small market capitalization but high turnover. For example, Norway and India had below-average market capitalization but above-average turnover (table 1). Alternatively, South Africa's market capitalization to GDP ratio was the highest in the world, but its turnover ratio was one of the smallest.

Turnover also complements total value traded/GDP. Although total value traded/GDP captures trading compared with the size of the economy, turnover measures trading relative to the size of the stock market. Put differently, a small, liquid market will have a high turnover ratio but a small total value traded/GDP ratio. For example, there was not much equity trading in Brazil relative to the size of its economy, but Brazil's turnover ratio was high, reflecting a small but active stock market. By contrast, Malaysia had the third-highest market capitalization

Table 1. *Indicators of Stock Market Development, 1986–93*
(annual average)

	Market capitalization[a]		*Total value traded/GDP*[b]		*Number of listed companies*[c]		*Turnover*[d]		*Volatility*[e]		*Market concentration*[f]		*Institutional development*[g]		*APT pricing error*[h]		*ICAPM pricing error*[h]	
Economy	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*
Argentina	40	0.06	34	0.02	26	187	19	0.34	37	0.34	25	0.64	10	1.16	14	4.98	24	11.58
Australia	10	0.54	12	0.17	5	1,184	21	0.31	11	0.04					13	4.94	12	4.14
Austria	35	0.10	22	0.07	39	90	5	0.69	14	0.05								
Belgium	18	0.36	28	0.04	27	182	35	0.12	6	0.04								
Brazil	34	0.11	26	0.05	9	579	11	0.48	36	0.25	7	0.26	4	1.54	24	7.26	23	6.92
Canada	13	0.48	13	0.15	6	1,118	20	0.31	5	0.04	8	0.27						
Chile	11	0.52	30	0.04	21	225	37	0.08	25	0.06	19	0.50	5	1.52	17	5.56	13	4.25
Colombia	38	0.07	40	0.01	40	87	38	0.07	23	0.06	26	0.74	11	1.16	19	5.62	15	4.82
Denmark	19	0.28	23	0.07	17	267	23	0.24										
Finland	26	0.19	27	0.04	42	62	30	0.21	13	0.05								
France	20	0.27	18	0.09	8	641	16	0.35	15	0.05	6	0.26						
Germany	22	0.24	8	0.35	11	551	1	1.47	10	0.04	15	0.41						
Greece	32	0.12	37	0.02	34	126	34	0.13	31	0.10	17	0.47	18	0.77	16	5.29	19	5.23
Hong Kong	2	1.36	2	0.59	14	318	12	0.44										
India	31	0.16	25	0.06	2	4,614	9	0.50	24	0.06	3	0.22	8	1.34	7	3.33	7	2.89
Indonesia	39	0.06	36	0.02	38	91	27	0.23					17	0.96	9	3.68	8	3.03
Ireland									21	0.06								
Israel	25	0.21	15	0.11	15	312	3	0.72	18	0.06								
Italy	29	0.16	29	0.04	19	227	24	0.24	20	0.06								
Japan	4	1.08	1	0.62	3	2,027	8	0.54	12	0.04	2	0.19			1	2.39	4	2.26
Jordan	9	0.57	14	0.13	36	103	29	0.22	7	0.04	23	0.59	12	1.16	2	2.55	1	2.05
Korea, Rep. of	15	0.40	6	0.37	10	576	2	0.93	30	0.08	9	0.28	3	1.55	10	3.73	9	3.18
Luxembourg					23	205												
Malaysia	3	1.28	3	0.46	16	291	26	0.24	17	0.05	12	0.36	1	1.63	11	3.90	5	2.45
Mexico	24	0.22	19	0.09	25	193	7	0.56	32	0.10	10	0.36	2	1.61	21	5.94	21	5.77
Netherlands	12	0.49	11	0.21	18	239	14	0.41	3	0.03								
New Zealand	16	0.39	24	0.06	20	226	32	0.17	16	0.05								
Nigeria	41	0.04	41	0.00	33	127	41	0.01			21	0.51	20	0.64	8	3.66	11	3.72

Norway	27	0.19	17	0.09	35	126	10	0.48	27	0.07								
Pakistan	33	0.11	38	0.01	12	487	36	0.08	1	0.03	5	0.25	13	1.09	3	2.59	2	2.15
Philippines	23	0.24	31	0.04	30	152	28	0.23	29	0.08	22	0.52	9	1.32	15	5.26	16	4.90
Portugal	30	0.16	32	0.03	29	162	31	0.20	4	0.03	14	0.41	6	1.37	12	4.02	20	5.28
Singapore	5	1.04	7	0.35	31	147	18	0.34										
South Africa	1	1.54	21	0.08	7	700	39	0.05										
Spain	21	0.25	20	0.08	13	383	17	0.35	19	0.06								
Sweden	14	0.46	16	0.10	32	133	25	0.24	22	0.06								
Switzerland	7	0.77	9	0.31	28	176	15	0.39	8	0.04	20	0.50						
Taiwan (China)					24	197			34	0.15	13	0.40	16	0.98	20	5.68	14	4.54
Thailand	17	0.36	10	0.22	22	210	4	0.70	26	0.07	11	0.36	7	1.36	6	3.12	10	3.18
Turkey	37	0.08	33	0.03	37	91	22	0.28	35	0.17	18	0.50	14	1.06	22	6.38	22	6.66
United Kingdom	6	0.92	5	0.41	4	1,932	13	0.44	9	0.04	4	0.24			5	2.94	6	2.56
United States	8	0.64	4	0.41	1	7,087	6	0.65	2	0.03	1	0.14			4	2.71	3	2.24
Venezuela	36	0.10	35	0.02	41	82	33	0.15	33	0.13	24	0.63	15	1.00	23	6.67	17	5.15
Zimbabwe	28	0.18	39	0.01	43	57	40	0.03	28	0.07	16	0.44	19	0.66	18	5.57	18	5.18
Average		0.41		0.15		627		0.36		0.08		0.40		1.19		4.49		4.34
Number of economies	41		41		43		41		37		26		20		24		24	

Note: For each indicator, the stock market development of each economy is ranked from high to low. Thus, for market capitalization, total value traded/GDP, number of listed companies, turnover, and institutional development, the ranking by value of the indicator is from high to low. For volatility, market concentration, APT pricing error, and ICAPM pricing error, the ranking by value of the indicator is from low to high.

a. Market capitalization is the value of stocks divided by GDP.

b. Total value traded/GDP is total value of traded shares divided by GDP.

c. Number of companies listed represents the number of shares listed on the exchange.

d. Turnover is given by total value traded divided by market capitalization.

e. Volatility is the twelve-month rolling standard deviation estimate based on market returns.

f. Market concentration is the share of market capitalization held by the ten largest stocks.

g. Institutional development is an average of institutional indicators as described in the text.

h. APT and ICAPM pricing errors are obtained from Korajczyk (1994).

Source: Authors' calculations and Korajczyk (1994).

and total value traded/GDP ratios from 1986 to 1993, but it had below-average turnover (table 1). Thus, incorporating information on market capitalization, total value traded/GDP, and turnover provides a more comprehensive picture of development than any single indicator can provide.

Concentration

In some countries a few companies dominate the market. High concentration is not desirable because it may adversely affect the liquidity of the market. To measure the degree of market concentration, we compute the share of market capitalization accounted for by the ten largest stocks and call this measure *concentration*. The United States and Japan have very low concentration. The ten largest stocks account for less than 20 percent of the markets. In Venezuela, Argentina, and Colombia, where the concentration ratio averaged above 0.60 in the period from 1986 to 1993 (table 1), concentration is three times larger than that in the United States and Japan.

Volatility

We include a measure of stock market *volatility*, because volatility of stock returns is another attribute that has received significant attention in the literature and is of great interest to practitioners. This indicator is a twelve-month, rolling, standard-deviation estimate based on market returns. We cleanse the return series of monthly means and twelve months of autocorrelations using a procedure defined by Schwert (1989). Greater volatility is not necessarily a sign of more or less stock market development. Indeed, high volatility could be an indicator of development, so far as revelation of information implies volatility in a well-functioning market (see, for example, Bekaert and Harvey 1995). Here we refer to "less volatility" as reflecting "greater stock market development" for simplicity. As with the other indicators, there are great cross-country differences in volatility. Volatility in Pakistan, the United States, and the Netherlands averaged about 0.03 from 1986 to 1993; volatility in Brazil and Argentina was above 0.25.

Asset Pricing

Academic researchers and market practitioners have devoted prodigious resources to measuring the degree of integration between national stock markets and the world market and to gauging whether markets price risk efficiently (see Bonser-Neal and others 1990; Cho, Eun, and Senbet 1986; Claessens, Dasgupta, and Glen 1995; Errunza and Losq 1989, 1985a, 1985b; Errunza and Senbet 1981; Errunza, Losq, and Padmanabhan 1992; Gultekin, Gultekin, and Penati 1989; Jorion and Schwartz 1986; Korajczyk and Viallet 1989; Solnik 1974; Stehle 1977; and Wheatley 1988). Although a market need not be integrated into the world capital markets to be developed, analysts generally refer to countries that are more integrated and that price risk more efficiently as more developed.

To measure asset pricing efficiency, we use estimates of asset pricing errors computed by Korajczyk (1994, 1996). Unfortunately, the data only permit computation of these pricing errors for twenty-four countries. As argued in Korajczyk and Viallet (1989), the capital asset pricing model (CAPM) and arbitrage pricing model imply that the expected return on each asset is linearly related to a benchmark portfolio or linear combination of benchmark portfolios. In domestic versions of these asset pricing models the benchmark portfolios include only securities traded on the local exchange, but in the international versions the portfolios include all securities. If the models are correct, then the benchmark portfolio, or combination of portfolios, should explain all of the systematic expected returns on assets above the risk-free interest rate.[2] Thus, we term systematic deviations of expected returns as pricing errors under the maintained hypothesis that the model is correct. Using different asset pricing models, Korajczyk (1994) computes the systematic deviation between actual returns and those implied by the models.

The asset pricing theory (APT) and international capital asset pricing model (ICAPM) compute pricing errors using an international arbitrage pricing model and international capital asset pricing model, respectively. Korajczyk (1994) computes the extent of pricing error under the maintained hypothesis that the models are correct. We take the average of the absolute value of the pricing errors for the stocks in a country as a measure of capital market integration. Thus, under the maintained hypothesis, greater values of the APT and ICAPM measures reflect less international integration. Greater pricing errors may reflect poor information about firms, high transactions costs, and official barriers to international asset trading. We refer to greater pricing errors as indicating less stock market development. The APT and ICAPM pricing errors give similar country rankings. Brazil, Turkey, and Mexico had relatively large pricing errors, but the United States, Japan, Jordan, and Pakistan yielded lower pricing errors, which suggest a high level of international integration.

These two pricing-error estimates—APT and ICAPM—rely on the success of equilibrium models of asset pricing that investigators sometimes have rejected as good representations of the pricing of risk. However, these measures allow us to incorporate indicators, albeit imperfect indicators, of the ability of agents to diversify risk domestically and internationally. Furthermore, we analyze the evolution of the degree of integration between each domestic market and the world market over time.

Regulatory and Institutional Indicators

Regulatory and institutional factors may influence the functioning of stock markets (see Pagano 1993). For example, mandatory disclosure of reliable information about firms and financial intermediaries may enhance investor par-

2. Since no asset is riskless in real terms, Korajczyk and Viallet (1989) test the restrictions implied by a zero-beta asset.

ticipation in equity markets. Regulations that instill investor confidence in brokers and other capital-market intermediaries should encourage investment and trading in the stock market.

To measure the *institutional development* of emerging stock markets, we use information provided by the IFC and construct seven regulatory-institutional indicators. The first indicator shows whether the firms that are listed in a stock market publish price-earnings information. We give a value of 0 or 1, where 1 indicates that the information is comprehensive and published internationally. The second indicator measures accounting standards. We assign values of 0, 1, or 2, for countries with poor, adequate, or good (internationally accepted) accounting standards. The third indicator measures the quality of investor protection laws as judged by the IFC, where 0, 1, and 2 are used to indicate poor, adequate, or good investor protection laws. The fourth indicator shows whether the country has a securities and exchange commission. The fifth, sixth, and seventh indicators measure restrictions on dividend repatriation by foreign investors, capital repatriation by foreign investors, and domestic investments by foreigners. We assign values of 0, 1, and 2, indicating whether capital flows are restricted, have some restrictions, or are free, respectively. We compute an average institutional development indicator, which simply averages the seven regulatory-institutional indicators. These indicators are available on an annual basis from 1986 to 1993 for twenty developing countries.

There is substantial variation across countries and indicators. For example, Jordan freely allowed international capital flows to cross its borders, but did not publish regular price-earnings information and had poor accounting standards. India had accounting standards of internationally accepted quality, but restricted capital inflows and the repatriation of capital and dividends. Nigeria tightly restricted capital flows over most of the period and did not publish price-earnings information on firms in a comprehensive and internationally accepted manner. In contrast, Malaysia, Mexico, Korea, Brazil, and Chile had very high institutional development indicators overall (table 1).

Correlations between Various Indicators of Stock Market Development

Many stock market indicators are significantly correlated in an intuitively plausible fashion.[3] First, market size is significantly positively correlated with total value traded/GDP and the average institutional indicator, and significantly negatively correlated with pricing error and volatility. Countries with big stock markets have less volatile, more efficient stock markets with a high volume of trading relative to GDP. Second, countries with highly concentrated markets have markets that are underdeveloped. Market concentration is significantly negatively correlated with market size and market liquidity, and significantly positively correlated with pricing error. Third, countries that have stock markets which are more integrated internationally—as measured by low APT and ICAPM

3. We do not report the actual values here due to space constraints. For these and for more detailed statistics throughout the article, see Demirgüç-Kunt and Levine (1995).

values—have less volatile stock returns. Fourth, countries with well-developed regulatory and institutional systems, as defined by the IFC, tend to have large, liquid stock markets.

Although many stock market development indicators are significantly correlated in intuitively attractive ways, the correlation coefficients are frequently below 0.60. The correlations suggest that the different indicators capture different aspects of stock market development. For example, the correlation between the two measures of market liquidity, total value traded/GDP and turnover is only 0.50. Thus, although the degree of trading relative to the size of the economy is significantly correlated with the degree of trading relative to the size of the market, the two liquidity measures do not move one for one. Instead, they provide complementary information about stock market liquidity. Therefore, to measure how well stock markets function in general, that is, to compute an index of overall stock market development, we need to incorporate the information contained in a broad selection of these indicators.

II. Which Stock Markets Are Most Developed?

Which stock markets are most developed overall? To answer this question, we construct four conglomerate indexes of stock market development that aggregate the information contained in the individual indicators. We then use these conglomerate indexes to rank countries in terms of overall stock market development.

The Indexes

To compute the conglomerate indexes of stock market development, we average the means-removed values of particular stock market development indicators. To construct each index, we follow a two-step procedure. INDEX1 aggregates information on market capitalization, total value traded/GDP, and turnover. First, for each country, i, we compute the means-removed market capitalization, total value traded/GDP, and turnover ratios. We define the means-removed value of variable X for country i as $X(i)^m = [X(i) - \text{mean}(X)] / [ABS[\text{mean}(X)]]$, where the term in the denominator is the absolute value of the average value of X across all countries from 1986 to 1993. For the pricing-error measures (APT and ICAPM) and the market concentration measure, where larger numbers refer to less stock market development, we multiply the indicator numbers by negative 1 before computing the means-removed values. Second, we take a simple average of the means-removed market capitalization, total value traded, and turnover ratios to obtain an overall index of stock market development, INDEX1.[4] INDEX1 is calculated for forty-one countries (see table 2). INDEX2 is constructed in the same way. It aggregates information on the three

4. We computed principal components indexes of the indicators, which allow the data to choose the weights rather than taking a simple average. However, we do not report these indexes because the rankings they produce are very highly correlated with the indexes we report.

Table 2. *Aggregate Indexes of Stock Market Development, 1986–93*

	INDEX1[a]		INDEX2[b]		INDEX3[c]		INDEX4[d]	
Economy	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*
Argentina	32	–0.59	15	–0.47	23	–0.87	15	–0.50
Australia	13	0.19	7	0.12	7	0.15		
Austria	19	–0.15						
Belgium	28	–0.47						
Brazil	24	–0.29	11	–0.38	12	–0.37	10	–0.23
Canada	14	0.09						
Chile	27	–0.46	12	–0.40	11	–0.34	13	–0.37
Colombia	40	–0.88	23	–0.71	22	–0.68	21	–0.73
Denmark	26	–0.37						
Finland	30	–0.53						
France	21	–0.21						
Germany	3	1.38						
Greece	36	–0.73	18	–0.61	17	–0.60	16	–0.52
Hong Kong	2	2.01						
India	23	–0.26	9	–0.13	9	–0.11	7	–0.01
Indonesia	35	–0.71	17	–0.52	14	–0.48		
Israel	15	0.08						
Italy	29	–0.51						
Japan	1	2.02	1	1.63	1	1.63	1	1.41
Jordan	16	–0.08	8	0.04	8	0.07	8	–0.06
Korea, Rep. of	6	1.05	4	0.84	4	0.85	4	0.73
Malaysia	8	0.90	5	0.72	5	0.79	5	0.60
Mexico	18	–0.14	10	–0.16	10	–0.17	9	–0.11
Netherlands	12	0.32						
New Zealand	25	–0.33						
Nigeria	41	–0.96	20	–0.67	21	–0.67	19	–0.59
Norway	20	–0.18						
Pakistan	39	–0.82	16	–0.51	16	–0.49	11	–0.33
Philippines	31	–0.54	14	–0.43	13	–0.42	14	–0.40
Portugal	33	–0.61	13	–0.42	15	–0.49	12	–0.34
Singapore	7	1.04						
South Africa	10	0.48						
Spain	22	–0.25						
Sweden	17	–0.10						
Switzerland	9	0.75						
Thailand	11	0.38	6	0.36	6	0.36	6	0.31
Turkey	34	–0.61	19	–0.61	19	–0.62	17	–0.54
United Kingdom	4	1.23	3	1.01	3	1.02	3	0.89
United States	5	1.21	2	1.01	2	1.03	2	0.94
Venezuela	37	–0.74	22	–0.68	18	–0.61	20	–0.66
Zimbabwe	38	–0.81	21	–0.67	20	–0.66	18	–0.56
Average		0.02		–0.07		–0.07		–0.05
Number of economies	41		23		23		21	

Note: Details of the calculation of the indexes are discussed in the text. Definitions of the indicators are given in table 1. The ranking order, by index, is from high to low. The indexes represent averages during the period from 1986 to 1993.

a. INDEX1 is the average of market capitalization, total value traded/GDP, and turnover.

b. INDEX2 adds APT pricing error to INDEX1.

c. INDEX3 adds ICAPM pricing error to INDEX1.

d. INDEX4 adds market concentration to INDEX2.

Source: Authors' calculations.

indicators used in INDEX1 and APT pricing error to obtain an overall indicator of stock market development that incorporates international integration. INDEX2 includes only the twenty-three countries with APT estimates. INDEX3 combines INDEX1 with the ICAPM pricing error. INDEX3 includes only the twenty-three countries with ICAPM pricing-error estimates. INDEX4 averages the means-removed values of market capitalization, total value traded/GDP, turnover, APT pricing error, and market concentration. We compute this index only for the twenty-one countries with data on all five underlying indicators.

Rankings of Stock Market Development

Table 2 gives the country-by-country values and rankings for the four aggregate indexes. Although there are variations in country rankings, the indexes are very highly correlated, with correlation coefficients of 0.96. Thus, the various conglomerate indexes give very similar country rankings. Here we briefly summarize the results from table 2.

Consider first INDEX4, which aggregates the largest number of individual stock market development indicators but has the fewest countries. The INDEX4 variable says that Japan, the United States, the United Kingdom, and Korea have the most developed stock markets when aggregating information on market size, liquidity, international integration, and market concentration. Colombia, Venezuela, Nigeria, and Zimbabwe have the four lowest rankings in this twenty-one-country sample.

Next, consider INDEX1, which aggregates the least information but includes the most economies (forty-one) with data on all the underlying indicators. INDEX1 ranks Japan, Hong Kong, Germany, the United Kingdom, the United States, Korea, Singapore, and Malaysia as having very highly developed stock markets when aggregating information on market size and liquidity. INDEX1 implies that Nigeria, Colombia, Pakistan, and Zimbabwe have the least developed stock markets. As noted above, Germany's high ranking is strongly influenced by the tumultuous years surrounding reunification when there was an explosion of equity transactions. If Germany's two years of exceptionally high trading are removed in computing its averages during the period from 1986 to 1993, Germany falls from the top ten.

Although it is difficult to answer unambiguously the question of which stock markets are most developed, our evaluation of the indexes presented in table 2 suggests that the three most developed markets are in Japan, the United States, and the United Kingdom. The most underdeveloped markets are in Colombia, Venezuela, Nigeria, and Zimbabwe. Furthermore, the data suggest that Hong Kong, Singapore, Korea, Switzerland, and Malaysia have highly developed stock markets, and Turkey, Greece, Argentina, and Pakistan have underdeveloped markets.

Note that there is a close correspondence between income per capita and stock market development. Poorer countries have lower stock market development than richer countries on average. Also note that there are important exceptions. Fre-

quently, many markets termed emerging—such as Korea, Malaysia, and Thailand—are uniformly ranked higher than markets termed developed—such as France, the Netherlands, Australia, Canada, Sweden, and many other European countries.

III. Which Stock Markets Are Developing Most Rapidly?

Which stock markets are developing most rapidly? To answer this question, we rank countries according to the growth rates of the individual indicators of stock market development.

Growth Rates of Individual Indicators of Stock Market Development

Table 3 presents the average annual growth rates of the individual indicators of stock market development from 1986 to 1993. Here we highlight three points. First, in terms of market size, Indonesia and Turkey boomed over this period, growing at average annual rates of more than 100 percent a year. As a benchmark, market capitalization in the United States grew at 4 percent annually. At the other extreme, Finland, Japan, Germany, Sweden, New Zealand, and Italy saw their market capitalization ratios shrink from 1986 to 1993. Using another measure of market size, Indonesia, Turkey, Portugal, and Thailand saw the number of listed companies grow at an annual rate of over 18 percent.

Second, as measured by total value traded/GDP, Indonesia, Portugal, Turkey, Venezuela, and Greece experienced rapid liquidity growth (more than 200 percent), while Japan and Italy weathered rapid declines (−12 and −14 percent, respectively). As with total value traded/GDP, the turnover measure of liquidity identifies Indonesia as the fastest-growing market in terms of liquidity.

Third, some cross-country quandaries emerge from studying stock market growth. Consider, for example, the cases of Mexico and Portugal. Both countries liberalized their capital markets and privatized public enterprises, and both countries experienced very rapid improvements in international integration (as measured by the APT pricing error). In terms of market volatility, Mexico saw rapid declines in return volatility as it liberalized its economy and privatized state enterprises. In contrast, stock return volatility in Portugal exploded as it liberalized its capital markets and privatized its public enterprises. Another noteworthy difference between the two countries is that while market concentration grew dramatically in Mexico, it shrunk steadily in Portugal.

Growth Rates of Aggregate Indexes of Stock Market Development

Using individual stock market development indicators, we found it difficult to assess which markets experienced the most rapid overall development. Thus, we now evaluate the growth rate of overall indexes of stock market development. In section II, the goal was to compare the level of stock market development across countries. Here, however, we seek to measure the growth rate of each country's level of overall stock market development. Consequently, we now use the growth rate of each country's stock market

indicator. We average these growth rates to compute an overall index of stock market development.

We construct INDEXG1, which aggregates information on market capitalization, total value traded/GDP, and turnover, by computing the average annual growth rate for each indicator for each country. We then take a simple average of the growth rates to obtain an overall index of stock market development for each country. This index allows us to examine the growth rate of each country's overall level of stock market development.

INDEXG2 combines the growth rates of market capitalization, total value traded/GDP, turnover, and the APT pricing-error measure. INDEXG2 includes only countries with APT pricing-error estimates. INDEXG3 is similar to INDEXG2, except that INDEXG3 uses the ICAPM pricing-error estimates instead of the APT pricing-error estimates. Finally, INDEXG4 averages the annual growth rates of market capitalization, total value traded/GDP, turnover, APT pricing error, and market concentration. We compute this index only for the twenty-five countries with data on all five underlying indicators for the period from 1986 to 1993.

Table 4 reports the aggregate indexes of overall stock market growth. The main findings are straightforward. Regardless of the index, Indonesia, Turkey, Portugal, and Venezuela experienced the most rapid overall stock market development over the eight years. Although these countries began the period with underdeveloped markets, other countries with similarly underdeveloped stock markets—such as Colombia, Pakistan, and Zimbabwe—did not enjoy the explosive development experienced by Indonesia, Turkey, Portugal, and Venezuela.

We investigated whether stock markets that were initially underdeveloped grew faster. There is some evidence in support of convergence. Markets that were initially small and illiquid grew faster and became more liquid. Markets that initially were volatile and priced risk poorly tended to grow larger but not necessarily more liquid.

IV. Is Stock Market Development Linked to the Rest of the Financial System?

Do countries with well-developed stock markets have well-developed banks and nonbank financial intermediaries? To address this question, we discuss four types of measures of financial intermediary development: financial system, banks, nonbank financial corporations, and insurance and pension companies. We look at correlations among the indicators. We then construct aggregate indexes of financial intermediary development, which we use to examine the correlation between stock market development and financial intermediary development.

Indicators of Financial Intermediary Development

Here we discuss the size of the financial system, the size and efficiency of the banking system, the size of nonbank financial corporations, and the size of private insurance and private pension funds.

Table 3. *Growth Rates of Indicators of Stock Market Development, 1986–93*

Economy	Market capitalization		Total value traded/GDP		Number of listed companies		Turnover		Volatility		Market concentration		Institutional development		APT pricing error		ICAPM pricing error	
	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Argentina	3	0.87	8	1.18	41	–0.03	21	0.17	31	0.09	22	0.08	6	0.09	18	0.14	24	0.43
Australia	31	0.02	34	0.08	32	0.00	29	0.06	5	–0.02					8	–0.01	10	0.01
Austria	12	0.37	6	1.48	13	0.06	5	0.91	26	0.04								
Belgium	33	0.00	37	0.01	38	–0.02	3	1.54	8	–0.02								
Brazil	16	0.30	21	0.34	37	–0.01	42	–0.11	24	0.04	21	0.07	14	0.04	5	–0.03	13	0.05
Canada	35	0.00	38	0.01	30	0.01	32	0.05	22	0.03	25	0.09						
Chile	19	0.27	23	0.27	25	0.03	43	–0.11	16	0.01	15	0.02	16	0.03	11	0.00	14	0.06
Colombia	11	0.42	15	0.54	35	–0.01	37	–0.03	35	0.15	18	0.05	10	0.05	17	0.09	23	0.27
Denmark	24	0.06	14	0.55	34	–0.01	13	0.38										
Finland	36	–0.02	28	0.19	23	0.03	18	0.24	27	0.05								
France	23	0.07	32	0.09	16	0.05	30	0.06	33	0.10	19	0.06						
Germany	38	–0.03	24	0.26	26	0.02	15	0.30	2	–0.05	8	–0.02						
Greece	9	0.51	5	2.50	17	0.05	11	0.43	29	0.08	10	0.00	2	0.22	23	0.19	18	0.13
Hong Kong	26	0.06	22	0.31	9	0.09	17	0.25										
India	15	0.32	29	0.16	29	0.02	40	–0.08	32	0.09	12	0.00	17	0.02	4	–0.06	8	0.00
Indonesia	1	1.89	1	17.74	1	0.37	1	1.82					20	–0.06	19	0.14	1	–0.26
Ireland									21	0.03								
Israel	7	0.53	16	0.50	5	0.15	7	0.54	25	0.04								
Italy	41	–0.10	41	–0.14	19	0.05	22	0.16	6	–0.02								
Japan	37	–0.03	40	–0.12	27	0.02	39	–0.07	28	0.06	2	–0.09			3	–0.10	3	–0.07
Jordan	20	0.12	12	0.58	33	0.00	19	0.24	7	–0.02	5	–0.05	12	0.04	24	0.26	20	0.16
Korea, Rep. of	17	0.28	18	0.43	8	0.09	36	–0.01	18	0.01	24	0.09	15	0.03	12	0.03	9	0.01
Luxembourg					6	0.12	2	1.66										
Malaysia	14	0.34	7	1.31	10	0.09	12	0.40	3	–0.05	3	–0.08	19	0.01	14	0.04	5	–0.02

Mexico	10	0.49	11	0.62	22	0.04	34	0.01	1	–0.06	26	0.23	13	0.04	1	–0.15	4	–0.07
Netherlands	32	0.01	31	0.13	21	0.04	4	1.39	12	–0.01								
New Zealand	40	–0.05	26	0.20	43	–0.11	24	0.10	4	–0.03								
Nigeria	21	0.10	25	0.23	12	0.08	35	–0.01			9	0.00	4	0.11	9	–0.01	15	0.06
Norway	25	0.06	10	0.67	39	–0.03	9	0.45	23	0.03								
Pakistan	18	0.27	19	0.40	11	0.08	41	–0.09	11	–0.01	23	0.08	7	0.09	21	0.16	22	0.25
Philippines	5	0.61	13	0.57	18	0.05	38	–0.06	17	0.01	20	0.07	9	0.06	13	0.04	6	0.00
Portugal	8	0.51	2	3.25	3	0.20	14	0.35	37	0.85	7	–0.03	18	0.02	2	–0.14	2	–0.26
Singapore	29	0.04	20	0.34	15	0.06	10	0.43										
South Africa	28	0.04	30	0.13	20	0.04	27	0.08										
Spain	34	0.00	33	0.09	24	0.03	25	0.10	20	0.03								
Sweden	39	–0.05	39	–0.02	42	–0.05	26	0.09	30	0.08								
Switzerland	22	0.07	35	0.05	14	0.06	16	0.29	19	0.02	17	0.02						
Taiwan (China)					7	0.12	20	0.17	10	–0.02	6	–0.03	8	0.09	16	0.05	17	0.12
Thailand	6	0.57	9	0.76	4	0.18	31	0.05	15	0.01	1	–0.12	11	0.04	22	0.17	16	0.09
Turkey	2	1.02	3	2.87	2	0.23	6	0.65	34	0.13	13	0.01	1	0.29	20	0.14	19	0.14
United Kingdom	30	0.03	27	0.20	40	–0.03	23	0.10	14	0.00	14	0.02			7	–0.02	7	0.00
United States	27	0.04	36	0.04	36	–0.01	33	0.02	9	–0.02	16	0.02			6	–0.02	11	0.01
Venezuela	4	0.66	4	2.77	31	0.01	8	0.48	36	0.27	11	0.00	3	0.17	15	0.04	21	0.24
Zimbabwe	13	0.35	17	0.45	28	0.02	28	0.06	13	0.00	4	–0.07	5	0.11	10	–0.01	12	0.04
Average		0.27		1.02		0.05		0.31		0.05		0.02		0.07		0.04		0.06
Number of economies	41		41		43		43		37		26		20		24		24	

Note: Growth rates are the average annual growth rates. Definitions of the indicators are given in table 1. For each indicator, economies are ranked by the rate of growth of stock market development, from high to low. Thus, for market capitalization, total value traded/GDP, number of listed companies, turnover, and institutional development, the ranking by value of the indicator is from high to low. For volatility, market concentration, APT pricing error, and ICAPM pricing error, the ranking by value of the indicator is from low to high.

Source: Authors' calculations.

Table 4. *Growth Rates of Aggregate Indexes of Stock Market Development, 1986–93*

	INDEXG1		INDEXG2		INDEXG3		INDEXG4	
Economy	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*
Argentina	7	0.74	6	0.52	7	0.45	5	0.54
Australia	36	0.05	21	0.04	21	0.04		
Austria	6	0.92						
Belgium	10	0.52						
Brazil	24	0.18	15	0.14	15	0.12	16	0.12
Canada	38	0.02					24	–0.01
Chile	26	0.14	18	0.11	17	0.09	17	0.10
Colombia	18	0.31	12	0.21	14	0.17	12	0.22
Denmark	16	0.33						
Finland	28	0.14						
France	34	0.07					22	0.04
Germany	25	0.17					14	0.14
Greece	5	1.15	5	0.81	5	0.83	4	0.86
Hong Kong	22	0.20						
India	29	0.14	16	0.12	16	0.10	18	0.10
Indonesia	1	7.15	1	5.33	1	5.43		
Israel	9	0.52						
Italy	40	–0.03						
Japan	41	–0.07	23	–0.03	23	–0.04	25	–0.03
Jordan	17	0.31	13	0.17	12	0.19	9	0.25
Korea, Rep. of	21	0.23	14	0.17	13	0.17	13	0.15
Malaysia	8	0.68	7	0.50	6	0.52	6	0.53
Mexico	14	0.37	8	0.32	9	0.30	11	0.22
Netherlands	11	0.51						
New Zealand	33	0.09						
Nigeria	31	0.11	20	0.08	20	0.06	20	0.08
Norway	13	0.39						
Pakistan	23	0.20	17	0.11	18	0.08	15	0.13
Philippines	15	0.37	10	0.27	10	0.28	8	0.26
Portugal	3	1.37	3	1.06	3	1.09	2	1.04
Singapore	20	0.27						
South Africa	32	0.09						
Spain	35	0.06						
Sweden	39	0.01						
Switzerland	27	0.14					19	0.10
Thailand	12	0.46	9	0.30	8	0.32	7	0.37
Turkey	2	1.51	2	1.10	2	1.10	1	1.13
United Kingdom	30	0.11	19	0.09	19	0.08	21	0.08
United States	37	0.03	22	0.03	22	0.02	23	0.02
Venezuela	4	1.30	4	0.97	4	0.92	3	0.98
Zimbabwe	19	0.29	11	0.22	11	0.21	10	0.23
Average		0.53		0.55		0.54		0.31
Number of economies	41		23		23		25	

Note: Growth rates of indexes are obtained by averaging the growth rates of different stock market indicators, depending on the index. Indexes are defined in table 2. The ranking, by growth rate of each index, is from high to low.

Source: Authors' calculations.

FINANCIAL SYSTEM. On the basis of work by King and Levine (1993), we use three measures of financial system development. The ratio of liquid liabilities of the financial intermediaries to GDP is M3 money supply divided by GDP. The ratio is a measure of the overall size of the formal financial system. If the size of the financial system is positively related to the provision of financial services, then this ratio should be a good indicator of the provision of financial intermediary services.

The ratio of quasi-liquid liabilities to GDP is M3 money supply minus M1, divided by GDP. It subtracts narrow money from the liquid liabilities measure of financial intermediary size. Analysts sometimes use the quasi-liquid measure instead of liquid liabilities because M1/GDP represents highly liquid bank deposits and therefore may not be as closely associated with efficient financial intermediation as longer-term investments in financial intermediaries. The quasi-liquid measure focuses on longer-term liabilities.

Liquid and quasi-liquid liabilities that finance government deficits may not reflect the provision of efficient financial intermediary services (such as acquiring information about firms, monitoring managers, and facilitating transactions and risk diversification). Therefore, we compute a third variable, domestic credit to private firms divided by GDP. Unfortunately, although IMF (various issues) classifies credit as "claims on the private sector," some of these claims in some countries include credit to public enterprises.

Table 5 indicates that Hong Kong, Japan, and Switzerland had well-developed financial systems as measured by liquid and quasi-liquid liabilities to GDP and domestic credit to private firms. In contrast, Argentina, Brazil, Mexico, Colombia, and Nigeria had underdeveloped financial systems as revealed by these three indicators.

BANKS. To measure the level of development of the banking system, we use the ratio of the total claims of deposit money banks to GDP. The three countries with the largest values for this indicator were Switzerland, Luxembourg, and Japan. At the other extreme, Nigeria, Argentina, and Venezuela had the lowest ratio of bank credit to GDP during the period from 1986 to 1993.

We compute a measure of banking efficiency, which we call spread, that equals the difference between bank lending and borrowing rates. This measure may not accurately capture banking efficiency because the interest rate data may not accurately reflect borrowing and lending costs. The spread indicator will not provide accurate information on how well banks monitor firm managers, nor will it capture government intervention in the banking system in a very informative way. But the spread indicator is widely used and available across countries. We include it for completeness. For better measures of financial repression for a few select countries see Giovannini and De Melo (1993). According to the spread indicator, the banking systems of Switzerland, Canada, and the United Kingdom were among the most efficient, whereas Argentina, Israel, and Turkey had the least efficient banks.

Table 5. *Indicators of Financial Intermediary Development, 1986–93*
(annual average)

Economy	*Liquid liabilities to GDP*[a]		*Quasi-liquid liabilities to GDP*[b]		*Domestic credit to private sector to GDP*		*Total claims of deposit banks to GDP*		*Spread*[c]		*Assets of private nonbank financial corporations to GDP*		*Assets of private insurance and pension funds to GDP*	
	Rank	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*
Argentina	44	0.23	41	0.15	39	0.26	41	0.37	38	45.28				
Australia	24	1.13	19	0.89	16	1.07	22	1.19	28	6.28	5	0.45	8	0.35
Austria	9	1.72	7	1.44	11	1.36	4	2.39						
Belgium	31	0.94	33	0.55	29	0.61	20	1.20	26	5.70				
Brazil	43	0.26	42	0.14	38	0.29	36	0.51						
Canada	21	1.27	14	0.97	24	0.86	28	0.93	2	1.38	6	0.42	6	0.48
Chile	36	0.72	28	0.61	22	0.93	29	0.90	30	6.96				
Colombia	41	0.47	38	0.28	40	0.25			33	9.70	21	0.06	18	0.03
Denmark	23	1.19	27	0.62	21	0.98	21	1.20	23	5.35	15	0.12	5	0.54
Finland	25	1.10	21	0.82	8	1.60	14	1.60	12	3.55	12	0.21	9	0.33
France	16	1.36	20	0.87	6	1.77	8	2.00	34	10.57	10	0.28	11	0.20
Germany	17	1.34	15	0.94	5	1.80	5	2.16	22	5.15			10	0.33
Greece	12	1.54	9	1.21	33	0.45	27	0.95	31	7.19				
Hong Kong	1	3.91	1	3.53										
India	33	0.87	31	0.57	32	0.51	33	0.68	8	3.00				
Indonesia	37	0.65	35	0.44	28	0.66	34	0.65	16	4.23	22	0.02		
Ireland	32	0.88	26	0.64	31	0.52	30	0.87	21	5.10				
Israel	20	1.30	10	1.19	17	1.01	7	2.07	37	20.95				
Italy	13	1.47	23	0.75	27	0.71	24	1.01	32	7.34	9	0.33	17	0.06
Japan	2	3.57	2	3.00	2	2.27	3	2.58	11	3.31			7	0.43
Jordan	4	2.40	8	1.41	15	1.24	16	1.52	24	5.56	17	0.08	16	0.07
Korea, Rep. of	29	0.96	22	0.78	19	0.99	25	1.00	6	2.90	3	0.55	12	0.14
Luxembourg	6	2.36					2	2.59	4	2.31				
Malaysia	8	1.89	5	1.51	12	1.33	13	1.61	5	2.68	8	0.39	14	0.10

Mexico	42	0.42	37	0.29	37	0.29	38	0.48	35	13.76	18	0.08	19	0.02
Netherlands	10	1.61	11	1.16	9	1.53	9	1.97	29	6.92	25	0.00	1	1.08
New Zealand	27	1.03	29	0.61	23	0.92	23	1.10	17	4.49				
Nigeria	40	0.48	40	0.23	42	0.24	42	0.33	19	4.60	19	0.08		
Norway	22	1.26	30	0.61	14	1.27	15	1.57	15	4.21				
Pakistan	35	0.79	39	0.25	30	0.55	32	0.70			23	0.01	22	0.00
Philippines	38	0.63	34	0.48	36	0.34	37	0.48	20	5.04	20	0.07	20	0.01
Portugal	14	1.47	16	0.93	25	0.84	17	1.49	27	5.96				
Singapore	7	2.26	4	1.80	7	1.64	12	1.87	9	3.02	2	0.84	13	0.11
South Africa	26	1.06	24	0.72	26	0.74	31	0.78	10	3.20				
Spain	15	1.44	18	0.90	13	1.31	11	1.89	18	4.59	11	0.24	15	0.08
Sweden	30	0.96			20	0.98	18	1.41	25	5.68	1	0.89	4	0.56
Switzerland	3	2.83	3	2.26	1	3.14	1	3.26	1	0.87				
Taiwan (China)	5	2.38	6	1.49	4	1.80	6	2.10						
Thailand	19	1.31	12	1.12	18	0.99	19	1.23	13	3.60	13	0.15	21	0.01
Turkey	39	0.61	36	0.41	35	0.36	35	0.54	36	19.50	24	0.01		
United Kingdom	11	1.59	17	0.92	3	1.97	10	1.97	3	1.82	16	0.08	2	0.92
United States	18	1.33	13	0.99	10	1.42	26	0.99	7	3.00	4	0.53	3	0.67
Venezuela	34	0.80	32	0.55	34	0.40	40	0.45			7	0.40		
Zimbabwe	28	0.96	25	0.70	41	0.24	39	0.45	14	3.90	14	0.13		
Average		1.33		0.95		1.01		1.31		6.81		0.26		0.30
Number of economies	44		42		42		42		38		25		22	

Note: The financial intermediary development of each economy is ranked from high to low. This ranking is shown by ranking the value of the indicator from high to low for liquid liabilities to GDP, quasi-liquid liabilities to GDP, domestic credit to private sector to GDP, total claims of deposit banks to GDP, assets of private nonbanks to GDP, and assets of private insurance and pension funds to GDP; for spread, the ranking by value of the indicator is from low to high.

a. Liquid liabilities of the financial system are the M3 definition of money.

b. Quasi-liquid liabilities are M3 minus M1 money.

c. The spread is the difference between bank lending and borrowing rates.

Source: Authors' calculations.

NONBANK FINANCIAL CORPORATIONS. We use the ratio of assets of private nonbank financial intermediaries to GDP to measure the size of nonbank financial corporations, such as finance companies, mutual funds, and brokerage houses. The four economies with the largest values for this indicator were Sweden, Singapore, Korea, and the United States. Indonesia, Pakistan, Turkey, and the Netherlands had very low values.[5]

INSURANCE AND PENSION COMPANIES. Finally, we use the ratio of assets of private insurance companies and pension funds to GDP to measure the size of private insurance and pension companies. The three countries with the largest values for this indicator were the Netherlands, the United Kingdom, and the United States. The Philippines, Thailand, and Pakistan had very low values.

Correlations between Various Indicators of Financial Intermediary Development

The measures of financial system size—the liquid, quasi-liquid, and domestic credit to private firms indicators—are very highly correlated. The correlation coefficients are 0.79 or higher and significant at the 0.01 level. The correlations between the indicators of the size of the financial system and indicators of the size of banks, private nonbank financial corporations, and private insurance and pension companies are not as strong. Although all of the correlations are positive, many are not significant. Furthermore, the correlation coefficient of those that are significant is frequently below 0.50.

The different financial intermediary indicators give different country rankings of financial intermediary development. These differences reflect financial structures across countries, that is, different combinations of financial intermediaries and financial markets that compose a country's financial system. Differences in financial structure may reflect legal differences. For example, countries with universal banking, as distinct from the more segregated legal and regulatory impediments of the United States, may develop different combinations of financial intermediaries. The overall size of the financial system across countries with different financial structures, however, may be similar, as may be the provision of financial services to investors. For example, countries with big financial systems have big banks and nonbank financial corporations, but the correlation between financial system size and private insurance and pension companies is not strong.

Aggregate Indexes of Financial Intermediary Development

Because we want to compare an overall measure of financial intermediary development with our aggregate indicators of stock market development, we construct conglomerate indexes of financial intermediary development. Using

5. We collected data on private nonbank financial corporations, insurance companies, and pension funds from individual country reports, including documents published by ministries of finance, central banks, and regulatory agencies.

the same procedure for constructing conglomerate indexes discussed above, this section constructs three financial intermediary indexes. FINDEX1 averages the means-removed values of the ratio of liquid liabilities to GDP and the ratio of domestic credit to the private sector to GDP. FINDEX2 averages the means-removed values of the ratio of liquid liabilities to GDP, the ratio of domestic credit to the private sector to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension funds to GDP. FINDEX3 combines the means-removed values of the ratio of total claims of deposit banks to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension funds to GDP. Table 6 provides the country rankings and the values of these indexes from 1986 to 1993. The aggregate indexes of financial intermediary development are highly correlated, with correlation coefficients above 0.73 and *P*-values less than 0.01.

The results in table 6 on FINDEX3—which aggregates information on banks, private nonbank financial corporations, and private insurance companies and pension funds—suggest that the top five economies with the most developed financial intermediaries were Switzerland, Sweden, Luxembourg, Australia, and Singapore. The five countries with the least developed financial intermediaries were Colombia, Pakistan, the Philippines, Turkey, and Mexico. We prefer FINDEX3 to the other financial intermediary indexes because it combines information on particular financial intermediaries: banks, nonbank financial corporations, and insurance companies and pension funds. The other aggregate indexes mix information on particular intermediaries with information on liabilities that span across different types of intermediaries.

Stock Market Development and Financial Intermediary Development

Do countries with well-developed stock markets have well-developed banks and nonbank financial intermediaries? Table 7 presents the correlations between individual indicators of stock market development and individual indicators of financial intermediary development. Here we highlight three points.

First, stock market size (market capitalization) and liquidity (as measured by total value traded/GDP) are positively correlated with all of the indicators of financial intermediary development. They are significantly correlated with all of the indicators of financial intermediary development except the ratio of the assets of private insurance and pension companies to GDP. Second, volatility is significantly negatively correlated with all the indicators of financial intermediary development except the ratio of assets of private nonbank financial corporations to GDP. Thus, countries with well-developed financial intermediaries, large banks, and large private insurance companies and pension funds tend to have less volatile stock markets. Third, APT and ICAPM pricing errors are negatively correlated with indicators of financial intermediary development. Countries with stock markets that are internationally integrated tend to have larger financial systems and banks than countries with less internationally integrated markets.

Table 6. *Aggregate Indexes of Financial Intermediaries, 1986–93*

	FINDEX1[a]		FINDEX2[b]		FINDEX3[c]	
Economy	*Rank*	*Value*	*Rank*	*Value*	*Rank*	*Value*
Argentina	42	–0.79			37	–0.72
Australia	11	0.23			4	0.75
Austria	20	–0.12	7	0.23	12	0.34
Belgium	29	–0.35			23	–0.06
Brazil	41	–0.75			34	–0.58
Canada	17	–0.06	6	0.27	13	0.32
Chile	28	–0.29			28	–0.32
Colombia	40	–0.72	20	–0.78	43	–0.82
Denmark	21	–0.12	12	–0.02	19	0.01
Finland	13	0.12	10	0.03	20	0.01
France	8	0.31	9	0.09	18	0.06
Germany	9	0.30			14	0.31
Greece	26	–0.23			27	–0.30
India	30	–0.44			33	–0.48
Indonesia	32	–0.46			36	–0.72
Ireland	31	–0.45			29	–0.36
Israel	19	–0.07			10	0.54
Italy	22	–0.13	15	–0.17	26	–0.23
Japan	2	1.31			7	0.62
Jordan	6	0.42	14	–0.16	31	–0.45
Korea, Rep. of	24	–0.21	11	0.02	17	0.08
Luxembourg					3	0.94
Malaysia	10	0.29	8	0.10	21	0.00
Mexico	39	–0.71	19	–0.77	39	–0.77
Netherlands	7	0.34	4	0.53	6	0.65
New Zealand	23	–0.20			25	–0.19
Nigeria	38	–0.71			38	–0.72
Norway	15	0.03			15	0.16
Pakistan	33	–0.46	17	–0.72	42	–0.81
Philippines	37	–0.61	18	–0.73	41	–0.78
Portugal	18	–0.06			16	0.11
Singapore	4	0.56	1	0.70	5	0.68
South Africa	27	–0.23			30	–0.39
Spain	14	0.11	13	–0.15	24	–0.14
Sweden	25	–0.21	2	0.67	2	1.04
Switzerland	1	1.45			1	1.39
Taiwan (China)	3	0.64			11	0.51
Thailand	16	–0.02	16	–0.36	32	–0.48
Turkey	36	–0.59			40	–0.78
United Kingdom	5	0.45	5	0.53	9	0.55
United States	12	0.14	3	0.59	8	0.60
Venezuela	35	–0.52			22	–0.06
Zimbabwe	34	–0.52			35	–0.59
Average		–0.08		–0.00		–0.02
Number of economies	42		20		43	

Note: Details of the calculation of the indexes are discussed in the text. The ranking order, by growth rate of each index, is from high to low.

a. FINDEX1 is the average of the ratio of liquid liabilities (M3 money) to GDP and the ratio of domestic credit to the private sector to GDP.

b. FINDEX2 is the average of the ratio of liquid liabilities (M3 money) to GDP, the ratio of domestic credit to the private sector to GDP, the ratio of the assets of private nonbank institutions to GDP, and the ratio of assets of private insurance and pension funds to GDP.

c. FINDEX3 is the average of the ratio of total claims of deposit banks to GDP, the ratio of the assets of private nonbank institutions to GDP, and the ratio of the assets of private insurance and pension funds to GDP. FINDEX3 does not include the last two terms if data are not available.

Source: Authors' calculations.

Table 7. *Correlations between Indicators of Financial Intermediary and Stock Market Development, 1986–93*

	Financial intermediary indicator					
Stock market indicator	*Liquid liabilities to GDP*[a]	*Total claims of deposit banks to GDP*	*Domestic credit to private sector to GDP*	*Quasi-liquid liabilities to GDP*[b]	*Assets of private nonbanks to GDP*	*Assets of private insurance and pension funds to GDP*
Market capitalization						
Correlation	0.66	0.40	0.52	0.67	0.47	0.29
	[0.00]	[0.01]	[0.00]	[0.00]	[0.02]	[0.20]
Number of observations	41	40	40	40	25	22
Total value traded/GDP						
Correlation	0.75	0.58	0.70	0.78	0.46	0.33
	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.14]
Number of observations	41	40	40	40	25	22
Turnover						
Correlation	0.18	0.42	0.38	0.22	0.27	0.11
	[0.25]	[0.01]	[0.01]	[0.16]	[0.20]	[0.61]
Number of observations	41	40	40	40	25	22
APT pricing error						
Correlation	–0.49	–0.48	–0.54	–0.45	–0.06	–0.40
	[0.01]	[0.02]	[0.01]	[0.03]	[0.84]	[0.20]
Number of observations	24	24	24	24	16	12
ICAPM pricing error						
Correlation	–0.51	–0.47	–0.55	–0.46	–0.23	–0.38
	[0.01]	[0.02]	[0.01]	[0.02]	[0.39]	[0.22]
Number of observations	24	24	24	24	16	12
Volatility						
Correlation	–0.41	–0.42	–0.40	–0.37	–0.12	–0.52
	[0.01]	[0.01]	[0.01]	[0.03]	[0.60]	[0.02]
Number of observations	37	37	37	36	21	20
Market concentration						
Correlation	–0.24	–0.28	–0.32	–0.24	–0.42	–0.56
	[0.24]	[0.16]	[0.11]	[0.23]	[0.11]	[0.04]
Number of observations	26	26	26	26	16	14
Institutional development						
Correlation	–0.05	0.21	0.26	0.04	0.42	0.51
	[0.84]	[0.37]	[0.27]	[0.86]	[0.15]	[0.20]
Number of observations	20	20	20	20	13	8

Note: *P*-values are in brackets. Indicators of stock market development are defined in table 1.

a. Liquid liabilities are the M3 definition of money.

b. Quasi-liquid liabilities are M3 minus M1 money.

Source: Authors' calculations.

Table 8. *Correlations between Aggregate Indexes of Financial Intermediary and Stock Market Development, 1986–93*

	Stock market index			
Financial intermediary index	*INDEX1*	*INDEX2*	*INDEX3*	*INDEX4*
FINDEX1				
Correlation	0.72	0.83	0.84	0.81
	[0.00]	[0.00]	[0.00]	[0.00]
Number of observations	40	23	23	21
FINDEX2				
Correlation	0.67	0.89	0.89	0.92
	[0.00]	[0.00]	[0.00]	[0.00]
Number of observations	20	11	11	10
FINDEX3				
Correlation	0.62	0.79	0.79	0.80
	[0.00]	[0.00]	[0.00]	[0.00]
Number of observations	40	23	23	21

Note: *P*-values are in brackets. The stock market indexes are defined in table 2, and the financial intermediary indexes are defined in table 6. Details of the calculation of the indexes are discussed in the text.

Source: Authors' calculations.

Using the conglomerate indexes of stock market development and the conglomerate indexes of financial intermediary development, the strong positive correlation between stock market development and financial intermediary development emerges even more strongly. As shown in table 8, the aggregate indexes of stock market development are all significantly correlated with the aggregate indexes of financial intermediary development at the 0.01 level.

Furthermore, measures of stock market pricing errors, as represented by APT and ICAPM, are positively correlated with banking inefficiency as measured by the interest rate spread (table 9). Stock market development (including measures of pricing errors) and financial intermediary development (including measures of banking efficiency) go hand in hand. These results are consistent with Boyd and Smith's (1996) model, where there is a role for both banking and equity markets as economies develop. Thus, with increases in per capita income and wealth, stock markets emerge and complement (but not replace) bank lending. As economies develop, their financial systems display a wide array of institutions and markets.

V. SUMMARY

This article collected and summarized information on a wide assortment of indicators of stock market and financial intermediary development. To describe different characteristics of equity market development, we used measures of stock market size, liquidity, integration with world capital markets, volatility,

Table 9. *Correlations between Stock Market Pricing Errors and Financial Intermediary Inefficiency, 1986–93*

Indicator	*Spread*[a]	*APT pricing error*	*ICAPM pricing error*
Spread			
Correlation	1.00	0.20	0.81
	[0.00]	[0.39]	[0.00]
Number of observations	39	21	21
APT pricing error			
Correlation		1.00	0.68
		[0.00]	[0.00]
Number of observations		24	24
ICAPM pricing error			
Correlation			1.00
			[0.00]
Number of observations			24

Note: P-values are in brackets.
a. The spread is the difference between bank lending and borrowing rates.
Source: Authors' calculations.

concentration, and features of the regulatory system. To describe the development and structure of financial intermediaries, we used measures of the overall size of the financial intermediary sector, the allocation of credit, the spread between borrowing and lending interest rates, and the size of particular types of financial intermediaries, such as banks, insurance companies, and pension funds. No single measure is the correct measure of stock market or financial intermediary development. Indeed, each indicator may be the appropriate measure for a particular question. Consequently, this article's major contribution is the collection and comparison of a wide variety of indicators. The article constructs aggregate indexes of stock market and financial intermediary development that combine the information reflected in several individual indicators.

There are enormous cross-country differences for each indicator of stock market development. For example, the ratio of market capitalization to GDP is greater than 1 in five countries and less than 0.10 in five countries. Even so, there are intuitively appealing correlations among the individual stock market indicators and between the stock market indicators and measures of financial intermediary development. Big markets, for example, tend to be less volatile, more liquid, and less concentrated in a few stocks; internationally integrated markets tend to be less volatile; and institutionally developed markets tend to be large and liquid. Moreover, we find that across countries the level of stock market development is highly correlated with the development of banks, nonbank financial corporations, and insurance companies and private pension funds.

When we compute conglomerate indexes of overall stock market development, plausible and educational patterns emerge. We find that the three most

developed markets are Japan, the United States, and the United Kingdom. The most underdeveloped markets are Colombia, Venezuela, Nigeria, and Zimbabwe. The data suggest that Korea, Switzerland, and Malaysia have highly developed stock markets, while Turkey, Greece, Argentina, and Pakistan have underdeveloped markets. Furthermore, although richer countries generally have more developed stock markets than poorer countries, many markets labeled emerging—such as Korea, Malaysia, and Thailand—are systematically more developed than markets labeled developed—such as France, the Netherlands, Australia, Canada, Sweden, and Norway.

During the period from 1986 to 1993, some markets exhibit very rapid development in terms of size, liquidity, and international integration. Indonesia, Turkey, Portugal, and Venezuela have experienced explosive development. Future case studies into the underlying causes of and the economic consequences of this rapid development could yield valuable insights.

In this article, the goal has not been to test specific hypotheses rigorously. Rather, our objectives have been to compile and compare different indicators of stock market development, highlight some important correlations, and, most important, stimulate future research into the links between stock market development and economic development.

Appendix. The Cross-Country Comparability of Stock Market Data

The IFC began calculating emerging market indexes in 1981. IFC selects stocks for inclusion in the indexes on the basis of three criteria: size, liquidity, and industry. The indexes include the largest and most actively traded stocks in each market, targeting 60 percent of total market capitalization at the end of each year. The index targets 60 percent of trading volume during the year. Size is measured by market capitalization, and liquidity is measured by the total value of shares traded during the year. Selection criteria used by Morgan Stanley Capital International (MSCI) in creating industrial country stock indexes are comparable to those of the IFC. In constructing the MSCI indexes, 60 percent coverage of the total market capitalization of each market is the primary objective. In contrast to the IFC indexes, MSCI indexes have no secondary objective regarding volume of trading. Instead, they try to replicate the industrial composition of the local market and take a representative sample of large, medium, and small capitalization stocks. MSCI uses liquidity as a consideration in choosing among the medium and small capitalization stocks.

The IFC indexes represent value-weighted portfolios of the stocks in each market. Each stock is weighted by its market capitalization in the same way in which the MSCI country indexes are formed, using the chained Paasche method.

Most of the stock market indicators compiled in this study are constructed using complete market information, and are fully comparable. For example, the market capitalization ratio is the value of all listed shares in the stock exchange divided by GDP in all countries. This is true for all our indicators except the

volatility and asset pricing indicators, which use index information or individual stock prices for those indicators included in the indexes. For volatility and asset pricing, differences in constructing MSCI and IFC indexes may introduce a bias. However, as discussed above, the magnitude of this bias is likely to be small, and MSCI and IFC indexes have been used in cross-country empirical studies in the literature (see for example Bekaert and Harvey 1995 and De Santis 1993).[6]

6. This appendix is mostly based on IFC (1993) and Schmidt (1990).

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Stock Market Development and Long-Run Growth

Ross Levine and Sara Zervos

Is the financial system important for economic growth? One line of research argues that it is not; another line stresses the importance of the financial system in mobilizing savings, allocating capital, exerting corporate control, and easing risk management. Moreover, some theories provide a conceptual basis for the belief that larger, more efficient stock markets boost economic growth. This article examines whether there is a strong empirical association between stock market development and long-run economic growth. Cross-country growth regressions suggest that the predetermined component of stock market development is positively and robustly associated with long-run economic growth.

To assess whether stock markets are merely burgeoning casinos where more and more players are coming to place bets, or whether stock markets are importantly linked to economic growth, this article reviews a diffuse theoretical literature and presents new empirical evidence. In terms of theory, a growing literature argues that stock markets provide services that boost economic growth. Greenwood and Smith (forthcoming) show that large stock markets can lower the cost of mobilizing savings and thereby facilitate investment in the most productive technologies. Bencivenga, Smith, and Starr (1996) and Levine (1991) argue that stock market liquidity—the ability to trade equity easily—is important for growth. Although many profitable investments require a long-run commitment of capital, savers do not like to relinquish control of their savings for long periods. Liquid equity markets ease this tension by providing an asset to savers that they can quickly and inexpensively sell. Simultaneously, firms have permanent access to capital raised through equity issues. Moreover, Kyle (1984) and Holmstrom and Tirole (1993) argue that liquid stock markets can increase incentives for investors to get information about firms and improve corporate governance. Finally, Obstfeld (1994) shows that international risk sharing through internationally integrated stock markets improves resource allocation and can accelerate the rate of economic growth.

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Theoretical disagreement exists, however, about the importance of stock markets for economic growth. Mayer (1988) argues that even large stock markets are unimportant sources of corporate finance. Stiglitz (1985, 1994) says that stock market liquidity will not enhance incentives for acquiring information about firms or exerting corporate governance. Moreover, Devereux and Smith (1994) emphasize that greater risk sharing through internationally integrated stock markets can actually reduce saving rates and slow economic growth. Finally, the analyses of Shleifer and Summers (1988) and Morck, Shleifer, and Vishny (1990a, 1990b) suggest that stock market development can hurt economic growth by easing counterproductive corporate takeovers.

We use cross-country regressions to examine the association between stock market development and economic growth. To conduct this investigation, we need measures of stock market development. Theory does not provide a unique concept or measure of stock market development, but it does suggest that stock market size, liquidity, and integration with world capital markets may affect economic growth. Consequently, we use a conglomerate index of overall stock market development constructed by Demirgüç-Kunt and Levine (1996).[1]

More specifically, we use pooled cross-country, time-series regressions to evaluate the relationship between stock market development and economic growth. Using data on forty-one countries over the period from 1976 to 1993, we split the sample period, so that each country has two observations (data permitting) with data averaged over each subperiod. In the tradition of recent work (Barro 1991), we regress the growth rate of gross domestic product (GDP) per capita on a variety of variables designed to control for initial conditions, political stability, investment in human capital, and macroeconomic conditions. We then include the conglomerate index of stock market development. Thus, we evaluate whether there is a relationship between economic growth and stock market development that is independent of other variables associated with economic growth.

Our article builds on Atje and Jovanovic's (1993) study of stock market trading and economic growth in two ways. First, we use indexes of stock market development that combine information on stock market size, trading, and integration. Second, we control for initial conditions and other factors that may affect economic growth in light of the evidence that many cross-country regression results are fragile to changes in the conditioning information set (Levine and Renelt 1992). Thus, we gauge the robustness of the relationship between overall stock market development and economic growth to changes in the conditioning information set. We find a strong correlation between overall stock market development and long-run economic growth. After controlling for the initial level of GDP per capita, initial investment in human capital, political instability, and measures of monetary, fiscal, and exchange rate policy, stock market development remains positively and significantly correlated with long-run eco-

1. When we ran the regressions using the other aggregate indexes in Demirgüç-Kunt and Levine (1996), the results were similar to those presented in table 1.

nomic growth. The results are consistent with theories that imply a positive relationship between stock market development and long-run economic growth. The results are inconsistent with theories that predict no correlation or a negative association between stock market development and economic performance.

Cross-country growth regressions suffer from measurement, statistical, and conceptual problems. In terms of measurement problems, country officials sometimes define, collect, and measure variables inconsistently across countries. Further, people with detailed country knowledge frequently find discrepancies between published data and what they know happened. In terms of statistical problems, regression analysis assumes that the observations are drawn from the same population; yet vastly different countries appear in cross-country regressions. Many countries may be sufficiently different to warrant separate analyses. Conceptually, we should interpret the coefficients from cross-country regressions cautiously. When averaging over long periods, many changes are occurring simultaneously: countries change policies, economies experience business cycles, and governments rise and fall. Thus, aggregation may blur important events and differences across countries. Analysts should extend this research by examining the time-series relationship between stock market development and economic growth. Also, cross-country regressions do not resolve issues of causality. Consequently, we should not view the coefficients as elasticities that predict the magnitude of the change in growth following a particular policy reform. Instead, the coefficient estimates and the associated *t*-statistics should be used to evaluate the strength of the partial correlation between stock market development and economic growth.

These measurement, statistical, and conceptual problems, however, should not detract from the benefits that can accrue from cross-country comparisons. Elucidating cross-country empirical regularities between stock market development and economic growth will influence beliefs about this relationship and shape future theoretical and empirical research. Put differently, beliefs about stock markets and growth not supported by cross-country comparisons will be viewed more skeptically than those views confirmed by cross-country regressions.

Section I reviews the theoretical literature on the functioning of stock markets and economic growth. Section II turns to the data and constructs a conglomerate measure of stock market development. Section III evaluates the strength of the empirical link between stock market development and long-run economic growth. Section IV summarizes the findings.

I. Theoretical Framework

Is the financial system important for economic growth? One line of research argues that the financial system is unimportant for economic growth; another line stresses the importance of the financial system in mobilizing savings, allocating capital, exerting corporate control, and easing risk management. Fur-

thermore, some theories provide a conceptual basis for believing that larger, more efficient stock markets boost economic growth.

In a recent survey of development economics, Stern (1989) does not mention the role of the financial system in economic growth. At the end of his review, Stern lists various issues that he did not have sufficient space to cover. Finance is not even included in the list of omitted topics. Similarly, a recent collection of essays by the pioneers of development economics, including three Nobel prizewinners, does not describe the role of the financial system in economic growth (Meier and Seers 1984). Clearly, according to these economists, the financial system plays an inconsequential role in economic development. Furthermore, 1995 Nobel prizewinner Robert Lucas argues that economists frequently exaggerate the role of financial factors in economic development (Lucas 1988). Such a view is not limited to the recent past; Robinson (1952) argues that the financial system does not spur economic growth; financial development simply responds to developments in the real sector. Thus, many influential economists give a very minor role, if any, to the financial system in economic growth.[2]

In contrast, a prominent line of research stresses the role of the financial system in economic growth. Bagehot (1962), Schumpeter (1932), Cameron and others (1967), Goldsmith (1969), and McKinnon (1973) provide conceptual descriptions of how, and empirical examples of when, the financial system affects economic growth. Building on these seminal contributions, Gelb (1989), Ghani (1992), King and Levine (1993a, 1993b), and De Gregorio and Guidotti (1995) show that measures of banking development are strongly correlated with economic growth in a broad cross-section of countries. According to this vein of research, a well-functioning financial system is critical for sustained economic growth.

Besides evaluating the general importance of the financial system, this article provides empirical evidence regarding the growing debate concerning the specific role of stock markets in economic growth. A burgeoning theoretical literature suggests that the functioning of equity markets affects liquidity, risk diversification, acquisition of information about firms, corporate control, and savings mobilization. By altering the quality of these services, the functioning of stock markets can alter the rate of economic growth. Debate exists, however, over the sign of this effect. Specifically, some models suggest that stock market development has a negative effect on growth, while other models predict a positive relationship between stock market development and economic growth.

Stock markets may affect economic activity through their *liquidity*. Many high-return projects require a long-run commitment of capital. Investors, however, are generally reluctant to relinquish control of their savings for long periods. Therefore, without liquid markets or other financial arrangements that promote liquidity, less investment may occur in the high-return projects. Levine (1991) and Bencivenga, Smith, and Starr (1996) show that stock markets may

2. Many of these references are from Chandavarkar's (1992) insightful discussion of financial and economic development.

arise to provide liquidity: savers have liquid assets—such as equities—while firms have permanent use of the capital raised by issuing equities. Liquid stock markets reduce the downside risk and costs of investing in projects that do not pay off for a long time. With a liquid equity market, the initial investors do not lose access to their savings for the duration of the investment project because they can quickly, cheaply, and confidently sell their stake in the company. Thus, more liquid stock markets ease investment in long-run, potentially more profitable projects, thereby improving the allocation of capital and enhancing prospects for long-term growth. Theory is unclear, however, about the effects of greater liquidity on growth. Bencivenga and Smith (1991) show that by reducing uncertainty, greater liquidity may reduce saving rates enough to slow growth.

Risk diversification through internationally integrated stock markets is another vehicle by which stock market development may influence economic growth. Saint-Paul (1992), Devereux and Smith (1994), and Obstfeld (1994) demonstrate that stock markets provide a vehicle for diversifying risk. These models also show that greater risk diversification can influence growth by shifting investment into higher-return projects. Intuitively, because projects with high expected returns also tend to be comparatively risky, better risk diversification through internationally integrated stock markets will foster investment in projects with higher returns. Again, however, theory suggests circumstances in which greater risk sharing slows growth. Devereux and Smith (1994) and Obstfeld (1994) show that reduced risk through internationally integrated stock markets can depress saving rates, slow growth, and reduce economic welfare.

Stock markets may also promote the *acquisition of information about firms* (Grossman and Stiglitz 1980; Kyle 1984; Holmstrom and Tirole 1993). In larger and more liquid markets it will be easier for an investor who has gotten information to trade at posted prices. The investor will thus be able to make money before the information becomes widely available and prices change. The ability to profit from information will stimulate investors to research and monitor firms. Better information about firms will improve resource allocation and spur economic growth. Opinions differ, however, on the importance of stock markets in stimulating the acquisition of information. Stiglitz (1985, 1994), for example, argues that well-functioning stock markets quickly reveal information through price changes. Quick public revelation will reduce—not enhance—incentives for expending private resources to obtain information. Thus, theoretical debate still exists on the importance of stock markets in enhancing information.

Stock market development may also influence *corporate control*. Diamond and Verrecchia (1982) and Jensen and Murphy (1990) show that efficient stock markets help mitigate the principal-agent problem. Efficient stock markets make it easier to tie manager compensation to stock performance. A closer link helps to align the interests of managers and owners. Furthermore, Laffont and Tirole (1988) and Scharfstein (1988) argue that takeover threats induce managers to maximize a firm's equity price. Thus, well-functioning stock markets that ease corporate takeovers can mitigate the principal-agent problem and promote effi-

cient resource allocation and growth. Opinion differs on this issue, too. Stiglitz (1985) argues that outsiders will be reluctant to take over firms because outsiders generally have worse information about firms than do owners. Thus, the takeover threat will not be a useful mechanism for exerting corporate control; stock market development, therefore, will not improve corporate control significantly (Stiglitz 1985). Moreover, Shleifer and Vishny (1986) and Bhide (1993) argue that greater stock market development encourages more diffuse ownership and this diffusion of ownership impedes effective corporate governance. Finally, Shleifer and Summers (1988) note that by simplifying takeovers, stock market development can stimulate welfare-reducing changes in ownership and management.

In terms of raising capital, Greenwood and Smith (forthcoming) show that large, liquid, and efficient stock markets can ease *savings mobilization*. By agglomerating savings, stock markets enlarge the set of feasible investment projects. Since some worthy projects require large capital injections and some enjoy economies of scale, stock markets that ease resource mobilization can boost economic efficiency and accelerate long-run growth. Disagreement exists, however, on the importance of stock markets for raising capital. Mayer (1988), for example, argues that new equity issues account for a very small fraction of corporate investment.

II. Measures of Stock Market Development

Each theoretical model in the literature focuses on one characteristic of the functioning of stock markets, such as size, liquidity, or integration. Consequently, one research strategy is to evaluate empirically, characteristic by characteristic, the predictions from each individual theoretical model. Although useful, this strategy is model-specific and focuses narrowly on individual characteristics. We take a different approach here, as do Demirgüç-Kunt and Levine (1996) and Demirgüç-Kunt and Maksimovic (1996). We use a multifaceted measure of overall stock market development that combines the different individual characteristics of the functioning of stock markets. Thus, we provide an empirical assessment of whether overall stock market development is strongly connected with long-run economic growth.

Individual Stock Market Development Indicators

We use individual indicators of size, liquidity, and risk diversification. We measure the *size* of the stock market using the ratio of market capitalization divided by GDP. Market capitalization equals the total value of all listed shares. The assumption underlying the use of this variable as an indicator of stock market development is that the size of the stock market is positively correlated with the ability to mobilize capital and diversify risk.

We measure the *liquidity* of the stock market in two ways. First, we compute the ratio of total value of trades on the major stock exchanges to GDP. This ratio measures the value of equity transactions relative to the size of the economy.

This liquidity measure complements the measure of stock market size because markets may be large but inactive. Second, we compute the ratio of the total value of trades on the major stock exchanges divided by market capitalization. This ratio, frequently called the turnover ratio, measures the value of equity transactions relative to the size of the equity market. The turnover ratio also complements the measure of stock market size as well as the total value of equity transactions divided by GDP, because markets may be small (compared with the whole economy) but liquid. The liquidity indicators do not directly measure the ease with which agents can buy and sell securities at posted prices. They do, however, measure the degree of trading, compared with the size of both the economy and the market. Since liquidity may significantly influence growth by easing investment in large, long-term projects and by promoting the acquisition of information about firms and managers, we include these two liquidity measures in our stock market development index.

Theory suggests that the ability to *diversify risk*—by investing in an internationally diversified portfolio of stocks—can influence investment decisions and long-run growth rates (Devereux and Smith 1994; Obstfeld 1994). Barriers to international capital flows—such as taxes, regulatory restrictions, information asymmetries, and sovereign risk—may impede the ability of investors to diversify risk internationally. Thus, international capital flow barriers will impede risk diversification, reduce capital market integration, and keep arbitrageurs from equalizing the price of risk internationally. To measure the ability of agents to diversify risk internationally, we use Korajczyk's (1996) estimate of the degree of international integration of national stock markets.

Korajczyk (1996) uses a multifactor International Arbitrage Pricing Model (IAPM) to measure stock market integration. The IAPM implies that the expected excess return on each asset is linearly related to a linear combination of benchmark portfolios. For the benchmark portfolios, P, Korajczyk (1996) estimates the common factors based on an international portfolio of equities using the asymptotic principal components procedures of Connor and Korajczyk (1986). Given m assets and T periods, consider the following regression:

$$(1) \qquad R_{i,t} = \alpha_i + b_i P_t + \varepsilon_{i,t}, \qquad i = 1, 2, \ldots, m; \qquad t = 1, 2, \ldots, T$$

where $R_{i,t}$ is the excess return on asset i in period t above the return on a risk-free asset or zero-beta asset. In perfectly integrated stock markets, the intercept in a regression of any asset's excess return on P should be zero. Specifically, the IAPM plus the assumption of perfect integration imply that

$$(2) \qquad \alpha_1 = \alpha_2 = \ldots = \alpha_m = 0.$$

Rejection of the restrictions defined by equation 2 can be defined as rejection of the underlying asset pricing model or rejection of the assumption of market integration.

Korajczyk (1996) refers to α_i as the mispricing of asset i relative to the benchmark portfolio. We interpret estimates of the absolute value of the intercept terms from equation 1 as measures of market integration and the ability of agents to diversify risk internationally. Larger absolute values imply less integrated stock markets. To compute estimates of stock market integration for each national market, we compute the average of the absolute value of α_i across all assets in each country.[3]

Simple Indexes of Stock Market Development

To measure overall stock market development, we construct an index called STOCK by averaging the means-removed values of the market capitalization ratio, the total value traded ratio, the turnover ratio, and the IAPM pricing error measure of stock market integration.[4] Note that we multiply the absolute value of Korajczyk's (1996) pricing error measure by −1 before constructing the index, STOCK. Thus, larger (less negative) values imply better stock market development. The means-removed market capitalization ratio for country i equals the market capitalization ratio for country i minus the mean for all countries, divided by the mean for all countries. Then we take a simple average of the means-removed market capitalization ratio, the total value traded ratio, the turnover ratio, and the IAPM integration measure to obtain an index of stock market development. More formally, let $S(i, j)$ equal the average value (over the relevant period) of variable j for country i. Let $S(j)$ equal the average value of variable j across all countries. Define the means-removed value of $S(i, j)$ as $s(i, j)$, where

$$s(i, j) = [S(i, j) - S(j)] / S(j). \tag{3}$$

Then STOCK1 for country i is

$$\text{STOCK1}(i) = \Sigma_j\, s(i, j) \tag{4}$$

where we take the average across all the variables for country i.

Financial Depth

Gelb (1989), Ghani (1992), King and Levine (1993a, 1993b), and De Gregorio and Guidotti (1995) identify a significant correlation between financial depth and long-run economic growth rates in broad cross-country samples. To measure financial depth, these authors typically use a measure of broad money, such

3. For alternative ways of measuring the ability of agents to diversify risk internationally, see Bekaert and Harvey (1995).

4. STOCK equals the stock market development index, INDEX2, of Demirgüç-Kunt and Levine (1996). All of the indexes discussed by Demirgüç-Kunt and Levine (1996) yield similar results in the growth regressions. Thus, we simply report the results using one index. We call this index STOCK instead of INDEX2 for expositional purposes. Also, the IAPM pricing errors are available only for twenty-four countries. Since the indexes are means-removed averages of the *available* indicators, STOCK has values for all forty-one countries. For twenty-four countries, STOCK aggregates information on size, liquidity, and IAPM pricing errors. For the remaining seventeen countries, STOCK aggregates information only on size and liquidity.

as M2, divided by GDP. We use the King and Levine (1993a, 1993b) measure of financial depth, DEPTH, to evaluate whether stock market development is significantly correlated with growth even after controlling for financial depth.

DEPTH is defined as the ratio of liquid liabilities of the financial system to GDP. Liquid liabilities consist of currency held outside the banking system plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries.

III. Stock Market Development and Long-Run Economic Growth

This section describes the framework and presents the results for the cross-country growth regressions to analyze the impact of stock market development on long-run economic growth.

Cross-Country Growth Regression

This section empirically evaluates whether the index of stock market development, STOCK, is strongly linked to long-run economic growth. To conduct this analysis, we use pooled cross-country, time-series growth regressions. We have data on forty-one countries during the period from 1976 to 1993. Each country has two observations, data permitting. The first observation for each country uses data from 1976 to 1985. The second observation uses data from 1986 to 1993. Thus, the dependent variable, GROWTH, is the real per capita growth rate averaged over the relevant period.

The structure of our regression equation is the following:

$$\text{GROWTH} = \alpha X + \beta(\text{STOCK}) + u \tag{5}$$

where X is a set of control variables, α is a vector of coefficients on the variables in X, β is the estimated coefficient on STOCK, and u is an error term.[5]

The goal of the empirical analysis is to assess the strength of the independent partial correlation between stock market development and economic growth. Consequently, we use a large set of control variables, X, to control for a variety of factors that may be associated with economic growth. X includes initial income (the logarithm of initial real per capita GDP), initial education (the logarithm of the initial secondary school enrollment rate), a measure of political instability (the number of revolutions and coups), the ratio of government consumption expenditures to GDP, the inflation rate, and the black market exchange rate premium.

5. Throughout the analysis we use heteroskedasticity-consistent standard errors as developed by White (1980). We also examine the statistical distribution of the error term and check for the importance of outliers. Bekaert and Harvey (1995) find that stock returns are often not normally distributed. Consequently, some readers may have concerns about the distribution of the error term. However, we do not use data on stock returns but an aggregate index of stock market size, liquidity, and integration. For a discussion of the properties of the error term from cross-section, time-series regressions involving asset pricing errors, see Bekaert and Harvey (1995).

We include initial income and initial education because recent theoretical work suggests an important link between long-run growth and the initial per capita levels of physical and human capital (Lucas 1988; Mankiw, Romer, and Weil 1992). We follow Barro (1991), Barro and Sala-i-Martin (1992), and others in using the secondary school enrollment rate and initial income to proxy for the initial levels of per capita human and physical capital. We include political instability because it may be negatively associated with economic growth.

We include a variety of macroeconomic indicators to evaluate the strength of the partial correlation between stock market development indexes and economic growth (Levine and Renelt 1992; Levine and Zervos 1993). We include the government consumption ratio and the rate of inflation because the evidence suggests a strong connection between macroeconomic policy and economic activity, as shown by Fischer (1993), Easterly and Rebelo (1993), and Bruno and Easterly (1995). We include the black market exchange rate premium because international price distortions may impede economic growth, as suggested by Dollar (1992) and Levine and Zervos (1994). We expect the government consumption ratio, the rate of inflation, and the black market exchange rate premium to enter negatively.

We use instrumental variables to estimate equation 5 for two reasons. First, instrumental variables will help us examine the relationship between growth and the predetermined component of stock market development. If the predetermined component of stock market development (as identified by the instruments) is positively correlated with economic growth, this correlation will indicate that (a) stock market development does not simply follow economic development, and (b) contemporaneous shocks to both stock market development and economic growth are not the only factors that are driving the results. Thus, we use two-stage least squares to examine whether predetermined stock market development is closely associated with economic growth. In addition, because the IAPM pricing errors are generated regressors, which can lead to inconsistent standard errors, we use two-stage least squares to derive consistent standard errors as suggested by Pagan (1984).[6]

For the instrumental variables, we use the logarithm of initial real per capita GDP, the logarithm of the initial secondary school enrollment rate, political instability (the number of revolutions and coups), the initial black market exchange rate premium, the initial inflation rate, the initial ratio of government

6. The two-stage least squares estimator is consistent. Furthermore, we use White's (1980) heteroskedasticity-consistent standard errors. Although the generalized method of moments (GMM) estimator is sometimes used in pooled cross-section, time-series samples to obtain more efficient estimators in the presence of heteroskedasticity and serial correlation in large samples, GMM does not offer much value added in the current context. As we show, the results are already highly significant, so that a potentially more efficient estimator will only make the *t*-statistics larger. Furthermore, we are working with a small sample of only seventy-nine observations, and we do not have a true time-series dimension to the data. We consider only two periods because we average the data over long time periods in order to focus on the relationship between stock market development and *long-run* growth.

spending to GDP, the initial ratio of exports plus imports to GDP, the initial ratio of market capitalization to GDP, the initial ratio of total value traded to GDP, and the initial turnover ratio.[7] These instruments, except for political instability, are predetermined. We use these instrumental variables to extract the predetermined component of the government consumption ratio, the rate of inflation, the black market exchange rate premium, and STOCK.

We obtained the stock market data from the International Finance Corporation's (IFC's) Emerging Markets Data Base and IMF (various issues). Data on real per capita GDP growth, secondary school enrollment rate, and government consumption ratio, and information on exports and imports are from the World Bank's National Accounts Data Base. We obtained the number of revolutions and coups from Barro (1991) and computed per capita GDP from Summers and Heston (1988). Data on the black market exchange rate premium are from *Picks Currency Yearbook* (various issues) and International Currency Analysis, Inc. (various issues).

Results

Table 1 summarizes the results on the links between stock market development and economic growth. Regression 1 presents the regression results when we only include a constant, per capita GDP, the secondary school enrollment rate, and political instability. Regression 2 includes also the government consumption ratio, the rate of inflation, and the black market exchang. rate premium. All of the variables enter with the anticipated signs, but only initial income and political instability are consistently significant at the 0.05 level.

Regressions 3 and 4 include the index STOCK. There is a significant, positive correlation between the predetermined component of stock market development and real per capita GDP growth. The relationship between STOCK and growth remains significant at the 0.05 level whether or not we control for the government consumption ratio, rate of inflation, and black market exchange rate premium. Thus, stock market development is positively correlated with economic growth even after controlling for other factors associated with long-run growth.

As shown by Demirgüç-Kunt and Levine (1996), stock market development is positively correlated with measures of financial intermediary development. Consequently, to assess the independent empirical link between stock market development and growth, we include the measure of financial depth, DEPTH, in the growth regression. As shown in regression 5, the predetermined component of DEPTH is positively and significantly correlated with long-run growth at the 0.05 significance level when STOCK is excluded. When all of the variables are included together in regression 6, the predetermined component of STOCK remains positively and significantly correlated with growth. DEPTH, however,

7. The term "initial" refers to variables measured at the start of the estimation period. Since we use pooled cross-country time-series data for the period from 1976 to 1985 and from 1986 to 1993, "initial" refers to 1976 and 1986 measures.

Table 1. *Stock Market Development and Economic Growth, 1976–93*

	Regression					
Independent variable	*1*	*2*	*3*	*4*	*5*	*6*
Constant	0.023	0.061	0.041	0.050	0.042	0.047
	(1.367)	(2.147)	(2.772)	(1.726)	(2.451)	(1.540)
	[0.176]	[0.035]	[0.007]	[0.089]	[0.017]	[0.128]
Initial real per capita GDP[a]	–0.011	–0.007	–0.012	–0.010	–0.015	–0.007
	(2.256)	(1.378)	(2.625)	(1.835)	(2.637)	(1.430)
	[0.027]	[0.172]	[0.011]	[0.071]	[0.010]	[0.157]
Secondary school enrollment rate[a]	0.023	0.013	0.020	0.019	0.018	0.022
	(2.044)	(0.838)	(2.095)	(1.218)	(1.468)	(1.431)
	[0.045]	[0.405]	[0.040]	[0.227]	[0.146]	[0.157]
Number of revolutions and coups	–0.019	–0.018	–0.015	–0.016	–0.011	–0.021
	(2.710)	(2.362)	(2.514)	(2.337)	(1.518)	(2.241)
	[0.008]	[0.021]	[0.014]	[0.022]	[0.133]	[0.028]
Ratio of government consumption expenditures to GDP		–0.128		–0.090		–0.121
		(1.911)		(1.805)		(1.671)
		[0.060]		[0.075]		[0.099]
Inflation rate		–0.022		–0.020		–0.035
		(2.001)		(2.354)		(1.844)
		[0.049]		[0.021]		[0.069]
Black market exchange rate premium		–0.0002		–0.00001		0.0001
		(1.179)		(0.973)		(0.234)
		[0.242]		[0.812]		[0.816]
DEPTH[b]					0.026	–0.021
					(4.349)	(0.965)
					[0.001]	[0.338]
STOCK[c]			0.015	0.012		0.020
			(5.513)	(4.503)		(2.205)
			[0.000]	[0.000]		[0.031]

Note: Regression results are from pooled, cross-country instrumental variables estimation. The dependent variable is average annual growth rate of per capita GDP. Instruments include the constant term; logarithm of initial real per capita GDP; logarithm of initial secondary school enrollment rate; the number of revolutions and coups; and initial values of the ratio of government consumption expenditures to GDP, the rate of inflation, the black market exchange rate premium, market capitalization, total value traded, the turnover ratios, and the ratio of international trade to GDP. Standard errors are in parentheses; *P*-values are in brackets. Data are for forty-one economies for two periods, 1976–85 and 1986–93. Each regression has seventy-nine observations (data are available for only one period for New Zealand, Pakistan, and Turkey). The forty-one economies are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Indonesia, Israel, Italy, Japan, Jordan, the Republic of Korea, Luxembourg, Malaysia, Mexico, the Netherlands, New Zealand, Nigeria, Norway, Pakistan, the Philippines, Portugal, Singapore, Spain, Sweden, Taiwan (China), Thailand, Turkey, the United Kingdom, the United States, Venezuela, and Zimbabwe.

a. Logarithm of initial value: 1976 for the 1976–85 period and 1986 for the 1986–93 period.

Table 1. *(continued)*

b. DEPTH is a measure of financial depth, the ratio of liquid liabilities of the financial intermediaries to GDP.

c. STOCK is the stock market development index, the average of means-removed values of the market capitalization, total value traded, turnover ratios, and asset pricing theory (APT) mispricing indicator. STOCK includes data on stock market size and liquidity for all forty-one economies. For the IAPM pricing error indicator, data are included for twenty-four economies: Argentina, Australia, Brazil, Chile, Colombia, Greece, India, Indonesia, Japan, Jordan, the Republic of Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Portugal, Taiwan (China), Thailand, Turkey, the United Kingdom, the United States, Venezuela, and Zimbabwe.

Source: Authors' calculations based on stock market data from the IFC's Emerging Markets Data Base and IMF (various issues); data on real per capita GDP growth, the secondary school enrollment rate, and the government consumption ratio and information on exports and imports from the World Bank's National Accounts Data Base; number of revolutions and coups from Barro (1991); data used to compute per capita GDP from Summers and Heston (1988); and data on the black market exchange rate premium from *Picks Currency Yearbook* (various issues) and International Currency Analysis, Inc. (various issues).

becomes insignificant.[8] The instrumental variable results show that the predetermined component of stock market development as extracted by the first-stage regression is strongly, positively correlated with growth.

The empirical relationship between stock market development and long-run growth remains strong even after controlling for initial conditions, inflation, the size of the government, the black market exchange rate premium, and the predetermined component of financial depth. Moreover, the results hold after checking for outliers and removing individual countries. As discussed in the introduction, measurement, statistical, and conceptual problems plague cross-country growth regressions. Nonetheless, the results suggest a comparatively strong link between the functioning of stock markets and economic growth.

IV. Summary

This article empirically evaluated the relationship between stock market development and long-run growth. The data suggest that stock market development is positively associated with economic growth. Moreover, the instrumental variables procedures indicate a strong connection between the predetermined component of stock market development and long-run economic growth. Although these cross-country growth regressions imply a strong link between stock market development

8. Note that these results do not necessarily conflict with the findings of Gelb (1989), Ghani (1992), King and Levine (1993a, 1993b), and De Gregorio and Guidotti (1995). First, these studies of financial depth typically cover eighty countries over thirty years. This article, because of limited data availability on stock market development, covers only forty-one countries over eighteen years. Second, financial depth is a widely available indicator of overall financial sector development. In contrast, the stock market development index measures the functioning of only one part of the financial system. Clearly, researchers should attempt to build models of and develop data on the links between growth and the different components of the financial system: banks (private and public), nonbanks (mutual funds, private pension funds, insurance companies, and others), stock markets, bond markets, and derivatives markets. By adding stock markets to the study of the ties between finance and growth, we see this article as a small building block toward this longer-term objective.

and economic growth, the results should be viewed as suggestive partial correlations that stimulate additional research rather than as conclusive findings.

Much work remains to better understand the relationship between stock market development and economic growth. Careful case studies might better identify the causal interactions between the two. Future research also needs to identify the policies that will ease sound securities market development.

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Stock Market Development and Financing Choices of Firms

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In many developing countries with emerging stock markets, banks are fearful of stock market development because they think that stock markets will reduce the volume of their business. This article empirically analyzes the effects of stock market development on firms' financing choices using data from thirty developing and industrial countries from 1980 to 1991. The results imply that initial improvements in the functioning of a developing stock market produce a higher debt-equity ratio for firms and thus more business for banks. In stock markets that are already developed, further development leads to a substitution of equity for debt financing. By contrast, in developing stock markets, large firms become more levered as the stock market develops, whereas small firms do not appear to be significantly affected by stock market development.

Recent research in corporate finance has identified how asymmetries of information and imperfections in capital markets affect the firm's ability to raise funds and invest. Although empirical evidence suggests that specific imperfections may significantly affect the firm's financial and investment policies, there has been little work on the effect of the level of development of the financial markets on the firm's policies. In this article we explore this relationship by providing empirical evidence on the association between the financing choices of the firm and the level of development of financial markets in thirty industrial and developing economies from 1980 to 1991.

The finance literature suggests that stock markets serve important functions even in those economies in which a well-developed banking sector already exists, the reason being that equity and debt financing are in general not perfect substitutes. Equity financing has a key role in the management of the conflicts of interest that may arise between different stakeholders in the firm. Stock markets also provide entrepreneurs with liquidity and with opportunities to diversify their portfolios. Stock trading transmits information about the firm's prospects to

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potential investors and creditors. For example, Allen (1993) contrasts the comparative advantages of stock markets and financial institutions in processing information about investment projects. As a result of the different attributes of debt and equity, the development of markets that facilitate the issuance and trade of equity should be reflected in the financing decisions of individual firms.

Although differences in financial systems have been noted in the literature, there have been few attempts to formally model the effects of financial market development on firms' financing choices or on their investment decisions. Notable exceptions are Pagano's (1993) model of the effect of opportunities for diversification on entrepreneurs' portfolio choices; Bencivenga, Smith, and Starr's (1994) analysis of the effect of financial liquidity on technology choice; and Boyd and Smith's (1996) framework analyzing complementarities of debt and equity financing for capital investments. The empirical work in this area is also sparse. There are empirical studies of firm debt-equity ratios by Titman and Wessels (1988) for the United States, Rajan and Zingales (1994) for a sample of industrial countries, and Demirgüç-Kunt and Maksimovic (1994) for a sample of developing countries. In addition, Mayer (1989) and Singh and others (1992) have looked at corporate financing patterns in industrial and developing countries, respectively.

This article empirically explores the effect of financial market development, particularly stock market development, on the financing choices of firms. We compare the relationship between the choice of capital structure and financial market development in our sample. We investigate the extent to which the variation in the aggregate debt-equity ratios within these countries can be explained by (a) the level of development of the country's financial markets, (b) macroeconomic factors, (c) the differences between the tax treatment of debt and equity securities, and (d) the firm-specific factors that have been identified in the corporate finance literature as determining financial structure.

We find that in general there is a significant positive relationship between bank development and leverage and a negative but insignificant relationship between stock market development and leverage. However, when we break the full sample down into subsamples and control for the other determinants of firm financing, an interesting relationship between leverage and stock market development emerges. In stock markets that are already developed, further development leads to a substitution of equity for debt financing. By contrast, in developing stock markets, large firms become more levered as the stock market develops, whereas small firms do not appear to be significantly affected by stock market development.

Our results have important implications. In many developing countries with emerging stock markets, banks are fearful of stock market development because they think that stock markets will reduce the volume of their business. Instead, our results imply that initial improvements in the functioning of a developing stock market produce a higher debt-equity ratio for firms and thus more business for banks. These results also suggest that in countries with devel-

oping financial systems, stock markets and banks play different yet complementary roles. Thus policies undertaken to develop stock markets need not affect existing banking systems adversely. Our results are also consistent with the conclusion of Demirgüç-Kunt and Levine (1996) that stock market and financial intermediary development proceed simultaneously.

The predicted relationship between financial market development and debt-equity ratios is discussed in section I. The sample of countries and the sources of the data are described in section II. The statistical model is described in section III, and the results are reported in section IV. The conclusions are stated in section V.

I. Framework for Analysis

Corporate finance theory suggests that corporations optimally structure financing packages to reduce the economic costs that result from taxes and from imperfections in financial markets. As financial markets develop, the comparative significance of different imperfections is likely to change. As a consequence, the issuance of specific securities may become more or less advantageous for certain categories of firms. Thus, there may be a relationship between financial market development and financing choices. In this section we focus on equity market development, in part because it has been most evident during our period of analysis (for a discussion, see Demirgüç-Kunt and Levine 1996). However, there are important spillovers between development of the equity market and development of the banking system.

Inadequately Developed Financial Markets

Here we consider three classes of imperfections that may result from inadequately developed financial markets. In the first class, investors and entrepreneurs face insufficient opportunities for diversification of portfolios. In the second, the firm lacks financing contracts appropriate for its investment projects. In the third, asymmetries of information between investors and the firm occur because stock markets do not efficiently aggregate information. For each of these imperfections, we identify the effect of financial market development on the firm's financing choices.

Diversification by entrepreneurs and stock market liquidity. In an economy in which equity markets are imperfect, entrepreneurs face the costs of diversifying their portfolios. Outside investors may require a premium to acquire the stock of a firm that is traded on an illiquid market. Moreover, as Pagano (1993) has emphasized, the benefits to the entrepreneur of exchanging the ownership of a stake in a firm for a portfolio of financial assets may be limited if the financial market on which these assets are traded does not provide opportunities for diversification. The costs of diversification may induce the entrepreneur to avoid the use of financial markets and, instead, to alter the firm's

investment and product decisions so as to optimally balance the entrepreneur's personal portfolio. This argument parallels the more familiar argument in finance that the firm's financial policies are chosen so as to take advantage of tax shields that the owners cannot exploit on their personal accounts. Here, the argument is that the firm's investment policy may be chosen to achieve a risk-return tradeoff that owners cannot obtain by altering their portfolio investments. The firm's investment policies may be affected in several ways by the owners' inability to diversify optimally in financial markets. First, the firm may diversify into areas in which it does not have a comparative advantage. Second, the firm may invest less than it would if its shares were widely held. Third, it may choose less capital-intensive production technologies that are subject to less long-term risk.

OPTIMAL CONTRACTING AND FINANCIAL MARKETS. Conflicts of interest characterize relations between the firm and its customers and suppliers and between different classes of investors in the firm. These conflicts may induce the firm's owners, or managers who represent them, to harm the interests of the other parties. Because such opportunistic behavior can be anticipated, it may make it more difficult for the firm to obtain financing. However, by optimal structuring of the contracts between the firm and outside investors, the owners' incentives to engage in opportunistic behavior can be mitigated. There is a large literature on conflicts of interest between different classes of investors (see Barnea, Haugen, and Senbet 1985; Harris and Raviv 1991; Jensen and Meckling 1976; Myers 1977; and Myers and Majluf 1984). The corporate finance literature has identified several cases in which reliance on outside debt financing increases the incentives of the firm's owners to act opportunistically or to otherwise harm the creditors, customers, and suppliers. Jensen and Meckling (1976) argue that highly levered firms may have an incentive to take on projects that have negative expected net present values and are risky, thereby harming creditors. Myers (1977) shows that firms with significant risky growth opportunities may forgo profitable projects if the resulting increases in value are captured by the firms' creditors. Titman (1984) argues that as high leverage increases the probability of financial distress sufficiently, the firm will enter into contracts that it may be unable to execute. Maksimovic (1988) and Maksimovic and Titman (1991) argue that leverage increases the firm's incentive to renege on value-enhancing implicit contracts with rival firms or with customers.

Because debt financing creates incentives to act opportunistically, a highly levered firm may not be able to obtain credit or to exploit fully opportunities for mutually beneficial contracting with customers, rivals, or suppliers. In these cases, issuance of equity would mitigate the incentive problems created by debt financing.

EQUITY MARKETS AND INFORMATION AGGREGATION. In addition to their primary role of supplying capital to the economy, equity markets have an important informational role. Equity markets aggregate information about the prospects

of the firms whose shares are traded (Grossman 1976). This aggregated information becomes publicly observable by the firm's creditors and investors. Equity markets thereby facilitate the monitoring of the firm by making it more profitable for investors to contribute capital to the firm. This role of financial markets is sufficiently important that many investment funds and mutual funds are prohibited from investing in companies whose stock does not trade on a recognized exchange. In addition to aggregating information, financial markets provide incentives for the investors' acquisition of information. As markets for publicly traded equity increase in size, it becomes profitable for analysts to invest in the acquisition of information about firms (for a formal model, see Grossman and Stiglitz 1980). The resulting increase in the quality of information further facilitates monitoring by creditors.

The Effect of Developing an Equity Market

Consider an entrepreneurial firm operating in an environment without a functioning equity market. The firm is financed by inside equity, trade credit, and bank borrowing. Because we are assuming that an effective equity market does not exist, the firm's initial debt-equity ratio will not be an economic optimum. Hence, once the market is opened we would expect the firm's owners to move away from the initial debt-equity ratio.

The initially limited access to equity markets suggests that such a firm is likely to have a suboptimally high debt-equity ratio for its scale of operations. A possible secondary implication of limited access is that the firm may be suboptimally small: it may pass up growth opportunities that would be exploited if a functioning equity market existed. This may occur for the reasons identified above. First, if expansion can only be financed using the entrepreneur's own capital or debt, investment in risky growth opportunities may increase the risks borne by the undiversified entrepreneur enough to make it unattractive. Second, certain projects are optimally financed with equity capital; such projects may not be profitable if financed by debt. Third, in the absence of a public market aggregating information, informational asymmetries may make it too costly to raise capital from outside investors.

Now allow an equity market to begin functioning. There will be three direct effects on the firm's debt-equity ratio. First, a substitution effect occurs as outside equity is substituted for outside debt by firms that had previously been constrained to issue only outside debt. This effect will decrease the firm's debt-equity ratio. Second, outside equity will be substituted for inside equity. This will not affect the firm's debt-equity ratio. Third, the entrepreneur's ability to diversify risks may make expansion more attractive. The effect of such expansion on the firm's debt-equity ratio is ambiguous and will depend on the optimal financial structure of the firm.

The development of an equity market may also have an indirect effect on the firm's leverage. Equity markets aggregate information that investors possess about firms. This makes it less costly for investors and financial intermediaries

to monitor firms. Thus, external equity and debt should become less risky. We would therefore expect to see an increase in external financing. It is unclear, however, whether external equity or debt would benefit more. To the extent that debt is provided by the product market and by banks, who are probably already well informed, we would expect to see a decrease in leverage as financial markets reduce the costs of monitoring to investors.

The net effect of these considerations is that the effect of equity market development on the debt-equity ratio is ambiguous. All of the above arguments are conditioned on the hypothesis that equity markets develop relative to the market for debt. If the debt market develops faster, then the effects may be reversed.

II. Description of Sample and Financial Market Indicators

Our sample consists of thirty industrial and developing economies from 1980 to 1991. We have selected these economies because they have a developed or emerging stock market and because data on individual firms' financial structures are available for a sufficiently large number of firms.

Table 1 lists all the economies in the sample, together with several indicators of their economic development. As an inspection of the table reveals, the sample represents a wide range of economic development: the gross domestic product (GDP) per capita for 1991 ranges from $27,492 for Switzerland to $359 for Pakistan. With the exception of Jordan and South Africa, all the economies experienced growth in per capita income during the sample period. Some economies, especially Brazil, Mexico, and Turkey, experienced high rates of inflation in this period.

In the absence of a theory of financial market development, we use empirical indicators to measure the level of development of the equity market and financial intermediaries in each country for each year of the sample. Our first three stock market indicators are the ratio of stock market capitalization to GDP, the ratio of total value of shares traded to GDP, and the ratio of the total value of shares traded to market capitalization. In our sample, data for these three indicators are drawn from the International Finance Corporation's (IFC's) Emerging Markets Data Base.

Our indicators of stock market development have been used in previous studies (for example, Pagano 1993 and Demirgüç-Kunt and Levine 1996) and provide intuitive summary statistics for the level of activity of the stock market and the significance of that activity for each of the economies in the sample. The ratio of stock market capitalization to GDP is a measure of both the stock market's ability to allocate capital to investment projects and its ability to provide significant opportunities for risk diversification for investors. The ratio of total value of shares traded to GDP and the ratio of total value of shares traded to market capitalization are indicators of market liquidity. The former measures the ability to trade economically significant positions on the stock market, and the latter is an indicator of liquidity of assets traded on the market, not adjusted for

Table 1. *Economic Development Indicators, Selected Economies*

Economy	*GDP per capita, 1991 (U.S. dollars)*	*Average annual growth in GDP per capita, 1980–91 (percent)*	*Average annual inflation, 1980–91 (percent)*	*Life expectancy at birth, 1991 (years)*
Switzerland	27,492	1.7	3.8	78
Japan	23,584	3.9	1.5	79
Norway	19,664	1.7	5.2	77
Sweden	19,649	1.6	7.4	78
United States	18,972	1.9	4.2	76
Finland	18,046	1.6	6.6	76
France	17,365	1.8	5.7	77
Austria	17,288	2.2	3.6	76
Netherlands	16,479	2.3	1.8	77
Germany	16,439	1.8	2.8	76
Canada	16,098	2.0	4.3	77
Belgium	16,051	2.2	4.2	76
Italy	14,570	2.5	9.5	77
Australia	13,095	1.6	7.0	77
United Kingdom	12,585	2.3	5.8	75
New Zealand	10,643	1.0	10.3	76
Singapore	10,294	4.9	1.9	74
Hong Kong	9,820	5.8	7.5	78
Spain	8,752	3.3	8.9	77
Korea, Rep. of	4,259	6.8	5.6	70
Malaysia	2,465	3.6	1.7	71
South Africa	2,198	−1.0	14.4	63
Brazil	2,073	2.1	327.6	66
Mexico	1,801	1.0	66.5	70
Turkey	1,375	3.1	44.7	67
Jordan	1,372	−2.1	1.6	69
Thailand	1,362	7.0	3.7	69
Zimbabwe	630	1.7	12.5	60
India	375	3.3	8.2	60
Pakistan	359	3.9	7.0	59

Note: Economies are in order of 1991 GDP per capita, from highest to lowest.
Source: IMF (various issues).

the size of the market relative to the economy. We also combine the three indicators in an equally weighted index of market development, INDEX1. Table 2 lists the annual averages from 1980 to 1991 for the indicators of stock market development for each economy.

We also report INDEX1 augmented by Korajczyk's indicator of securities mispricing (Korajczyk 1995). This indicator measures the extent of mispricing of securities relative to a domestic capital asset pricing model (CAPM) for each country.[1] The augmented index is reported as INDEX2 in table 2.

1. The indicator is similar to the indicator estimated in Korajczyk and Viallet (1989) and is described in that paper and Korajczyk (1995). We also used mispricing indicators obtained from international CAPM and asset pricing theory (APT) models; these, however, are not reported since the results are not significantly different. In addition, we have experimented with other indexes discussed in Demirgüç-Kunt and Levine (1996). Again, results were not significantly different.

Table 2. *Indicators of Stock Market Development, Selected Economies, 1980–91*
(annual average)

Economy	*Stock market capitalization to GDP*	*Total value of traded shares to GDP*	*Total value of traded shares to market capitalization*	*INDEX1*[a]	*INDEX2*[b]
Hong Kong	1.26	0.51	0.41	0.73	
Japan	0.98	0.53	0.51	0.67	
Germany	0.24	0.29	1.23	0.59	
United Kingdom	0.86	0.35	0.39	0.53	
United States	0.61	0.36	0.58	0.52	
Singapore	0.95	0.31	0.31	0.52	
Switzerland	0.75	0.31	0.39	0.49	
South Africa	1.35	0.07	0.05	0.49	
Malaysia	0.88	0.16	0.16	0.40	–0.07
Korea, Rep. of	0.22	0.17	0.69	0.36	–0.21
Thailand	0.21	0.18	0.67	0.35	–0.22
Netherlands	0.46	0.19	0.39	0.35	
Australia	0.49	0.15	0.30	0.31	
Canada	0.46	0.13	0.29	0.29	
Sweden	0.43	0.10	0.25	0.26	
Mexico	0.10	0.05	0.69	0.26	–0.63
Jordan	0.48	0.07	0.14	0.23	–0.24
India	0.07	0.04	0.59	0.23	–0.26
Norway	0.18	0.08	0.42	0.23	
Austria	0.08	0.05	0.51	0.22	
Brazil	0.11	0.05	0.48	0.21	–0.97
France	0.23	0.08	0.32	0.21	
Spain	0.21	0.07	0.31	0.20	
New Zealand	0.38	0.06	0.16	0.20	
Belgium	0.31	0.04	0.12	0.15	
Italy	0.15	0.04	0.23	0.14	
Finland	0.17	0.04	0.18	0.13	
Zimbabwe	0.10	0.01	0.08	0.06	–0.71
Pakistan	0.04	0.01	0.11	0.06	–0.20
Turkey	0.05	0.01	0.08	0.05	–0.31

Note: Economies are in order of the value for INDEX1, from highest to lowest.

a. INDEX1 is the average of the ratio of stock market capitalization to GDP, the ratio of total value of traded shares to GDP, and the ratio of total value of traded shares to market capitalization.

b. INDEX2 is the average of the indicators in INDEX1 and a pricing indicator estimated using a domestic CAPM for developing countries.

Source: Authors' calculations.

In ten of the economies the financial markets are classified as "emerging" by IFC (various issues): Brazil, India, Jordan, the Republic of Korea, Malaysia, Mexico, Pakistan, Thailand, Turkey, and Zimbabwe. Interestingly, several emerging markets, such as Korea, Malaysia, and Thailand, have ratios of market capitalization to GDP that are higher than or comparable to those in some industrial economies, such as France and Germany. The correlation between the ratio of market capitalization to GDP and GDP per capita is only 0.23. Similarly, the ratios

of total value of shares traded to GDP and total value traded to market capitalization are only weakly correlated with per capita GDP (correlation coefficients of 0.23 and 0.34, respectively).

The principal indicators we use are measures of activity, rather than measures of the institutional determinants of conditions under which securities are traded. This choice is in part due to the difficulty of quantifying differences in, for example, the regulatory environment that may affect firms' decisions to issue equity or debt in the United States and the United Kingdom. However, differences in the institutions among the ten emerging markets are large enough to be quantified. Table 3 details several important institutional indicators in the emerging markets.

As shown in the table, by the end of our sample period the institutions in Brazil, Mexico, Malaysia, and Korea were more developed than those of, for example, Zimbabwe. The principal differences resulted from lower restrictions on dividend and capital repatriation and from higher quality of firm disclosures in the former group. An arithmetic average of the institutional indicators for emerging markets is listed in the fourth column of table 2.

We use three empirical indicators to measure the significance of the banking sector in each of the economies in our sample (table 4). Each indicator quantifies different components of banks' provision of funds to the private sector in each of the economies. First, the ratio of banks' liquid liabilities (the M3 money supply) to GDP is an indicator of the size of the banking sector in relation to the economy as a whole. This indicator has been used in several studies of the effect of the financial sector on the growth of the economy (King and Levine 1993; Levine and Renelt 1992; Levine and Zervos 1996). Second, the ratio of domestic credit to the private sector to GDP measures the role of banks in the provision of longer-term financing to private corporations. A third indicator is the ratio of deposit bank domestic assets to GDP. The first and second indicators are averaged to yield an index we call FINDEX1. The data used to construct the indicators are drawn from IMF (various issues).

Although in many developing economies banks are the only significant financial intermediaries, in industrial economies significant insurance companies, pension funds, and other intermediaries also exist. To gauge the importance of financial intermediaries in general on provision of credit, we use the average of the ratio of assets held by deposit banks, nonbank private financial assets, and assets of private insurance and pension companies to GDP (FINDEX2).

Data on individual firms in Korea, India, Mexico, Jordan, Brazil, Turkey, Pakistan, and Zimbabwe come from the IFC's Corporate Finance Data Base. It consists of financial data on the hundred largest firms trading on the stock exchanges of these countries. For some markets the data are only available for a subperiod, as noted in table A-1. Data on firms in the remaining countries in table 1 come from the Global Vantage Data Base. The number of firms available from the Global Vantage sample is also noted in table A-1.

Table 3. *Institutional Indicators, Selected Economies, 1992*

Economy	*Price-earnings information published*[a]	*Accounting standards*[b]	*Quality of investor protection laws*[b]	*Securities exchange commission*[c]	*Restrictions on foreign investors' repatriation of dividends*[d]	*Restrictions on foreign investors' repatriation of capital*[d]	*Restrictions on foreigners' domestic investments*[d]	*Average institutional indicator*[e]
Brazil	1	2	2	1	2	2	2	1.71
Mexico	1	2	2	1	2	2	2	1.71
Malaysia	1	2	2	1	2	2	2	1.71
Korea, Rep. of	1	2	2	1	2	2	2	1.71
Thailand	1	1	1	1	2	2	2	1.43
Turkey	1	1	1	1	2	2	2	1.43
Pakistan	0	1	1	1	2	2	2	1.29
India	1	2	2	1	1	1	1	1.29
Jordan	0	1	1	1	2	2	2	1.29
Zimbabwe	0	1	1	1	0	0	1	0.57

Note: All data are as of end-1992. Economies are in order of the average institutional indicator (eighth column), from highest to lowest.
a. The value 1 indicates that comprehensive price-earnings information is published regularly and internationally; the value 0 indicates otherwise.
b. The values 0, 1, or 2 indicate poor, adequate, or good, respectively.
c. The value 1 indicates that the country has a securities exchange commission; the value 0 indicates otherwise.
d. The values 0, 1, or 2 indicate that capital flows are restricted, somewhat restricted, or free, respectively.
e. Average value of the indicators in the first seven columns.
Source: Authors' calculations based on data from IFC (various issues).

Table 4. *Indicators of Financial Intermediary Development, Selected Economies, 1980–91*
(annual average)

Economy	*Ratio of banks' liquid liabilities to GDP*	*Ratio of domestic credit to private sector to GDP*	*Ratio of deposit bank domestic assets to GDP*	FINDEX1[a]	FINDEX2[b]
Hong Kong	3.64	—	—	—	—
Switzerland	2.82	3.01	3.12	2.91	3.12
Japan	3.41	2.13	2.45	2.77	1.42
Singapore	2.14	1.67	1.88	1.91	0.95
Jordan	2.00	1.13	1.34	1.56	1.34
Malaysia	1.87	1.24	1.54	1.56	0.67
Netherlands	1.63	1.47	1.89	1.55	1.89
France	1.40	1.67	1.91	1.53	0.77
Germany	1.30	1.72	2.07	1.51	1.19
Austria	1.66	1.34	2.26	1.50	2.26
United Kingdom	1.31	1.62	1.62	1.47	0.92
United States	1.32	1.41	0.96	1.37	0.67
Spain	1.37	1.27	1.80	1.32	0.70
Finland	1.02	1.42	1.41	1.22	0.77
Norway	1.20	1.16	1.50	1.18	1.50
Thailand	1.26	0.96	1.19	1.11	0.54
Italy	1.48	0.67	1.05	1.07	0.68
Canada	1.26	0.87	0.95	1.07	0.56
Australia	1.10	0.89	1.01	0.99	0.80
Sweden	0.97	0.92	1.37	0.94	0.93
South Africa	1.06	0.72	0.76	0.89	0.76
New Zealand	0.97	0.71	0.88	0.84	0.88
Korea, Rep. of	0.77	0.88	0.92	0.83	0.45
Belgium	0.92	0.58	1.14	0.75	1.14
Pakistan	0.79	0.52	0.66	0.66	0.24
India	0.81	0.48	0.63	0.65	0.32
Turkey	0.57	0.36	0.49	0.46	0.25
Zimbabwe	0.77	0.14	0.33	0.46	0.22
Mexico	0.42	0.23	0.41	0.32	0.16
Brazil	0.31	0.27	0.45	0.29	0.22

— Not available.

Note: Economies are in order of the value for FINDEX1, from highest to lowest.

a. FINDEX1 averages the ratio of banks' liquid liabilities to GDP and the ratio of domestic credit to the private sector to GDP.

b. FINDEX2 averages the ratio of deposit bank domestic assets to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension companies to GDP. The last two terms are omitted when not available.

Source: Authors' calculations based on data from IMF (various issues).

Research in the United States shows that financial policies are in part determined by firm size. There are economies of scale in issuing securities (Ritter 1987). Larger firms may have more access to financial markets and be followed by a larger number of analysts. Table 5 provides information on the size distribution of firms. In each market, firms were ranked according to average size, measured by total assets, over the sample period. The average of each quartile of firm size is reported in the table.

Table 5. *Average Firm Size, Selected Economies*
(thousands of U.S. dollars)

Economy	*Smallest quartile*	*Second-smallest quartile*	*Second-largest quartile*	*Largest quartile*
Sweden	192,704	518,652	1,178,085	3,094,530
Japan	116,234	256,922	556,993	4,160,906
Italy	85,290	255,579	697,713	4,476,867
Finland	69,528	257,053	682,230	1,848,150
Korea, Rep. of	63,000	121,000	178,000	527,000
Spain	38,505	107,061	234,046	965,833
India	28,300	57,200	89,800	286,000
Norway	19,788	65,377	202,275	946,660
France	19,731	74,939	284,118	2,502,375
Switzerland	18,732	76,266	214,584	2,146,239
New Zealand	17,932	55,886	126,671	648,212
Germany	16,899	77,579	266,325	2,779,747
Netherlands	14,596	69,812	216,311	1,958,973
Hong Kong	13,549	39,891	83,068	607,075
United States	13,484	50,751	137,437	1,220,276
Austria	11,884	40,867	149,432	1,039,347
Brazil	9,900	17,800	30,800	93,900
United Kingdom	9,548	35,739	110,966	1,180,701
Turkey	7,800	17,600	29,200	81,400
Singapore	7,541	26,065	68,452	206,160
South Africa	6,530	40,300	140,793	827,443
Mexico	5,900	18,000	44,300	210,600
Zimbabwe	5,900	11,600	21,000	64,400
Pakistan	5,700	11,800	17,600	76,500
Canada	5,519	32,984	106,909	629,526
Malaysia	4,886	14,092	29,770	148,555
Jordan	4,100	9,600	17,300	177,800
Belgium	4,092	31,236	144,011	1,242,865
Australia	2,961	18,059	59,657	509,707
Thailand	2,532	7,744	16,841	65,730

Note: The values are average total assets, for each quartile of firms classified by total assets, during the country's sample period. Economies are listed in order of average value of assets in the smallest quartile.

Source: Global Vantage Data Base and IFC's Corporate Finance Data Base.

Table 5 reveals that firm sizes differ materially across economies. The average asset value of the largest quartile of Italian firms is approximately $4,500 million, but it is approximately $65 million in Thailand and Zimbabwe. The differences are equally marked in the smallest quartile: the average firm in the lowest quartile in Sweden is seventy-seven times larger than the average firm in the same quartile in Thailand.

In fourteen of the markets the average firm in the smallest quartile has assets under $10 million. In some countries the difference in size between the largest and smallest firms is very large. Thus in Belgium the average firm in the largest quartile is approximately 300 times larger than the average firm in the smallest quartile. The large differences in firm sizes in the sample suggest that the devel-

opment of markets may have different effects on large and small firms in the same market.

III. Determinants of Financial Structure

In order to isolate the contribution of financial market development to the firm's choice of financial structure, we control for other variables that may affect the firm's financing choices. We control for three categories of variables: individual firm characteristics, the tax levels in each of the economies in our sample, and macroeconomic factors.

As discussed above, the firm's optimal financing mix will depend on the owners' ability to engage in opportunistic behavior at the expense of creditors and other parties. This, in turn, will in part depend on the composition of the firm's assets. We control for asset composition by measuring the firm's net fixed assets to total assets and net sales to net fixed assets. Firms with high ratios of fixed assets to total assets and low ratios of sales to fixed assets are predicted to have high long-term and short-term leverage, respectively (see Demirgüç-Kunt and Maksimovic 1994).

We use two variables as proxies for the firm's requirement for debt financing: the ratio of earnings to total assets and the ratio of dividends to total assets. The ratio of earnings to total assets is included because several studies, such as Titman and Wessels (1986), have found an inverse relationship between profitability and leverage. The ratio of dividends to total assets is included because cash-constrained firms are unlikely to pay out large dividends.

Our last two firm characteristics measure the firm's nondebt tax shields and its size relative to the economy (total assets to GDP). All other factors being equal, a firm with significant nondebt tax shields is less able to exploit tax shields obtained from debt financing than a firm with smaller, insignificant nondebt tax shields. Size relative to the economy is included as a measure of the firm's access to the financial markets. The sample means for each of these variables for each country are reported in table 6.

The firm's choice of debt level will depend in part on the tax treatment of interest income relative to income derived from dividends and capital gains. For each economy and each year, we have calculated the relative tax advantage of debt and equity using data drawn from Coopers & Lybrand (various years) during our sample period (see Demirgüç-Kunt and Maksimovic 1995).

Finally, we also control for two macroeconomic variables: the inflation rate and the growth rate of GDP (see table 1). Because debt contracts are typically written in nominal dollars, the rate of inflation may affect the riskiness, in real terms, of debt financing. GDP growth is included as a measure of the growth opportunities available to firms in the economy. Finance theory suggests that growth options should not be financed by debt. Thus, we would expect debt financing to be inversely related to per capita GDP growth.

Table 6. *Firm Characteristics by Economy, Selected Economies*

Economy	Long-term debt to total equity	Short-term debt to total equity	Total debt to total equity	Net fixed assets to total assets	Depreciation to total assets	Dividends to total assets	Earnings to total assets[a]	Net sales to net fixed assets	Nondebt tax shield[b]	Total assets to GDP
Australia	0.563	0.653	1.248	0.385	0.033	0.025	0.064	4.509	–0.008	0.0024
Austria	1.201	1.495	2.696	0.293	0.051	0.017	0.075	3.477	0.012	0.0046
Belgium	0.764	1.259	2.023	0.221	0.039	0.022	0.092	6.153	0.030	0.0087
Brazil	0.139	0.421	0.560	0.640	—	0.002	0.057	1.166	0.017	0.0033
Canada	0.990	0.539	1.600	0.479	0.045	0.014	0.064	3.674	–0.031	0.0018
Finland	3.094	1.856	4.920	0.341	0.042	0.007	0.077	3.977	0.010	0.0154
France	1.417	2.108	3.613	0.234	0.043	0.014	0.094	7.727	0.010	0.0019
Germany	1.479	1.188	2.732	0.321	0.070	0.013	0.087	7.209	–0.007	0.0018
Hong Kong	0.309	0.967	1.322	0.344	0.017	0.057	0.121	6.676	0.020	0.0094
India	0.763	1.937	2.700	0.405	0.038	0.019	0.132	5.614	0.027	0.0006
Italy	1.114	1.954	3.068	0.327	0.041	0.014	0.080	3.287	0.000	0.0049
Japan	0.938	2.726	3.688	0.245	0.026	0.007	0.067	8.373	–0.016	0.0008
Jordan	0.266	0.915	1.181	0.459	—	0.033	0.073	2.979	—	0.0089
Korea, Rep. of	1.057	2.390	3.662	0.371	0.053	0.008	0.100	4.340	0.002	0.0023
Malaysia	0.284	0.639	0.935	0.405	0.021	0.026	0.087	3.264	0.010	0.0032
Mexico	0.375	0.442	0.817	0.579	—	—	0.076	1.445	0.013	0.0021
Netherlands	0.710	1.297	2.156	0.334	0.043	0.020	0.094	7.500	0.018	0.0089
New Zealand	0.752	0.776	1.527	0.401	0.030	0.025	0.106	5.067	0.022	0.0224
Norway	3.495	1.880	5.375	0.433	0.049	0.009	0.092	2.703	–0.005	0.0143
Pakistan	0.595	2.358	2.953	0.384	0.038	0.028	0.115	11.155	0.055	0.0012
Singapore	0.491	0.718	1.232	0.363	0.022	0.018	0.077	5.152	–0.004	0.0104
South Africa	0.597	0.518	1.115	0.535	0.013	0.062	0.206	4.036	0.066	0.0120
Spain	1.086	1.649	2.746	0.446	0.040	0.016	0.095	3.613	0.017	0.0070
Sweden	2.879	2.321	5.552	0.342	0.036	0.011	0.100	4.398	0.021	0.0146
Switzerland	0.878	0.872	1.750	0.304	0.043	0.016	0.073	5.463	–0.081	0.0090
Thailand	0.518	1.769	2.215	0.380	0.030	0.029	0.129	5.710	0.007	0.0007
Turkey	0.485	1.511	1.996	0.414	—	0.068	0.239	4.240	0.011	0.0011
United Kingdom	0.387	1.065	1.480	0.336	0.032	0.025	0.108	6.447	0.009	0.0010
United States	1.054	0.679	1.791	0.370	0.045	0.016	0.091	6.943	–0.015	0.0003
Zimbabwe	0.187	0.615	0.801	—	0.031	0.028	0.131	—	0.033	0.0063

— Not available.

Note: The value of each item is calculated as the average of all firms for each economy's sample period.

a. Income before interest and taxes divided by total assets.

b. Earnings before taxes minus the ratio of corporate taxes paid to corporate tax rate, deflated by total assets.

Source: IFC's Corporate Finance Data Base and Global Vantage Data Base.

Our control model for financial structure is

$$y_{it} = a_i + \Sigma\beta x_{it} + \Sigma\gamma m_{it} + \Sigma\delta\, t_{it} + \Sigma\lambda d_{it}$$

where y is a measure of leverage, x are the firm-specific characteristics (the ratio of net fixed assets to total assets, the ratio of earnings to total assets, the ratio of net sales to net fixed assets, nondebt tax shields, the ratio of dividends to total assets, and the ratio of total assets to firm size), m are the macroeconomic factors (the growth rate of GDP per capita and the inflation rate), t are the tax variables, d are the time and country dummies, and i and t denote country and time, respectively. In the regressions reported in section IV, this equation is augmented by indicators of financial institution and stock market development.

Using this model, it is possible to estimate the impact of stock market development on the financing choices of firms. A negative coefficient estimate for the stock market variable indicates that firm leverage decreases with a marginal development in stock markets, leading the firms to substitute equity for debt. If the coefficient estimate is positive, however, this implies complementarities between debt and equity finance. If the coefficient estimate is not significant, we can conclude that stock market development does not affect firm leverage.

IV. Results

In this section we present our analysis of the effects of financial market development on the financing choices of firms. First, we discuss the correlations between firms' capital structures and indicators of financial market development. Second, we discuss financial market development as a determinant of the capital structure of all firms. Third, we characterize the relationship between stock market development and firms' capital structure in developing and developed financial markets. Fourth, we analyze the different effects of stock market development on large and small firms.

Simple Correlations

Our primary focus is on the effect of financial market development on the use of equity and debt financing in each of the economies under consideration. To this end, we use the average ratio of debt to equity as the dependent variable. Specifically for each economy, for each year, and for the firms in our sample, we calculate the average ratios of short-term debt to total equity, long-term debt to total equity, and total debt to total equity. The simple correlations of these three ratios with each other and with indicators of stock market and financial institution development are shown in table 7. By using aggregated data we avoid problems posed for empirical testing by the observed heterogeneity of capital structures adopted by seemingly identical firms (Myers 1984). Such heterogeneity is predicted by theories that focus on macroeconomic (Miller 1977) or industry-level (Maksimovic and Zechner 1991) determinants of financial structure.

Table 7. *Correlations of Leverage and Financial Indicators*

Measure or index	*Short-term debt to total equity*	*Total debt to total equity*	*Stock market capitalization to GDP*	*Total value of shares traded to GDP*	*Total value of shares traded to market capitalization*	*INDEX1*[a]	*Banks' liquid liabilities to GDP*	*Deposit bank domestic assets to GDP*	*FINDEX1*[b]	*FINDEX2*[c]	*GDP per capita, 1991*
Long-term debt to total equity	0.531 [0.000]	0.890 [0.000]	−0.191 [0.002]	−0.094 [0.141]	0.054 [0.398]	−0.120 [0.060]	−0.106 [0.088]	0.194 [0.002]	0.066 [0.294]	0.162 [0.010]	0.471 [0.000]
Short-term debt to total equity		0.846 [0.000]	−0.261 [0.000]	−0.007 [0.910]	0.076 [0.231]	−0.106 [0.097]	0.008 [0.902]	0.130 [0.038]	0.066 [0.295]	−0.036 [0.571]	0.087 [0.153]
Total debt to total equity			−0.246 [0.000]	−0.051 [0.421]	0.079 [0.215]	−0.117 [0.066]	−0.065 [0.293]	0.191 [0.002]	0.074 [0.239]	0.083 [0.188]	0.344 [0.000]
Stock market capitalization to GDP				0.664 [0.000]	0.051 [0.277]	0.782 [0.000]	0.555 [0.000]	0.365 [0.000]	0.500 [0.000]	0.268 [0.000]	0.228 [0.000]
Total value of shares traded to GDP					0.523 [0.000]	0.894 [0.000]	0.592 [0.000]	0.470 [0.000]	0.594 [0.000]	0.311 [0.000]	0.334 [0.000]
Total value of shares traded to market capitalization						0.648 [0.000]	0.178 [0.000]	0.249 [0.000]	0.270 [0.000]	0.239 [0.000]	0.198 [0.000]
INDEX1[a]							0.530 [0.000]	0.462 [0.000]	0.529 [0.000]	0.315 [0.000]	0.292 [0.000]
Banks' liquid liabilities to GDP								0.816 [0.000]	0.951 [0.000]	0.707 [0.000]	0.451 [0.000]
Deposit bank domestic assets to GDP									0.905 [0.000]	0.868 [0.000]	0.645 [0.000]
FINDEX1[b]										0.742 [0.000]	0.631 [0.000]
FINDEX2[c]											0.578 [0.000]

Note: *P*-values are in brackets.

a. INDEX1 is the average of the ratio of stock market capitalization to GDP, the ratio of total value of traded shares to GDP, and the ratio of total value of traded shares to market capitalization.

b. FINDEX1 averages the ratio of banks' liquid liabilities to GDP and the ratio of domestic credit to the private sector to GDP.

c. FINDEX2 averages the ratio of deposit bank domestic assets to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension companies to GDP. The last two terms are omitted when not available.

Source: Authors' calculations based on IFC's Corporate Finance Data Base and Global Vantage Data Base.

As revealed in table 7, the firms' use of short-term and long-term debt in an economy is positively correlated. The ratio of long-term debt to total equity is negatively correlated with the size of the stock market, positively correlated with the size of the banking sector, and positively correlated with real per capita income. The results for short-term debt to total equity are similar. Thus, a large stock market is associated with reductions in both long-term and short-term debt financing. Interestingly, the level of activity of the stock market (as measured by the ratio of total value of shares traded to market capitalization or the ratio of total value of shares traded to GDP) is not significantly correlated with the long- or short-term debt-to-equity ratio. Similarly, the ratio of banks' liquid liabilities to GDP, which has been used as a measure of the size of the banking sector, is not correlated with the financing choices of firms.

Financial Market Development as a Determinant of a Firm's Capital Structure

Although the simple correlations between debt and the level of development of the stock market and the banking sector suggest that equity is a substitute for both short-term and long-term debt financing, they do not take into account the other determinants of firms' financing choices. Thus, for example, the observed correlations may result from differences in industry composition, in tax regimes, or in growth rates and macroeconomic factors. To investigate these issues further, we perform an ordinary least squares (OLS) regression of each of the firms' financing variables on the firm characteristics, macroeconomic factors, tax variables, and time and country dummies as well as the financial intermediary and stock market indicators. By controlling for the determinants identified in the literature, this regression is a more conservative test of the relationship between financing choices and indicators of stock market development than the simple correlations reported in table 7. Furthermore, it is likely that some of the time and country dummies may pick up unmeasured differences in financial markets between countries and over time.

We have explored this specification in unreported regressions. Our independent variables explain approximately 80 percent of the variation in the ratios of short-term, long-term, and total debt to total equity. Among the newly added control variables, firm characteristics and country dummies have highly significant explanatory power. This is consistent with the results of firm-level regressions in Demirgüç-Kunt and Maksimovic (1994), where these variables are discussed in detail. Consistent with corporate finance theory, tax variables are significant in the regressions using the long-term debt ratio. The macroeconomic variables, growth and inflation, jointly have a negative and significant effect on short-term debt and total debt, but not on long-term debt. The growth variable itself has a negative and significant sign in all three equations, indicating that debt financing is indeed inversely related to growth, as theory predicted.

Turning to the variables of primary interest, the ratio of deposit bank domestic assets to GDP is positively related to firms' debt levels. This relationship is generally significant at the 5 percent level in the case of long-term debt and at

the 10 percent level in the case of short-term debt. A stronger association with long-term debt is expected because financial intermediaries are likely to have a comparative advantage in making long-term loans, whereas short-term financing may be available through trade credit.

The stock market indicator INDEX1, or alternative stock market indicators—such as the ratio of stock market capitalization to GDP, the ratio of total value of shares traded to GDP, and the ratio of total value of shares traded to market capitalization—consistently yield negative, but insignificant, coefficients in the regressions explaining the short-term, long-term, and total debt-to-equity ratios. This pattern suggests that a relationship between the financing choices of firms and stock market development does exist, but that it may not be captured with the simple linear specification. Next we explore this finding further, and attempt to characterize more fully the interactions between stock market development and financing choices.

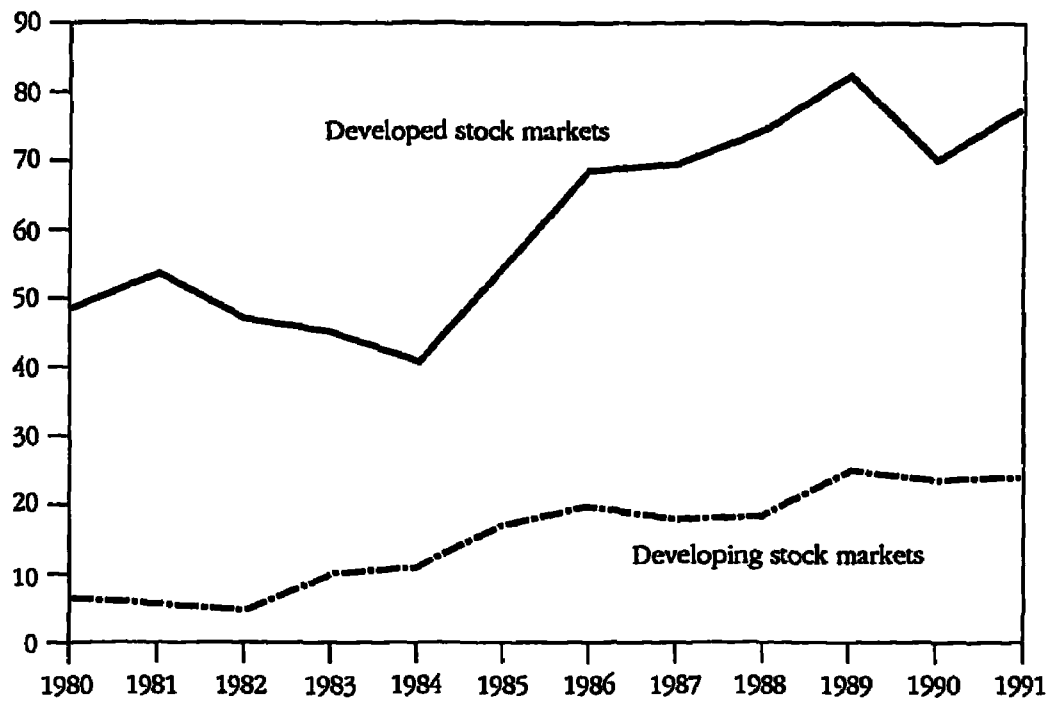
Stock Market Development and a Firm's Capital Structure in Developed and Developing Markets

Pagano (1993) and others argue that stock markets may play different roles in financing enterprises in economies with small stock markets compared with those with well-developed markets. To investigate the possibility that stock markets may have different effects on firms' financing choices as the level of market development varies, we split the sample into subsamples and estimate the effect of stock market development separately in each. We use INDEX1 scores to split the sample into those markets that are developed and those that are developing. The fifteen markets with the largest values for INDEX1 in table 2 are classified as developed, and the remaining markets are classified as developing.[2]

Consistent with the findings of Demirgüç-Kunt and Levine (1996), the well-developed stock markets in developing countries such as Korea, Malaysia, and Thailand belong to the developed group, whereas the relatively underdeveloped markets in some European countries, such as Austria, Finland, and Italy, fall into the developing category. This grouping is superior to a split based on industrial compared with developing countries because it takes into account the fact that some markets classified as emerging may already have a significant role in financing the national private corporate sector. The average ratios of stock market capitalization to GDP in the two subsamples over the sample period are shown in figure 1. The difference between the two groups is evident and appears to be constant through time.

2. Results are not sensitive to minor changes in the cutoff. Including Mexico in the developed category and Sweden in the developing category, or dropping both from the sample, yields very similar results. Splits based on other indexes calculated in Demirgüç-Kunt and Levine (1996) are not significantly different because all those indexes are 99 percent correlated with INDEX1. Another interesting split could be based on capital market integration. However, as Bekaert and Harvey (1995) discuss, capital market integration is closely correlated with market size and liquidity, measures that compose INDEX1.

Figure 1. *Average Ratios of Stock Market Capitalization to GDP in Developing and Developed Stock Markets, 1980–91*



Note: The data are annual averages for fifteen economies with developing stock markets (Mexico, Jordan, India, Norway, Austria, Brazil, France, Spain, New Zealand, Belgium, Italy, Finland, Zimbabwe, Pakistan, and Turkey) and fifteen economies with developed stock markets (Hong Kong, Japan, Germany, the United Kingdom, the United States, Singapore, Switzerland, South Africa, Malaysia, Korea, Thailand, the Netherlands, Australia, Canada, and Sweden). The split between developing and developed stock markets was based on each economy's value for an index of stock market development, INDEX1 (see table 2).

Source: Data from IFC's Emerging Markets Data Base.

We examine the effect of stock market development on firm financing in the developing and developed market subsamples separately. Table 8 shows the coefficients of the stock market development indicator in our equation explaining firms' choice of short-term, long-term, and total debt to equity in the two subsamples. The basic equation with firm characteristics, macroeconomic factors, and tax variables was estimated separately on each subsample with one indicator of stock market development (the ratio of stock market capitalization to GDP, the ratio of total value of shares traded to GDP, the ratio of total value of shares traded to market capitalization, INDEX1, or INDEX2) and one indicator of financial intermediary sector development (the ratio of banks' liquid liabilities to GDP, the ratio of deposit bank domestic assets to GDP, FINDEX1, or FINDEX2).

Table 8 shows an interesting contrast between the developed market and developing market subsamples. The coefficients of the stock market indica-

Table 8. *Capital Structure and Stock Market Development in Developed and Developing Stock Markets*

Dependent variable and financial intermediary sector explanatory variable	*Stock market capitalization* to GDP	*Total value of shares traded* to GDP	*Total value of shares traded to market capitalization*	INDEX1[a]	INDEX2[b]
Developed stock markets[c]					
Short-term debt to total equity					
Banks' liquid liabilities to GDP	–0.23	–0.36	–0.04	–0.27	–0.14
Deposit bank domestic assets to GDP	–0.07	–0.48	–0.06	–0.24	–0.16
FINDEX1[d]	–0.04	–0.47	–0.07	–0.23	–0.16
FINDEX2[e]	–0.06	–0.48	–0.07	–0.23	–0.17
Long-term debt to total equity					
Banks' liquid liabilities to GDP	–0.43	–0.62*	–0.34*	–0.78**	–0.43
Deposit bank domestic assets to GDP	–0.50*	–0.81**	–0.37*	–0.90***	–0.53*
FINDEX1[d]	–0.54*	–0.82**	–0.37*	–0.94***	–0.52*
FINDEX2[e]	–0.49*	–0.80**	–0.37*	–0.90***	–0.53*
Total debt to total equity					
Banks' liquid liabilities to GDP	–0.49	–0.93*	–0.35	–0.95*	–0.52
Deposit bank domestic assets to GDP	–0.47	–1.18**	–0.38	–1.04**	–0.60
FINDEX1[d]	–0.42	–1.21**	–0.40	–1.07**	–0.62
FINDEX2[e]	–0.44	–1.15**	–0.38	–1.02*	–0.61
Developing stock markets[f]					
Short-term debt to total equity					
Banks' liquid liabilities to GDP	0.10	0.97	0.06	0.20	0.74***
Deposit bank domestic assets to GDP	0.16	0.84	0.05	0.17	0.69***
FINDEX1[d]	0.15	0.93	0.07	0.22	0.74***
FINDEX2[e]	0.29	1.21	0.08	0.31	0.76***
Long-term debt to total equity					
Banks' liquid liabilities to GDP	1.06	2.26	0.03	0.50	0.99***
Deposit bank domestic assets to GDP	1.04	1.94	–0.01	0.39	0.90**
FINDEX1[d]	1.03	2.10	0.02	0.47	0.97***
FINDEX2[e]	1.27	2.52	0.04	0.59	0.98**

Table 8. *(continued)*

Dependent variable and financial intermediary sector explanatory variable	*Stock market capitalization to GDP*	*Total value of shares traded to GDP*	*Total value of shares traded to market capitalization*	*INDEX1*[a]	*INDEX2*[b]
Total debt to total equity					
Banks' liquid liabilities to GDP	1.40	3.61	0.16	0.93	1.80***
Deposit bank domestic assets to GDP	1.39	3.09	0.09	0.76	1.65***
FINDEX1[d]	1.39	3.39	0.16	0.90	1.77***
FINDEX2[e]	1.79	4.06	0.18	1.11	1.81***

* Significant at the 10 percent level.

** Significant at the 5 percent level.

*** Significant at the 1 percent level.

Note: Values in the table are for coefficients on the indicators of stock market development from regressions of short-term, long-term, and total debt-to-equity ratios on firm characteristics (net fixed assets to total assets, earnings to total assets, net sales to net fixed assets, nondebt tax shields, dividends to total assets, and total assets to GDP), macroeconomic factors (inflation and growth in GDP per capita), tax variables, the stock market variables listed in the table, the financial intermediary variables listed in the table, and time and country dummy variables. Only the indicated stock market and financial intermediary variables are included in each regression. The split between developed and developing stock markets is based on INDEX1.

a. INDEX1 is the average of the ratio of stock market capitalization to GDP, the ratio of total value of traded shares to GDP, and the ratio of total value of traded shares to market capitalization.

b. INDEX2 is the average of the indicators in INDEX1 and a pricing indicator estimated using a domestic CAPM for developing countries.

c. Hong Kong, Japan, Germany, the United Kingdom, the United States, Singapore, Switzerland, South Africa, Malaysia, Korea, Thailand, the Netherlands, Australia, Canada, and Sweden. See table 2 for values for INDEX1.

d. FINDEX1 averages the ratio of banks' liquid liabilities to GDP and the ratio of domestic credit to the private sector to GDP.

e. FINDEX2 averages the ratio of deposit bank domestic assets to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension companies to GDP. The last two terms are omitted when not available.

f. Mexico, Jordan, India, Norway, Austria, Brazil, France, Spain, New Zealand, Belgium, Italy, Finland, Zimbabwe, Pakistan, and Turkey. See table 2 for values for INDEX1.

Source: Authors' calculations based on IFC's Corporate Finance Data Base and Global Vantage Data Base.

tor in the developed market subsample are uniformly negative, but the coefficients in the developing market subsample are all positive with one exception. These patterns suggest that in economies with more developed stock markets, further development of the market leads to a substitution of equity financing for debt financing. This is seen most clearly in the case of long-term debt, where the coefficients are predominantly statistically significant. By contrast, in those economies in which the stock market is developing, further development of the market leads to opportunities for risk sharing and for aggregation of information that allow firms to increase their borrowing.

Differences between Large and Small Firms

It is likely that the effect of stock market development may be different for large and small firms. In particular, the information aggregation role of the market is likely to be more significant for large firms that trade often and are followed by many analysts. To test this hypothesis, we formed portfolios consisting of the largest and smallest quartiles of firms in each country on the basis of their asset size. (Since our data include mostly the largest firms in the countries, we are really looking at the differences between large and very large firms within each country.) Our basic regression equation was then estimated on four subsamples: the largest quartile of firms in developed and developing stock markets and the smallest quartile of firms in developed and developing stock markets.

Table 9 reports the results of the splits according to size. The coefficients of the stock market variable for large firms in the developed stock markets sample are uniformly negative. For the ratio of long-term debt to total equity the coefficients are statistically significant at the 5 percent level when the ratio of stock market capitalization to GDP is used as the indicator of market development. By contrast, the coefficients of the stock market variable for large firms in the developing stock markets sample are uniformly positive and for the most part statistically significant at the 5 percent level for the short-term, long-term, and total debt-to-equity ratios.

These findings suggest that for large firms in developed stock markets, further market development acts to enhance opportunities for substitution of equity for debt financing. By contrast, large firms in developing stock markets take advantage of further stock market development to increase their borrowing.

The coefficients of the stock market indicator for small firms in developed stock markets are negative. This accords with the results for large firms in the same markets and suggests that small firms are also taking advantage of stock market development by substituting debt for equity financing. Interestingly, the coefficients of small firms in developing markets are also predominantly negative, although not statistically significant.

We follow Barro (1991) to obtain a visual representation of the interaction between the financing choices of large firms and stock market development. That is, we subtract from the dependent variables of the regressions (long- and short-term debt-to-equity ratios) for the two subsamples of developed and developing markets all the independent variables multiplied by their estimated coefficients with the exception of the stock market indicator. We use INDEX1 as the stock market indicator and the ratio of deposit bank domestic assets to GDP as the financial intermediary variable, and we estimate the regression using slope and intercept dummies for the developed markets. Figure 2 shows the unexplained residuals for the short- and long-term debt-to-equity ratios plotted against INDEX1 at the sample means of each variable during the sample period for each

Table 9. *Capital Structure and Stock Market Development: Developed and Developing Stock Markets, by Small and Large Firms*

Dependent variable and financial intermediary sector explanatory variable	*Smallest quartile of firms*[a]			*Largest quartile of firms*[a]		
	Stock market capitalization to GDP	*INDEX1*[b]	*INDEX2*[c]	*Stock market capitalization to GDP*	*INDEX1*[b]	*INDEX2*[c]
Developed stock markets[d]						
Short-term debt to total equity						
Banks' liquid liabilities to GDP	–0.32	–0.64	–0.41	–0.39	–0.59	–0.44
Deposit bank domestic assets to GDP	–0.43	–0.75	–0.51	–0.14	–0.28	–0.27
FINDEX1[e]	–0.47	–0.74	–0.53	–0.25	–0.39	–0.31
FINDEX2[f]	–0.44	–0.79*	–0.56	–0.17	–0.26	–0.26
Long-term debt to total equity						
Banks' liquid liabilities to GDP	–0.68	–1.28	–0.84	–0.39**	–0.29	–0.03
Deposit bank domestic assets to GDP	–0.85	–1.72	–1.19	–0.39**	–0.28	–0.03
FINDEX1[e]	–1.22	–1.92*	–1.25	–0.45**	–0.31	–0.04
FINDEX2[f]	–0.85	–1.67	–1.15	–0.39**	–0.28	–0.03
Total debt to total equity						
Banks' liquid liabilities to GDP	–0.71	–2.17	–1.29	–0.68	–0.83	–0.48
Deposit bank domestic assets to GDP	–1.03	–2.67*	–1.71	–0.62	–0.66	–0.35
FINDEX1[e]	–1.44	–2.99**	–1.85	–0.71	–0.76	–0.41
FINDEX2[f]	–1.02	–2.63*	–1.71	–0.65	–0.63	–0.34
Developing stock markets[g]						
Short-term debt to total equity						
Banks' liquid liabilities to GDP	–1.11	–1.02	–0.22	0.47	1.64**	1.23***
Deposit bank domestic assets to GDP	–1.07	–1.05	–0.24	0.02	1.49**	1.00***
FINDEX1[e]	–1.13	–1.06	–0.24	0.26	1.58**	1.18***
FINDEX2[f]	–1.17	–1.05	–0.21	0.74	1.77**	1.19***
Long-term debt to total equity						
Banks' liquid liabilities to GDP	–0.34	–0.26	0.23	2.85*	3.06**	2.17***
Deposit bank domestic assets to GDP	–0.34	–0.30	0.19	1.80	2.70*	1.72**
FINDEX1[e]	–0.39	–0.30	0.21	2.27	2.88*	2.05***
FINDEX2[f]	–0.43	–0.28	0.25	3.10**	3.23**	2.16***

(Table continues on the following page.)

Table 9. *(continued)*

Dependent variable and financial intermediary sector explanatory variable	*Smallest quartile of firms*[a]			*Largest quartile of firms*[a]		
	Stock market capitalization to GDP	*INDEX1*[b]	*INDEX2*[c]	*Stock market capitalization to GDP*	*INDEX1*[b]	*INDEX2*[c]
Total debt to total equity						
Banks' liquid liabilities to GDP	−1.50	−1.26	0.00	3.98*	4.92**	3.57***
Deposit bank domestic assets to GDP	−1.38	−1.31	−0.06	2.13	4.30**	2.77***
FINDEX1[e]	−1.52	−1.32	−0.04	3.10	4.65**	3.38***
FINDEX2[f]	−1.57	−1.28	0.05	4.48**	5.24**	3.54***

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Note: Values in the table are for coefficients on the indicators of stock market development from regressions of short-term, long-term, and total debt-to-equity ratios on firm characteristics (net fixed assets to total assets, earnings to total assets, net sales to net fixed assets, nondebt tax shields, dividends to total assets, and total assets to GDP), macroeconomic factors (inflation and growth in GDP per capita), tax variables, the stock market variables listed in the table, the financial intermediary variables listed in the table, and time and country dummy variables. Only the indicated stock market and financial intermediary variables are included in each regression. The split between developed and developing stock markets is based on INDEX1.

a. Based on total assets; see table 5.

b. INDEX1 is the average of the ratio of stock market capitalization to GDP, the ratio of total value of traded shares to GDP, and the ratio of total value of traded shares to market capitalization.

c. INDEX2 is the average of the indicators in INDEX1 and a pricing indicator estimated using a domestic CAPM for developing countries.

d. Hong Kong, Japan, Germany, the United Kingdom, the United States, Singapore, Switzerland, South Africa, Malaysia, Korea, Thailand, the Netherlands, Australia, Canada, and Sweden. See table 2 for values for INDEX1.

e. FINDEX1 averages the ratio of banks' liquid liabilities to GDP and the ratio of domestic credit to the private sector to GDP.

f. FINDEX2 averages the ratio of deposit bank domestic assets to GDP, the ratio of assets of private nonbank financial corporations to GDP, and the ratio of assets of private insurance and pension companies to GDP. The last two terms are omitted when not available.

g. Mexico, Jordan, India, Norway, Austria, Brazil, France, Spain, New Zealand, Belgium, Italy, Finland, Zimbabwe, Pakistan, and Turkey. See table 2 for values for INDEX1.

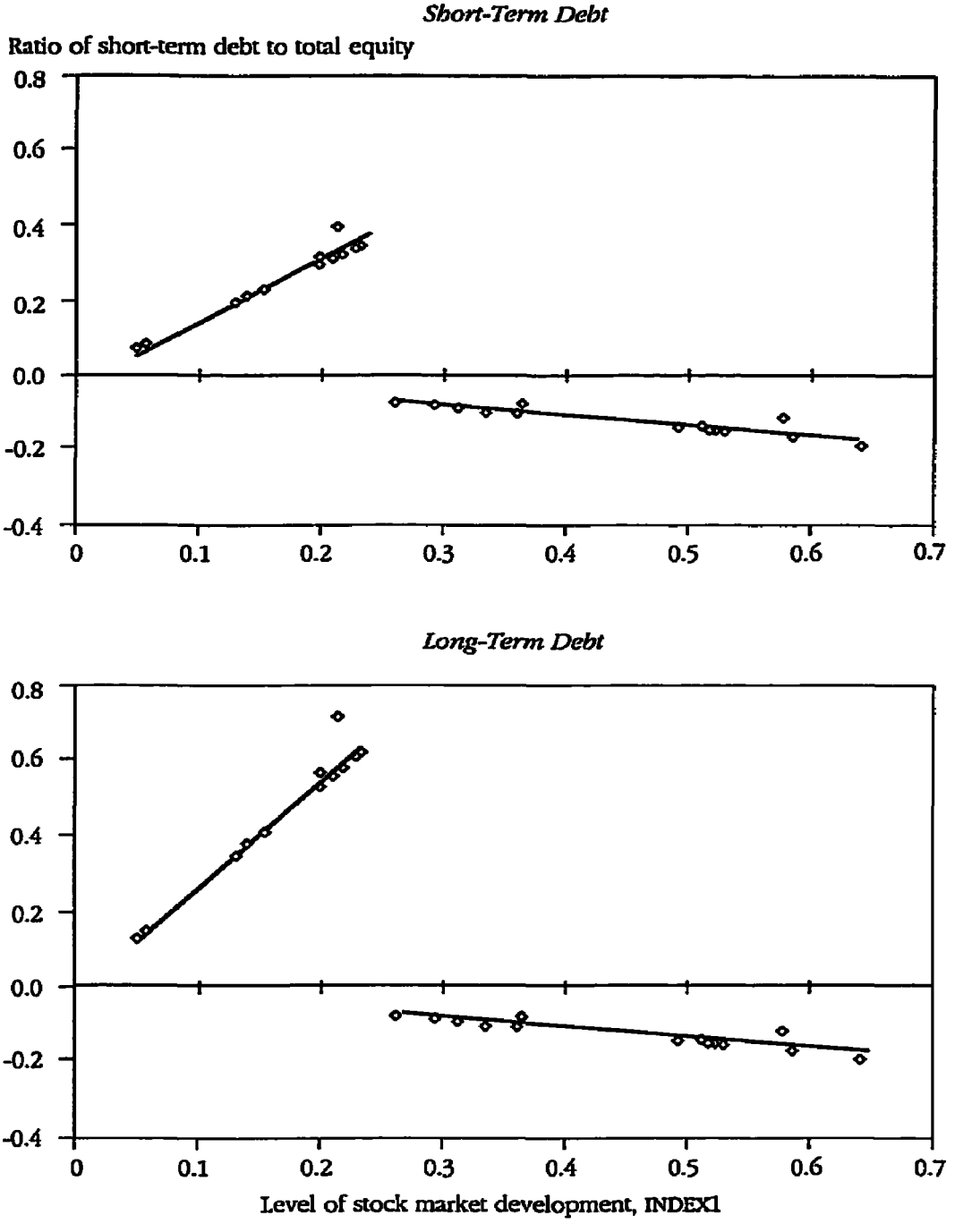
Source: Authors' calculations based on IFC's Corporate Finance Data Base and Global Vantage Data Base.

economy. Moving to the right along the x-axis corresponds to greater stock market development.

The visual evidence is striking. It suggests that for economies with developing stock markets, debt-equity ratios of large firms increase with the development of the stock market. For large firms in economies with more developed markets, further development is associated with lower debt-to-equity ratios.

Taken together, the results suggest that further development of stock markets may affect firms differently in economies where the markets already play a significant role than in those where they do not. If stock markets are already significant, further development leads to a substitution of equity financing for debt. However, in economies where stock markets are too small to have a sig-

Figure 2. *Leverage and Stock Market Development*



Note: Values are the unexplained residuals for short- and long-term debt-to-equity ratios plotted against INDEX1 at the sample means of each variable during the sample period for each economy. INDEX1 is the average of the ratio of stock market capitalization to GDP, the ratio of total value of traded shares to GDP, and the ratio of total value of shares traded to market capitalization. See table 2 for the economies included in the sample and for values for INDEX1. Residuals are from regressions of the debt-to-equity ratios on INDEX1, the ratio of deposit bank domestic assets to GDP, firm characteristics, macroeconomic and tax variables, and slope and intercept dummy variables for the developed markets.

Source: Authors' calculations.

nificant role in the economy, as measured by our indicators, development permits large firms to increase their leverage.

One possible explanation of these results is that, at early stages of stock market development, improvements in information quality, monitoring, and corporate control may be large enough to induce creditors to lend more. For these firms, debt and equity finance are complementary. This information aggregation role of the market may be especially important for large firms because their stocks are traded more often and are followed by many analysts. Small firms may not benefit as much from stock market development, at least initially, because they may find their access limited by high issuance costs. Even those small firms that list may not have their stock traded as often because it may be more costly for traders to acquire information about their prospects.

V. Conclusions

This article has empirically explored the effect of financial market development, particularly stock market development, on the financing choices of firms. We used aggregated firm-level data for a sample of thirty countries from 1980 to 1991. We measured stock market development by the ratio of market capitalization to GDP, the ratio of total value traded to GDP, and the ratio of total value of shares traded to market capitalization.

Taking all the countries in the sample together, we find that there is a statistically significant negative correlation between stock market development, as measured by market capitalization to GDP, and the ratios of both long-term and short-term debt to total equity of firms. There is also a statistically significant positive relationship between the size of the banking sector and leverage.

The negative linear relationship between leverage and stock market development loses statistical significance when we control for variables that have been identified in the corporate finance literature as determining firms' financial structures. However, when we break the full sample down into subsamples, an interesting pattern emerges. In developed markets, further development leads to a substitution of equity for debt financing, especially for long-term debt. In developing markets, large firms become more levered as the stock market develops, but small firms do not appear to be significantly affected by market development.

These findings suggest that the development of a stock market initially affects directly the financial policies of only the largest firms. This may be because diversification of ownership and the aggregation of information provided by the development of stock markets initially benefits the larger firms more because of the need to spread fixed issuance costs and traders' costs of information acquisition. Moreover, these firms increase leverage. Thus, initially at least, an important role of the stock market is to aggregate information and thereby induce lenders to extend credit to firms whose stock is traded.

Table A-1. *Number of Firms and Sample Period, Selected Economies*

Economy	*Number of firms*	*Sample period*
Australia	401	1983–91
Austria	44	1983–91
Belgium	89	1983–91
Brazil	100	1985–91
Canada	494	1983–91
Finland	55	1983–91
France	544	1983–91
Germany	359	1983–91
Hong Kong	173	1983–91
India	100	1980–90
Italy	81	1983–91
Japan	1,104	1983–91
Jordan	38	1980–90
Korea, Rep. of	100	1980–90
Malaysia	143	1983–91
Mexico	100	1984–91
Netherlands	165	1983–91
New Zealand	41	1983–93
Norway	52	1983–91
Pakistan	100	1980–88
Singapore	213	1983–91
South Africa	67	1983–91
Spain	116	1983–91
Sweden	68	1983–91
Switzerland	150	1983–91
Thailand	137	1983–91
Turkey	45	1982–90
United Kingdom	1,275	1983–91
United States	3,247	1983–91
Zimbabwe	48	1980–88

Source: IFC's Corporate Finance Data Base for developing countries and Global Vantage Data Base for industrial countries.

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

John Boyd and Bruce Smith

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

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

Moreover, with some exceptions, the level of activity in financial markets does not evolve along with the economy, and the status of various markets is often exogenously imposed. Examples of the kind of literature we have in mind include Bencivenga and Smith (1991), Cooley and Smith (1992), Greenwood and Jovanovic (1990), Levine (1991), and Bencivenga, Smith, and Starr (1994, 1995, 1996). In the first three papers, all investment is financed by bank lending; in the last four papers, all investment is financed either inter-

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nally or by issuing equity. Of this literature, only Greenwood and Jovanovic (1990) has a volume of financial market activity that explicitly evolves over time.

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

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

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

Since our focus here is on the interactions among real development, equity market development, and the financing of capital investment, we must pose these questions in an environment that allows for growth and capital accumulation. In addi-

Table 1. *Average Market Capitalization, Selected Economies, 1980–91*

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

Source: Demirgüç-Kunt and Maksimovic (1995).

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

I. Overview

The composition of the external finance that investors—and firms more generally—obtain represents the solution to a constrained minimization prob-

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

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

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

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

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

In the most standard CSV environments, the entire set of firm returns is unobservable (Diamond 1984; Gale and Hellwig 1985; Williamson 1986). This fact has a strong implication. Since equity claims promise payments based on firm

performance, and since firm performance is costly to observe, the use of equity would require that excessive verification costs be incurred. It is therefore optimal for firms to be 100 percent debt financed. Indeed, debt claims make contractual payments contingent on firm performance only in the event of a bankruptcy, and therefore the use of debt minimizes expected verification costs.

The CSV model cannot be adequate for our purposes because it predicts that equity markets will never be active. However, the CSV environment does provide a simple and tractable explicit model of bankruptcy costs. Therefore, we pursue the implications of a CSV model altered in one basic way. Whereas the conventional CSV literature gives investors access to only a single investment technology with unobservable returns, we give investors access to two technologies. In particular, we assume that physical capital can be produced using either of two technologies. One, the unobservable-return technology, yields a return that is freely observable only by the initiating investor, and hence is subject to the CSV problem. The other, the observable-return technology, yields a return that is freely observable to all agents. Under the assumption that the expected amount of capital produced (exclusive of verification costs) by the former technology exceeds that produced by the latter, agents undertaking capital investments face a tradeoff. The technology with the unobservable return is intrinsically more productive, but it is also associated with larger bankruptcy costs.[1] Our analysis allows capital producers to make a choice as to how heavily they will use each technology; their choice will depend on the relative expected returns on the two technologies and on the perceived costs of state verification. When the perceived costs of verification are low, the unobservable-return technology will be particularly attractive, and its higher expected return implies that—when costs are perceived to be low enough—it will be used exclusively. In this event our model mimics the conventional CSV environment, and expected verification costs are minimized by having firms be 100 percent debt financed. Equity markets will not be active.

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

1. If the expected amount of capital produced by the observable-return technology is higher than that produced by the unobservable-return technology, then the latter technology is dominated and will never be used. This would leave us with a model where the Modigliani-Miller Theorem applies.

issue of some equity—when equity is used—reduces the cost of issuing debt. In this important sense, equity finance is not just a substitute for debt finance, but rather a complement of debt finance. This theoretical result is consistent with many empirical findings, such as those of Demirgüç-Kunt and Levine (1994), Rojas-Suarez and Weisbrod (1994), and Demirgüç-Kunt and Maksimovic (1995), suggesting the complementary nature of debt and equity market activity in the financing decisions of a firm, and in the general process of development.

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

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

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

Our analysis also suggests that financial market frictions will be less severe in industrial economies than in developing economies. This appears to be consistent with observation (World Bank 1989), and indeed it is often argued that developing economies are less developed because their financial market frictions are more severe than those of their more developed counterparts (McKinnon 1973; Shaw 1973). In all our examples, economies that are more developed lose fewer resources (per unit of funding) because of the presence of intermediation

costs than do less mature economies (see section V and Boyd and Smith 1995), a social benefit yielded by the development of equity markets and an endogenous outcome. Financial market frictions become less severe over time as a natural consequence of development. In this sense, the evolution of financial markets in the development process does tend to provide an economy with a more efficiently functioning set of capital markets.

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

II. The Model

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

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

Capital Production Technologies

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

a. There is a commonly available, nonstochastic linear technology whereby one unit of current output invested at t yields $r > 0$ units of capital at $t + 1$. In addition, there are two stochastic linear technologies that convert current output into future capital.
b. Technology o (for observable return) produces y units of capital at $t + 1$ per unit invested at t, where y is an independent and identically distributed (iid) (across agents and across time periods) random variable, realized at $t + 1$. We assume that $y \in \{y_1, y_2, \ldots, y_N\}$, and we let $p_n \equiv \text{prob}(y = y_n)$. Obviously $0 \leq p_n \leq 1$ for all n, and $\Sigma p_n = 1$. Finally, we assume that for any investor the amount of capital yielded by investments in technology o is publicly observable at zero cost.
c. Technology u (for unobservable return) is assumed to produce w units of capital at $t + 1$ per unit invested at t; w is a continuous, iid (across investors and periods) random variable with cumulative density function G and probability density function g; g is continuously differentiable with support $[0, \overline{w}]$. In addition, the return on investments in technology u can be observed (by any agent other than the initiating investor) only by bearing a fixed cost of $\gamma > 0$ units of the current consumption good. Thus, a CSV problem arises for investments in technology u.

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

Define $\hat{y} \equiv \Sigma_n p_n y_n$ to be the expected gross return (in units of capital) on investments in technology o, and $\hat{w} \equiv \int_o^{\overline{w}} w g(w) dw$ to be the expected gross return (in units of capital), not inclusive of verification costs, on investments in technol-

ogy u. We assume that $\hat{w} > \hat{y} > r$. Thus, the commonly available technology is relatively unproductive. It should be clear that, unless $\hat{w} > \hat{y}$ holds, the unobservable-return technology will never be employed.

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

Trade and Finance

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

$$\rho_t = f'(k_t) \tag{1}$$

$$\omega_t = f(k_t) - k_t f'(k_t) \equiv \omega(k_t). \tag{2}$$

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

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

$$(1 - \alpha)\omega(k_t) \geq \alpha q \tag{3}$$

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

III. Funding Contracts between Borrowers and Lenders

A funding contract specifies a quantity of resources that will be transferred to a particular borrower (i_t), as well as how these resources will be allocated among technologies o and u. We assume that external investors can observe both i_t and the allocation of investments among the two investment technologies. In addition, the contract specifies a set of payments that are contingent on firm performance. Since the return y is observable, repayments can always be made contingent on it. However, since the return w can be observed externally only if monitoring (or verification) occurs, repayments can only meaningfully be made contingent on w if state verification occurs. Hence a contract must specify a set

of states $A_t(y)$, in which monitoring will occur, and $B_t(y)$, in which monitoring will not occur at $t + 1$. This set can obviously be conditioned on y. In monitoring states only, repayment can also be made contingent on w. We let $R_t(w, y)$ be the promised repayment at $t + 1$, in units of consumption and per unit borrowed at time $t + 1$, if monitoring occurs at that date. In addition, we let $x_t(y)$ be the promised repayment at $t + 1$, in units of consumption and per unit borrowed at time $t + 1$ if monitoring does not occur.

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

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

$$R_t(w, y) \leq \rho_{t+1}[\theta_t y + (1 - \theta_t)w] \tag{4a}$$

$$x_t(y) \leq \rho_{t+1}[\theta_t y + (1 - \theta_t)w], \quad \text{for all } w \in B_t(y) \tag{4b}$$

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

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

$$R_t(w, y) \leq x_t(y), \quad \text{for all } w \in A_t(y). \tag{5}$$

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

$$[\Sigma_n p_n \int_{w \in A_t(y_n)} R_t(w, y_n) g(w) dw + \Sigma_n p_n \int_{w \in B_t(y_n)} x_t(y_n) g(w) dw] i_t - \gamma \Sigma_n p_n \int_{w \in A_t(y_n)} g(w) dw \geq r\rho_{t+1} i_t. \tag{6}$$

Borrowers announce funding contract terms to maximize their own expected utility, subject to the constraints given by equations 4, 5, and 6. The expected utility of a borrower is simply the expected return on the borrower's investments, less the expected repayment implied by the contract. Thus, borrowers choose contract terms to maximize

$$(7)\qquad i_t\{\rho_{t+1}[\theta_t\hat{y} + (1-\theta_t)\hat{w}] - \Sigma_n p_n \int_{w\in A_t(y_n)} R_t(w, y_n)g(w)dw - \Sigma_n p_n \int_{w\in B_t(y_n)} x_t(y_n)g(w)dw\}$$

subject to equations 4, 5, and 6.

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

IV. The Nature of Equilibrium Contracts

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

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

$$(8)\qquad z_{nt} \equiv \{[x_t(y_n)/\rho_{t+1}] - \theta_t y_n\}/(1-\theta_t).$$

Formally, z_{nt} is the smallest possible realization of w, conditional on $y = y_n$, that enables an entrepreneur to meet contractual commitments and to avoid verification. In other words, if $y = y_n$ at t, then monitoring occurs if and only if the return on technology u is less than z_{nt}. In effect, then, the variables z_{nt} govern the conditional probability (and expected cost) of state verification. If $y = y_n$ at t, the probability of monitoring is just $G(z_{nt})$. In addition, since w and y are independent, if the borrower's optimization problem displays enough concavity, borrowers will wish to smooth monitoring costs across realizations of y. Hence $z_{1t} = z_{2t} = \ldots = z_{Nt} = z_t$ holds, and the probability of state verification, $G(z_t)$, will be independent of the realization of y. Thus, the variable z_t indexes the amount of state verification that is associated with a particular contract.

The optimal value of z_t depends on two endogenous factors. First, it depends on the composition of a borrower's investment between technologies o and u; that is, on $\theta_t \equiv i_t^o/i_t$. Note that this composition is chosen by the borrower. The higher is θ_t, the more investment is done in the observable-return technology,

permitting less monitoring to occur, so that higher values of θ_t are associated with lower values of z_t. Second, z_t depends on the relative cost of monitoring, $\iota_{t+1} \equiv \gamma/q\rho_{t+1}$. Monitoring uses γ units of final goods and services; γ/q is this cost relative to the size of individual investment projects. Dividing this quantity by the relative price of capital gives monitoring costs measured in units of capital. Since investment projects yield capital, this puts monitoring costs and investment returns in comparable units. The cost of monitoring is taken as parametric by the borrower, but it is endogenous to the economy. To denote the dependence of z_t on θ_t and on ι_{t+1}, we write $z_t = z(\theta_t; \iota_{t+1})$. $z(\theta_t; \iota_{t+1})$ must be chosen, given θ_t and ι_{t+1}, so that providers of external funding receive the market-expected return ($r\rho_{t+1}$) on their investments at t.

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

$$q\rho_{t+1}[\theta_t\hat{y} + (1-\theta_t)\hat{w} - r - \iota_{t+1}G[z(\theta_t;\iota_{t+1})]]. \tag{9}$$

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

$$d\theta^*/d\iota \geq 0. \tag{10}$$

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

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

$$x_t(y) = \rho_{t+1}[(1-\theta_t^*)z(\theta_t^*;\iota_{t+1}) + \theta_t^* y]. \tag{11}$$

Notice that this promised repayment consists of the sum of two terms;

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

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

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

Given these allocations of payments and monitoring responsibilities among debt and equity holders, the quantities of debt and equity issued by any bor-

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

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

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

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

In our model, this decline in the relative price of capital has three closely related implications that are not present in more standard models. First, entrepreneurs are engaged in the production of capital, but state verification consumes final goods and services. The latter is not essential, as we discuss in more detail below. Thus, the price of what entrepreneurs produce falls relative to the cost of monitoring or, in other words, the perceived relative cost of monitoring rises in the development process. Second, as we have argued, the decline in the relative price of capital causes entrepreneurs to shift the composition of invest-

ment toward the observable-return technology, in order to economize on (increasingly expensive) state verification. This shift in the composition of investment is typically associated with the increasingly heavy use of equity markets. And third, as the composition of investment changes, less monitoring occurs, and the quantity of resources consumed by the presence of the CSV problem declines. This is the social benefit associated with the development of equity markets, and it conforms to the observation that the development of direct transactions in securities tends to reduce the costs of intermediation (Watson and others 1986).

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

Capital Accumulation and Production

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

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

$$K_{t+1} = \alpha q[\theta_t^*\hat{y} + (1-\theta_t^*)\hat{w} - r] + r(1-\alpha)\omega(k_t). \tag{12}$$

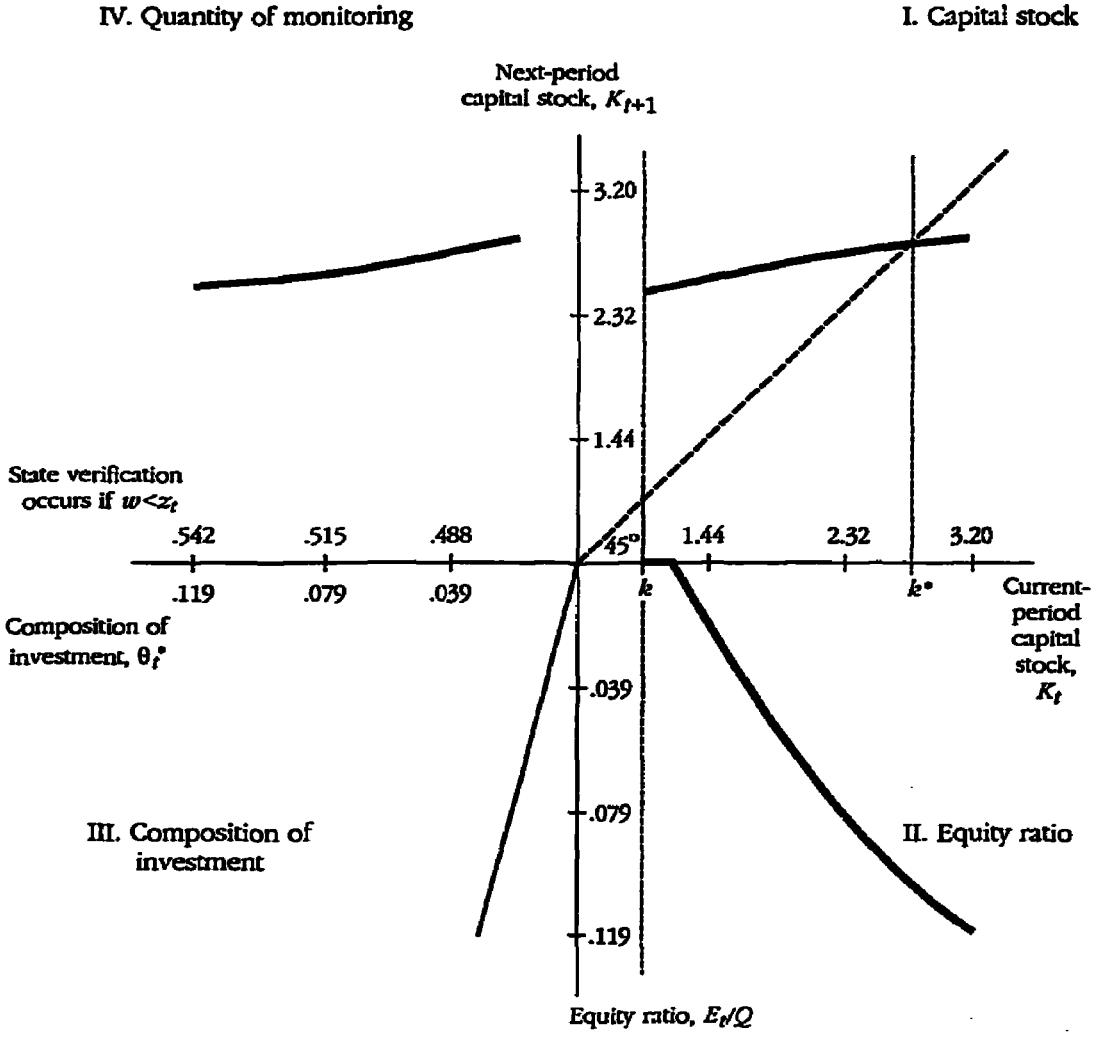
Converting the left-hand side of equation 12 into a capital-labor ratio $[K_{t+1}/(1-\alpha)]$ yields

$$k_{t+1} = [\alpha/(1-\alpha)]q[\hat{w} - r - (\hat{w} - \hat{y})\theta_t^*] + r\omega(k_t). \tag{13}$$

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

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

Figure 1. *Evolution of the Capital Stock, Equity Ratio, Composition of Investment, and Quantity of Monitoring Relative to the Development of an Economy*



Note: The parameter values are for the expected return on investments in the unobservable-return technology, $\hat{w} = 2.5$; for the expected gross return on investments in the observable-return technology, $\hat{y} = 2.2805$; for the rate of return on investment, $r = 0.5$; for the production function, $B = 2.0$; for the scale of investment projects, $q = 1.0$; for the resources used in monitoring, $\gamma = 0.8$; for borrowers as a percentage of the population, $\alpha = 0.5$; and for the production function, $\beta = 0.5$.

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

Relative Monitoring Costs Rise over Time

As we have just described, under the appropriate technical assumptions $\{k_t\}$ is an increasing sequence. It follows that $\{\iota_{t+1}\} = \{\iota(k_{t+1})\}$ is an increasing sequence as well, so that borrowers perceive effective monitoring costs that are rising over time. This fact has an important implication. If equation 10 holds (which it does uniformly in the examples reported by Boyd and Smith 1994c, 1995), then $\{\theta_t^*\}$ is also increasing over time. Thus, as an economy develops, an increasing fraction of investment will take place in the observable-return technology. As a consequence, the development process will be accompanied by a declining (gross of verification cost) return on investment.

This shift in the composition of investment also allows for the possibility that total resources consumed in state verification decline as an economy grows. In particular, resources used in monitoring in real terms are given by $\alpha\gamma G[z(\theta_t^*; \iota_{t+1})]$, per capita. As k rises, the variable $z_t = z(\theta_t; \iota_{t+1})$ that describes the amount of monitoring can, theoretically speaking, either rise or fall. However, it is intuitive that it should fall; an intuition confirmed by all of the numerical examples reported by Boyd and Smith (1995). Thus, we expect more advanced economies to typically use fewer resources (and a smaller fraction of total resources) in dealing with financial intermediation costs. Because our model has a fixed quantity of total resources (αq) always being transferred to entrepreneurs, the analysis does not distinguish between a decline in the unit costs and a decline in the total costs of intermediation. A more general analysis would have more funds being transferred in financial markets as an economy develops. Such an analysis would then predict that the unit costs of intermediation fall with development, although the behavior of total costs would depend on the rate of growth of intermediary activity.

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

Activity in Equity Markets

The equilibrium equity ratio e^*/q may, theoretically, either increase or decrease with the growth process. However, all of the numerical examples produced by Boyd and Smith (1994c, 1995) have the property that e^*/q is increasing in ι. Thus, as an economy develops, capital is accumulated, and ι increases, our results suggest that the typical observed pattern should be that the volume of equity market activity increases over time. This prediction is consistent with a wealth of empirical evidence documenting the strong positive correlation be-

tween the level of activity in equity markets and real development (Antje and Jovanovic 1992; Demirgüç-Kunt and Levine 1993, 1994; Demirgüç-Kunt and Maksimovic 1995; Gurley and Shaw 1967; Levine and Zervos 1995; Michie 1987).

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

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

$$g(w) = \begin{cases} 4w/\overline{w}^2; & 0 \le w \le \overline{w}/2 \\ 4(\overline{w} - w)/\overline{w}^2; & \overline{w}/2 \le w \le \overline{w}. \end{cases} \tag{14}$$

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

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

An Example

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

Figure 1 depicts various aspects of how the capital stock (or capital-labor ratio) and other equilibrium quantities evolve as an economy develops. The upper right-hand quadrant of figure 1 represents the equilibrium law of motion for

k, given these parameter values. As noted previously, k_{t+1} is a monotone increasing function of k_t. There is a unique nontrivial steady-state equilibrium capital-labor ratio satisfying all of our hypotheses and, in addition, the steady state is asymptotically stable. The steady-state value of the capital-labor ratio is approximately 2.83, and steady-state per capita output is about 1.68.

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

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

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

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

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

In our model, simplicity has dictated that a constant quantity of total investment be intermediated over time. Thus, the declining unit costs of intermediation are reflected in declining total resources consumed by this activity. A richer

model would allow for the total volume of financial activity to grow over time; such growth would be facilitated by a decline in unit costs.

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

Summary

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

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

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

VI. Toward a Set of Policy Implications

We have yet to undertake a systematic welfare analysis of the competitive equilibrium allocations that arise in this economy. Nor have we formally analyzed the consequences of specific policy actions. However, in this section we make a few observations about the likely consequences of various policy interventions that might be contemplated in this context.[2]

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

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

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

Inflation

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

2. A technical observation is that competitive equilibrium allocations in our economy are what Balasko and Shell (1980) term "weakly Pareto Optimal"; that is, it is not possible to achieve a Pareto improvement by transferring resources between a finite number of generations. However, this does not imply that competitive equilibrium allocations are fully Pareto optimal; capital overaccumulation is still possible, as it is in the standard Diamond (1965) model. If our economy does not display capital overaccumulation—that is, if steady-state real interest rates are not too low—and if there are no other interventions, then competitive equilibria will be Pareto optimal, and any policy interventions that are not entirely negative in their consequences must necessarily be redistributive. In this situation, policies must be evaluated with respect to whether these redistributions are deemed socially desirable.

ment bearing a fixed nominal return. In addition, particularly in many developing countries, binding nominal interest rate ceilings limit the flexibility of nominal returns, and relatively high reserve requirements force banks to hold large amounts of real balances. Both kinds of factors will tend to allow increases in the rate of inflation to put downward pressure on real returns to savings. Indeed, Choi, Smith, and Boyd (1995) document that in several countries the real rate of return on both safe savings instruments and on equity is very strongly negatively correlated with the rate of inflation. Thus, higher rates of inflation will tend to reduce the real returns perceived by savers and to lower the opportunity cost of funds to borrowers.

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

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

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

The Relation between Debt and Equity Markets

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

VII. Conclusions

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

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

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

It is also the case that, in all of our numerical examples, the quantity of resources consumed by monitoring declines as an economy develops. This pro-

vides a sense in which the endogenous evolution of debt and equity markets in the development process provides an economy with a more efficient set of capital markets.

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

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