The Finance-Growth Nexus and Stock Market Infrastructure in Bangladesh: 1980-2007

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ABSTRACT

This thesis attempts to investigate, theoretically and empirically, whether financial development (bank development and stock market development) has led to economic growth in Bangladesh, and it explores the important factors behind the evolution of the financial system itself. The literature survey in Chapter 2 argues that finance enhances growth while banks and stock markets are complementary in development; however the application to low-income countries is unclear. After reviewing financial sector policy and institutional background in Bangladesh in Chapter 3, a combination of various theoretical insights into one structural framework is proposed in Chapter 4. Our empirical findings for Bangladesh in *Model 1* using the ARDL cointegration method are as follows. Both banks (quasi-money/GDP) and the stock market (number of listed companies) have enhanced physical capital accumulation from 1980 to 2005. Using the same cointegration technique, growth in GDP per capita is found to lead to growth in banks (private-credit/GDP ratio). And there is a cointegrating relationship between banks and the stock market which indicates that debt and equity are complementary. The main message from Chapter 6 is that the finance-growth nexus can be shown to operate in the case of Bangladesh where banks are the main providers of finance. The key policy implication of *Model 1* is that overall financial development (banks and stock markets) can lead to economic growth, while feedback effects promote further financial activity. We then identify and assess relationships that operate within the stock market itself. *Model 2A* begins the analysis of the stock market infrastructure by relating the number of listed shares to the value of traded shares or turnover (market liquidity). Empirical results in Chapter 7 for Bangladesh using the ARDL approach show support for cointegration from 1990Q1 to 2005Q4. *Model 2B* then investigates the relationship between trading activity and price volatility on the stock exchange. Using a GARCH framework and Granger Causality tests, empirical results in Chapter 8 indicate that trading volume and particularly trading value carry predictive power for price volatility with daily data from 1995 to 2007. The overall conclusion in Chapter 9 is that to understand the finance-growth nexus in Bangladesh it is necessary to appreciate the essential role played by banks as well as the forces behind the stock market. The encompassing framework presented here along with its reinforcing and constrained features points to a growth-promoting and sustainable financial structure for central bank regulators to target.

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CHAPTER 1
INTRODUCTION

1.1 The main motivation and research questions

This study examines the *Finance – Growth Nexus* and the *Stock Market Infrastructure* in Bangladesh. Our objective is to answer the following questions: 1) what has been the impact of finance (banks and stock markets) on economic growth? 2) what are the determinants of bank development and stock market development?

Such an analysis of the Bangladesh financial system is warranted for three reasons. The first reason is that economic theory predicts a positive, possibly two-way causal relationship between financial development and economic growth, as well as a changing financial structure in the process of development and liberalization (Levine, 1997; Auerbach and Siddiki, 2004). The second reason is to come up with an explanation as to *why* we obtain the results we do. Bangladesh is a poor developing country which has a banking sector with non-performing loans and other structural deficiencies, a stock market which although growing remains relatively small and susceptible to manipulation, and a political system plagued by unrest and corruption[1]. Given this description of the institutional environment in Bangladesh, how are we able to explain our results, particularly those involving the stock market? And the third reason why this study may prove useful is in suggesting directions for future research on the finance-growth relationship and on stock markets. Our findings are that economic growth in Bangladesh is partly explained by bank development and stock market development, both of which in turn are explained by the overall growth process and by financial sector interactions. The stock market is also developing according to its own specific features.

[1] Manipulation and corruption are of course global phenomenon. Bernard Madoff's $50bn fraud originally uncovered in December 2008 involved a 'Ponzi-type' scheme where existing investors were paid by funds from new investors. In January 2009, Ramalinga Raju, founder of Satyam Computer Services, confessed to having manipulated the accounts of India's fourth largest IT outsourcing company and inventing a $1bn cash pile. In June 2008, Viren Rastogi, a metals trader and company owner based in the UK, was convicted for conning banks out of £350 million. He claimed to have a network of 'client companies', two of which in fact turned out to be a cow shed in India and an American laundrette. And in 2007, Jerome Kerviel, an equities trader, generated a €4.9bn loss for France's second largest bank SocGen by placing unauthorised bets on futures markets, faking documents, exceeding trading limits, and hacking computers.

1.2 A description of Bangladesh at a glance

Bangladesh is a densely populated country of around 150,000 square kilometres and a population of approximately 140 million. The country has a limited natural resource base and is subject to regular natural disasters such as floods and cyclones. There are however sizeable reserves of natural gas which have sparked international interest in the form of FDI. Power and telecommunication industries are also the key recipients of foreign investment. While geographically small, the population of Bangladesh is ethnically homogenous compared to other countries in South Asia. Bangladesh is the 50th-largest economy in the world if judged by its gross national income, and the 10th-largest state in the world if judged by its population. With a growing labour force of approximately 50 million, the country is witnessing a demographic transition resulting in a surge of young entrants into the labour market, a rise in female labour force participation, and substantial rural to urban migration. There is a growing primacy of the capital city Dhaka which now accounts for one third of the urban population. The urban sector's share in population is projected to further increase to 40 percent by 2030.

The need for an efficiently operating financial system to provide the necessary funds and services for innovative and growth enhancing projects in Bangladesh cannot be emphasized enough.

Bangladesh is often characterized by its volatile political situation, inadequate infrastructure, frequent power failures, labour unrest, and rampant (some would even argue institutionalized) corruption. It is in light of these bleak assessments that the country remains an interesting case study. Performance in the Bangladesh economy has been reasonably consistent[2]. GDP per capita growth averaged 3.3% over the FY01-05 period, which has been the highest 5-year average since the country's independence. The explanation behind this growth is obviously important. We believe that part of the reason lies in the activities of the financial sector.

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[2] Bangladesh has been recently included by Goldman Sachs in a list of 11 developing countries that, according to its analysts, have the greatest potential to emulate the long-term economic success expected from China and India.

1.2.1 A historical overview of Bangladesh

The development process in the economy can be broadly categorized into three phases. The first phase of development (1972-1978) witnessed a period of reconstruction after a brief experiment with socialist planning whereby the private sector was under a centrally regulated system. The second phase of development (1979-1990) was a period of gradual withdrawal of government intervention towards achieving the free play of market forces. Beginning in 1980 the Government of Bangladesh took its first real steps towards institutional reform. Importantly for the purposes of this study, policies were implemented in order to promote financial liberalization and financial development. The government pushed for greater export-oriented industrialization and encouraged more involvement from the private sector in the development process. During this period, the emergence of competitive industries such as ready made garments contributed substantial foreign exchange for Bangladesh in addition to remittance flows from nationals working abroad. The third phase began in 1991 and represented a period of further significant structural reform of the economic system. The government continued with financial and trade liberalization, policies to encourage greater emphasis on investment, and a privatization policy for state-owned companies.

Problems continue to curtail any positive developments observed in Bangladesh. Poor quality of infrastructure remains a significant barrier towards achieving growth. The lack of transparency, accountability, regulatory effectiveness, and incentive to monitor has created a culture of default and secrecy in the financial sector. Deterioration of law and order, government ineffectiveness, and large-scale corruption all point towards governance issues that could derail the country's progress, thwart democratic development, and threaten stability. At the heart of the country's governance difficulty is the longstanding political struggle between the two major parties, the BNP (Bangladesh National Party) and Awami League. While Bangladesh has been largely unable to solve its economic and political difficulties and to eliminate poverty, as mentioned before it has still managed to achieve positive, if modest rates of economic growth. The prevailing view however is that annual economic growth of at least 7 to 8 percent is needed to eliminate widespread poverty by 2015 as laid out by the Millennium Development Goals.

Agriculture is still the single most important sector of economy. The role of the manufacturing sector has nevertheless been slowly growing. According to a recent study

by the World Bank[3], the manufacturing sector over 1991-2005 increased its share in GDP from 13 percent to 16 percent while manufacturing exports and garments now account for 90 percent of total exports. A number of other products such as ceramics, pharmaceuticals and food products have experienced growth over the last decade, but these still remain small compared to the garments sector. Bangladesh has also attempted to promote its service sector, especially the tourism and information technology sector. However in doing so it increasingly competes with neighboring India and other countries.

1.2.2 How effective has existing financial policy reform been in Bangladesh?

Bangladesh began its first proper attempts at financial reform in 1980 when it privatized some of its state-run banks and allowed banks to lend to the private sector. Formal restructuring of its financial system took place under the appointment of the National Commission on Money, Credit and Banking in 1987 which recommended broad structural changes. The main objective was to improve the soundness, competitiveness and efficiency of financial intermediation (Bangladesh Bank, 2006). The major focus was on deregulating interest rates, strengthening loan classification standards, and reducing the Bangladesh Bank's direct involvement and control over banking operations. This policy has led to an upward trend in measures of bank development such as deposit-taking and private-credit (see Chapter 3). It has also resulted in a greater push for stock market growth, more emphasis on institutional capacity building, and higher accountability. A key finding of this thesis is that while looking good on paper, these financial policies and structural reforms have in fact been implemented without a firm understanding and appreciation of the way the finance-growth nexus operates within the economy. In particular, the ultimate goal of any policy should be to encourage and if necessary force a culture of disclosure which would lead to improved information production and dissemination. The role of both banks and stock markets is somehow better at characterizing this particular growth-enhancing feature of the financial system, in addition to the normal growth-accelerating effects such as enhanced liquidity provision. These ideas will be expanded on further as we proceed.

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[3] "Bangladesh: Strategy for Sustained Growth", Bangladesh Development Series Paper No. 18 (2007). The World Bank Office, Dhaka.

1.3 What is financial development, and why is it important?

The financial sector represents the institutions in an economy offering financial services to consumers and firms. It can include everything from banks, stock exchanges and insurers, to credit unions, microfinance institutions and local money lenders. The focus here though shall be on the formal financial sector, that is, financial intermediaries or commercial banks, and the stock market which we will also refer to as the equity market.

In Chapter 2, we present the main theoretical background on why financial development enhances capital accumulation and growth. The basic argument made by the New Growth or Endogenous Growth theory is that financial development helps to enhance liquidity of the financial system by reducing the amount of investment capital that is 'lost' in the intermediation process between savers and borrowers. Banks – and to an extent the equity markets – thus make it easier for investors to diversify and to minimize risk (particularly liquidity risk[4]), and growth is accelerated. While we agree with the main thrust of the New Growth theory, throughout the course of this study we intend to show that this definition needs to be sufficiently enriched in order to allow a greater role for interactions within the financial sector along with other feedback effects.

Whether higher growth is due to financial development or whether financial development is the result of growth, the results have important implications for developing countries. From a policy perspective, a finding that finance leads to growth means that greater investment in the size, efficiency and soundness of the financial sector will result in higher growth for the economy. The need for a healthy and vibrant financial sector will motivate domestic regulators and international organisations to ensure that there is enough liquidity in the banking system and strong enough regulation. On the other hand, if growth is found to lead to finance then the need to have a large financial sector is dampened somewhat. Financial development here would simply be the by-product of the overall process of economic development, and higher growth would be better achieved through other factors.

[4] We note here that the model by Pagano (1993b) also uses risk diversification and liquidity-externalities to explain the growth in firm listings and investor trading on the stock exchange.

1.3.1 Importance of the finance-growth effect for poverty alleviation

A growing literature argues that financial development can reduce income inequality and poverty levels, directly through widening access of the poor to financial services, and indirectly through the impact of finance-led growth on poverty reduction. Green, Kilpatrick, and Murinde (2005) for instance state that:

> "in order to design effective financial sector policies for growth and poverty reduction, it is imperative to have an intimate understanding of the key relationships between the financial sectors of the economy and the role of the financial sector in the development process" (2005:p.17).

The relationship between financial market development and growth should therefore be of particular relevance to low income countries, given the linkage between growth and poverty alleviation. The International Conference of Financing and Development, which was held in Monterrey in March 2002, highlighted the initiatives as well as serious difficulties towards achieving the Millennium Development Goals including halving world poverty by the year 2015. A greater understanding of the ways in which finance contributes to economic growth and poverty reduction is imperative in order to achieve these goals. Berthelemy and Varoudakis (1996) suggest that insufficient financial development may leave a country in a 'poverty trap'. They argue that, because of increasing returns to scale in the financial sector, a vicious circle can be created, where low levels of financial intermediation result in only a few market players. The lack of competition results in high costs, leading to low real deposit rates and hence low savings, which in turn limits the amount of financial intermediation and therefore economic growth. Financial sector underdevelopment can therefore be a serious obstacle to growth, even when a country has established other conditions necessary for sustained economic development such as educational attainment.

1.3.2 A justification for our focus on the formal financial sector

While the focus of this work is on the formal financial sector, Bangladesh is in fact better known for its 'micro finance' industry than for its commercial banks or its stock market. Grameen-style informal lending in Bangladesh has recently achieved high status and popularity after the Nobel Prize was awarded to its founder Dr Mohammad Yunus in 2006. Micro finance is undoubtedly effective at helping the extremely poor and disadvantaged sections of society, particularly women who are often discriminated

against in the society. But micro finance in Bangladesh is small in relative terms to the overall financial sector, and also in terms of the contribution of finance to economic growth. In addition, while it is an interesting concept to be admired, micro finance and informal lending practices are less useful in reaching large numbers of people in sizeable amounts. The poor in developing countries often do not have access to ongoing, formal financial services, and are forced to rely instead on a narrow range of sometimes risky and expensive informal services (DFID, 2004). A widening of financial services provision by formal private sector institutions (such as commercial banks) is necessary to tackle this problem on an adequate scale, and the barriers to achieving this must therefore be identified and addressed where possible. Rather than focus narrowly on one type of financial service it is wiser instead to consider the financial sector in broader way.

1.3.3 Why is our analysis of finance an effective policy tool for Bangladesh?

We are faced with two challenges which need to be addressed in order for our policy suggestions to be of use in the future development of Bangladesh. Firstly, we need to carefully identify and explain the mechanisms relating banks and stock markets to economic growth. Here it is important that we discuss some of institutional features in Bangladesh such as inefficiencies in lending and non-performing loans in the banking sector, misreporting and manipulation on the stock market, and so on. Secondly, we need to justify the finance-growth relationship by accounting for the development of the banks and stock markets themselves. In highlighting these issues for a country like Bangladesh, we are therefore following in the footsteps of previous authors who have also studied the (two-way) causal relationship between finance and growth as well as assessing the merits of different financial structures ("bank-based" versus "market-based" systems).

1.3.4 The relevance of the stock market for Bangladesh

It is important at the beginning to have a very clear focus on our objective. Our intention is to show that knowledge of bank development in addition to knowledge of stock market development is important in order to fully appreciate the finance-growth nexus in Bangladesh. In the course of our presentation we shall attempt to build a richer, more sophisticated model which can hopefully be used to show how overall financial development contributes to economic growth. But a difficulty immediately arises at this point: how can we be so sure that the stock market itself is relevant, particularly when

given the background of the country we are working with and the key position held by banks in almost every economy around the world?

The problem regarding the relevance of equity (and any focus on the stock market for that matter) is found not only in application to Bangladesh but for richer economies as well. Mayer (1988) has shown that even large, established stock markets in industrialized countries have been relatively unimportant sources of corporate finance. More recently Henderson et al. (2006) find that equity issues are dwarfed by debt issues worldwide. In contrast, Singh (1997) notes that companies in emerging economies have made significant use of equity finance – despite this Singh has grave reservations about relying on stock markets for achieving economic growth. The question of stock market relevance has not therefore been resolved satisfactorily[5].

We argue that the missing piece of the story is a thorough understanding of the stock market infrastructure. By stock market infrastructure we are referring to the setup and operation of the stock exchange – the listing of shares by firms, the trading of those shares by investors, and the method of forming prices at which buyers and sellers agree to exchange their assets and wealth. When this piece is incorporated, the puzzle is solved. The financial system (banks and stock markets) helps to resolve asymmetric information issues, enhance liquidity provision, and accelerate growth in Bangladesh, while financial development itself is endogenously determined. To get to that point will take a lot of work – this thesis will be seen by many as being left incomplete. But we can be confident that we have at least presented the important questions, allowed for some theoretical justification, and provided firm empirical support for our main ideas and motivation.

1.4 What this thesis will attempt to do

Given the pressing need for higher economic growth in Bangladesh, what role, if any, can the financial sector play? We first present three theoretical models that when integrated together are shown to form the finance-growth nexus in Bangladesh. We will refer to this model as *Model 1*. The following papers are important in describing *Model 1*:

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[5] The over-reliance on debt instead of equity has not been without its consequences. In the aftermath of the credit crunch companies have had to raise approximately $150bn globally through rights issues in 2008, a 66% increase over the amount raised in 2007 (Source: Thomson Reuters).

Figure 1.1

Model 1: The finance-growth nexus

MODEL 1

"The Finance-Growth Nexus"

1) Greenwood and Smith (1997)
2) Harrison, Sussman, Zeira (2004)
3) Besanko and Kanatas (1993)

Model 1 says that both banks and stock markets enhance economic growth, economic growth leads to bank development, and banks and stock markets are complementary in the process of development. *Model 1* therefore encompasses a number of different mechanisms. Expanding our focus in this way allows for greater insights to be achieved as well as stronger policy recommendations to be given.

In addition to establishing relationships within the finance-growth nexus where banks and stock markets are shown to coexist in the process of development, the stock market itself will be shown to develop according to its own infrastructure. What this means is that, although the stock market may be tied to the overall growth process and to the development of banks (as in *Model 1*), the stock market in Bangladesh is also impacted by the development of its own factors. Stock market liquidity or trading, the number of listed shares, and the trading volume – price volatility aspects are important for *Model 2*. This we will refer to as the stock market infrastructure. The following papers are important in describing *Model 2*.

Figure 1.2

Model 2: The stock market infrastructure

MODEL 2

"The Stock Market Infrastructure"

1) Pagano (1993b)
2) Lamoureux and Lastrapes (1990)
3) Suominen (2001)

Model 2 (two sub-models: *2A* and *2B*) says that the listing of shares by firms and the trading of shares by investors are related, trading volume and conditional price volatility reflect information flow arrivals to the stock market, and stock returns are causally related to trading volume.

This thesis argues that *Model 1* together with *Model 2* adequately captures the main dynamics of the finance-growth nexus and stock market infrastructure in Bangladesh. We avoid the highly ambitious task of delicately integrating all six theoretical models shown above. Instead, we give suggestions as to how the main insights of *Model 1* and *Model 2* can be combined into one diagram (figure 4.1, Chapter 4). It is only when all the six models are described together within an overall structured framework that we can appreciate the role of the financial system and also reconcile existing theory with our empirical findings for Bangladesh.

1.5 Main contributions – What do our results show?

This is the first work that relates financial development and financial structure to the process of economic development in Bangladesh using advanced time-series techniques. The analysis for the Dhaka Stock Exchange (DSE) by itself represents a new contribution to the literature. As above, we separate our results into two main blocks. *Model 1*'s results on the finance-growth nexus are the following.

1.5.1 Results for Model 1: "The finance – growth nexus"

- *Bank development has enhanced economic growth.* For Bangladesh, the channel of finance-to-growth operates via the capital stock with bank deposits representing financial development.
- *The growth-enhancing effect is present only when banks enter with the stock market.* In other words, the financial sector needs to be seen in its aggregate form if a positive finance-to-growth effect is to be observed.
- *Banks and stock markets are complementary.* Bank activity appears to promote stock market activity.
- *Economic growth leads to more bank development.* Banks respond to greater demand by extending more credit.

Model 2's results on the stock market infrastructure are the following.

1.5.2 Results for Model 2: "The stock market infrastructure"

- *Trading in stocks leads to more shares being listed.* As long as companies decide to list shares and investors wish to trade them, the stock market can develop somewhat independently of the banks and the growth process.
- *Trading can predict stock returns and stock returns can predict trading.*
- *Trading can improve the prediction of future volatility.*
- *Trading value is superior to trading volume in all of the above.*

1.6 The entire picture

Not only is evidence for such relationships of interest in its own right. This thesis for the first time attempts to unify the two areas in the literature – the finance-growth nexus and stock market infrastructure – that were previously considered to be separate. And we do it for the case of Bangladesh, one of the poorest countries in the world. It is only when the evidence is seen in the context of the integration of the '*entire picture*' and the '*five main effects*' that the findings and theory make sense. Using such an approach which combines the elements of different theoretical insights with our own intuition is the best way to reconcile our empirical findings with existing theory.

The five main effects or relationships with help to drive this structural model of the financial system and real economy are : (i) the *finance-to-growth effect*; (ii) the *growth-to-finance effect*; (iii) the *banks-to-stock market effect*; (iv) the *listing-trading effect*; (v) the *trading – volatility effect*, and the *trading – stock return effect*. We discuss each of these in turn.

1.7 The five main effects

1.7.1 The finance-to-growth effect

Our principal finding is that both banks and the stock market can accelerate growth via physical capital accumulation. This result is established through a liquidity provision argument and it is the main theoretical prediction of the Greenwood and Smith (1997) model. At first glance this result will seem surprising to many. Bangladesh is a low-income country – how is it possible that the stock market may have helped accelerate growth? Later we will see why this result is possible by combining insights of different theoretical models. The bank development indicator is the finance-to-growth effect is quasi-money/GDP, while the stock market indicator is the number of listed companies.

1.7.2 The growth-to-finance effect

We find that economic growth leads to bank development. More growth leads to more bank branches entering the financial sector, and higher competition will usually reduce the cost of financial intermediation. The level of private credit – which here now represents bank development – is then increased. This is the main theoretical prediction of Harrison, Sussman and Zeira (2004). In contrast to the positive finance-growth result above, this result seems to be more reasonable for a developing country like Bangladesh.

1.7.3 The banks-to-stock market effect

While equity plays a relatively small role in corporate financing and debt a much greater role[6], through bank-stock market interactive channels[7] financial development may

[6] See also Fry (1995, 1997).

[7] These are admittedly complicated linkages, but for now it will help to think of the following ordering of events: 1) Economic growth leads to bank development. 2) Bank development encourages stock market

enhance growth. There are various models which can help to explain why a connection between bank development (here now taken to be private credit) and stock market development might occur. For reasons that later shall become clear we focus on Besanko and Kanatas (1993).

1.7.4 The listing - trading effect

As more companies list their shares on the stock exchange, trading in those shares will increase. Here the number of listed companies is replaced by the *total number of all listed shares*. This higher level of trading or market liquidity will again encourage more firms to list their shares, thereby fulfilling expectations. This 'listing-trading' effect is identified in the Pagano (1993b) model. This result represents an important additional aspect of the finance-growth nexus, since it establishes how the stock market may essentially develop according to its own forces.

1.7.5 The volume - volatility and trading - stock return effect

The persistence in volatility and other features of stock returns is well documented in the literature. But what drives the volatility process? Empirically for the Dhaka Stock Exchange we find that the GARCH (1, 1) framework is made stable when indicators of trading activity (volume and value) are incorporated. Trading volume and trading value are also causally related with stock returns and returns volatility. These theoretical predictions are established in the Lamoureux and Lastrapes (1990) and the Suominen (2001) models. However, trading *value* rather than trading *volume* is found to be the preferred measure of trading.

1.8 Outline of chapters

The rest of the thesis is structured as follows. Chapter 2 is a literature review. Chapter 3 describes the institutional aspects of the financial sector in Bangladesh and the reforms which have been implemented. Chapter 4 offers a theoretical overview the encompassing

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development (or economic growth may, indirectly through banks, encourage the stock market to develop). 3) Through the *liquidity-enhancing* effect and the *information-enhancing* effect both banks and the stock market accelerate economic growth. And 4) The stock market infrastructure responds to its own factors. In (1) and (2), bank credit to the private sector represents bank development. In (3), quasi-money represents bank development. In (2) and (3), the number of listed companies represents stock market development. Together, the events (1), (2), and (3) represent the finance-growth nexus. In (4) the total number of listed shares, value of shares traded, turnover and volatility represent the stock market infrastructure.

finance-growth nexus and stock market infrastructure framework. Chapter 5 explains the data and methodology. Chapter 6 presents the finance-growth nexus theoretical and empirical model. Chapter 7 presents the first stock market infrastructure theoretical and empirical model. Chapter 8 presents the second stock market infrastructure theoretical and empirical model, and Chapter 9 concludes.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter we present the main theoretical background for the thesis. It is important to note that the literature review here does not aim to isolate any theoretical model in particular. Rather it seeks to present a wide ranging review of the different ways through which finance operates in the economy, as well as explaining stock market activity.

We begin by explaining the terminology of financial development i.e. the functions which banks and stock markets provide. We then present a thorough review of the financial development and economic growth linkage. Theories on bank development are discussed. We then review the relationship between banks and stock markets, first within an overall economic growth setting and second as a complementary/competitive feature of the financial sector itself. One of the main criticisms in our opinion is that work until now has modelled the emergence of a stock market at some critical date rather than its continuous development over time. Finally, the theory behind the stock market infrastructure is presented. This part of the review is important not just because such relationships are interesting in their own right. As economic theory does not properly justify the existence of a stock market for a low-income country, we need to know about how exactly stock markets operate to be more certain that they are in fact relevant in the context of Bangladesh. We conclude by reviewing the current status of existing empirical work on Bangladesh.

2.2 The terminology of financial development

What are banks and stock markets?

In this section we define exactly what we mean by financial development. Specifically, what are banks and stock markets and their functions and services in the economy?

Banks

A bank is an institution whose current operations consist of granting loans and receiving deposits from the public. This is the definition given by Freixas and Rochet (1997: p. 1). The fact that loans and deposits are both offered is important because it is the combination of lending and borrowing that is typical of commercial banks. Banks usually deal with financial contracts which cannot be easily resold (marketed), as opposed to financial securities (stocks, bonds, and derivatives contracts), which are anonymous (in the sense that the identity of their holder is irrelevant) and thus easily marketable. Therefore, banks typically must hold these contracts in their balance sheets until the contracts expire[1]. Banks or financial intermediaries provide services of divisibility, term, and risk transformation. The role of the central bank and its policy mandate is imperative since it can influence the cost and the terms which other banks charge to borrow and lend to each other over both short and long maturities. The central bank is thus in charge of the overall health of the financial sector as well as fulfilling the role of being the banker to the banks and to the government itself.

The stock market

The basic operational function of the stock market is to provide an institutional and contractual arrangement for transferring shares that represent partial ownership of public companies. New issues of stock on the *primary* market may be either initial public offerings (IPOs), which are sales of stocks by newly organized public corporations or by private corporations now going public, or secondary offerings, which are new shares sold by a public corporation that already has shares outstanding[2]. Investors who purchase

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[1] It is interesting to note the connection between the global financial turmoil in 2007-2008 and deviations from typical bank practice. The work in this thesis suggests that it is essential to have a growing, adequately liquid, and well-regulated banking system in place which allows banks and stock markets to bee complementary. Corporate finance however attempts to go one step further and identify the 'optimal' proportion of low-cost debt and more expensive equity, thereby creating the lowest possible weighted average cost of capital (WACC). Many observers in the financial press have commented on how bankers in recent times would urge firm managers to push their debt levels up as far as possible. When the credit crunch happened the result was more and more firms being forced to raise fresh equity through the stock market in the form of new offerings (including the largest banks such as Royal Bank of Scotland's record rights issue of £12bn in April 2008). The essential idea also extends to Bangladesh. There the relevance of equity is hardly comparable to the relevance of debt; nevertheless a dynamic relationship can exist between banks (debt) and stock markets (equity) at each stage of economic development.

[2] Such new offerings are sometimes difficult because of 'pre-emptive rights'. These rights refer to rights of first refusal that the company's existing shareholders have over new shares. If the shareholders take up all of their rights and buy the new stock then they will end up owning the same percentage of the company's share capital when the rights issue is complete as they did beforehand. The company's shareholders may

shares or equity hope to gain from the future performance of the company, profits being realized in the form of either dividends or capital gains. Stock market transactions are carried out on the *secondary* market. The companies whose shares are being traded receive no revenues from sales in the stock market. However by increasing the liquidity of marketability of the securities of public corporations an active market for existing stocks increases the ability of public corporations to acquire funds through equity issuance.

Companies can list stock on an organized exchange or in the over-the-counter market. While stock prices are reflective of supply (the number of existing shares) and demand (the number of shares desired), they are also impacted through the market microstructure. This involves either a market maker or a limit-order system. In the former case, the market making service is often provided by specialists who are required to buy if the current supply exceeds current demand or to sell if the current demand exceeds current supply. In the latter case there is no designated market-maker. Instead the market making arrangement is undertaken by a computerized automated trading system where brokers enter all buying and selling (bid, ask) prices and the trading system then executes any crossing trades sequentially until no potential trades with bids in excess of asks remain[3].

2.3 Why should finance matter for growth? A variety of perspectives

2.3.1 'New' versus 'Old' growth theory

In the original neo-classical growth theory (Solow, 1956), the key determinants of economic growth are exogenous variables. Sustained growth in output per head is only possible as a result of exogenous technical change. The presence of diminishing returns to capital would mean that growth in per capita income will not be enhanced by an increase in investment. Financial variables can only influence the level of income and not the growth of income. Any increase in the rate of saving generated by financial institutions will therefore not affect the rate of growth. The last two decades has seen the emergence of new growth theory inspired largely by the Romer (1986) – Lucas (1988) paradigm of endogenous growth, in which the key determinants of output growth may be endogenous variables. In this paradigm, output per head can grow over time because of

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choose not to take up their rights if they cannot afford to do so – these shareholders would typically sell their rights to other investors. Another form of share is 'preference shares': unlike ordinary shares these have no voting rights, however their coupons must be paid out before dividends on common stock.

[3] One such automated process of stock market trading is described in the model by Suominen (2001).

endogenous forces within the economy, particularly human capital and the knowledge base. Increased investment by one firm could have spillover effects for other firms. As a result, increases in productivity are generated for the industry as a whole and hence economic growth can result from increased investment. A key implication of endogenous growth theory is that government financial policies directed at influencing the rate of saving and investment may affect the steady state rate of economic growth.

However, the early endogenous growth literature had little to say regarding the role of the financial sector. In the Kenneth Arrow (1964) – Gerard Debreu (1959) world, there are no information or transaction costs, and no need for a financial system. Therefore in order to for the financial system to exist, operate, and contribute to economic growth, specific frictions have to be added. The endogenous growth literature has in recent years made significant progress in discussing the ways through which financial development may contribute to economic growth.

2.3.2 The new classical perspective

Traditional mainstream macroeconomics is based on neoclassical theory, which in combination with the quantity theory of money and the rational expectation hypothesis leads to the new classical perspective. According to this approach, Say's Law prevails and money is neutral in the long run. Money neutrality in this context means that a doubling or halving of the amount of money in an economy will not affect the relative prices between goods. Therefore, real saving is the key variable determining investment. Because the quantity of money does not matter according to the new classical perspective, the creation of additional money which arises due to the issuance of credit by banks does not directly influence the real economy in the long run.

Typically, financial contracts involve two components: debt and equity. *Equity* entails a repayment which depends on the firm's profits (or losses), and this repayment is directly proportional to the firm's investment return. *Debt* on the other hand involves a fixed, pre-determined repayment which only depends on the firm's profits up to the point where that profit is enough to repay the lender that which has been contractually promised. While debt involves the possibility of bankruptcy, equity does not. Starting with the seminal work by Modigliani and Miller much research has been carried out regarding optimal

capital structure[4]. The original proposition I of Miller and Modigliani (1958, 1963) uses an arbitrage argument to show that assuming a perfect capital market and the classical dichotomy, the equilibrium market value of a firm is independent of its capital structure, i.e. the debt-equity ratio. The implications of the presumption of money neutrality was startlingly made clear by the Modigliani and Miller (1958) theorem. In a fiction-less, perfectly competitive world financial variables could have no effect upon real outcomes. Within the neoclassical framework, how might the existence of banks be justified?[5] The main function of banks within the neoclassical tradition is to *reduce transaction costs* and to *mitigate information asymmetries* for economic agents. The existence of banks is justified by the fulfilment of the following functions: *Transformation*: Banks transform the illiquid primary securities issued by firms into secondary liquid assets desired by consumers (Gurley and Shaw, 1955); *Screening and monitoring*: Banks screen potential borrowers and monitor actual borrowers on behalf of the depositors (Diamond, 1984); *Payments*: Banks facilitate payments between economic agents by providing payment systems. In spite of the minor role which money plays in the long-run analysis, financial activities might matter a lot if they increase the efficiency of economic transactions and allow for optimal risk allocation. Therefore, a positive correlation between the amount of financial transactions and economic growth would not be surprising from the new classical perspective.

2.3.3 A precursor to Endogenous Growth 1

As a result of the above, economists in the neoclassical tradition felt no urge to pay a lot of attention to the way growth is financed. They were mainly occupied with analyzing economic growth in terms of real variables for which the financial sector is supposed to play a secondary role and can be neglected without losing much explanatory power as explicitly stated by Lucas (1988, p.6). This led to the conclusion that firms' investment decisions could be analyzed independently from the finance process. However, some early contributions to the literature on finance and growth did argue for a relationship between finance and growth. These include Schumpeter (1912), Robinson (1952), Patrick (1966), and Gurley and Shaw (1955), Gerschenkron (1962) and Kindleberger (1984).

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[4] There is a vast literature on the optimal capital structure of the firm. See Harris and Raviv (1991).
[5] For an example of why a model of banking cannot be developed that builds on standard microeconomic theory, see Fama (1980).

Schumpeter (1912) highlighted the impact of financial intermediaries on productivity growth and technological change by impacting the allocation of savings in the economy. During the evolution of capitalist economies the real constraint was constantly eased by new innovations which create new profit opportunities. However, there are also periods in economic development when a lack of profitable investment opportunities become a real constraint to the whole economy, because existing production possibilities are not sufficient any more to create enough prospects for profits. Then, the economy must expand to totally new areas, in which additional profit opportunities may emerge due to new kinds of innovations. This would require the removal of another type of constraint, the finance constraint. Financial innovations and institutional arrangements could therefore also contribute to the relaxation of the real constraint as they have the potential to increase profits in the aggregate without a corresponding increase in production. According to Schumpeter, economic development is therefore a story of co-evolution between the financial and the real sectors in which the financial sector plays a major causal role. The benefits provided by financial services are due to enhancing the efficiency of financial intermediation between ultimate lenders and borrowers by mobilizing savings, managing risk, screening and monitoring investment projects and reducing transaction costs. All these elements also feature prominently in modern interpretation of financial activities, which stress their importance in increasing market efficiency by mitigating information asymmetries and reducing transaction costs[6].

Joan Robinson (1952)[7] argued that money in the form of credit is essential to the capitalist organization of production because it allows for specialization, the division of labour, and the vehicle of movement of capital in response to profitable opportunities. Banks exist to provide currency in the form of loans that create notes and deposits. The business of the economy is carried out by means of these flows. Given this flexible employment system, a flexible monetary system is required in which bank advances adjust promptly to changes in demand. This means that the money supply will be

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[6] Schumpeter also highlighted the function of the financial sector (mainly of banks) as a provider of credit by which money is injected into the economy. Schumpeter's theory of economic development includes a theory of endogenous money creation where 'loans make deposits' and therefore endogenous money creation. According to Schumpeter banks are also 'manufacturers of credit'. Thus, the ability of the financial sector to create credit money is also essential according to Schumpeter and in fact becomes a prerequisite for growth in modern credit money economies.

[7] This particular version of the model is from Nell (2005) who extends Robinson's original model to allow for the role of circulation.

endogenously determined so that the supply of media of exchange adapts itself to the requirements of trade. The capital of the banking system has to grow with the economy, from period to period, in order to continue to supply the need for advances. Banks' reserves (profits) must therefore grow at the same rate as the economy.

Patrick (1966) viewed the financial system as both supply-leading and demand-following. Demand-following financial development appears as a consequence of the development of the real sector. This implies a continuous widening of financial markets and a growing product differentiation which makes it necessary to have more efficient risk diversification as well as better control of transaction costs. This type of financial development therefore plays a more passive role in the growth process. On the other hand, the 'supply-leading' financial development precedes demand for financial services and can have a direct positive impact on growth. Its role is essentially to mobilise the resources that are being underutilized in the traditional sector, transfer them to the modern sector which is capable of promoting growth, and ensure they are used to finance the most dynamic, profitable projects. Patrick's hypothesis therefore also highlights the two-way causality which may exist between financial development and growth. It is incomplete, however, as it does not take the complementarity of the two phenomena into account (Berthelemy and Varoudakis, 1996). While supply-leading financial development can speed up economic growth, demand-following financial development is not just a passive adaptation of the financial system to the development requirements of the real sector. On the contrary, real growth enables the financial system to accomplish its own autonomous evolution, since the sustained increase in real income provides the means to set up a costly and increasingly sophisticated financial intermediation along with human capital accumulation.

Gurley and Shaw (1955) described financial innovation as a dynamical process which both causes, and is caused by, the development of the real sector. In very primitive economies investment in either human or physical capital is typically financed either by the individual investor, or within a small group of individuals who borrow and lend among themselves. Intermediation is not observed. As economies become somewhat more developed banks emerge and intermediate borrowing and lending. However, at first claims created in this process are rarely traded. Only at relatively advanced stages of development do debt, equity, and other markets in financial claims become important.

Gerschenkron (1962) asked the question: what does it take for a 'latecomer' country to industrialise and become like the early industrialisers such as Britain and Germany? His answer was that economic backwardness and deprivation provided opportunities for poorer countries to improve their situation. Banks exerted a fundamental influence on capital allocation, risk sharing and economic growth. The advantages of large-scale 'universal banks' are especially crucial because they are committed to the long-term financing of industry. Universal banks (combining both commercial and investment banking) provide all forms of financial services to the firms they develop relationships with, and become closely influential at the firm management level. Banks in the UK on the other hand were sometimes criticized for keeping industry at arm's length rather than being a dominating force. All of the 'special' roles of banks remain present in the case of universal banking such as achieving economies of scale and scope in information, risk diversification, influencing the strategy of the firm, and monitoring firm performance.

Kindleberger (1984) argued that finance was important but he stressed that it could result in good as well as bad outcomes for the real economy. Rather than accommodating and flexible, finance was "an independent force for good or ill" (1984: p. 3). Banking evolution could fail to achieve breakthroughs in situations where entrepreneurship was missing. In his opinion, if entrepreneurship was lacking then the growth promoting role of finance could not be guaranteed. His arguments do not seem to fit into any particular school of thought with regards to the role of financial development, or how finance ought to be structured. On balance, though, he did think of finance as being one of the requirements for growth. And he certainly did not perceive finance to be a force which only responded passively to growth opportunities.

2.3.4 A precursor to Endogenous Growth 2

There are three main schools of thought regarding the role of finance in economic allocation and growth which specifically consider the debate on financial liberalization: The McKinnon-Shaw School; the Neo-Keynesians, and the Neo-Structuralists. In their seminal contribution, McKinnon (1973) and Shaw (1973) argue that financial repression – indiscriminate distortions of financial prices like interest rates and exchange rates – reduces economic growth and the overall size of the financial system. We briefly review this highly influential model below.

2.3.41 The McKinnon and Shaw Financial Repression Paradigm

In their respective models, McKinnon (1973) and Shaw (1973) argue that financial repression negatively impacts saving, investment and the rate of economic growth. Removal of ceilings on deposits leads to positive real interest rates, an increase in saving (and therefore funds for investment), and economic growth. The essential elements of the McKinnon-Shaw model are: (a) a saving function that responds positively to both the interest rate on deposits and the rate of growth in output; (b) an investment function that responds negatively to the loan rate of interest and positively to the growth rate; (c) an administratively fixed interest rate that is below the equilibrium level; and (d) inefficient non-price rationing of loanable funds. In a financially repressed economy, the average efficiency of investment is reduced as the loan rate ceiling is lowered because investments with lower returns now become profitable, and entrepreneurs who were previously deterred from requesting bank loans decide to enter the market. Low interest rates would also produce a bias in favour of current consumption and against future consumption, and potential lenders may engage in relatively low-yielding direct investment instead of lending by way of depositing money in a bank.

In light of the adverse effects of financial repression, McKinnon and Shaw (1973) argued that raising the interest rate ceiling towards its competitive free-market level would help increase both saving and investment. It would also deter entrepreneurs from undertaking all low-yielding investments that are no longer profitable at the higher rate. Hence the average efficiency and aggregate investment increases. Output growth is increased which leads to further increased saving. The increased quantity and quality of investment then enhance the output growth rate. In a free market without government controls on interest rates, savings will equal investment in equilibrium (at a positive real interest rate). No profitable project would fail to secure credit from financial institutions. According to McKinnon and Shaw, policy prescription for developing countries is that interest rate ceilings should ideally be abolished altogether. Financial repression exerted an adverse impact on saving, investment and the rate of economic growth while financial liberalization positively affected these factors.

2.3.42 The Neo-Keynesian School

In contrast with the McKinnon-Shaw approach, neo-Keynesian and post-Keynesian economists have argued that financial liberalization can reduce effective demand and

economic growth and increase instability in the financial system (Stiglitz, 1994). The post-Keynesian approach contests the view that investment matches saving for a market determined equilibrium interest rate since the investment decision depends on many other factors such as expectation about future demand (i.e. 'animal spirits') and political stability. Saving in the Keynesian tradition is primarily a function of income rather than interest rates. Thus, an increase in saving does not necessarily raise investment. Financial liberalization in the form of interest rate deregulation has two opposing effects in the short-run. First, a rise in deposit rates influences agents to increase deposits and hence, there will be a rise in the supply of loans that reduces the lending rate and boosts investment and economic growth. Second, the increase in saving reduces aggregate demand and results in a decline in profits, saving, investment and output. Uncertainty or a pessimistic view regarding future profits can further worsen the negative impact, resulting in a decline in saving, investment and economic growth.

2.3.43 The McKinnon-Shaw Hypothesis and the Stiglitz Controversy

The McKinnon-Shaw hypothesis states that credit rationing mainly results from a ceiling on interest rates, since these ceilings cause an under-supply of saving which generates an excess demand for credit. This hypothesis predicts that there would be no excess demand if interest rates were allowed to be determined by supply and demand. However, Stiglitz and Weiss (1981) have also showed that under imperfect information (adverse selection and incentive effects), credit-rationing by banks arise from normal competitive operations and not simply due to financial repression[8]. Borrowers differ by a risk parameter θ, which is privately observed. The bank knows only the statistical distribution of θ among the population of potential borrowers. The characteristics of the loan offered by the bank will affect the composition of the population of firms that apply for loans. All firms are assumed to bring the same amount of collateral, which can therefore not be used as a screening device. Being unable to observe θ, banks cannot discriminate among firms and so they offer the same standard debt contract, in which all firms have to repay a fixed

[8] Cho (1986) used this result to show analytically that in order to achieve an efficient resource allocation, credit markets would need to be supplemented by a well-functioning equity market. Unlike bank borrowings, it is assumed that equity finance is not subject to adverse selection and moral hazard effects. Equity market development is then necessary for financial liberalization to be successful.

amount (if they can) or their cash flow will be seized. The expected profit related to the firm's cash flow is further assumed to be an increasing function of θ.

Given this framework, the effect of an increase in interest rates on the banks' expected profit is twofold. One the one hand, it increases the profit the bank makes on any individual loan granted to a given firm θ. On the other hand, since it decreases the expected profit of the firm's cash flow for every θ, it has to increase θ^*, so that the population of firms that demand a loan becomes more risky. Consequently, financial institutions maximizing expected profits usually charge lower than equilibrium rates. Financial institutions therefore attempt to reduce adverse selection and moral hazard problems by avoiding high interest rates and screening out risky borrowers. Hence, a loan market in equilibrium is generally associated with credit rationing.

2.3.44 The Neo-Stucturalist School

In LDCs, formal financial institutions are unlikely to cater for poor borrowers who cannot obtain loans due to their inability to provide the required collateral and to fulfil other formalities. A significant proportion of people living in rural areas may be unable to access the formal banking system and depend on the operation of unorganized money markets (UMMs) (Ghatak, 1975). The Neostructuralist school criticized financial liberalization and deregulation from a macroeconomic point of view. Taylor (1983) and van Wijnbergen (1982, 1983a,b) argued that curb or unorganized money markets play a crucial role in determining whether financial liberalization can accelerate growth or not. If an increase in the real deposit interest rate leads to a shift of assets from the unorganised to the formal credit market, the existence of reserve requirements will lead to a decline in financial intermediation. The neostructuralist models, however, rest on the assumption that unorganised money markets are competitive which may not be the case.

UMMs incorporate all types of 'non-institutional' lenders such as village money lenders, landlords and shopkeepers who supply loans to small borrowers in the rural areas. UMMs can be quite profitable as they usually charge relatively higher interest rates than formal financial institutions. However, the high interest rates and the hoarding of saving in the form of gold or jewellery is indicative of the pressing need for a more efficient financial system which is able to substantially enhance financial savings, human and capital investment, and economic growth.

2.3.5 Justification for the existence of financial intermediaries

In the seminal model by Diamond and Dybvig (1983), banks are considered as "pools of liquidity" or "coalitions of depositors" that provide households with insurance against idiosyncratic liquidity shocks, which are privately observed. A fraction of savers receive shocks after choosing between two investments: an illiquid, high-return project and a liquid, low-return project. Those receiving liquidity shocks want access to their savings before the illiquid project produces. This risk creates incentives for investing in the liquid, low-return projects. Since it is prohibitively costly to verify whether another individual has received a shock or not, it is not possible to write incentive compatible state-contingent insurance contracts. Financial intermediaries – coalitions of agents that combine to provide financial services – can help in this situation to enhance liquidity and reduce liquidity risk. By the law of large numbers, a large coalition of investors will be able to invest in illiquid but more profitable securities, while preserving enough liquidity to satisfy the needs of individual investors.

In the seminal paper by Diamond (1984), a bank arises as the optimal mechanism for channelling funds from investors to firms when costly information asymmetries exist between the investors and project insiders. If firms are able to form coalitions then the cost of capital per firm is a decreasing function of the number of firms in the coalition (size of the intermediary). Assume that there is a fixed cost[9] to acquiring information about a production technology. Without intermediaries, each investor must pay the fixed cost. Instead of each individual acquiring evaluation skills and then conducting evaluations, an intermediary (a bank) can do it for all its members. Economizing on information acquisition costs facilitates the acquisition of information about investment opportunities. This "delegated monitor" arrangement economizes on aggregate monitoring costs because a borrower is monitored only by the intermediary, not all individual savers (Diamond, 1984). Duplicate monitoring is therefore reduced and financial intermediaries foster efficient investment by lowering monitoring costs.

Lenders therefore need to monitor, or verify, the claims of borrowers about project's returns. However, since verification is costly, lenders find it optimal to verify only in a limited set of possible continent states. Typically, the optimal solution to a standard

[9] The argument will not work however when proportional transaction costs are assumed.

costly state verification (CSV) problem, under the assumption that agents are risk neutral and monitoring costs do not depend on project returns, is always a debt contract. In other words, the loan repayment is predetermined and independent of the actual outcome of the investment (Townsend, 1979; Diamond, 1984; Gale and Hellwig, 1985; Williamson, 1986; 1987). The reason for this is that debt, which involves a fixed repayment, does not require costly monitoring providing that the contractual repayment is honoured. This would not be feasible if the loan repayment were a function of the project's return, like in the example of equity, and where monitoring was required in all states.

The presence of information asymmetries can also explain some aspects of corporate financing choices with a higher place set aside for debt rather than equity (Myers and Majluf, 1984). Suppose a firm issues common stock to raise cash to undertake productive investment. Management is assumed to know more about the firm's value than potential investors. Investors interpret the firm's choice rationally. The management acts in the interests of existing shareholders, so if the new investment opportunities are profitable then managers would prefer internal sources of funds and prefer debt to equity, if external financing is required. Managers would refuse to exploit new profitable investment opportunities by using risky securities to finance these projects unless the ability to issue low risk debt had already been used up. However, stockholders are better off *ex ante* when the firm carries sufficient slack to undertake potentially good investment opportunities. This slack can be built up by restricting dividends. If the manager has superior information, the issuance of new stock will reduce stock prices, other things equal, while the issuance of debt will raise the stock price[10]. In the Myers (1984) and Myers and Majluf (1984) "pecking order" model, there is thus no optimal capital structure, but rather a strict ordering or hierarchy of sources of finance. After internal funds have been exhausted, the preference is then for debt, and finally equity finance is tapped as a last resort. Equity will always be dominated by debt[11].

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[10] Conversely, if more bank debt raises the stock price then the firm would be more likely to issue more shares since the cost of equity capital would be lower. A similar mechanism is present in the model by Besanko and Kanatas (1993) where having more bank debt increases the stock price.

[11] According to this reasoning the optimal strategy would be one that minimizes the amount of equity capital. The recent global financial crisis of 2007-08 however has challenged this view which sees debt as being relatively cheap and equity capital expensive. As the Modigliani-Miller theorem formally shows, there will be a link between the cost of debt and the amount of equity in a firm. Having more equity could make debt safer and also cheaper. The apparent extra cost of raising equity may therefore be offset by the benefits it brings in terms of a lower cost of debt.

2.4 The New Growth Theory incorporating a financial sector

2.4.1 The Pagano (1993a) overview

The co-evolutionary perspective between the real and financial sector has recently been stressed again by exponents of the new growth theory. Pagano (1993a) argues that overall financial development (banks and stock markets) affects economic growth via three paths: channelling more savings to investment, raising the marginal productivity of capital, and encouraging a higher level of saving. *In the context of Bangladesh, the policy implication is that a larger, more efficient financial sector enhances growth.*

Pagano begins with the 'AK' model, with aggregate output Y being a linear function of aggregate capital stock, K.

$$Y_t = AK_t \tag{2.4.1}$$

where A stands for the marginal productivity of capital K, which can be thought of as a combination of physical and human capital.

Gross investment in capital depreciates at a constant rate per period.

$$I_t = K_{t+1} - (1-\delta)K_t \tag{2.4.2}$$

Equilibrium requires that gross saving S equals investment I in any period. However, a proportion of the flow of saving is 'lost' in the process of financial intermediation, since part of the saving is needed to organize the process of intermediation:

$$\phi S_t = I_t \tag{2.4.3}$$

The growth rate of the described economy can be expressed as:

$$g_{t+1} = Y_{t+1}/Y_t - 1 = K_{t+1}/K_t - 1 \tag{2.4.4}$$

which, after dropping the time indices and using equations (2.4.1), (2.4.2), and (2.4.3), can be used to give the steady state growth rate:

$$g = A(\phi)s - \delta \tag{2.4.5}$$

Equation (2.4.5) is used to explain how financial development can affect growth in the endogenous growth theory framework. First, it can raise the overall ϕ, which means that less money is 'lost' in the financial sector due to an increase in efficiency in the intermediation process. Second, it may increase the productivity of capital, A, through various channels. Particularly, financial institutions are supposed to screen and monitor investment projects and reallocate risk among economic agents and by that increase overall capital productivity as they help to funnel savings to the most productive investment projects. Third, financial development may influence the saving rate s (S/Y).

2.4.2 The Greenwood and Smith (1997) model: a first look

Greenwood and Smith (1997) embed the Diamond-Dybvig financial intermediation model in an overlapping-generations model with production and capital accumulation. With the introduction of banks, individuals can hold deposits which banks then invest in currency and capital. By exploiting the law of large numbers, banks ensure that they never have to liquidate capital prematurely. Banks also rely on the law of large numbers to estimate deposit withdrawals which are unpredictable individually but predictable for the economy as a whole. Hence, banks avoid the uncertainty which leads to resource misallocation by individuals. By ensuring that capital is never wasted, financial intermediation may produce higher rates of economic growth. By engaging in maturity intermediation, financial institutions offer liquidity to savers and, at the same time, long-term funds to investors. In so doing, they stimulate productive investment by persuading savers to switch from relatively unproductive investment in tangible assets to more productive investment projects in firms. In this framework, equity markets are shown to further enhance economic growth in addition to banks. The greater provision of liquidity by both banks and equity markets works to limit the exposure of savers to idiosyncratic risks, and prevents the costly premature liquidation of long-term capital investment.

2.5 Determinants of Bank Development

2.5.1 The Harrison, Sussman and Zeira (2004) model: a first look

To explain the existence of banks, economies of scope must exist between deposit and credit activities. One possible explanation for this process is found in the location model literature, in which agents are geographically dispersed and face transportation costs. In

this setup it is efficient for the same bank branch to offer deposit and credit services in a single location. The model by Harrison, Sussman and Zeira (2004) or HSZ is a variant of a location model which we believe highlights an important chain in the finance-growth nexus: the growth-to-finance effect. On the one hand, economic growth has a 'deepening' effect, which tends to decrease the cost of financial intermediation. On the other hand, economic growth raises labour costs, thus increasing the cost of financial intermediation.

The framework of HSZ (2004) involves costly state verification (Townsend, 1979; Gale and Hellwig, 1985), banks as delegated monitors (Diamond, 1984), and spatial competition (Salop, 1979). Monitoring costs are increasing with the distance between the bank and the borrowing firm. In equilibrium banks are regionally specialized on a certain segment of the market. When the economy grows, banks profit and new entry into the industry is promoted. The average distance between a bank and a borrowing firm falls, which decreases the cost of financial intermediation[12]. The authors refer to this as the *deepening* or he *specialization effect*. There is also another effect which operates in the opposite direction. Monitoring is intensive in labour input, and economic growth raises wages which will tend to increase the cost of financial intermediation. This is the *wage effect*. Resolution of which effect dominates is established through empirical analysis; even so, in the case of a developing country in particular we would expect that the cost of financial intermediation will tend to fall with economic growth.

2.6 Determinants of Stock Market Development 1

2.6.1 The role of economic growth for the stock market

In this section we review two models that describe how a stock market develops along the growth path of an economy. These are the models by Boyd and Smith (1998) and Blackburn, Bose and Capasso (2005). The focus of this literature is on the role of the underlying financial contracts of debt and equity after assuming various asymmetrical information problems. The main result is to explain the emergence of a stock market by analysing how capital accumulation affects firms' optimal financing choice and, in turn, how firms' corporate financing decisions affect investments and capital accumulation.

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[12] In order to apply the model to Bangladesh, we assume that this decreased cost of financial intermediation (due to higher economic growth) allows banks to advance more credit, which they then decide to do. The lower cost of intermediation is then accompanied by a higher volume of funds to the private sector.

2.6.11 The Boyd and Smith (1998) and Blackburn et al. (2005) models

In Boyd and Smith (1998) producers of capital choose between two different types of technology that are financed in two different ways. The first type of technology is one that yields a relatively low expected return, is publicly observable and is financed by means of equity at no expense. The second type of technology is one that yields a relatively high expected return, is not directly observable by lenders and is financed by means of debt subject to a standard costly state verification (CSV) problem. The expected return on the former technology exceeds that on the latter (gross of verification costs), so agents undertaking capital investments face a trade-off. The technology with the unobservable return is (on average) more productive, but is also subject to a CSV problem. The less productive project can therefore be used to reduce verification costs. State verification costs are born in the form of final goods and services. Therefore as an economy moves along a growth path and accumulates capital, the *relative* price of capital will fall. Since investment projects produce capital while state verification consumes final goods and services, the implication is that investors will see *relative* monitoring costs that rise as an economy develops[13]. As a consequence, under weak conditions investors will tend to employ the observable return capital production technology more and more intensively as an economy grows. Since the use of the observable return technology is associated with equity issues, it will therefore be the case that economic growth is accompanied by an increased volume of equity market activity, and a falling (aggregate) debt-equity ratio[14]. In an economy of this type, equity market activity will not occur at all for fully endogenous reasons – until the economy attains a critical level of development. Debt and equity markets become complementary as economies increasingly develop.

In Blackburn, Bose and Capasso (2005) equity contracts emerge as the result of lenders' attempts to solve multiple enforcement problems when a firm's choice of investment project and level of effort devoted to that project are private information. The lender, who has the task of designing the optimal financial contract, cannot directly control the firm's effort; however, he or she has the option to either impose his or her own choice of project at a cost, or leave this choice up to the borrower. When the lender chooses the project, the optimal financial contract is a typical debt contract. When the firm chooses the project, the optimal financial contract is a mixture of debt and equity. The reason for this is that

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[13] Development for instance may be associated with increasingly complex production processes, so that monitoring costs increase as an economy grows.

[14] Theoretically the debt-equity ratio can either increase or decrease. See BS (1998) for more details.

when the choice of project is imposed by the lender, a fixed repayment (debt contract) is sufficient to induce the optimal level of effort by the firm. By contrast, when the choice of project is left up to the borrower, a fixed repayment is not enough to induce the best effort level, nor the best choice of project: in this case, part of the payment must be a function of the actual return (equity payment) in order to induce the borrower to exert the optimal effort level. At low levels of capital, it pays a lender to forego some labour income and take control over the choice of the project because the amount of income foregone is low due to low levels of wages. The lender then needs to concern herself only with a firm's choice of effort which she contends with by offering a pure debt contract. At some critical level of capital and beyond, however, the cost is so high as to make it profitable for a lender to cede project choice to the firm, using all of her labour to produce output and offering a mixed debt-equity contract. Nevertheless, an equity market might never appear if the economy reaches a steady state before the switch in the financial system occurs.

2.6.12 Possible extensions of BS (1998) and BBC (2005)

In the last footnote of their paper, BBC (2005) highlight the principal deficiency of the model: the assumption of one and only one critical level of income threshold after which the stock market can emerge:

> "The abrupt nature of this transition has been instilled deliberately into the model as a means of focusing and simplifying the analysis. In principle, the model could be extended (e.g. by introducing heterogeneity among entrepreneurs) to allow for a smoother process of transition and a more gradual increase in stock market trading. [2005: p. 149]

Therefore the analysis can be strengthened if different size firms are considered. Such an extension is also suggested by BS (1998), again at the very end of their paper:

> "Another possible extension would be to allow for more ex ante heterogeneity among investors. Some empirical evidence suggests that while less developed economies in the aggregate have less active equity markets than do more developed economies, large firms in LDCs often make more use of equity markets than do their counterparts in the developed world (Singh and Hamid, 1992). It would be interesting to investigate why this is the case". [1998: p. 557]

In the context of developing countries such extensions could provide additional insights into the finance-growth nexus and the operation of banks and equity markets.

2.7 Determinants of Stock Market Development 2

2.7.1 The Besanko and Kanatas (1993) model: A first look

The coexistence of banks and stock markets is justified by Besanko and Kanatas (1993) Firms present a moral hazard problem which is partially solved by the monitoring services performed by the banks. But a bank must be provided with the correct incentives to monitor its borrowers, and this occurs only when the bank has a sufficient stake in the firm. Once the bank lends to a firm and has incentives to monitor it, the firm can attempt to list on the stock market and thereby obtain equity financing, so the stock market essentially gets a free ride on the bank's monitoring services. The probability of success of the investment by the firm depends on the effort of entrepreneurs, which is not directly observable: this is the source of the moral hazard problem. However, banks can influence the entrepreneur's effort through monitoring activities, the cost of which increases with the effort level that is required from the entrepreneurs. The equilibrium that is obtained is characterized by the fact that each firm combines direct lending and intermediated lending. Also, there is always a positive amount of monitoring, since it is not possible to reach the first best effort level. Finally, substituting bank financing for direct financing will increase the firm's stock price[15].

2.8 A critique of stock market efficiency

The case on behalf of stock markets in developing countries often originates from arguments regarding their 'efficiency'. According to the efficient markets approach, a well-functioning stock market correctly evaluates firms according to their 'fundamentals' – i.e., their potential profitability. Stock markets are argued to play an important role in aggregating and conveying information through price signals. Even in small, emerging stock markets, efficient stock prices and dividend yields provide benchmarks against which the cost of capital for and returns on investment projects can be judged, even if such projects are not financed through the stock market (Green, Maggioni and Murinde, 2000). An efficient pricing process will reward the well-managed and profitable firms by valuing their shares more highly than those of unsuccessful and unprofitable firms. This

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[15] Thus 'excessive' bank development may even increase stock prices and this will make it more desirable for firms to list on the stock exchange since the relative cost of equity finance has fallen. The number of listed companies therefore will tend to rise in line with the expansion in bank size and activity.

mechanism lowers the cost of capital and hence ensures a greater allocation of new investment resources and in aggregate will enhance economic growth.

Fama (1970) defined 'efficient markets' as existing when trading systems based on available information fail to produce profits in excess of the market's overall rate of return. Fama reported three different sets of tests of market efficiency: the weak form in which price behaviour contains no information useful for predicting future prices behaviour; the semi-strong form in which public information has already been incorporated into prices; and the strong firm in which all information, including insider information, has been incorporated in prices.

The obsession economists have for frequently assessing whether markets are efficient is not a very useful tool for guiding policy makers in developing countries. Auerbach and Siddiki (2004) criticize the approach for classifying the markets according to such a narrow notion of efficiency:

> Since the semi-strong form of efficiency asks whether a market is efficient *given* the state of publicly available information, it may well be that, in this sense, the financial markets in the coffee houses of seventeenth century Britain were 'efficient' then, and that they are efficient today as well. The question begged, in this context, is how the expansion in the quantity and quality of publicly available information have changed the working of the capital market, moving it perhaps closer in the direction of 'perfection', if we evaluate financial markets in static terms (2004: p. 236).

Instead, arguments relating to the supposed efficiency of financial markets would be better addressed along with arguments over appropriate financial structures or suitable competitive arrangements. The method by which the financial system is operating given its constituent components, the extent of asymmetric information and transaction costs, and the two-way connection between finance and the real economy largely determines whether or not the financial market is 'efficient'.

2.8.1 The Granger and Morgenstern (1970) critique of stock markets

Granger and Morgenstern (1970) was an early contribution which supported the view that the random walk characterized well the behaviour of stock prices. These authors were highly critical of the stock market's ability to determine 'intrinsic value'. A stock or share is supposed to represent a claim against the corporation, its profits and dividends or in

other words the corporation's net assets. This calculation would then determine an inner or intrinsic value. However, while this "claim" is a legal one, economically it is quite a different matter. The liquidation of a firm would give results quite different from those obtained by multiplying the number of shares outstanding with a price. Even if the liquidation proceeds should reveal a "true" value this would be of no significance in setting a price per share since the latter applies to an operating entity. The claim is made even more fictitious by the fact that the vast majority of shareholders have only indirect influence on operations in the corporation and cannot possibly hope to make their legal claim economically effective.

The authors were critical of the trading process as being indicative of supply and demand laws. Generally only a small percentage of total existing stocks in any corporation is traded at any given time. Yet the current valuation of the much larger number of shares not traded will be based upon the prices at which the few actually trade. Such a valuation is highly tenuous. If owners of very many shares decided to sell at the current market quotations, the increased supply would depress the price, thereby reducing the market value of all the outstanding shares. In this way, the market for shares operates entirely differently to the market for any produced good or service. Granger and Morgenstern therefore argued that market capitalization was hardly a convincing valuation and that is was a poor indicator of intrinsic value. In fact, the method for calculating market capitalization itself was flawed and "quite meaningless" (1970: p.10). Interestingly our graph in Chapter 3, figure 3.10 of adjusted market capitalization (which divides through by the stock index) appears to show an upward trend for the Dhaka Stock Exchange. Even though Granger and Morgenstern (1970) have stated that we are likely to expect random variations in the stock price, they also mention the possibility that longer-period time trends could be observed. These trends may in some cases prove to be potentially useful for corporations wishing to raise new capital. Thus while the authors maintain that prices obeyed the probabilistic features of the random walk model, the random walk could be superimposed on possible long term trends. Attempts made by the authors to remove the trends in the data revealed that there remained some extra power in low frequencies indicating the existence of weak, very long term cycles. This suggests that

even with the presence of random fluctuations in the stock market, companies may still benefit if they can time their offerings of new and existing stock to investors[16].

Stock markets are viewed by Granger and Morgenstern to represent a mechanism which generates prices obeying a random walk, having strong similarities with a gambling casino. This fact makes it hard to subscribe to the idea that the stock market assures the "optimal" allocation of investment funds. However, there is one important difference noted by the authors: when a company floats *new stock*, which it does through the primary market, the initial proceeds will in all probability be used in production. When new funds are brought by the players to the casino, it is not known in which direction the gains made by winning players will eventually go. Granger and Morgenstern therefore seem to argue a case for viewing the *number of listed companies* on the Stock Exchange as the most appropriate measure of the contribution of the stock market to economic growth, instead of measures such as market capitalization[17]. They were highly critical of secondary market activity indicators due to the fact that prices were randomly influenced.

2.8.2 The Singh (1997) critique of stock markets

Singh (1997) considers the issue of stock market development in developing countries and concludes that stock markets cannot be expected to enhance long-term growth in developing countries; more emphasis should be placed on promoting group-banking style models such as those in Germany and Japan. Singh argues that problems can arise from asymmetric information between corporate management and investors about project returns. As Myers and Majluf (1984) showed, in these circumstances, rational managers will adopt the 'pecking order' pattern of finance – preferring retained earnings to debt and only as a last resort tapping the equity market to raise finance for their investment

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[16] This view is similar to the 'window of opportunity' hypothesis proposed in the literature for the timing of IPOs by firms. The explanation there however is quite different to the proposition made in Granger and Morgenstern. In the IPO under-pricing and performance literature (see Ritter, 1991; Ritter and Welch, 2002) it is theorized that investors may not be rational and that they are perhaps excessively optimistic.

[17] Market capitalization is calculated as $M = KV$ where K is the total number of companies listed and V is the valuation (arrived at by some method) of all these companies. Granger and Morgenstern would argue that this valuation process is subject to so many influences that market capitalization eventually bears little relationship to economic reality. The number of companies K may however be less impacted by the adverse features of the pricing mechanism. In Chapter 3, our graph of the re-weighted market capitalization series for the DSE (figure 3.10) could be interpreted as $(M/V) = K$. This 'purged' measure of market capitalization is more closely related to the growth enhancing feature of primary stock market development. This makes a strong case for using the number of listed companies (and also the total number of listed shares) as the main indicator for the contribution of the stock market to economic growth.

needs[18]. Thus, Singh says that it is likely that firms under asymmetric information can just as likely be equity-rationed as they can be credit-rationed, and therefore that the addition of a well-functioning stock market in the financial sector cannot therefore be expected to lead to an improvement in the allocation of resources in the real economy.

Singh also argues that the young firms listed will not have enough records for their reputations to be accurately assessed. This will lead to a noisy stock market environment, with arbitrary pricing and considerable volatility. The volatility and arbitrariness of the stock market pricing process under developing country conditions make it a poor guide to efficient investment allocation. Finally, stock market development is likely to undermine the existing group-banking systems in developing countries. Singh is therefore highly critical of the stock market's potential for economic development. In his opinion, they are unlikely to help in achieving faster long-term economic growth in most developing countries and developing countries would be better off reforming and expanding their group-banking systems rather than establishing stock markets[19].

There are a number of criticisms in response to Singh's assessment. For instance, Singh ignores completely the complementary nature of debt and equity finance. He uses the result in Myers and Majluf (1984) to promote the 'pecking order' view of finance: firms prefer retained earnings to debt and only use equity as a last resort. Besanko and Kanatas (1993) in contrast is a complementary view of banks and stock markets, while Boyd and Smith (1998) and Blackburn et al. (2005) extend the complementarity feature in a growth framework. Singh argues the young listed firms on the stock market will not have enough records for their reputations to be accurately assessed. While this may be true, for large firms this point is mostly inconsequential. Large firms can be more immune to a noisy stock market environment because their reputation is more easily verifiable. The argument of excessively high volatility on even developed stock markets though is persuasive. In emerging markets, volatility is typically very high and this often results in a 'noisy' environment. Even allowing for this point, we can still be in favour of stock market development so long as companies consider the primary market to be a

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[18] However Myer's pecking order theory of financing may break down for the riskiest firms since banks will not be willing to finance their projects. In that case, the riskiest firms may be constrained to issue equity because investors are willing to invest in their firms only if they get an equity stake so that they share the upside when the firm succeeds.

[19] The drawbacks of universal banking are that it may retard financial innovation and financial market development, which can lead to non-competitive outcomes (Boot and Thakor, 1998).

complement to bank loans. Furthermore, we can even take this position while still agreeing with the unique features of bank services (see Fama, 1980, 1985; Besanko and Kanatas, 1993) as well as the predominance of banks in developing countries (Fry, 1995).

Singh also criticizes what he sees as the 'instant' liquidity on stock exchanges (Singh, 1997, p. 775; see also Bhide, 1993). Singh follows in the tradition of Keynes who laid much of the blame for stock market instability at the feet of easy liquidity provision:

> This is the inevitable result of investment markets organized with a view to so-called 'liquidity'. Of the maxims of orthodox finance none, surely, is more anti-social than the fetish of liquidity, the doctrine that it is a positive virtue on the part of investment institutions to concentrate their resources upon the holding of 'liquid' securities. It forgets that there is no such thing as liquidity of investment for the community as a whole (1936: p. 155).

Keynes is often interpreted as regarding stock markets as simply gambling casinos due to their speculative nature:

> Speculators may do no harm as bubbles on a steady steam of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes the by-product of the activities of a casino, the job is likely to be ill-done (1936, p. 159).

But a dilemma now becomes apparent: while the liquidity of investment sometimes impedes the course of new investment it often also facilitates it. The thought that their commitment is liquid tends to calm the nerves of the individual investor and he or she is then willing to accept the risk. If individual purchases of investments were illiquid, new investment would likely be severely impeded as long as the individual had alternative ways of holding his savings. As long as individuals can employ their wealth by either holding or lending money, they will not be very interested in purchasing actual assets unless they know that those assets can quickly be sold in organized markets (Keynes 1936, p. 160). The model by Greenwood and Smith (1997) also shows that enhanced liquidity services provided by both the banks and the stock market will result in a higher rate of economic growth. Liquidity would seem to be a weak argument with which to attack stock market development[20].

[20] An interesting model in this regard is by Diamond (1997). Banks lower the cost of obtaining rapid access to capital and they improve the liquidity of financial markets. Increasing participation in financial markets however reduces the size of the banking sector.

One point in which we are in broad agreement with Singh is the arbitrary nature of stock market pricing. Stock prices are a largely poor guide for investment allocation. This is because of their random nature, whereby prices are influenced by countless factors that lie outside the production and management decisions of a company. But excessive volatility is more of a secondary market phenomenon that should be considered separately to the operation of the primary market. If it is the primary market which is mainly important, then the focus should instead be on the number of listed companies on the stock exchange. However, one may correct for the arbitrariness in stock pricing on the secondary market to some degree by dividing market capitalization by the aggregate stock index. Such a method can help to purge the forward looking aspect of the stock price, thereby giving a better overall assessment of financial market development.

2.9 The Functional View of Finance

While the theoretical literature has provided many arguments on the relative advantages of bank-based and market-based financial system, the functional view (Levine, 1997; Merton and Bodie, 1995) argues that it is the overall level of financial development which is important rather than the specific composition of the financial system. The financial services view is a functional approach, focusing on ways to overcome informational and transaction frictions. It considers the institutional question of who provides these services of secondary importance.

2.9.1 Levine (1997): the functional approach to finance and growth

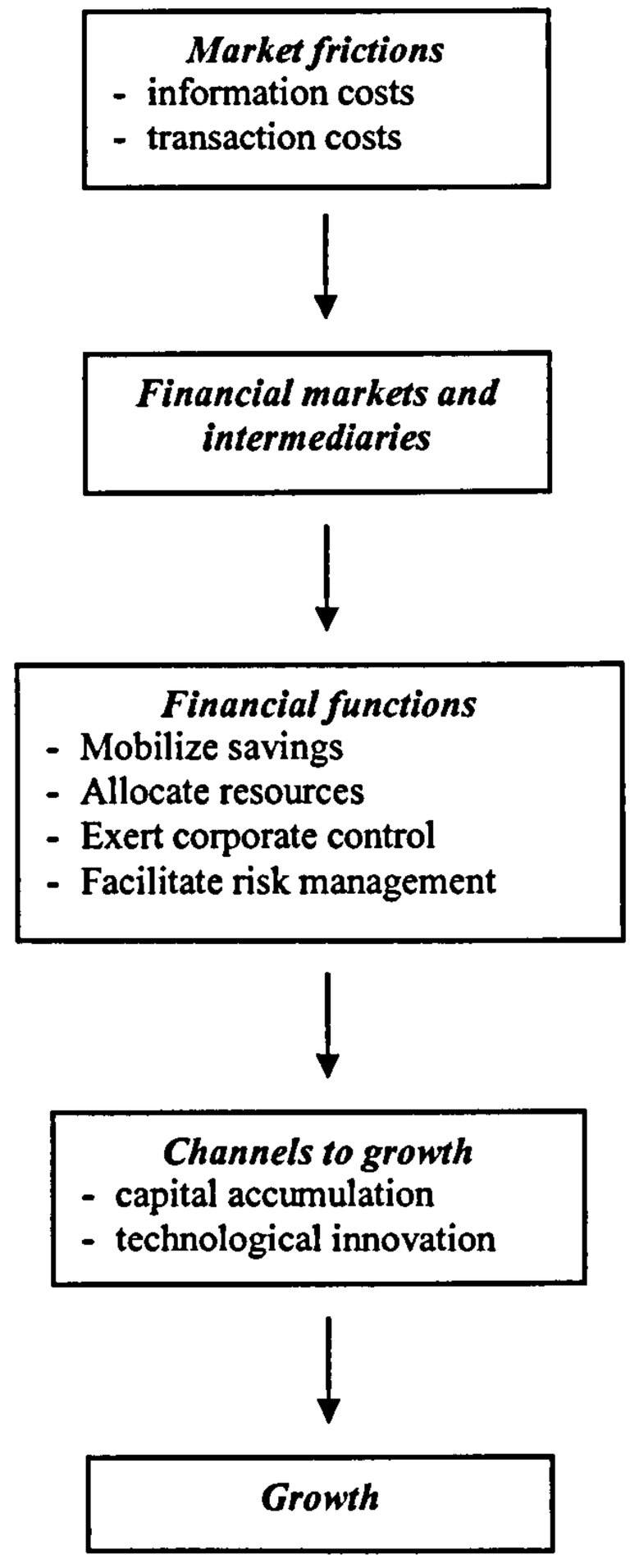
In what has now become a key survey on the topic, Levine (1997) states that:

> "...a satisfactory understanding of the factors underlying economic growth requires a greater understanding of the evolution and structure of financial systems," (p. 690).

Levine, along with other authors, has been an advocate of the functional approach to understanding the role of financial systems in economic growth. This approach focuses on the ties between growth and the quality of the functions provided by the financial system. Specifically, financial systems help to: *facilitate the trading, hedging, diversifying, and pooling of risk, allocate resources, monitor managers and exert corporate control, mobilize savings, and facilitate the exchange of goods and services.*

Figure 2.1

A Theoretical Approach to Finance and Growth (Levine, 1997)



The functional view (also known as the financial services view) – as articulated by Merton and Bodie (1995) and Levine (1997) – minimizes the importance of the bank-based versus market-based debate[21]. It stresses that financial arrangements – contracts, markets, and intermediaries – arise to ameliorate market imperfections and provide financial services: to assess potential investment opportunities, exert corporate control, facilitate risk management, enhance liquidity, and ease savings mobilization. By providing these financial services more or less effectively, different financial systems

[21] See also Demirguc-Kunt and Levine (2001) and Beck and Levine (2004).

promote economic growth to a greater or lesser degree. According to this view, the main issue is not banks or markets, but how to create an environment in which intermediaries and markets provide sound financial services. The main message of this literature therefore is that financial development matters for economic growth, but financial structure does not. From a policy perspective, the need to ensure an environment that is conducive to financial sector development is crucial for the functional approach. In applying the functional approach to Bangladesh, it is overall financial development and an overall supporting framework of laws and regulations which is the key to growth.

2.9.2 A critique of the functional approach

In advocating the functional approach to financial development, Levine (1997) avoids being specific about which type of institution is best placed to provide the growth promoting functions of the financial sector. According to Levine, this is a matter of ongoing research:

> "....we do not have adequate theories of why different financial structures emerge or why financial structures change.... we need models that elucidate the conditions, if any, under which different financial structures are better at mitigating information and transaction costs." (p. 703)

That the financial structure must evolve with financial development has been noted by Levine (1997), and in the above passage he states that this gap needs to be addressed. While these gaps in our knowledge have been highlighted, a number of authors in the literature seem keen to triumph the superiority of various forms of financial system based on their structure, i.e. whether they are 'market-based' or 'bank-based'. This trend is in contrast to the flexible position put forward by the original pioneers of the functional approach for finance[22]. What we observe is that the possibility of interactions within the financial sector has not been adequately dealt with by the functional approach to finance. This leads us to consider a *modified functional approach.*

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[22] See also Chakraborty and Ray (2006), Tadesse (2002), and Deidda and Fattouh (2008) for models where bank-based system might outperform a market-based one. Financial structure could also rely on the wealth distribution (Chakraborty and Ray, 2007). Deidda and Fattouh (2008) provide a model which shows how the interaction between banks and stock markets can be detrimental to growth. The authors' empirical findings still confirm the result that both bank and stock market variables are positive and significant in the growth regressions, but the size of the bank coefficient becomes smaller once the 'interaction' term is incorporated. Interestingly our findings in Chapter 6 seem to suggest the opposite: both banks and stock markets have to be included in the regressions to obtain the finance-to-growth effect.

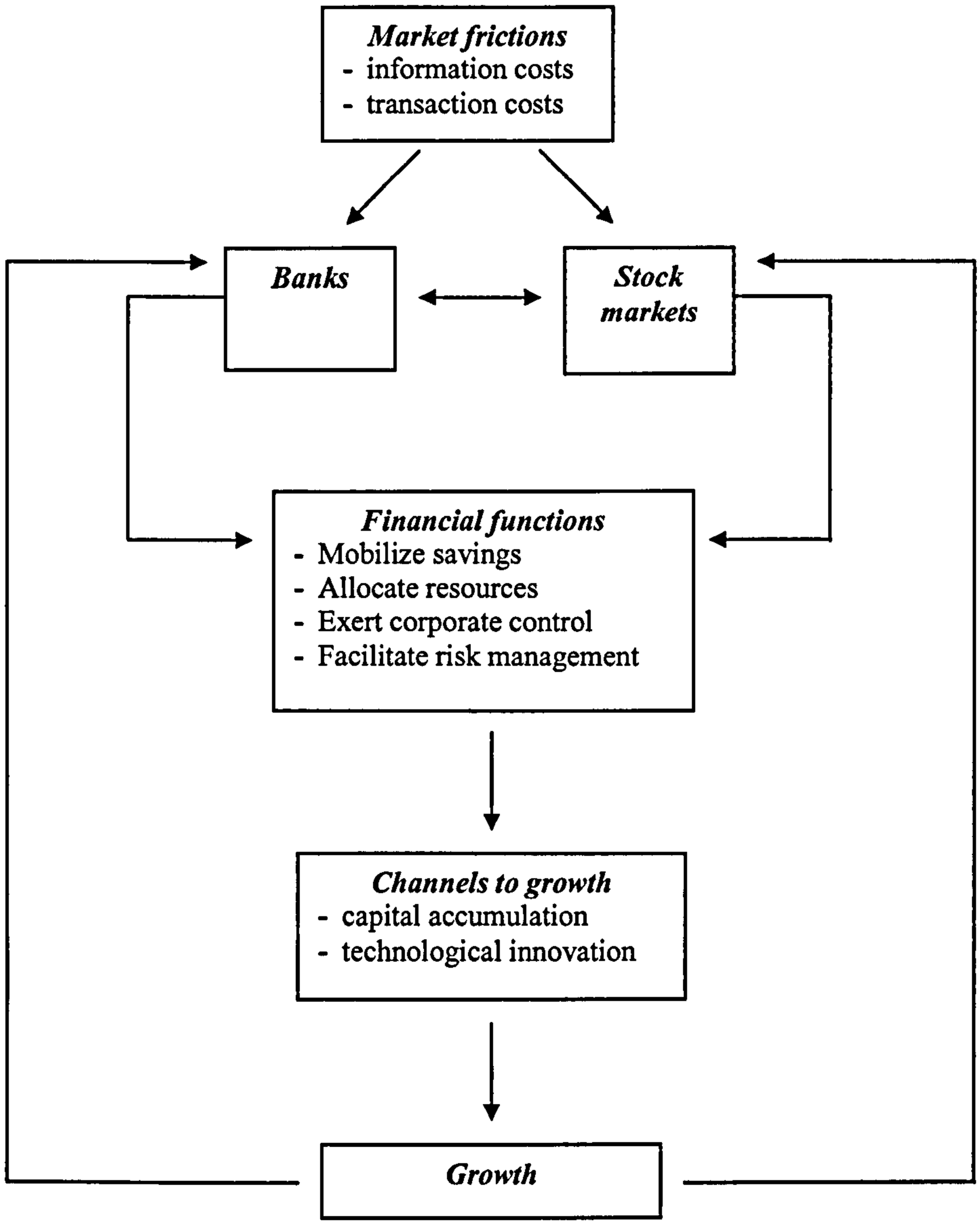
2.10 The modified functional view

This modified approach attempts to incorporate in greater detail the interactions behaviour between banks, stock markets, and the growth process. It is otherwise largely in the same spirit as that of the functional approach to finance and growth. However, the message with regards to policy prescription in the case of the functional approach is no longer the same. The main message given in the functional approach is that financial structure – the mixture of financial markets and intermediaries – is not important for explaining differential growth rates across countries: it is a more efficient overall financial system that is supportive of growth. There would thus be no reason to specifically prefer one form of financial structure over another, i.e. to argue that bank-based systems are superior over market-based systems and vice versa. According to the functional approach what matters are factors such as a sound legal system and regulatory framework for protecting investors. One should therefore use policy to strengthen the overall supporting environment within which finance operates.

The main implication of the modified functional view is that, in the presence of a dynamic financial structure, policy may be tailored differently depending on the specific features of either banks or stock markets as well as across the whole financial sector. The functional approach only suggests the need for having a supportive framework of laws and institutions in place and improving the overall financial and regulatory environment. But if there are now assumed to be interactions between banks, stock markets, and the growth process then financial structure (the combination of debt and equity markets in development) could matter for economic growth. Figure 2.2 below shows the modified framework for the enriched analysis on the finance-growth relationship.

Figure 2.2

A Modified Functional Approach to Finance and Growth



2.11 Is the stock market relevant only for top-tier companies?

Any 'intimate' nature of firm-bank relationships, while perhaps conducive in the sense that firms may be more likely to reveal information as it will not immediately be made public, may encourage a culture of secrecy. This is a particular problem in poor countries like Bangladesh, where a heavy concentration of financial activities can occur between a

few connected individuals in the capital city Dhaka. On the other hand, while stock markets play a role in promoting a culture of information and disclosure, the danger there is that they tend to focus on the largest and most sophisticated firms and sectors of the economy, at the expense of others. The criticism here might be that stock markets are perhaps only relevant for the select few companies rather than for the greater number of companies that are seeking to secure finance or to use the services of the financial sector. Consider then if the most important aspect of the benefits of stock market activity in Bangladesh were indeed limited to the top tier of companies. In an institutional environment like Bangladesh, a significant problem is the lack of information disclosure by firms. The stock market in this context might allow for greater disclosure of information, since when a company wishes to list new shares to the public it must submit its records and future plans for scrutiny. The usual moral hazard problem arises – company management might not wish for this kind of openness because the possibility now exists that their poor performance or corruptive behaviour would then be discovered. Another cause for concern could be information leakage to rivals. The implication of this in the Bangladesh context is that legislation forcing *all* companies (presumably with broader disclosure for listed companies) to reveal information is necessary to create a culture of disclosure which, to some extent, will now 'trickle down' to smaller enterprises. Hence the need for some level of stock market development in Bangladesh.

It is a powerful argument. Banks together with the stock market enhance and enrich the information flow, which should then lead to acceleration in the rate of growth (via enhanced liquidity). If instead the emphasis for policy was only on banks, or at the other extreme more focused on markets, then given the overall institutional weakness in Bangladesh we might fail to realize the highest growth-enhancing effect for the economy.

2.12 Determinants of Stock Market Infrastructure I:

The listing – trading relationship

In this section we take a look at various models which argue in some way for a '*trading-listing*' relationship on the stock exchange. The basic mechanism at work is that the amount of trading or market liquidity on the stock market is related to the number of companies that list on the stock market. The main conclusion of the review here is that it

shows how a stock market can evolve somewhat separately to the growth process, as in Harrison et al. (2004) (see also Boyd and Smith (1998) and Blackburn et al. (2005), and the bank development process as in Besanko and Kanatas (1993). In other words, the stock market is also able to respond and develop according to its own infrastructure.

In Subrahmanyam and Titman (1999), if the stock market consists of a relatively small number of firms the information conveyed in the public markets is less accurate, which generally decreases the advantage of being publicly financed. As the stock market grows, the information conveyed by stock prices generally improves, which, in turn, increases the incentive for private firms to go public. By going public, firms generate positive externalities by increasing the size, liquidity, and informational efficiency of the stock market. When the influence of 'serendipitous information' on production choices is strong enough, these additional active investors improve the capital allocation process. As more individuals become active investors, market liquidity is further enhanced. A snow-balling effect is then created whereby more firms then find it in their interest to go public, which in turn makes markets more liquid and efficient, which then makes it again more attractive for additional firms to go public. Policies that reduce barriers associated with becoming active investors and lowering information costs can therefore move the economy from a "bad" to a "good" equilibrium.

In Chemmanur and Fulghieri (1999), insiders have private information about firm value and outsiders can produce information about firm value at a cost. If a firm raises capital by going public it faces duplication in outsiders' information production costs which ultimately must be borne by the firm through a lower share price (the share price is observable by outsider investors who also use it in order to make inferences), since it needs to convince a number of investors that the firm's projects are worth investing in[23]. This has the advantage that each investor, with only a small stake in the firm, is fully diversified and has almost no bargaining power relative to the entrepreneur. Additionally many unsophisticated investors can "free-ride" from the information contained in the stock price when the firm goes public. In contrast, if the firm raises capital privately there is no duplication in information production because a large investor contributes the

[23] The model by Chemmanur and Fulghieri (1999) is a single firm model. It makes no allowance for the possibility that *multiple* firms may wish to list e.g. that there may be diversification/liquidity motives. This is exactly why we believe Pagano's (1993b) diversification story (as a multiple firm model) is relevant.

entire capital required after evaluating the entrepreneur's firm only once. However, the provider of private financing (a "venture capitalist") will then charge a risk premium over his or her cost of funds due to their undiversified position in the firm. The resolution of this trade-off depends on the magnitude of outsiders' information production costs: firms with longer track records will have lower costs of information acquisition for outsiders. Therefore in equilibrium, firms go public only when a sufficient amount of information about them has accumulated in the public domain (so that the costs to outsiders of assessing firm value becomes small enough); younger firms entail a greater information acquisition cost, so they would instead choose the venture capitalist in equilibrium[24].

One criticism that can be made against the models of Subrahmanyam and Titman (1999) and Chemmanur and Fulghieri (1999) is that they place too much emphasis on the stock price, whereas the stock price in reality underlies a more complicated process. Simply looking only at the stock price (and doing little else) does not convey enough useful information to agents. Aspects *relating* to the stock price – and especially when treated in a market microstructure context – could however prove to be informative. See for instance the mixture of distributions (MDH) inspired approach of Lamoureux and Lastrapes (1990) and Suominen (2001).

2.12.1 The Pagano (1993b) model: a first look

The model by Pagano (1993b) sheds more light on stock market infrastructure. The stock market is shown to be able to develop of its own accord, rather than just be tied to the bank-stock market effect or just tied to the growth process as in Boyd and Smith (1998) and Blackburn et al. (2005).

In Pagano (1993b), the decision made by one firm to list on the stock exchange can then lead to more firms deciding to list. This encourages more trading by investors who would now have more opportunities to diversify their portfolio of shares. More trading by investors is then shown to lead to the higher equilibrium number of firms who do in fact list their shares on the stock exchange. The existence of liquidity externalities in the stock

[24] An interesting suggestion is to incorporate the main insights of Chemmanur and Fulghieri (1999) into the Pagano (1993b) diversification story. This would enable both older (and larger) firms as well as newer (and younger) firms to approach the stock exchange for listings.

market means that a single entrepreneur's decision to float his company's shares increases the risk sharing opportunities for others entrepreneurs in the market. The flotation decision (i.e., whether or not to list shares on the stock market) is then positively correlated across entrepreneurs since other entrepreneurs can only diversify their portfolios if they also go public on the stock market themselves. If trading shares is initially costly, then entrepreneurs lack liquidity and so they require a certain number of public issues to be listed in order that a sufficient number of investors are attracted to the market and that trading in shares then becomes viable. When this 'critical threshold' is reached, a relationship between trading shares and the number of firms who list on the stock market will emerge. In the presence of capital market imperfections, therefore, the very fact that a company goes public can raise the demand for other companies' shares, and thus induce other unlisted companies to go public. This strategic complementarity creates the potential for multiple equilibria on the stock exchange.

2.13 Determinants of Stock Market Infrastructure II

The volume – volatility relationship

The objective of this section is to motivate a discussion of the '*volume - volatility*' relationship as well as the '*trading - stock return*' relationship. These relationships are argued to form another important component of the stock market infrastructure in Bangladesh. Identification of these various relationships improves knowledge of the infrastructure of the stock market. The more we empirically observe theoretical predictions on the stock exchange, the more we can be sure that the stock market is able to support the environment necessary for trading and listing shares in Bangladesh.

Two models are particularly helpful in understanding price and trading dynamics on the stock exchange. The Lamoureux and Lastrapes (1990) model describes GARCH effects (conditional volatility) in terms of information arrivals to the market. The Suominen (2001) model develops a microstructure framework which can further derive a causal relationship between stock returns and trading volume in addition to a closed-form expression for the conditional variance.

2.13.1 The Lamoureux and Lastrapes (1990) model: a first look

In Lamoureux and Lastrapes (1990) the authors test whether there are GARCH effects remaining after the conditional volatility specification expands to include the contemporaneous trading volume, which is a proxy for information arrival. The daily price change is a sum of intra-day price changes, which depend on the number of information events m occurring in any one day and assumed random. For a given m the Central Limit Theorem implies that the daily price change is approximately normal with variance proportional to m. Thus, the conditional variance of the daily price change is considered to be an increasing function of the rate at which new information enters the market. As new information is unobservable, a proxy variable is required to account for it. Trading volume is one such proxy variable. Prices and trading volume (or trading value) have a joint response to information because of the fact that the distribution of both is subordinate to the distribution of m. Assume the daily number of information arrivals is serially correlated and where innovations to the directing variable persist. The autoregressive structure of the mixing variable is now translated into the conditional variance thus generating the typical GARCH structure. According to the MDH, GARCH parameters should diminish or disappear altogether from the formulation after inserting the (serially correlated) trading volume or trading value variable into the conditional variance. Trading volume or value indicators should be positive and significant.

2.13.2 The Suominen (2001) model: a first look

In Suominen (2001), trading volume and price volatility on the stock market are related both in a causal way and in terms of conditional volatility. Private information about equity returns is available in any given period with some probability that changes stochastically over time. Informed speculators compete in trading with liquidity traders, and they trade aggressively as soon as they receive new private information. Their trading soon reveals their private information to other market participants and leads the other traders to revise their estimates for both the value of the asset and the availability of private information. As the probability of the existence of private information increases, liquidity traders become wary and start posting more conservative limit orders. Traders therefore estimate the availability of private information using lagged trading volume, and modify their trading strategies as the probability of private information entering the market increases. Under this setting it is trading volume, or more precisely the order

flows of informed investors, which reflects the flow of private information. Price innovations will therefore no longer be sufficient for predicting changes in the conditional variance. Information on volume will also become necessary to forecast the conditional variance of returns. When the probability of public information arrival is zero, the transition equation for the conditional variance for returns in Suominen's model becomes similar to the GARCH model. However, in that restrictive case trading volume would no longer have greater predictability than the returns series for future volatility.[25]

2.13.3 Reconciling Lamoureux and Lastrapes (1990) with Suominen (2001)

The approach taken by Lamoureux and Lastrapes (1990) in testing the volume-volatility relationship is to determine whether trading volume has a significant role in explaining the conditional variance of daily returns and if it can reduce the GARCH parameters. Such a finding would have implications for the informational efficiency of the market, as well as provide understanding of the determinants of volatility on the stock exchange. The Suominen (2001) microstructure[26] model of the stock market is able to derive a causal relationship between market trading and subsequent stock return movement. His model also provides a specification for the conditional variance. However, in Suominen (2001), trading variables are shown to drive the volatility process itself because investors refer to the previous period's trading to determine their strategies. In Lamoureux and Lastrapes (1990), both trading and stock returns are driven by the same latent information flow and by incorporating the trading measure into the variance equation should cause the GARCH parameters to fall. The model by Suominen (2001) now says that this may not necessarily happen since trading volume contains additional information which the returns series does not incorporate. That is, including trading variables into the volatility specification in a GARCH type model may not cause the GARCH parameters to fall. Future work should therefore attempt to specifically formulate a GARCH type model where the conditional variance is capable of being driven by previous stock returns as well as by informed trading.

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[25] When the probability of public information arrival is non-zero, the formula for the conditional variance in the Suominen (2001) model becomes rather complicated as trading volume now allows investors to separate private from public information. In any case, the model operates quite differently compared to the assumptions of most GARCH-type models.

[26] Biais et al. (2005) and Madhavan (2000) provide key reviews on the market microstructure literature.

2.13.4 Why is volatility important?

The groundbreaking work of Engle (1982) showed how the ARCH family of models were capable of predicting heteroskedastic residuals from the mean return equation. The study of stock market volatility has become increasingly important to academics, policy makers, and investors for several reasons. First, volatility represents a measure of risk exposure to investment. Prediction of volatility therefore helps economic agents make rational portfolio risk diversification, risk reduction, and management-based decisions. Second, a volatile stock market is often associated with an unstable stock market. This can be a concern for policy makers since instability in the stock market might impact the economy negatively. When stock markets are perceived as highly volatile then this "may act as a potential barrier to investing" (Poshakwale and Murinde, 2001, p. 445). A fall in stock prices can be explained by increases in the risk premium associated with a rise in stock volatility. The higher risk premium then leads to a higher cost of capital for firm investment and may therefore negatively impact economic growth.

Third, from a theoretical perspective, volatility is a key factor in the pricing of derivative securities. The Black-Scholes formula for instance demonstrates that the pricing of European call and put options is a function of implied volatility. Finally, stock return forecasting is in a sense volatility forecasting. Empirical research in modelling volatility may therefore increase confidence in forecasting time-varying stock returns. The accuracy of returns and volatility forecasts should thereby improve. The dynamic relation between stock market returns and measures of trading activity has itself been a subject of considerable research[27], and much of it has pre-dated the ARCH/GARCH literature. Researchers have recently attempted to link the two areas of trading activity and price volatility[28] and this has resulted in the volume-volatility relationship. As Poon and Granger (2003, p. 505) comment, "the volume-volatility research may lead to a new and better way for modelling returns distributions." Volatility forecasting may thus be significantly improved if we also incorporate the role of trading volume.

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[27] See Karpoff (1987) and Gallant et al. (1992) for surveys.
[28] Research into volume-volatility was first attempted by Lamoreux and Lastrapes (1990).

2.13.5 An application to the Bangladesh Stock Market

Volatility analysis is arguably even more important in emerging markets where the risks are undoubtedly higher than in developed markets. Investors in the Dhaka Stock Exchange of Bangladesh who carefully consider price volatility and stock return dynamics therefore will directly experience benefits in terms of enhanced portfolio management. A deeper understanding of the trading process and its relationship with volatility should similarly lead to further benefits in terms of risk reduction and perhaps higher end period wealth; at the very least knowledge of these issues will minimize the likelihood of experiencing poor performance. Bangladeshi financial regulators who are in charge of formulating policy in order to encourage trading may like to know more about stock market dynamics. As Pagano (1993b) shows, the level of trading in shares of listed companies is related to the number of companies who will seek a market listing. Multiple equilibrium can therefore result and the stock market may remain in a low level of trading and listing whereas the higher level would obviously be preferred. Given that trading and stock price movement may also be related, policy makers often choose to closely observe price and volume movements in order to promote stock market development. Consequently a better understanding of the stock market in Bangladesh should be of interest to domestic and international investors seeking profitable opportunities and lower risk exposure, and to regulators wishing to maintain an orderly environment in the marketplace. Confirming empirical results in the analysis of stock market data for Bangladesh would also give credibility to the theory used to justify the volume-volatility relationship. Finally, the results in this paper will hopefully help change the image of a developing country's financial market that has experienced little growth, high fraudulent activity, and weak regulation[29].

2.14 Existing empirical work on Bangladesh

In this section we now take a look at the existing empirical work in the literature for Bangladesh. To the best of our knowledge, none of these studies on economic growth have considered the role of the stock market in the economic development. Nor has there been any work to date on the DSE that specifically investigates the volume-volatility relationship.

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[29] See Solaiman (2006) for a critical (and rather negative) overview of the stock market in Bangladesh.

2.14.1 Studies on finance and growth

Fase and Abma (2003) examine the relationship between financial development and economic growth in nine emerging economies in Asia, including Bangladesh. Using cointegration methods they find that although financial development in most countries improves economic growth, weaker results are for the South Asian countries: Bangladesh displays a low Durbin-Watson statistic implying some misspecification, while in India and Sri Lanka the coefficient of financial development within the error correction is statistically insignificant. Siddiki (2000) investigates the impact on real demand for money of real per capita income, domestic interest rates, foreign interest rates and exchange rate distortions in Bangladesh from 1975-1995. The removal of financial repression, i.e. financial liberalization in LDCs increases interest or deposit rates which raises monetary accumulation, i.e. financial savings, investment and economic growth. Using the ARDL approach to co-integration the author finds a unique long-run cointegrating relationship between the variables with broad money as the dependent variable. While the focus of this study is slightly different to ours, it is particularly to note that Siddiki (2000) is able to explain the accumulation of money in terms of an increase in real GDP per capita. Our empirical results in Chapter 6 are similar in that real GDP per capita is found to be the long-run forcing variable for private-credit in Bangladesh.

Siddiki (2002) further investigates the finance-growth nexus by assessing the joint impact of financial and trade liberalization on economic growth in Bangladesh from 1975-1995. Using standard co-integration techniques, and again using broad money or the M2/GDP ratio to represent financial development, he finds that both financial and trade liberalization together with human capital investment enhanced economic growth in Bangladesh. He also finds that investment had an insignificant impact on growth, a result which might be due to the inefficiency of investment expenditures as well as government regulation in the economy, or alternatively because financial development and human capital captured the impact of investment on growth. The result for the investment variable and the reasoning behind it may be linked in some ways to our empirical findings in Chapter 6. There we find that another broad money indicator – the quasi-money/GDP ratio – has been an important driving factor (along with the stock market) for physical capital accumulation, whereas no connection between quasi money and real GDP per capita is found.

Beck and Rahman (2006) test whether finance leads to growth in Bangladesh from 1975 to 2005. Variables include the short-term real lending rate, private-credit-to-GDP, investment-to-GDP, and GDP per capita. Structural vector autoregression is used to impose long-run structural restrictions on the relationship between the different variables. They posit that the short-term real lending rate impacts financial development, the investment-to-GDP ratio and GDP per capita. Financial development, in turn, impacts the investment-to-GDP ratio and income per capita, while the investment-to-GDP ratio only impacts directly GDP per capita. Results show a positive impact of financial development on per capita income even after controlling for the indirect impact through investment activity, suggesting that financial development enhances both investment and resource allocation. Results also indicate a positive and significant relationship between investment activities and per capita income. The long-run response of financial development, investment and per capita income with respect to real lending rate changes, however, do not appear with the expected signs. A positive relationship is found between changes in the real lending rate and financial development, investment-to-GDP and per capita income.

Hassan and Islam (2005) investigate whether financial development and trade openness increase economic growth from 1974-2003. Variables include private-credit/GDP, domestic-credit/GDP, broad-money/GDP, and real GDP per capita. Empirically they find no evidence for cointegration between the variables using the Johansen multivariate cointegration method. Granger Causality tests in first difference VARs also fail to confirm a causal relationship between either trade openness or financial development and economic growth. Some causal linkage is found between financial development and trade openness. They conclude that financial development and trade do not have a positive direct effect on economic growth.

Ahmed and Ansari (1995) have estimated saving and money demand functions to examine the prediction of the McKinnon-Shaw model in Bangladesh using annual data from 1973-91. The authors found that financial intermediation and interest rate rises increase saving; the saving-income ratio positively and interest rates negatively affect the demand for money, providing some support for the McKinnon-Shaw model. However this study does not analyse the time series properties of the data. In another similar vein,

Hossain (1996) employs co-integration techniques to money demand in Bangladesh during 1973-1991. Although that study found a high, statistically significant and positive long-run income elasticity of money demand, the results suffer from the presence of high serial correlation.

2.14.2 Studies on the stock market

Islam and Khaled (2005) use heteroscedasticity-robust tests and find short-term predictability of share prices prior to the 1996-crash period, but not in the post-crash period. They argue that the finding of weak-form efficiency during the latter period is explained by steps taken by the Securities and Exchange Commission to promote transparency and efficiency in the DSE after the 1996 episode. Hasan (2004) generally finds evidence supporting the random walk hypothesis although tests also seem to suggest predictable components for stock returns. Bin Hoque (2007) explores the dynamics of stock price movements on the DSE along with those of the USA, Japan and India. He finds evidence of a cointegrating vector implying that stock prices in these countries share a common stochastic trend. Shocks to the US market have an impact on the Bangladesh market, while shocks in India and in Japan do not seem to have any effect. Narayan et al. (2005) also examine linkages between regional stock markets in South Asia. Stock prices in Bangladesh, India and Sri Lanka Granger-Cause stock prices in Pakistan in the long run, while in the short run unidirectional Granger Causality runs from Pakistan to India, from Sri Lanka to India, and from Pakistan to Sri Lanka. Bangladesh Interestingly Bangladesh is the most exogenous out of the four regional markets, which according to the authors is due to its small size and modest market capitalization. Basher et al. (2007) examine the time-varying risk return relationship with a GARCH in mean (GARCH-M) framework. They find evidence for stock market inefficiency – negative skewness, excess kurtosis, deviation from normality, and serially correlated stock returns. While a significant relationship between conditional volatility and the stock returns is found, contrary to portfolio theory the risk-return parameter appears negative. They justify this result by explaining that in emerging markets investors may not demand higher risk premia if they are better able to bear risk at times

of particular volatility[30]. Basher et al. (2007) argue that policy should improve the timely disclosure and dissemination of information to shareholders and investors.

2.15 Conclusion

This chapter has surveyed the main theoretical literature on the finance-growth relationship, financial structure, bank development, stock market development, and trading volume – price volatility effects. While the theory is seen to be well-developed, there has been little attempt at combining the various insights and implications of these models. In addition, we have determined that there is sparse empirical work on Bangladesh which has examined the testable implications of the theoretical predictions regarding the financial sector and the economy.

The main conclusion we draw therefore is that an existing theoretical framework can be shown to already exist; one field which broadly considers the *finance-growth nexus*, and one field which broadly considers the *stock market infrastructure*. These two fields have not been adequately integrated or linked together in the literature. And very little attempt has been made to apply such insights to the experience of the developing countries. Our intention is to offer a first-attempt at assessing these issues for Bangladesh. To do this requires integrating the institutional background of Bangladesh (Chapter 3), the overall theoretical framework (Chapter 4), and the empirical results (Chapters 6, 7, 8).

[30] Basher et al. (2007) point out that "information asymmetry may play a crucial part in influencing the distribution of returns among investors" (p. 1406). This shows the importance of considering the dynamics of information flow on the Dhaka Stock Exchange.

Table 2.1

Article	Country/s	Period	Cointegration Methodology	Financial variables	Main finding
Ansari (2002)	Malaysia	1960-1996	Engle and Granger, Johansen	Banks	Uni-directional (FD to EG)
Arestis, Demetriades, Luintel (2001)	5 Industrialized	1973:1-1998:4	Johansen	Banks + Stock Market	Uni-directional (FD to EG)
Bhattacharya and Sivasubramanian (2002)	India	1970-1999	Johansen, Perron	Banks	Uni-directional (FD to EG)
Caporale, Howells, Soliman (2004)	7 Developing	1977:1-1998:4	Toda and Yamamoto	Banks + Stock Market	Uni-directional (FD to EG)
Caporale, Howells, Soliman (2005)	4 Developing	1979:1-1998:4	Toda and Yamamoto	Stock Market	Uni-directional (FD to EG)
Chang and Caudill (2005)	Taiwan	1962-1998	Johansen	Banks	Uni-directional (FD to EG)
Christopoulos and Tsionas (2004)	10 Developing	1970-2000	Johansen	Banks	Uni-directional (FD to EG)
Darrat (1999)	Saudi Arabia, Turkey, UAE	Various periods	Johansen	Banks	Uni-directional (FD to EG)
Fase and Abma (2003)	9 Asian	1974-1999	Engle and Granger	Banks	Uni-directional (FD to EG)
Ghali (1999)	Tunisia	1963-1993	Engle and Granger, Johansen	Banks	Uni-directional (FD to EG)
Ghatak (1997)	Sri Lanka	1950-1987	Engle and Granger	Banks	Uni-directional (FD to EG)
Luintel, Khan, Arestis, Theodoridis (2008)	14 Countries	1979-2005	Phillips and Hansen	Banks + Stock Market	Uni-directional (FD to EG)
Murinde and Eng (1994)	Singapore	1979:1-1990:4	Engle and Granger	Banks	Uni-directional (FD to EG)
N'Zue (2006)	Cote D'Ivoire	1976-2002	Johansen	Stock Market	Uni-directional (FD to EG)
Rousseau and Wachtel (1998)	5 Industrialized	1870-1929	Johansen	Banks	Uni-directional (FD to EG)
Shahbaz, Ahmed, Ali (2008)	Pakistan	1971-2006	Johansen, Pesaran Shin Smith ARDL	Stock Market	Uni-directional (FD to EG)
Siddiki (2000)	Bangladesh	1975-1995	Pesaran and Shin ARDL	Banks	Uni-directional (EG to FD)
Siddiki (2002)	Bangladesh	1975-1995	Engle and Granger, Phillips and Hansen	Banks	Uni-directional (FD to EG)
Thangavelu and Jiunn (2004)	Australia	1960-1999	Engle and Granger	Banks + Stock Market	Uni-directional (FD to EG)
Al-Yousif (2002)	30 Developing	1970-1999	Johansen	Banks	Bi-directional
Arestis and Demetriades (1997)	Germany, USA, South Korea	1979:1-1991:4	Johansen	Banks + Stock Market	Bi-directional
Demetriades and Hussein (1996)	16 Developing	Various periods	Engle and Granger, Johansen	Banks	Bi-directional
Demetriades and Luintel (1996)	India	1961-1991	Banerjee et al. UECM	Banks	Bi-directional
Ghirmay (2004)	13 Sub-Saharan African	Various periods	Johansen	Banks	Bi-directional
Handa and Khan (2008)	13 Various	1960-2002	Johansen	Banks	Bi-directional
Luintel and Khan (1999)	10 Developing	Various periods	Johansen, Toda and Phillips	Banks	Bi-directional
Neusser and Kugler (1998)	13 OECD	Various periods	Engle and Granger, Johansen	Banks	Bi-directional
Shan, Morris, Sun (2001)	9 OECD + China	Various periods	Toda and Yamamoto	Banks + Stock Market	Bi-directional
Al-Awad and Harb (2005)	10 Middle Eastern	1969-2000	Johansen	Banks	No firm relationship
Atidehou, Guyeie, Amenounve (2005)	12 West African	Various periods	Engle and Granger	Banks	No firm relationship
Shan and Morris (2002)	19 OECD + China	1985:1-1998:4	Toda and Yamamoto	Banks + Stock Market	No firm relationship

Table 2.2
Finance-growth empirical studies: Cross-section/Panel

Article	Countries	Period	Methodology	Financial variables	Main finding
Ahmed and Ansari (1998)	3 South Asian	1973-1991	Pooled OLS	Banks	Uni-directional (FD to EG)
Atje and Jovanovic (1993)	40	1980-1988	Pooled OLS	Stock Market	Uni-directional (FD to EG)
Beck and Levine (2004)	40	1976-1998	GMM	Banks + Stock Market	Uni-directional (FD to EG)
Beck, Levine, Loayza (2000)	63	1960-1985	GMM	Banks	Uni-directional (FD to EG)
Bekaert, Harvey, Lundblad (2005)	95	1981-1997	GMM, Pooled OLS	Stock Market	Uni-directional (FD to EG)
Benhabib and Spiegel (2000)	Various	1965-1985	GMM	Banks	Uni-directional (FD to EG)
Christopoulos and Tsionas (2004)	10 Developing	1970-2000	Panel Cointegration	Banks	Uni-directional (FD to EG)
De Gregorio and Guidotti (1995)	98	1960-1985	Pooled OLS	Banks	Uni-directional (FD to EG)
Deidda and Fattouh (2008)	100	1980-1995	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Evans, Green, Murinde (2002)	82	1972-1993	Pooled OLS, Translog Specification	Banks	Uni-directional (FD to EG)
Habibullah and Eng (2006)	13 Asian	1990-1998	GMM	Banks	Uni-directional (FD to EG)
Khan and Senhadji (2003)	80	1960-1989	Pooled OLS, 2SLS	Banks	Uni-directional (FD to EG)
King and Levine (1993)	80	1960-1989	Pooled OLS	Banks	Uni-directional (FD to EG)
Levine (2002)	48	1980-1995	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Levine and Zervos (1998)	47	1976-1993	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Levine, Loayza, Beck (2000)	74	1960-1995	GMM	Banks	Uni-directional (FD to EG)
Luintel, Khan, Arestis, Theodoridis (2008)	14	1979-2005	Panel Cointegration	Banks + Stock Market	Uni-directional (FD to EG)
Neusser and Kugler (1998)	13 OECD	Various periods	Panel Cointegration	Banks	Uni-directional (FD to EG)
Rajan and Zingales (1998)	41	1980-1990	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Rousseau and Wachtel (2000)	47	1980-1995	GMM	Banks + Stock Market	Uni-directional (FD to EG)
Shen and Lee (2006)	48	Various periods	Pooled OLS, 2SLS	Banks + Stock Market	Uni-directional (FD to EG)
Tadesse (2002)	36	1980-1995	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Tadesse (2007)	34	1980-1995	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Wurgler (2000)	28 Manufacturing	1963-1995	Pooled OLS	Banks + Stock Market	Uni-directional (FD to EG)
Tang (2007)	14 APEC	1981-2000	Pooled OLS	Banks + Stock Market	No firm relationship
Durham (2002)	64	1981-1998	Pooled OLS	Banks + Stock Market	No firm relationship
Liu and Tsu (2006)	3 Asian	1981-2001	GMM, Principal Components	Banks + Stock Market	No firm relationship
Naceur and Ghazouani (2006)	11 MENA	1979-2003	GMM	Banks + Stock Market	No firm relationship
Rioja and Valev (2004)	74	1961-1995	GMM	Banks + Stock Market	No firm relationship

Table 2.3

Empirical determinants of stock market development

Empirical determinants of stock market development	
Article	**Main finding**
Amihud, Mendelson, Lauterbach (1997)	Improvement in the trading mechanism for Tel Aviv led to price appreciation, liquidity gains, and liquidity externalities (spillovers).
Bortolotti, Jong, Nicodano, Schindele (2007)	Share issue privatization is a major source of stock market liquidity in 19 developed economies.
Boutchkova and Miggins on (2000)	Share issue privatizations have increased market liquidity and the number of shareholders.
Brau, Francis, Kohers (2003)	Industry concentration, high-tech industry, debt, hot IPOs, firm size, and insider ownership are positively related to IPO probability.
Butler, Grullon, Weston (2005)	Investment banks' fees are significantly lower for firms with more liquid stock.
Chun and Smith (2003)	Korean firms go public to take advantage of windows of opportunity and rebalance portfolios.
Datar, Naik, Radcliffe (1998)	Turnover (no. of shares traded / shares outstanding) is the main proxy for liquidity.
Easley, Kiefer, O'Hara, Paperman (1996)	Many listed stocks trade infrequently.
El-Wassal (2005)	Economic growth has mainly led to stock market growth (market capitalization, turnover) in 40 emerging economies.
Gallego and Loayza (2001)	Quantity measures of market capitalization demonstrate better how the stock market enhances growth in Chile.
Garcia and Liu (1999)	Income, savings, financial intermediaries and market liquidity are important determinants for market capitalization in 15 countries.
Hedge and McDermott (2003)	Additions to the S&P 500 index increases in liquidity of the added stocks.
Hoffman-Burchardi (2001)	Firms learn from an IPO about the costs of staying private. This leads to clustering by industry.
Hmaied and Sioud (2006)	The development on an electronic limit order market in Tunisia has led to dynamic relationships between liquidity and volatility.
Lesmond (2005)	Price-based liquidity measures perform better at representing liquidity effects than volume-based liquidity measures.
Loughran, Ritter, Rydqvist (1994)	High IPO volume is associated with stock market peaks.
Majnoni and Massa (2001)	Reforms in Italy (e.g. specialized intermediaries, offical and screen-based trading, cash settlement) increased market efficiency.
McKenzie (2007)	The past level of listing activity is the most important factor explaining the current level of listing activity across 38 exchanges.
Naceur, Ghazouani, Omran (2007)	Savings, financial intermediaries, and market liquidity are important determinants for market capitalization in 12 MENA countries.
Pagano, Panetta, Zingales (1998)	The main determinants of IPOs in Italy are company size and industry market-to-book ratio. Companies go public not to finance future investment but rather to rebalance their accounts.
Stoughton, Wong, Zechner (2001)	Hot IPO markets are driven by technological innovation or productivity shocks.

Table 2.4

Empirical determinants of stock market volatility with trading

Empirical determinants of stock market volatility with trading	
Article	**Main finding**
Bessimbinder and Seguin (1993)	Conditional volatility still exhibits strong persistence even when trading volume is included.
Bohl and Henke (2003)	Volatility presistence is in most cases reduced when trading volume is incorporated for Polish firms.
Brailsford (1996)	The value of shares traded is the preferred measure of trading volume for the Australian stock market.
Chen, Firth, Rui (2001)	Bi-directional causality exists between trading volume and stock returns in nine national stock markets.
Gallant, Rossi, Tauchen (1992)	Documents the stock return volatility - contemporaneous trading volume correlation.
Gurgul, Majdosz, Mestel (2006)	There is no causal relationship between trading volume and stock returns for Poland.
Huang and Yang (2001)	Volatility persistence is still strong after incorporating trading volume for the Taiwan stock market.
Karpoff (1987)	Documents the stock return volatility - contemporaneous trading volume correlation.
Lee and Rui (2001)	GARCH effects remain significant when trading volume is included in the Chinese stock market.
Lee and Rui (2002)	Trading volume forecasts volatility in the US, UK, and Japan; however no causal relationships exist.
Omran and McKenzie (2000)	GARCH parameters are insignificant when volume volume is included, however autocorrelation remains.
Phylaktis, Kavussanos, Manalis (1996)	The GARCH model becomes stable once trading value is incorporated for the Athens Stock Exchange.
Poon and Granger (2003)	Survey of the volatility literature.
Pyun, Lee, Nam (2000)	Trading volume reduces persistence in volatility in the Korean Stock Exchange.
Ratner and Leal (2001)	There is bi-directional causality between returns and volume in Latin American and Asian stock markets.

CHAPTER 3

INSTITUTIONAL ASPECTS OF THE FINANCIAL SECTOR IN BANGLADESH

3.1 Introduction

This aim of this chapter is to discuss the institutional background of the financial sector in Bangladesh. Broad trends in both financial and real variables are described. In light of the literature review presented in chapter 2, the work here is important because it forms the basis for our theoretical motivation of integrating the finance-growth nexus and stock market infrastructure.

This chapter considers the numerous financial reforms that were undertaken by the Government of Bangladesh, the World Bank and the DFID, and the motivations which were originally behind them. While these reforms have undoubtedly helped to improve the operation of the financial sector, the overall situation for Bangladesh continues to be less than impressive. The usual reasoning given for this failure is the standard long list of characterizations for any poor developing country, including weak enforcement of laws, perverse or 'wrong' incentives, too much state intervention and not enough free play of market forces. Yet the rather obvious policy prescription which follows from this simple analysis can be seen to hardly do justice to the richer picture of the financial system. We argue that in many cases economic realities have been misunderstood and even completely ignored. There has been an acute failure to appreciate the forces that operate within the financial system and the implications this has for economic growth. This we argue has been almost as damaging to the growth process as the very failures that many commentators are so eager to point out. In other words, Bangladesh may have suffered a double blow to its growth prospects, firstly due to the presence of various weaknesses (the roots of which have not been properly recognized), and secondly due to the misdirected focus of policy which was naively assumed to be the correct and best way to pursue the goal of economic development.

3.2 The financial system in Bangladesh: An overview

Upon achieving Liberation in 1971, the Bangladesh government initially nationalized the entire domestic banking system and proceeded to reorganize and rename the various banks. Foreign-owned banks were permitted to continue doing business in Bangladesh. Cooperative credit systems and postal savings offices handled service to small individual and rural accounts. The primary function of the banking system throughout the 1970s was to finance trade and the public sector. Bangladesh therefore inherited a repressive financial system, incorporating controls over interest rates, directed credit, and overvalued exchange rates.

The switch from state sponsored capitalist mode of industrial development to private sector-led industrial growth in Bangladesh began in the mid 1970s. With the famine in 1974, rising prices and a dwindling economy led to gradual shifts in the government's policies towards encouraging private sector participation in manufacturing and reducing the role of public sector through disinvestment. After the political change in August 1975, the Government declared a revised industrial policy, through which the public sector led industrialization was abandoned. Between 1975 and 1981, a number of important changes in the policies and institutions were introduced with a goal of bringing about a decisive shift towards a private sector driven industrialization. This period saw: (i) elimination of ceilings on private investment, (ii) reduction in the reserve list of industries under the public sector and creation of "free sectors", (iii) relaxation of investment sanctioning procedures, (iv) amendment of the Constitution to allow disinvestment and denationalization of both abandoned and taken-over industries, (v) establishment of a Disinvestment Board in 1975, (vi) reopening of the stock market, (vii) shift to a floating exchange rate, and (viii) introduction of various export promotion measures.

At the start of the 1980s the financial sector continued to remain repressed. The small and relatively underdeveloped sector was dominated by government-owned commercial banks which accounted for more than 90% of the system's total assets. The complex structure of interest rates was subject to controls, while extensive quantitative credit controls were in place. Weak supervisory banking frameworks and political interference led to a growing share of non-performing bank loans. There was no active capital market. Foreign currencies were strictly regulated and the domestic currency, taka, was highly

overvalued. The early 1980s was a decade which still saw a government owned, controlled and directed Bangladesh's financial system to ensure fund priority in respective sectors. Loan recovery was not emphasized and the quality of financial intermediation, judged by loan recovery rates, was poor.

A significant move in the privatization process occurred in 1982 with the announcement of the New Industrial Policy (NIP). The NIP aimed to accelerate the process of privatization and focused on ways to ensure macro-economic stability of in the economy. The Government introduced fundamental changes in the industrial policy environment and the adoption of various promotional measures, industries in the jute and cotton textiles were returned to their owners under the auspices of the NIP. The NIP of 1982 was the first holistic policy statement of the GOB to embrace the World Bank's Structural Adjustment Reforms. Importantly two nationalized commercial banks (NCBs) were privatized – Uttara Bank and Pubali Bank, and private commercial banks (PCBs) were finally given licenses to operate[1]. The main reason for allowing local private banks was the desire of the government to demonstrate its commitment towards encouraging private sector activity and to promote competition in the banking sector.

However, lending institutions in these early stages did not have adequate autonomy to choose borrowers and projects and were often instructed by the political authorities. In addition, the accounting and debt collection systems were inadequate to deal with the problems of loan recovery. It became more common for borrowers to default on loans than to repay them; the lending system was simply disbursing loans to private individuals who qualified for loans more for political than for economic reasons.

The structural adjustment process was accompanied with a combination of fiscal tightening and structural reforms, in particular the unification of the foreign exchange market and trade liberalization, reduced inflation and improvement in the external current account. Beginning in late 1985, the government pursued a tight monetary policy aimed at limiting the growth of domestic private credit and government borrowing from the banking system. The policy was largely successful in reducing the growth of the money supply and total domestic credit. Net credit to the government actually declined in FY 1986. The problem of credit recovery remained a threat to monetary stability. Although

[1] Another government owned bank, *Rupali Bank*, is currently in the process of being privatized.

the government had begun effective measures to improve financial discipline, the draconian contraction of credit availability contained the risk of inadvertently discouraging new economic activity.

Before 1989, interest rates for both deposits and loans were set by Bangladesh Bank, the central bank of Bangladesh. Since the early eighties, interest rates on deposits were raised to provide a positive, real return. In the early nineties, based on the recommendations of the National Banking commission, the government of Bangladesh initiated a managed interest rate policy by letting the interest rate to be set by the forces of the market but at the same time guiding the interest rate to achieve macro economic stability. It is to fulfil the latter objective that the government has introduced both the ceiling and floor on the interest rate, in order to ensure that the savers earn an adequate rate of return and the ceiling primarily from the concern that too high an interest rate will affect investment adversely and invite high risk investors. In January 1990, the government decided to set interest rate bands for both deposits and loans, and permitted commercial banks to fix their own rates. The floors on deposits were set close to the inflation rate and ceilings were established for preventing excessive increases in interest rates. These bands on loan are calculated on the basis of the average cost of funds, administrative expenses and other operational costs of the bank, the cost of provision of debt and an allowance for profit. Sectors like agriculture and small industry had different rates in recognition of higher operating costs of these industries.

The National Commission on Money, Credit, and Banking recommended broad structural changes in Bangladesh's system of financial intermediation early in 1987, many of which were built into a three-year compensatory financing facility signed by Bangladesh with the IMF in February 1987. In response to the Commission's report, the government of Bangladesh launched the Financial Sector Reforms Program (FSRP) in 1990 with financial assistance from a number of donor agencies including the World Bank.

3.2.1 The World Bank effort

In 1990 the World Bank set out its objectives for the Financial Sector Reform Programme (FSRP). According to Van Der Geest (2001), the key reform areas were the following:

- interest rate liberalization for both deposit and lending;

- abolition of sector-directed lending;
- improving loan portfolios through international standards of loan classification;
- strengthening banking supervision;
- improving the operation of money market instruments;
- improving the operation of capital markets;
- improving loan recovery through bankruptcy legislation and credit information.

After the financial reform process started, considerable progress was made in moving away from the previous system of direct controls in the banking system as well as in revising loan classification and provisioning criteria to make loan recovery more transparent, revising the legal provisions and procedures for enforcing loan recovery, and improving availability of credit risk information. An interest amnesty program was also introduced and the Financial Loan Courts Act was passed to facilitate prosecution of defaulters. The Credit Information Bureau was established in the Bangladesh Bank to record the performance of borrowers, and the Large Loan Review Cell was set up to review all newly sanctioned bank loans over Taka 10 million.

In order to encourage foreign private investment, the Foreign Private Investment (Promotion and Protection) Act of 1980 was promulgated and a "One-Stop" service, the Board of Investment (BOI), was set up, commencing its operations in January 1989. In 1991 the Government further stepped up the liberalization program by announcing a National Industrial Policy which emphasized the need for implementing a massive privatization program and the elimination of subsidies in the jute sector. The industrial policy of 1991 in addition sought to simplify investment procedures and diversify the country's export base, and encouraged both local and foreign investors to set up export-orientated enterprises. It offered foreign investors tax exemptions on the interest of foreign loans, royalties and technical assistance fees. It also allowed them to receive long-term credit facilities from financial institutions. In June 1993, the government adopted a comprehensive privatization policy and laid down detailed procedures to facilitate the process of privatization. The policy has aimed at relieving the financial and administrative burden of the government, improving efficiency and productivity, facilitating economic growth, reducing the size of the public sector in the economy and help meeting the national economic goals.[2]

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[2] For discussions on the main regulatory reforms of the private sector and also the overall assessment of the privatization process in Bangladesh, see Ahmed (2000) and Uddin (2005).

3.2.2 The CORBEC Financial Management Programme

In 1990 the Committee on Reforms in Budgeting and Expenditure Control (CORBEC)[3] was led by the Ministry of Finance and given responsibility to analyse the problems and prepare recommendations for reform. The 1990 CORBEC report noted:

- the lack of adequate and accurate financial information on a timely basis;
- A cumbersome, repetitive and overlapping budgetary system;
- the lack of updated, comprehensive and easy to use financial rules and regulations;
- the inadequacy of trained manpower.

Once the CORBEC report was published, both the World Bank and DFID offered support[4]. The Government chose to partner with DFID, officially because the UK's assistance would be a grant, not a loan, but reportedly also because there would be fewer conditions attached to the financing. Through the 1990s the program strived for:

- The computerization of the budgeting system in the Ministry of Finance
- Updating and consolidation of financial rules and regulations;
- A new government-wide budgeting and accounting classification structure;
- A computerized accounts consolidation system;
- Development of a Financial Management Academy (FIMA) to build skills;
- Training in the Ministry of Finance and Accounts offices on information technology.

In a secondary phase of assistance, the Financial Management Reform Programme (FMRP) was approved in 2002 at a cost of £25m over 5 years. The Netherlands also funded 25% of the programme costs. The FMRP had five components:

- To provide improved audit reports and well-researched reports;
- To enhance fiscal management and the regulatory framework for management;
- To enhance allocation, utilisation, and performance capacity in line ministries;
- To enhance financial management reporting systems;
- To build a Financial Management Academy as a sustainable centre of excellence.

While these reforms have encountered various difficulties and challenges, as a result of these efforts financial information has become more available and increasingly accurate. The new budgetary system along with new financial rules and regulations and training

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[3] This section refers to the "2006 Asian Regional Forum on Aid Effectiveness: Implementation, Monitoring and Evaluation" published by the Agulhas Consultancy group.

[4] While the DFID and the World Bank both compete for securing projects and influencing decision making, the experience of financial reform in Bangladesh demonstrates mutual support between these organizations.

programmes has also undoubtedly enhanced the human resource effectiveness. The impact of these reforms is therefore likely to have improved the operation of financial sector in Bangladesh. But the important question is the following: can these reforms be said to have led to a positive impact on the rate of growth in the economy? And are there no other issues other than ambitious capacity building that we perhaps should consider in order for future reforms to achieve their intent?

3.3 Assessing the performance of the financial system

3.3.1 Description of the banking sector

Bangladesh is by any standard best described as a bank-based system. Banks are the key providers of finance for firms and individuals and they easily dominate the financial sector. The bank sector of Bangladesh consists of the Bangladesh Bank (the central bank), scheduled banks (or deposit money banks, DMBs), non-bank financial institutions (NBFIs), various co-operative banks, insurance companies, micro finance institutions (MFIs), credit rating agencies and stock exchanges. Direct regulatory and supervisory responsibility over DMBs and NBFIs rests with Bangladesh Bank. Among scheduled banks there are 4 nationalized commercial banks (NCBs), 5 state-owned specialised banks (SBs), 30 domestic private commercial banks (PCBs), 9 foreign commercial banks (FCBs), and 28 NBFIs as of 30th December 2006 (Bangladesh Bank *Financial Sector Review*, 2006).

3.3.2 Assessing the performance of the financial sector

Below we present summary statistics of important real and financial variables for the economy. In terms of bank development, both the quasi-money/GDP ratio and the private-credit/GDP ratio displayed upward trends of similar magnitude over the full period 1980-2005. These two respective bank indicators displayed average 5-year growth rates of 6.60% and 7.44%. Looking at indicators of real development, GDP per capita grew at an average 5-year rate of 2.22%, while the capital stock grew faster at 4.69%. It is interesting to note that the change in the capital stock over time shows a similar pattern to the change in the financial indicators. In addition, the stock market has been impacted positively in the process of development. The number of companies approaching the

stock market for listings[5] has been steadily rising at an average 5-year rate of 10.92%. It is therefore apparent that Bangladesh's financial sector (both in terms of its banks and its stock market) has shown signs of development over the last two and a half decades, and that economic growth has steadily increased too. However the bank development ratios have been low. This suggests that economic growth, whilst being consistent, has the potential to be greater.

Table 3.1

Summary Indicators of Real and Financial Development: 1980-2005

	Real GDP per capita	Real capital stock / output	Quasi money/GDP	Private credit/GDP	Listed companies
1980	10826	68.91	7.20	5.77	22
1981	10970	75.87	7.59	6.96	25
1982	10958	83.93	8.14	7.34	28
1983	11121	90.31	10.35	9.26	43
1984	11415	95.79	11.91	12.12	56
1985	11504	102.77	12.16	13.44	69
1986	11716	108.60	13.09	13.16	78
1987	11878	115.05	14.65	13.68	85
1988	11863	123.17	15.75	14.94	101
1989	11901	130.91	17.13	16.57	116
1990	12325	134.33	16.83	16.66	134
1991	12449	140.11	17.72	15.92	138
1992	12780	143.25	18.25	14.55	145
1993	13064	147.45	18.87	15.29	153
1994	13297	152.77	20.49	16.27	170
1995	13651	157.23	20.06	20.88	183
1996	13983	162.76	20.87	21.60	186
1997	14435	167.79	21.24	22.79	202
1998	14886	173.93	21.66	23.24	208
1999	15303	181.08	23.83	24.41	211
2000	15896	186.18	26.40	25.56	221
2001	16411	191.94	27.66	26.71	230
2002	16807	199.42	29.80	28.93	239
2003	17355	205.38	31.11	28.75	247
2004	18099	209.69	32.54	30.14	250
2005	18726	215.45	34.35	31.65	262

Source: World Bank and IMF online databases; author's own calculations

[5] While the number of listed securities has been constantly rising, it does not immediately follow that the total equity finance raised from issues has correspondingly risen. Indeed we have no way of knowing exactly how much capital all listed companies managed to obtain from their listings as only data for some of the larger companies was available for a handful of years. However, we may still make the assumption, based on the fact that IPOs of firms are almost always heavily oversubscribed by investors in Bangladesh, that firms have obtained at least some funds through issuing equity – both publicly and privately.

Table 3.2

5-Year Average Growth Rates

	Real GDP per capita	Real capital stock / output	Quasi money/GDP	Private credit/GDP	Listed companies
1981-1985	1.23	8.34	11.40	18.80	26.53
1986-1990	1.40	5.51	6.82	4.50	14.24
1991-1995	2.07	3.20	3.64	5.36	6.47
1996-2000	3.09	3.44	5.71	4.14	3.88
2001-2005	3.33	2.96	5.41	4.41	3.47
Average	2.22	4.69	6.60	7.44	10.92

Figure 3.1

Real GDP per capita: 1980-2005

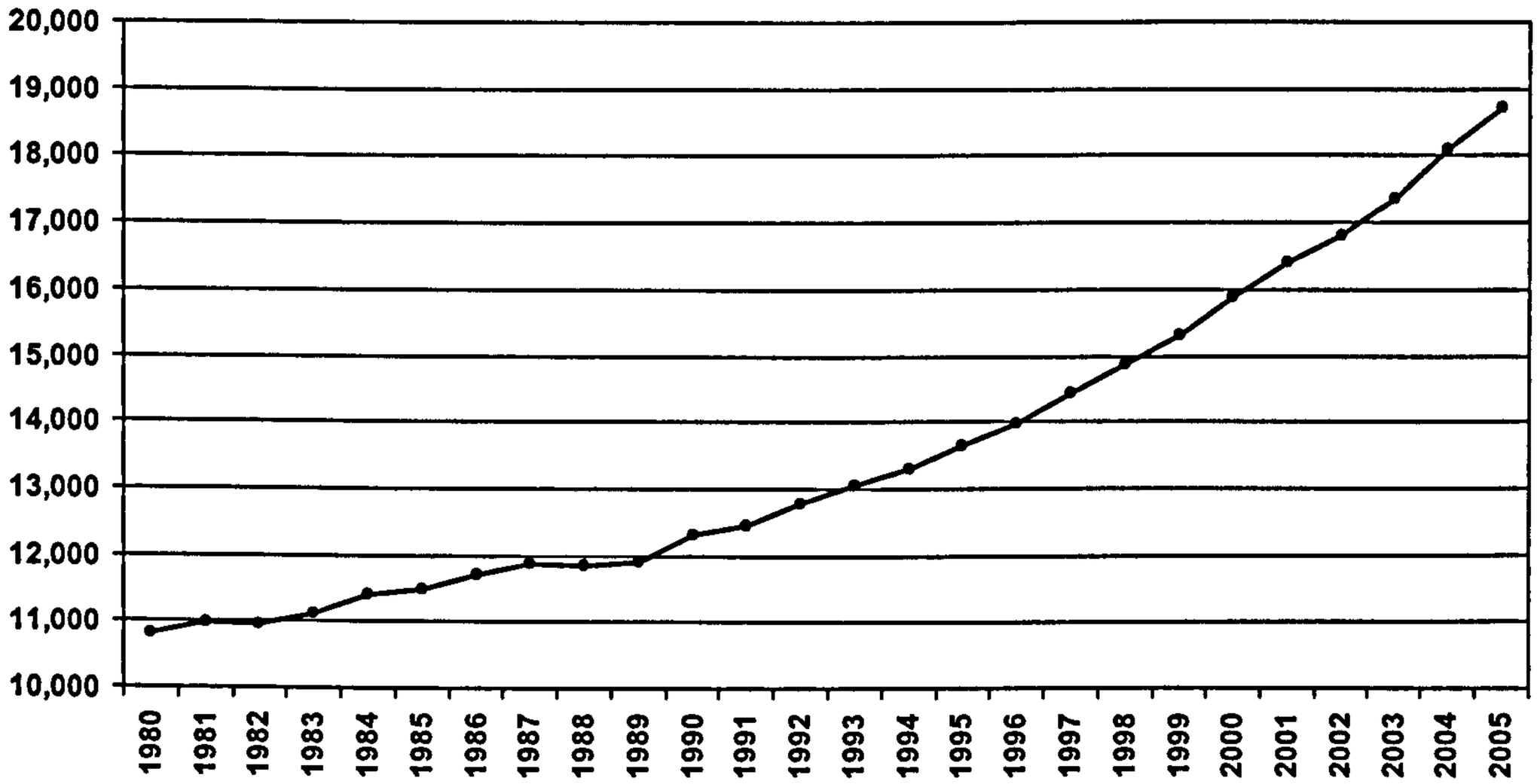


Figure 3.2

Real Capital Stock / Output: 1980-2005

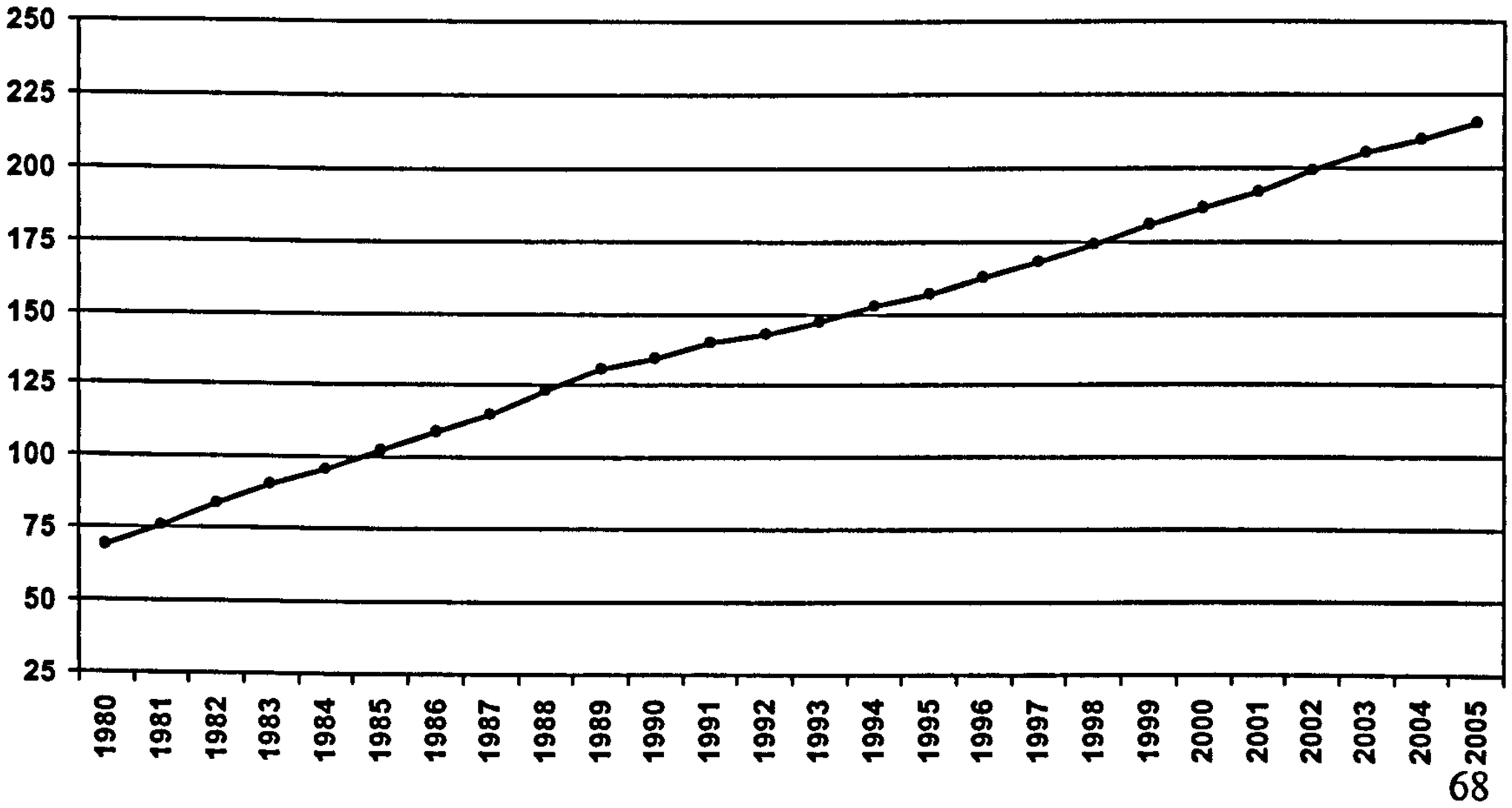


Figure 3.3

Quasi-money / GDP: 1980-2005

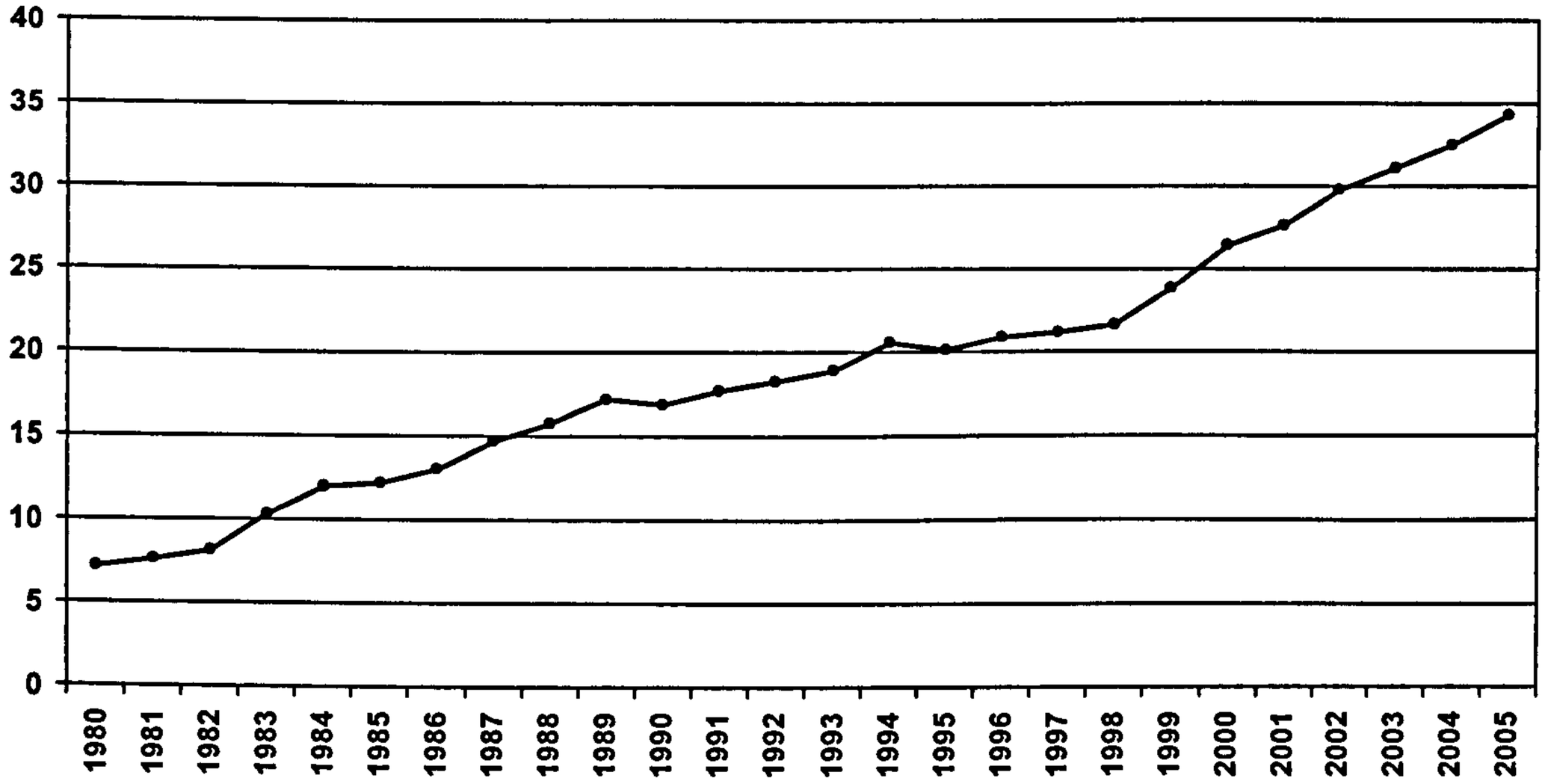


Figure 3.4

Private Credit / GDP: 1980-2005

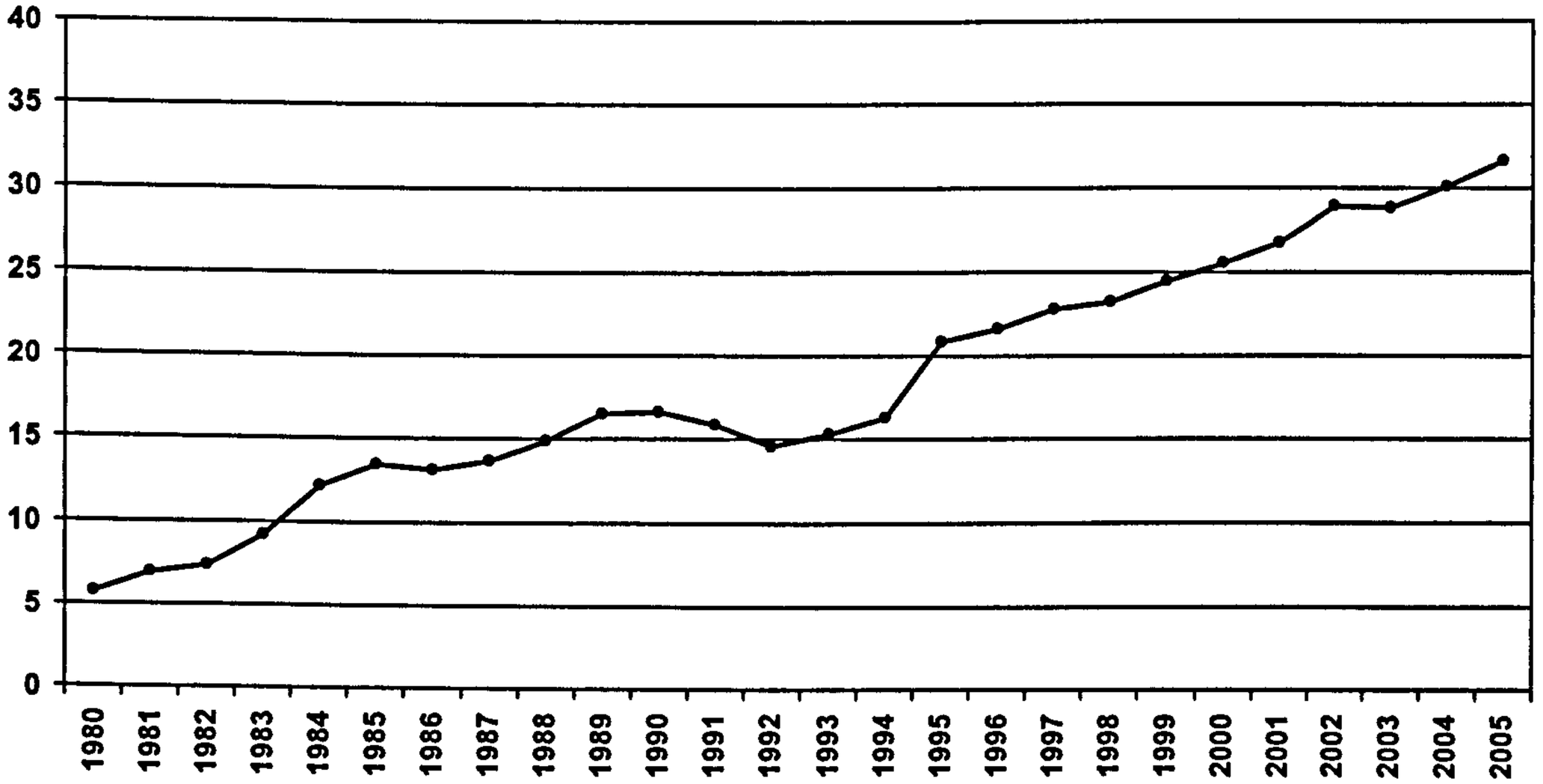
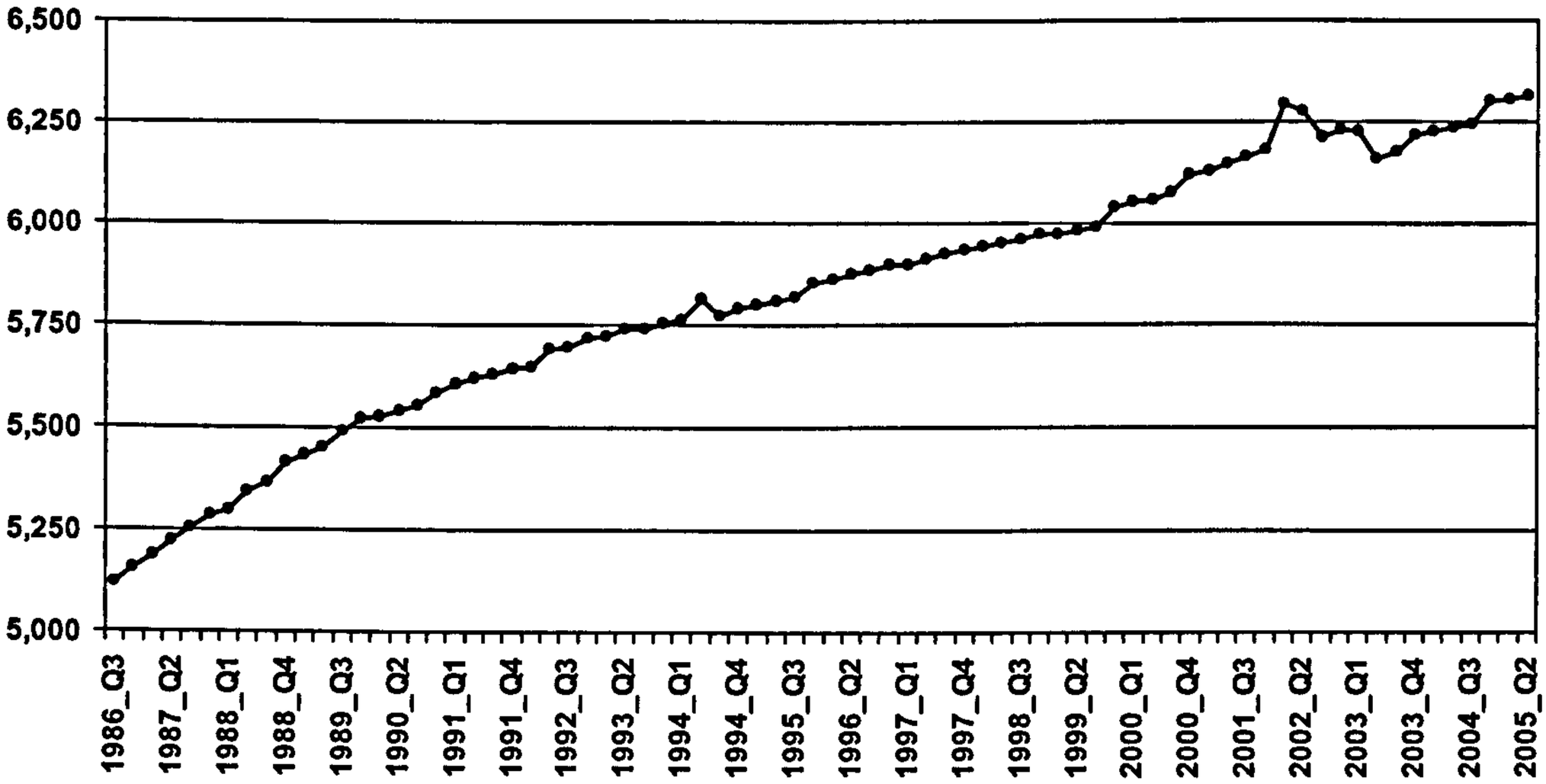


Figure 3.5

Number of Scheduled Banks: 1986Q3-2005Q2



Source: Bangladesh Bank *Economic Trends*

Figure 3.6

Number of listed companies: 1980-2005

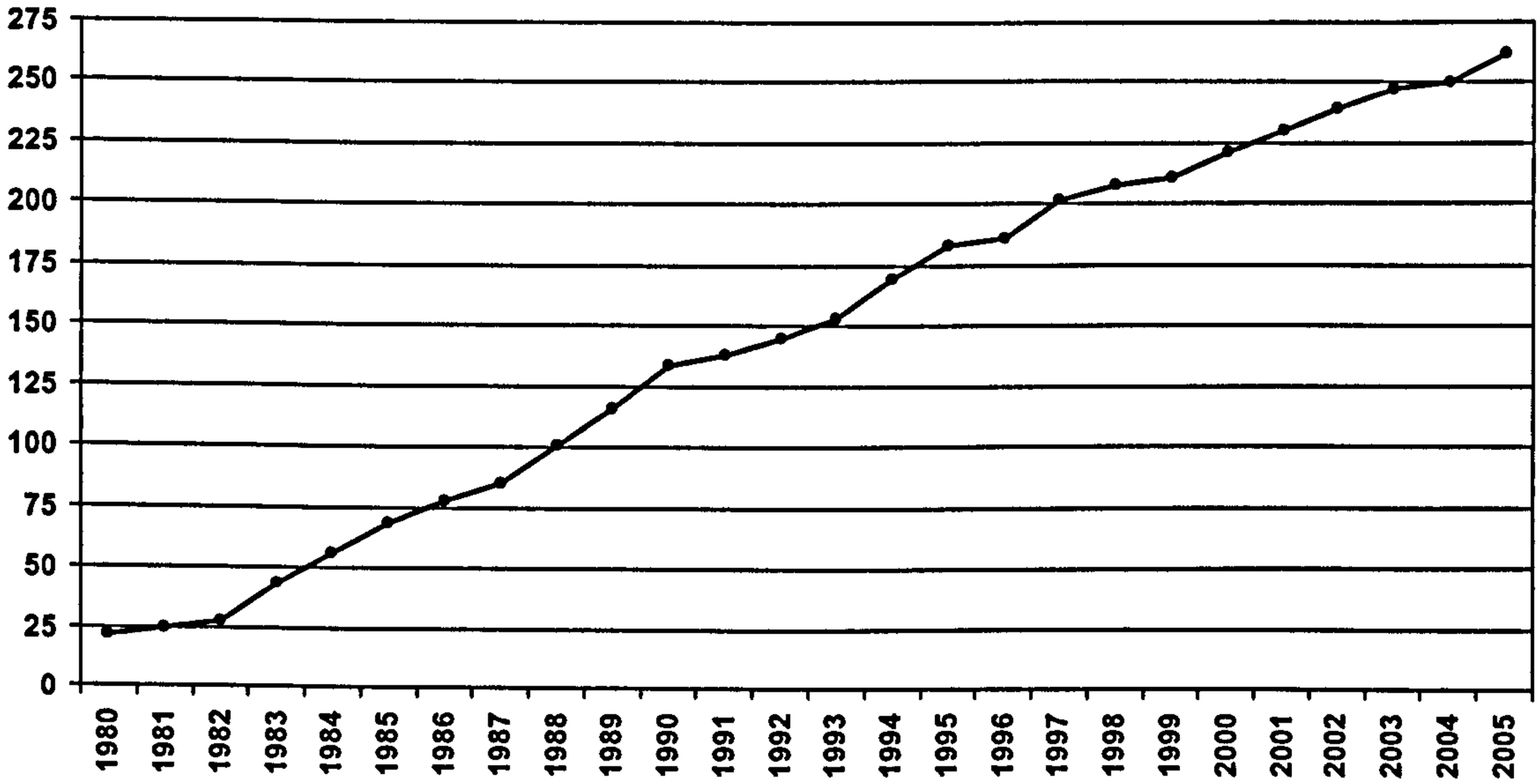


Figure 3.7

Total number of shares (millions): 1990Q1-2005Q4

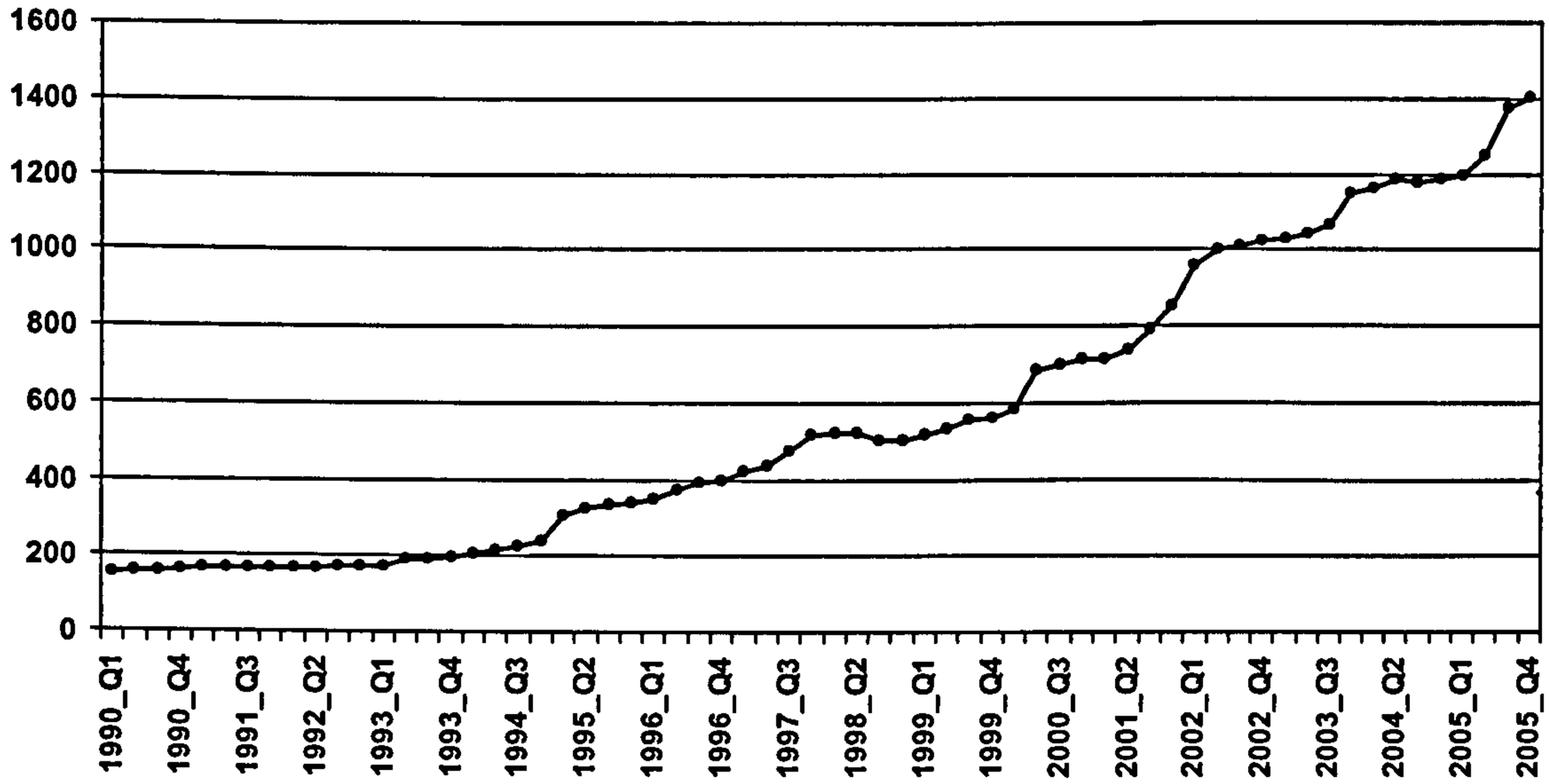
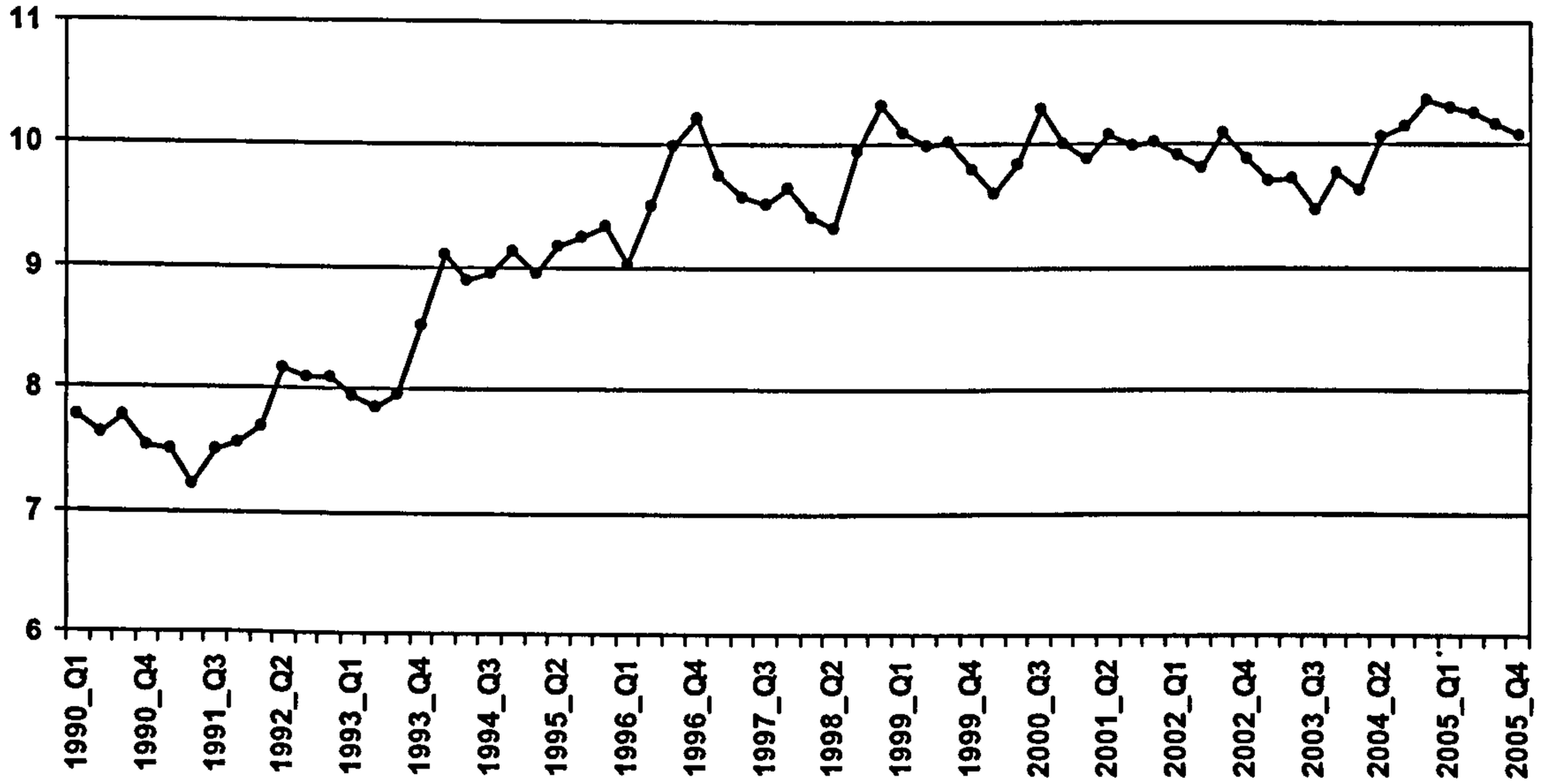


Figure 3.8

Log Value Traded: 1990Q1-2005Q4



Source (figures 3.7, 3.8): Dhaka Stock Exchange

3.4 A critique of financial policy reforms

As noted previously, the National Commission on Money, Banking and Credit was appointed by the Government of Bangladesh in 1986 with the aim of addressing some of the concerns regarding the status of the financial sector. Many observers felt it very necessary to identify and highlight what seemed like completely unjustifiable and highly inefficient features of the banking system. For instance, the Commission noted such features as high bank spreads, refinancing policy of the Bangladesh Bank, supply of needed loans to the rural and agricultural sectors, and even "supervisory problems, frauds and forgeries in the banking sector" (Bhattacharya and Chowdhury, 2003: p. 2).

Hossain and Rashid (1997) paint a picture of an underdeveloped banking sector that still has too many nationalized components and government regulations to be called competitive. Loans are currently not typically made based on assessments of project profitability and the probability of repayment. This happens for a number of reasons, including the political power of large lenders, faulty oversight of bank lending officials and a lack of legal or cultural repercussions for those who default on loans. An incentive system is needed for bank officials that alights interests with those of profit maximization.

Beck and Rahman (2006) pick up on this line of attack. These authors argue that while Bangladesh has embarked on a path to reform its financial system, most prominently by privatizing its government-owned Nationalized Commercial Banks (NCBs), sustainable development of the financial system requires a complete overhaul in the role of government. The government should move away from being operator and arbiter in the financial system to being more of a facilitator. This implies not only divestment from government-owned banks, but de-politicization of the licensing process and a market-based bank failure resolution framework that focuses on intermediation and not on the rescue of financial institutions. The government should also stop providing implicit guarantees for depositors and owners to applying the existing limited explicit deposit insurance for depositors. Regulation needs to come from market participants who would monitor and discipline banks instead. This redefinition of government's role is not to be limited only to the banking system, but should apply to other segments of the financial system as well such as capital markets and the micro-finance sector. In conclusion, the

agenda for financial sector and governance reform must be very wide-ranging with a view to move away from what the authors see as a relationship-based economy to a more market-orientated and arm's-length economy[6].

3.4.1 Assessment of Beck and Rahman (2006)

This section shall discuss the main assessments of the financial sector by Beck and Rahman (2006). These authors argue that a reduction in the level of government-owned banks, a de-politicization of the licensing process, and a market-based bank failure resolution framework will help Bangladesh to enable a sustainable and growth promoting financial sector. They suggest that the government should move away from the implicit guarantee[7] for depositors and owners, and rely more on market participants to monitor and discipline banks rather than the government itself micro-managing them. In sum, the authors are keen to promote the idea of a market-based, arm's-length economy rather than a relationship-based economy for Bangladesh.

In the post-reform period, the Bangladesh Bank required banks to go public at the stock exchange, where they would list 50% of their shares. Disclosure requirements became higher for financial institutions than for non-financial corporations: banks and non-bank financial intermediaries now must publish their annual financial statements in newspapers and ensure availability for public view in bank branches. Similarly, auditing requirements for banks are more stringent than for non-financial corporations; the Bangladesh Bank maintains a separate list of approved auditors for banks. However, the authors mention that because of the implicit guarantee for owners, creditors and depositors of all banks, these important improvements still cannot have served to enhance market discipline.

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[6] This conclusion does not seem to take into consideration the fact that relationship-based economies are linked with many of the most successful economies in the history of capitalism. Events in the global financial crisis of 2007-08 such as the spectacular collapse of Lehman Brothers and the part-nationalisation of some of the largest banks in the world point to the dangers of extreme 'arm's length' securitization.

[7] This seems highly impractical given the extent to which governments worldwide choose to intervene in their financial sectors in order to prevent financial crises from spreading. The suggestion by Beck and Rahman (2006) that the government should move away from the implicit guarantee for depositors and owners therefore strikes us as being "more Catholic than the Pope". Even the Untied States has Federal Deposit Insurance at hand to deal with problems and weaknesses in the financial system. Some governments like Sweden's in the early 1990s have also experimented with far-reaching bank nationalisation in order to deal with systemic risks posed by banking crises.

While the creditor and minority shareholder rights are relatively strong on paper, the enforcement is weak. Lenders and borrowers have to deal with an ineffective collateral system for movable and immovable assets. A recent World Bank report noted in 2003 that "the accounting and auditing practices in Bangladesh suffer form institutional weaknesses in regulation, compliance, and enforcement of standards and rules". While all incorporated companies must file annual audited financial statements with the Registrar of Joint Stock Companies (SEC), there is no effective enforcement of the timely and accurate filing. While listed companies are subject to additional oversight by the SEC, there are legal and judicial constraints to effective enforcement of this oversight. Companies also have failed to hold annual general meetings, pay dividends and comply with the disclosure requirements. Experience in Bangladesh as in other countries has shown that government-owned banks are often used by politicians to finance commercially unviable government projects or state-owned enterprises. Politicians also may use government-owned banks for electoral purposes. Although it privatized two of the six nationalized commercial banks (NCBs) in the 1980s and allowed private banking, Bangladesh started out the 21st century with a banking system dominated by government-owned banks and several weak privately-owned banks. The dominance by NCBs has fostered a culture of non-payment[8], has provided rents to more efficient privately owned banks and has distorted resource allocation. Bangladesh has recently embarked on a wide-ranging divestiture program for the NCBs. The restructuring and divestiture process, however, has been slow and plagued by political interference, resistance form labour unions, and judicial roadblocks.

While the Bangladesh Bank is formally independent, this is not reflected in reality: anecdotal evidence suggests that the licensing process is a political one, with the Bangladesh Bank following "recommendations" of the political class to allow new banks into the system. This has also caused a number of weak PCBs, plagued by insider lending and other owner abuse. No domestic bank has been allowed to fail except one (Eastern Bank, formerly BCCI), and weak banks are referred to the Problem Bank Monitoring Department within Bangladesh Bank where they are subject to special supervisory oversight and certain regulatory restriction and enjoy regulatory forbearance.The

[8] NCBs and SBs as of FY06 have non-performing loans of 22.94% and 33.68%. PCBs by contrast had non-performing loans of 5.45%.

dominance of government-owned banks and politically connected private banks and the reluctance to resolve the weak banks among them result in inefficiencies in the financial system. As weak banks have to cover loan loss provisions, this drives up the spread between lending and deposit rates and allows other healthy banks to enjoy rents in the form of higher profits. Given the politicized licensing process and the implicit guarantee extended by the Bangladesh Bank even for privately-owned banks, bank owners face large and unchecked incentives to take aggressive credit risk[9]. There are no incentives for depositors or other creditors to exercise any market discipline given the implicit guarantee.

3.4.2 Has the focus of financial reform in Bangladesh been misguided?

The presence of such deficiencies for an entire financial sector as highlighted above by many observers appears quite alarming at a first glance. These observers appear justified in therefore suggesting that Bangladesh is in dire need of a strongly performing financial system which operates efficiently in a highly competitive market environment. But that does not go far enough. The financial sector must be closely monitored and overseen by responsible and reputable regulatory agencies, who do not seek to abuse in any way the existing apparatus for their own personal benefit. Moreover the financial system should be very responsive in fulfilling the needs of every economic agent with a profitable investment project. Finally, and above all else, the emphasis in Bangladesh should be on strengthening and improving the commercial banks, with little or no emphasis on other aspects of the financial sector such as equity and bond markets.

The above paragraphs sum up the majority of the views of observers, policy makers and other interested parties when asked about the current status of the financial sector in Bangladesh or about new announcements for financial reform. While these commentators are eager to waste no time in pointing out perceived market failures and misallocation of funds or resources, they appear to ignore institutional features and the economic and political realities which are driving the financial system itself. By disregarding the

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[9] In Bangladesh the lenders and borrowers are often the same groups of people. There is in other words a culture of secrecy in lending practices, mostly in the capital city Dhaka. In this situation, it may not be the case that aggressive credit risk will necessarily occur. This indicates the presence of complicated borrower-lender relationships for which standard economic models – which are mainly concerned with static behaviour – are ill suited for.

importance of these wider issues and providing a standard list of policy recommendations, the end result has been that the finance-growth nexus in Bangladesh has firstly not been properly assessed, and secondly the growth-enhancing impact of financial development has not been as high as it might have been.

While financial sector deficiencies certainly need to be identified, the course of action to be undertaken needs to be carefully formulated after the particular institutional environment has been appreciated. This includes a careful analysis of social, economic and political characteristics of firm-borrower relationships. It also requires a sound understanding of the reasons why firms in Bangladesh desire debt finance and equity finance along with other related financial services which both banks and stock markets provide. One needs to particularly allow for the economic circumstances of the country being investigated. The activities and strategies of the banking sector are affected by the wider economy. Bank operations for instance are affected by the potential performance and profitability of the firms which they lend to. If economic growth potential in Bangladesh is weak due to some structural weakness[10], banks might naturally choose to respond by restricting their loans and services. Banks might also restrict lending simply due to the pure operation of competitive market forces given the prospects in the economy – in order words, banks can refuse to give loans due to the poor projected return on projects which firms are currently undertaking. But even here, the essential role of monitoring firms give banks a unique advantage in making (forcing?) firms to act diligently and thereby ensure the highest return on the project (for a given level of risk).

Bangladesh is operating under an environment of severely high asymmetric and transaction costs. This can lead to the development of corruptive practices and it can stifle the attempts of policy at removing financial sector deficiencies. Even if the practices and activities of banks appear much like sub-optimal behaviour to the outsider, a closer look at the institutional environment reveals that such inefficient behaviour may partly be in the best interests of bank owners. Certainly this is not an ideal situation. It means that profitable and innovative projects may ultimately be unable to secure finance. However,

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[10] In Bangladesh some of this structural weakness is undoubtedly a direct result of inefficiencies and corruptive practices within the financial system. This is where policy can potentially have an impact on improving financial activity and enhancing growth. But as we argue in Chapter 4, such policy reform is likely to be beneficial only when enough appreciation is given to the way the '*entire picture*' and the '*five main effects*' operate together with the institutional framework of the country.

such a system provides a workable short-term fix to the problem of institutional weakness in the economy, and it allows for continuous deposit taking, some level of credit issuance, and even some investment to take place.

Given this description of life in Bangladesh, any long-term improvement will only materialize if weaknesses in *both* the real economy (i.e. weak legal framework) *and* the financial sector (i.e. restructuring of nationalized or privatized banks, expanding and improving the small and volatile stock market) are simultaneously addressed. What has happened in the case of Bangladesh is that the need to come up with easily applicable, 'quick fix' policy recommendations has not helped the process of development. Policy makers and economists have failed to appreciate the overall institutional picture and have not given enough consideration to the various forces operating within the finance-growth nexus and the overall financial system.

The literature provides strong support for a hands-off approach to the issue of bank regulation. In a recent cross-country study, Beck et al. (2006) examine the relationship between bank supervision and the degree to which bank corruption is an obstacle to firms raising external finance. The authors find the following results. Firstly, countries with powerful supervisory agencies tend to have firms that face greater obstacles to obtaining bank loans because of corrupt bank officials than firms in countries where the supervisory agency is less powerful. Secondly, powerful supervisory agencies are prone to capture and manipulation by politicians, regulators, or both. These results support the 'private monitoring view' which emphasizes that bank supervisory strategies should focus on forcing accurate information disclosure and not distorting the incentives of private creditors to monitor banks. The authors also find that private monitoring is particularly beneficial in countries with sound legal bureaucratic institutions.

In the context of Bangladesh, what this research says is that excessive government intervention will not help and may even hinder bank development and financial soundness. The more powerful the overseeing agencies are the greater is the possibility that corruption and manipulation (which are extremely high in Bangladesh) will take hold and negate any positive impact of financial reform policies. A more effective approach

for Bangladesh would therefore be one that emphasizes private monitoring, where 'correct' incentives should ensure that the right kind of regulation takes place[11].

The arguments of Beck et al. (2006) and the Bangladesh-specific study of Beck and Rahman (2006) are therefore firmly against what the authors call the 'micro-managing' of financial institutions during periods of non-performance and other problems. But what we find in reality is that such intervening behaviour is not just restricted to developing countries. The United Kingdom for instance experienced an incredibly damaging bank run as a result of the 2007-08 global credit crunch and financial crisis. The government eventually had to state to the financial markets and to the media that it was not prepared to let the Northern Rock Bank collapse. This was the case despite the long-standing position by the Bank of England that it would not bail out financial intermediaries when they were in trouble, preferring instead to let market forces determine their fate. This example is a good illustration that even advanced countries sometimes find the need to inject liquidity through buying up stakes if a major bank is having difficulty. The regulatory authority in Bangladesh therefore should not be singled out for coming to the aid of its banks. Rather it is concerned that future prospects for the domestic economy could be severely hit should any of its main banks suffer. Banking is different from other industries because depositors savings must be protected and, even more importantly, because a breakdown in bank lending has catastrophic effects on the flow of credit to the economy as a whole. Moreover, banks finance a significant fraction of their loans through the deposits of the public. A public good (access to a safe and efficient payment system) is therefore provided by private institutions (commercial banks). These two reasons (protection of depositors and the safety and efficiency of the payment system) have traditionally justified public intervention in banking activities.

The prevailing view in the literature is that governments are bad owners for banks. They are seen to be heavily conflicted as politicians often push banks to lend freely in order to make voters and important business leaders content. In Bangladesh such politically motivated lending has been a problem which has undoubtedly resulted in a lower rate of growth. The consensus in the literature is to favour banks being privatized rather than remaining under the influence of the state (see for instance Beck and Rahman, 2006).

[11] Beck et al. (2006) offer no firm theoretical basis for this private monitoring claim: the authors rely instead on coefficient from cross-country regressions.

Nevertheless, focusing the debate solely on the pros and cons of privatization vs. nationalization in the banking sector misses the point. As the recent global financial crisis of 2007-08 has shown, the landscape for banking supervision, the role of ratings agencies, and the scope for regulatory power has now fundamentally changed. In the aftermath of the collapse of Lehman Brothers in September 2008, governments in the US, Britain and elsewhere in Europe have been forced to inject unprecedented amounts of capital and in some cases have brought their leading banks under partial or full nationalisation[12].

The important question we should be asking is the following: is the financial system in Bangladesh being allowed to operate with a reasonable level of effectiveness? By 'reasonable', we are asking in relation to the current institutional and political climate of a developing country. A secondary question would be: are the banks not being restricted or hindered in any major way? That is, can banks in Bangladesh make loans to whomever they wish, including preferred groups of individuals? [13] And the answer to both questions in recent times appears to be yes. The present system is acceptable by the Bangladesh authorities, the banks themselves, and even the population at large. While there are many calls for improvements in regulation and reform, the financial system in Bangladesh continues to function, adapt and respond to the changing needs of investment[14].

We are not excusing in any way the corruptive practices which some studies have found to permeate almost every level of society in Bangladesh[15]. Many of these practices have

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[12] The UK government for example was forced to intervene in October 2008 and invest in Lloyds TSB, HBOS and Royal Bank of Scotland. These banks altogether took £60bn in a move that left 58 per cent of RBS and 43 per cent of Lloyds Banking Group owned by the taxpayer. This has led to a deepened recession and a contraction of bank credit. Interestingly such a credit crunch has now increased the number of companies looking to list on the equity markets to help offset the burden of debt on their balance sheets.

[13] While such lending to preferred individuals or groups is inefficient, from the perspective of banks such an arrangement may be optimal given the existing institutional framework of the country. Lending to connected political individuals and businesses may result in losses to the banks if these loans are not repaid, and this seems to be the case in Bangladesh. But this does not explain why the inefficient arrangement continues to be feasible, why these losses are having few consequences on bank managers, and why the flow of deposits has continued thus avoiding a banking crisis in the country. It is in this light that our empirical results on the stock market for Bangladesh are especially striking. They point towards a potentially huge interest in the future growth of stock market development, which in fact can be traced as early as 1980 (and gaining momentum since the early 1990s – see the figures for number of listed companies, total shares, and trading levels earlier in the chapter).

[14] The literature review in Chapter 2 shows that development of the stock market in Bangladesh can be related in principle to the changing requirements of firms and investors (and in particular to the development of banks and the growth process).

[15] See for example rankings by Transparency International and the Heritage Foundation.

resulted in relatively low levels of financial development, depressed the level of human capital and skilled manpower, and have very likely retarded growth (although paradoxically growth has remained relatively consistent in recent decades). Nor do we take a position regarding the pros and cons of relationships in loan transactions and dealings. What we are stating simply is that the institutional make up in Bangladesh – the operating environment in the real sector, the financial sector, and the laws and regulations that are in place – did not just suddenly materialize. Rather the financial architecture has been the result of a continuous process of evolution and adaptation. The country in other words has inherited a financial system of its own choosing.

It light of these issues, it may be inappropriate to push for an across-the-board restructuring of the entire financial sector given that the financial sector itself has developed to suit the needs of the existing institutional climate in Bangladesh. The level of opposition from certain groups would be certainly be extremely high and would likely stifle such policy reforms. Individuals could also decide to move their operations in an attempt to adjust for the effects of new policy, and in the worst case scenario may even take entire investments abroad resulting in capital flight out of the country. The overall impact of such over-reaching policy could therefore be highly detrimental to economic growth, which is exactly the opposite outcome that reformers hope for.

The fact that some of these financial funds and investment projects might end up lining the pockets of a small circle of high-powered individuals and elite groups[16] is more of a social problem rather than an economic one. Economics seen in this context is not particularly suited to distinguishing one set of institutions from another set. Economic forces always will continue to exert some influence regardless of the type of market structure present. In this context, economic forces will therefore continue to operate in the financial sector. We think this has been the case for Bangladesh. Our empirical analysis has uncovered evidence to support a number of channels operating within the finance-growth nexus that are justified in accordance with various theoretical models (but only if insights are combined appropriately). One suggestion given these findings is that the finance-to-growth effect has not been as high as it could have been. We are in agreement with this view. This raises the question of what could be done to further improve the

[16] Again, there are numerous rankings, surveys and questionnaire results for Bangladesh which point towards the dominance of corruptive practice in day-to-day affairs.

growth-enhancing effect of financial development in Bangladesh. The finance-growth nexus empirical results uncovered in Chapter 6 for example allow for greater insights but at the price of being less tractable in policy recommendation terms. The answer to the question of what needs to be done is therefore not one-dimensional or easily straightforward; it is rather multi-dimensional. A number of policy recommendations could be considered given that the real and financial sectors are linked together in a bi-directional relationship. This will become clearer once we overview the '*entire picture*' and the '*five main effects*' in the next chapter.

3.4.3 Are bank spreads excessively high in Bangladesh?

High interest spreads are sometimes justified by arguing that banks provide efficient and quality customer services. However, the demand for cheaper credit pushes for a lower lending rate which would lead to a higher volume of credit. The solution is for market clearing to ensure a competitive level of interest. Yet the question remains: are prevailing spreads excessive? There are two possible reasons for persistent high interest rate spreads in Bangladesh. Either spreads are high due to competitive operation of market forces, or the financial system is not free from restrictive practices and various imperfections. While most of the work on the financial sector in Bangladesh has focused mostly on various structural weaknesses and inefficiencies, one should appreciate that the overall institutional environment in Bangladesh is a difficult one for banks to operate in. According to its own publication, *The Financial Sector Review*, the Bangladesh Bank has stated that the high interest rate spread reflects to some degree institutional inefficiency, which originated from the Government's interventionist policies. They add that if the situation of high spreads continues then private sector investment 'may be jeopardized' (2006: p, 60).

By contrast, a recent report[17] found that the main drivers of spreads in Bangladesh are a) the cost of funding, provision for non-performing loans (NPLs), the excessive costs of funding unremunerated assets (liquidity requirements); and b) the need to create enough net income to pay taxes and still leave enough to retain as extra capital to support ongoing growth. Spreads on average were high in Bangladesh but not excessively so, and

[17] "Bangladesh: reducing interest rate spreads", *First Initiative: Strengthening Financial Sectors*, Oxford Policy Management Ltd (2006)

not out of line with the experience in many developing and transitional economies, or in general with the costs and risks of doing banking in Bangladesh. Private commercial banks (PCBs) charge spreads – which averaged 5.5% - that are just high enough to cover net costs, pay taxes and maintain their minimum required capital plus some extra for shareholders. Furthermore, current lending rates at the lower end of the ranges quoted by banks were judged not to be seriously out of line with the prevailing levels of inflationary expectations in Bangladesh. Overall the conclusion is that there are no major issues in the level of interest rates and spreads in Bangladesh.

3.4.4 The changing distribution of urban/rural bank branches in Bangladesh

In Bangladesh there has been an increasing bias towards urban loan allocation and a shift of resources away from the rural sector. Not only has there been more emphasis on urban loan allocation, but the gap between urban and rural allocation itself has increased recently. Table 3.3 shows the trend of faster urban bank development relative to rural bank development. In 2002 it was announced by the Bangladesh Bank that 500 bank branches were to close, mainly under pressure from the World Bank and other multilateral agencies. The reasoning behind the decision was that the country's high level of bad debt and high surplus workforce in the financial sector were crippling the performance of the nationalised commercial banks. The governor of the Bangladesh Bank, Dr Farkhruddin Ahmed, identified approximately 800 branches belonging to state-owned commercial banks which had failed to make any profit in the preceding 5-year period, 500 of which were to be closed over a phased period of 3 years. Loss-accruing banks would be merged with nearby branches, however in addition at least one other branch must be within a five kilometre radius of the present branch location. This policy therefore has given preference to intra-bank merging and also inter-bank merging where necessary.

Many of the branches eventually closed were located in rural areas. Interestingly while the total number of bank branches was reduced after 2004, the labour force from the recently closed banks was simply transferred to other banks in urban areas[18]. Thus while there has been an upward trend in urban bank development and also to a degree in rural

[18] Detailed data on the split between urban and rural banks in Bangladesh is unavailable.

bank development, urban bank growth has expanded much faster. The urban sector constitutes the bulk of the share of credit allocation (and therefore deposit-taking). This demonstrates the influence that fast-paced growth in the main cities has on financial development, especially the huge influence of the capital Dhaka.

Table 3.3

Bank branch distribution in Bangladesh

	Urban	Rural	Total
1990	1900	3685	5585
1995	2242	3610	5852
1998	2349	3622	5971
2001	2502	3680	6182
2004	2579	3724	6303

Source: "Financial sector reform in Bangladesh: Developments and achievements", presentation given by Fakhruddin Ahmed (November 2005).

We mention here in passing that the disproportionately high (in terms of profitability) number of banks may have been required in Bangladesh due to barriers that resulted in high operation costs and also possibly because of a low level of overall expertise. Bhattacharya and Chowdhury (2003) are also in agreement with this view. They argue that "it is not the profit and loss of individual branches, rather the aggregate financial viability of a bank which matters most. If profit making is the only criteria for keeping a bank in business, then possibly we need to close down most of the state-owned banks which are effectively in red" (2003: p. 7).

Data at the individual bank level regarding private banks vis-à-vis state banks, the distance between bank branches, bank lending performance rates, and competitive behaviour within the sector is notoriously difficult to assess in Bangladesh. Much of the information is kept well-guarded and regulators often are forced to guess the level of these indicators. We therefore must look at other research for clues as to the relative importance that such factors may have on bank efficiency and bank intermediation costs. Degryse and Ongena (2005) assess the impact of geographical distance on activities of financial intermediaries through spatial price discrimination in Belgium. Banks can derive market power *ex ante* from their relative physical proximity to the borrowing firms or *ex post* from private information they obtain about firms during the course of the

lending relationship. Banks located closer to borrowing firms enjoy significantly lower transportation and monitoring costs, to such an extent that "if other banks are relatively far, close banks have considerable market power" (Petersen and Rajan, 1995, p. 417). Degryse and Ongena (2005) find that loan rates in Belgium decrease with the distance between the firm and its lending bank, and increase with the distance between the firm and competing lenders. The increasing distance between the borrower and alternative lenders is shown to signficantly relax price competition and results in substantially higher borrowing costs for the firm. This would seem to imply that transportation costs, not information asymmetries, are probably the main basis for the spatial price discrimination that is observed. Typically in order to obtain a loan, a new borrower has to visit the bank branch between two and three times. A repeat customer, on the other hand, is not required to undertake additional visits. Spatial price discrimination targeting borrowers located near the lending bank branch yields average bank rents of around 4% of the bank's marginal cost of funding. Taken together, these findings point towards an important source of rents accruing to financial intermediaries based on location. We include this study by Degryse and Ongena (2005) here because the Harrison et al. (2004) model deals with spatial bank competition.

3.4.5 The issue of non-performing loans in Bangladesh

The reader is referred to the thorough analysis of non-performing loans for Bangladesh in the report by Beck and Rahman (2006). NCBs and SBs as of FY06 have non-performing loans of 22.94% and 33.68%. PCBs by contrast had non-performing loans of 5.45%. This suggests that PCBs might be in a better position to deal with the issue of outstanding loans. Restructuring and divestment has been urged for the remaining NCBs in order to ensure their financial viability. The financial weakness of the remaining NCBs is seen by many as not being supportive of competition in the banking sector. Although the industry share of NCBs has declined over the past decade, it still commands around 35% of all scheduled bank advances as of December 2006, 23% of which remain classified[19].

[19] Here again, the culture of secrecy in Bangladesh banking denies us access to more detailed data. Ideally we would like to know more about the split of this figure with regards to repayment horizon, or at the very least the change in this figure over time. It is ironic that the availability of data on the stock market is superior to that of the banking sector.

However, the view of reducing dominance of the NCBs in favour of PCBs is likely to be resolved only when a detailed micro study at the bank branch level is undertaken for Bangladesh. Such a study would prove highly useful at describing the characteristics of old, existing and new borrowers and would allow for effective policy implementation.

3.4.6 Prudential regulation: the effect of regulatory forbearance

Brownbridge, Kirkpatrick and Maimbo (2005) highlight various weaknesses in prudential regulatory systems in developing countries. Here we shall concentrate on a particular weakness which we believe also to be prevalent in Bangladesh: *regulatory forbearance.* This describes a situation where regulators often fail to enforce prudential regulations properly. The regulator – sometimes intentionally – delays in explicitly recognizing that a bank is insolvent and therefore fails to close it down to prevent any further losses to its depositors, or fails to force the bank owners to recapitalize the bank at a fast enough pace. Regulatory forbearance has a number of causes including regulators facing political pressure to allow forbearance, the fact that the owners or debtors of distressed banks are politically influential, or because government fears that bank closures, with the attendant job losses and disruption to bank customers, will be politically unpopular. Political pressure for regulatory forbearance is likely to be strong in many DCs because of the concentration of political and economic power, including ownership of the banking system, in a few hands (Caprio and Honohan, 1999, pp. 10-11). Maimbo (2001) argues that in some cases a third form of forbearance is also prevalent, which is *bureaucratically institutionalized regulatory forbearance.* This form of forbearance may not only be embedded in the formal and informal administrative policies and procedures for effecting legislative and supervisory sanctions, but it may also become part of the organizational culture of decision making within the regulatory agency or central bank. The consequences of this include taking excessively long in order to implement corrective action, not only because of political and economic concerns but also because of the exhausting administrative policies and procedures. Regulatory processes may be further complicated by the decentralized responsibility structure in existence at the central bank operating within a highly-centralized decision-making environment.

3.4.7 Is the banking sector in Bangladesh competitive?

The nature of competition and structure in South Asian banking sectors is examined by Schrimal et al. (2006). These authors assess whether traditional interest-based product market segments are more competitive than those that also include fee- and commission-based products. Results for Bangladesh (and also Pakistan) show that competition is greater in the traditional interest-based product market. Results for India and Sri Lanka show more monopolistic competition in the fee-based product market. The results for all South Asian countries clearly reject the existence of market power except that created by differentiated products which offer unique utility to customers. This would seem to imply that ongoing financial deregulation and market liberalization in South Asia appears to have had an impact on the competitive structure of banking sectors. We review this influential paper in more detail.

Schrimal et al. (2006) examine commercial bank revenue behaviour and the nature of competition in South Asian countries including Bangladesh over the period 1995 to 2003. They distinguish between two types of bank revenue: interest-based markets including products such as loans and investments in financial instruments that generate interest income for banks; and fee- and commission-based services such as underwriting, guarantees, consultancies, and foreign currency conversions. Perera et al. (2006) test whether or not South Asian banks – India, Sri Lanka, Bangladesh, Pakistan – face monopolistic competition. Models are estimated using pooled OLS and fixed effects, with data obtained from a proprietary database covering more than 70% of total bank assets in each of the four countries considered.

Formally the authors apply the Panzar and Rosse (PR) approach based on properties of reduced form revenue function at the firm level. The statistic obtained is the *H* statistic, which proxies competitive behaviour of banks. This methodology behind the *H* statistic is shown to exploit the proposition that pricing reactions to changes in input prices depend on the market structure in which they operate. The test is derived from a general banking market model, which establishes the equilibrium output level and number of firms. The assumptions of the PR model include (a) profit maximization at firm and industry levels; (b) equilibrium in the industry; (c) conventional demand and cost structures; and (d) banks are single product firms. Firm *i* maximizes its profits where marginal revenue (a function of the output of the bank *i*, the number of firms and exogenous variables) equals

marginal cost (a function of the output of the bank *i*, input prices of firm *i*, and exogenous variables). At the industry level, when firms are in equilibrium, zero profits occur. Market power is then assessed by the extent to which a change in input prices is reflected in the equilibrium revenues earned by bank *i*. This then derives the *H* statistic.

Panzar and Rosse (1987) show that the *H* statistic cannot take positive values if each bank operates independently as under monopoly profit maximizing equilibrium. Due to the optimality condition for the monopolist, an increase in factor prices increases marginal costs of the firm reducing the equilibrium output level and total revenues. Under monopolistic competition, the H statistic is positive and varies between zero and unity (Panzar and Rosse, 1987). This is based on the premise that under monopolistic competition, individual firms face an inelastic demand curve and hence revenues increase less than proportionately to changes in factor input prices. In other words, a positive *H* value indicates that the data are not consistent with individual profit maximization as under monopoly.

Overall, the equilibrium tests of Schrimal et al. (2006) suggest that in each banking market input prices are not correlated with industry returns – that is, the authors cannot reject the null hypothesis that these markets are in equilibrium. The competitive position is thus supported in South Asia. Results for Bangladesh in particular reveal statistically large *H* statistics that are consistent with monopolistic competition. This is the case despite the high level of government ownership of banking assets. With regards to the degree of competition, the *H* statistics of the interest based product market are greater than those of total market. Traditional interest based banking in Bangladesh is thus more competitive than overall market (fee- and commission-based) banking).

3.5 Background to the Dhaka Stock Exchange

The Dhaka Stock Exchange was first incorporated in the East Pakistan Stock Exchange Association Limited. Formal trading began in 1956. In 1962 it was renamed as the Dhaka Stock Exchange (DSE) Limited. After 1971, trading activities on the DSE were ceased due to the liberation war and also due to the economic policies pursued by the then ruling Government. Trading resumed in 1976 when the Exchange was re-opened. The DSE is

registered as a Public Limited Company and its activities are regulated by its Articles of Association and its own rules, regulations and by-laws along with the Bangladesh Securities and Exchange ordinance, 1969; the Companies Act, 1994; and the Securities and Exchange Commission (SEC) Act, 1993. Management is appointed by the Board with the approval of the SEC. Trading on the DSE is done through an automated on-line system every day except Friday and other government holidays. There are four markets: 1) the Public Market: only trading of market lot share is done here through automatic matching; 2) Spot Market: spot transactions are done here through automatic matching which must be settled within 24 hours; 3) Block Market: a place where bulk quantities of shares are traded on a pick and fill basis; 4) Odd Lot Market: odd lot scripts are traded here based on a pick and fill basis. All transactions in the public market are settled and cleared through the DSE Clearing House. Members of the DSE are permitted to carry out transactions of foreign buyers and/or sellers involving a custodian bank.

3.5.1 Stock market reforms in Bangladesh

To supervise the smooth functioning of securities and capital, the Securities and Exchange Commission (SEC) was established in 1993 through an Act of Parliament. It has the important responsibility to ensure proper issuance of securities. Protection of due interest of the investors in the capital market is also a major objectives of SEC. The Commission's main functions included the following:

1) Regulating the business of the stock exchange and the securities market;
2) Registering and regulating stockbrokers, sub-brokers, share transfer agents, bankers and managers of an issue, registrars to an issue, underwriters, portfolio managers, investment advisers and other intermediaries;
3) Registering, regulating and monitoring collective investment and mutual funds;
4) Prohibiting fraudulent and unfair trading practices;
5) Promoting investment education and training of all intermediaries;
6) Prohibiting insider trading in securities;
7) Regulating substantial acquisition of shares or stocks and take-overs of companies,
8) Compiling and publishing indices on the financial performance of any issuer;
9) Conducting research for the above purposes.

The DSE became a fully computerized, continuously trading order-driven market in August 10th 1998[20]. Investors' orders are executed through an auction process one by one upon placement such that prices are determined multilaterally. Agents submit orders to a centralized system, which displays the best limit orders and automatically executes incoming market orders against them. As trades are executed, the transaction prices and quantities are automatically displayed on-screen so that all market participants can trace the recent history of the order flow. The DSE is therefore an example of a pure order-driven market. Security prices are determined by the buy and sell orders submitted by investors in the absence of designated market makers. Limit orders are placed through brokers and are consolidated into the electronic limit-order book and executed through the automated trading system. The limit orders for a specified price and quantity are stored in the system and executed using strict price and time priority.

Prior to the introduction of electronic trading, significant developments included a move to allow 100% foreign based purchase of equities along with repatriation of dividends in 1991. International equity capital flows have been low, apart from interest shown during the 1993-94 period when major gas reserves were discovered. There has been a trend of gradual increases in the number of companies that are available for trading. With the success of big public issues in 1994 and 1995, entrepreneurs may have presumed the securities market to be an alternative to bank-based system as a source of industrial financing. It was estimated that an aggregate amount of Tk 20 billion has been raised against public issues, right issues and private placement of shares and debentures during 1992 through 1996. This phenomenon attests to the depth and breadth of the market in even a low-income developing economy.

During the middle of 1996, a remarkably huge surge in stock market activity led to an inevitable crash in December 1996 and a market correction lasting nearly two years. The stock market crash occurred mainly as a result of market manipulation by a section of stockbrokers in collaboration with some other market participants (Report of the Committee formed by SEC, 1997).

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[20] A second stock exchange named the Chittagong Stock Exchange (CSE) was opened on 10th October 1995. While we only have data for the Dhaka Stock Exchange (DSE), the CSE has also shown impressive development in its automated trading system (CHITTRA): the CSE in fact established its nationwide automated trading platform two months before the DSE did.

Improvements in regulation and accountability have slowly helped to restore investor confidence both domestically and internationally. In November 2001, the main index of the DSE was re-weighted, and in 2004 a central depository system was established. In August 2005 a new trading platform was introduced. The trend observed recently in the DSE has been one of fewer new initial public offerings being made, as regulation has recently become more enforced. For example, companies are now required to submit more stringent information when they wish to list on the primary market, and investors are now required to submit bank account details as well as the approximate size of the stock they wish to purchase. In January 2004, the Asian Development Bank approved a technical assistance grant to Bangladesh to help prepare a Financial Markets Governance Program (FMGP).[21] This built on a Capital Market Development Program loan approved in 1997 in order to promote good governance. The 5 main objectives are to:

- Strengthen regulatory and supervisory capacity
- Improve governance and operations of market intermediaries
- Boost corporate governance and public disclosures
- Raise accounting and auditing standards to comply with international norms
- Enhance market knowledge, institutional capacity, and skills of market participants.

3.5.2 DSE company details

This section takes a closer look at the company specifics of listed stocks on the DSE. There are presently 273 listed companies on the DSE with an aggregate market capitalization exceeding $7.0 billion (June 2007). This represents 11% of GDP up from 6% in 2006. The DSE General Index improved 60.5% by June 2007 and this was supported mainly by strong domestic institutional buying. While the DSE remains small compared to other regional countries, many observers believe that there is scope for huge growth in the stock market of Bangladesh. However, there has been no study to date which has carefully assessed the potential for stock market development in Bangladesh.

[21] http://www.adb.org/Documents/News/BRM/brm_200406.asp

Table 3.4

DSE company sectors: summary statistics

	No. of companies	% of total companies	% of total shares	% of total market capitalization	% of total shares traded	P/E ratios
Banks	40	14.65	19.81	56.16	57.99	18.02
Insurance	32	11.72	1.90	2.92	2.06	9.19
Investment	15	5.49	8.76	1.29	3.30	12.60
Engineering	23	8.42	4.30	2.54	2.37	21.40
Food & Allied	35	12.82	10.24	1.64	0.23	13.23
Fuel & Power	7	2.56	4.67	11.69	17.70	27.21
Jute	4	1.47	0.43	0.03	0.00	6.22
Textile	39	14.29	16.78	2.66	2.57	13.18
Pharmaceuticals	25	9.16	10.16	9.21	6.24	14.93
Paper & Printing	8	2.93	1.79	0.07	0.00	5.19
Services & Real Estate	5	1.83	3.47	0.44	0.17	6.88
Cement	8	2.93	6.06	7.43	4.68	12.34
IT sector	7	2.56	4.17	0.55	1.71	12.74
Tannery Industries	8	2.93	1.45	0.81	0.39	8.57
Ceramic Industries	4	1.47	0.29	0.14	0.02	16.63
Miscellaneous	13	4.76	5.72	2.40	0.56	15.26
Total	273	100.00	100.00	100.00	100.00	17.28*

Source: Dhaka Stock Exchange *Monthly Review*, June 2007

In table 3.4, Banks, Textile industries, Food and Allied industries, Insurance companies, Pharmaceuticals and the Engineering sector together form the majority (approx 62%) of companies listed on the DSE (see also figure 3.9). These companies are large in terms of their sales and revenue streams and they easily dwarf the income of other medium and small-size businesses in Bangladesh. The production levels and investment projects of these listed companies are highly important for the continuing growth of output of the Bangladeshi economy. Table 3.5 shows high levels of market capitalization and shares traded for the top 20 performing companies on the DSE.

The price-earnings (P/E) ratio[22] is a measure of the price paid for a share relative to the income or profit earned by the firm per share. A higher P/E ratio means that investors are paying more for each unit of income of the company. From table 3.4 it can be seen that the Bank, Fuel & Power, and Engineering sectors have comparatively very high P/E

[22] The P/E ratio at the bottom of the table denoted with a star is the P/E ratio based on the entire market.

ratios. This demonstrates that the bulk of demand for company shares lie in sectors which are mainly capital intensive, with banks of course the providers of capital.

While banks represent approximately 15% of all listed companies and 20% of the total amount of shares listed, they account for a staggering 56% of market capitalization and 58% of all shares traded. This suggests a huge bias in investor interest towards the banking sector in Bangladesh. There are two main reasons why investors seem to value the shares of banks so highly. Firstly, the bank sector in Bangladesh is viewed as an essential contributor to a growing economy and a natural provider of financial capital. Secondly, the unstable and uncertain climate of entrepreneurship in Bangladesh means that bank sector is one of the few sectors almost guaranteed to continue operation for the foreseeable future.

Investor preference for bank shares in the stock market is far from an isolated feature unique to Bangladesh. Freeman (2003) finds that for many Southeast Asian countries the bulk of market capitalization and trading is associated with the banking sector. While this reflects the importance of financial companies on the stock exchange, he cautions that having too much emphasis in one sector could result in investors not being able to rotate their funds effectively between other sectors in the market. The presence of an overpowering bank share of the market might therefore not be ideal from the point of view of portfolio diversification. While this cause for caution is reasonable, it may be that bank activity will end up supporting the stock market. If banks view their role on the exchange as one of importance then they will likely invest more time, resources and expertise into their market operations. Banks can provide advice for investors wishing to purchase equities, and they often help underwriting company initial public offerings (IPOs) on the stock market. This supports the view that banks and stock markets are complementary forces rather than simply substitutes for corporate finance. We shall that this complementary perspective is a recurring theme throughout this thesis.

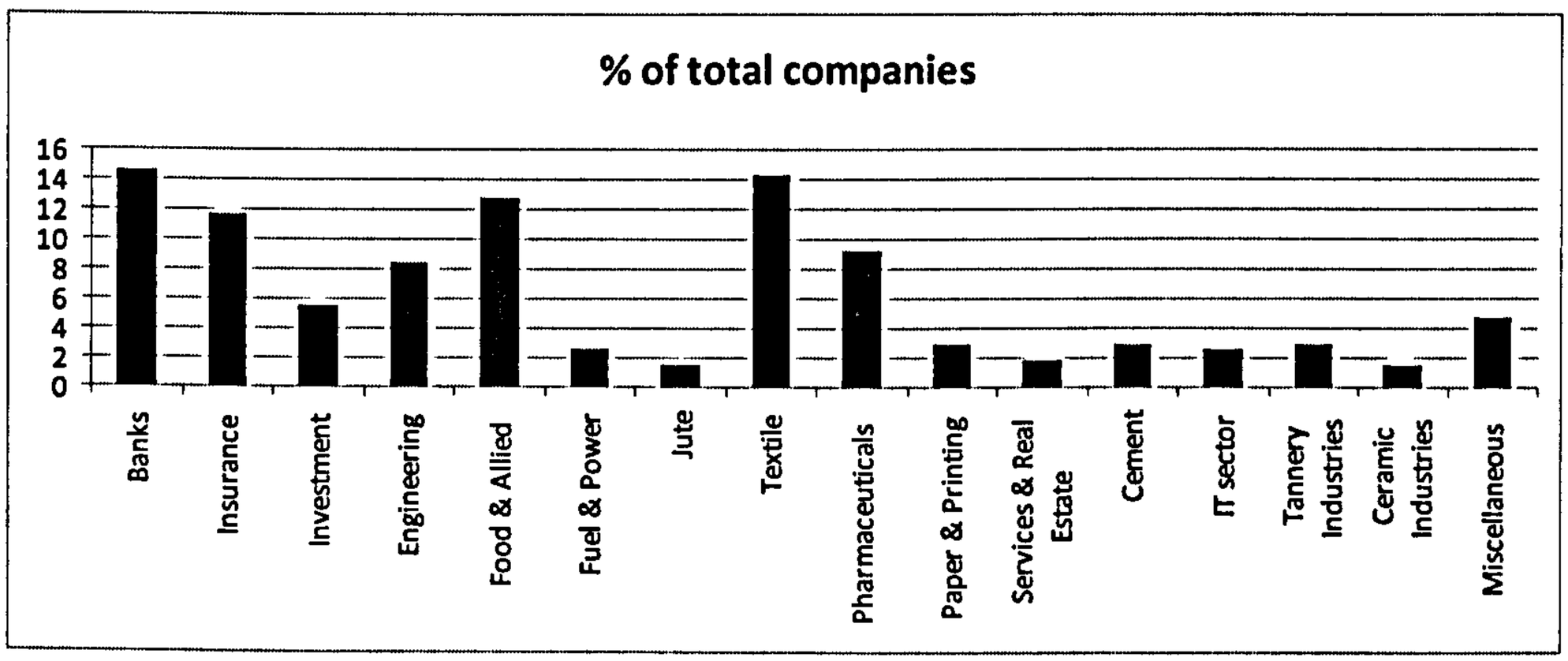
3.5.3 Are the firms listed representative of the whole economy?

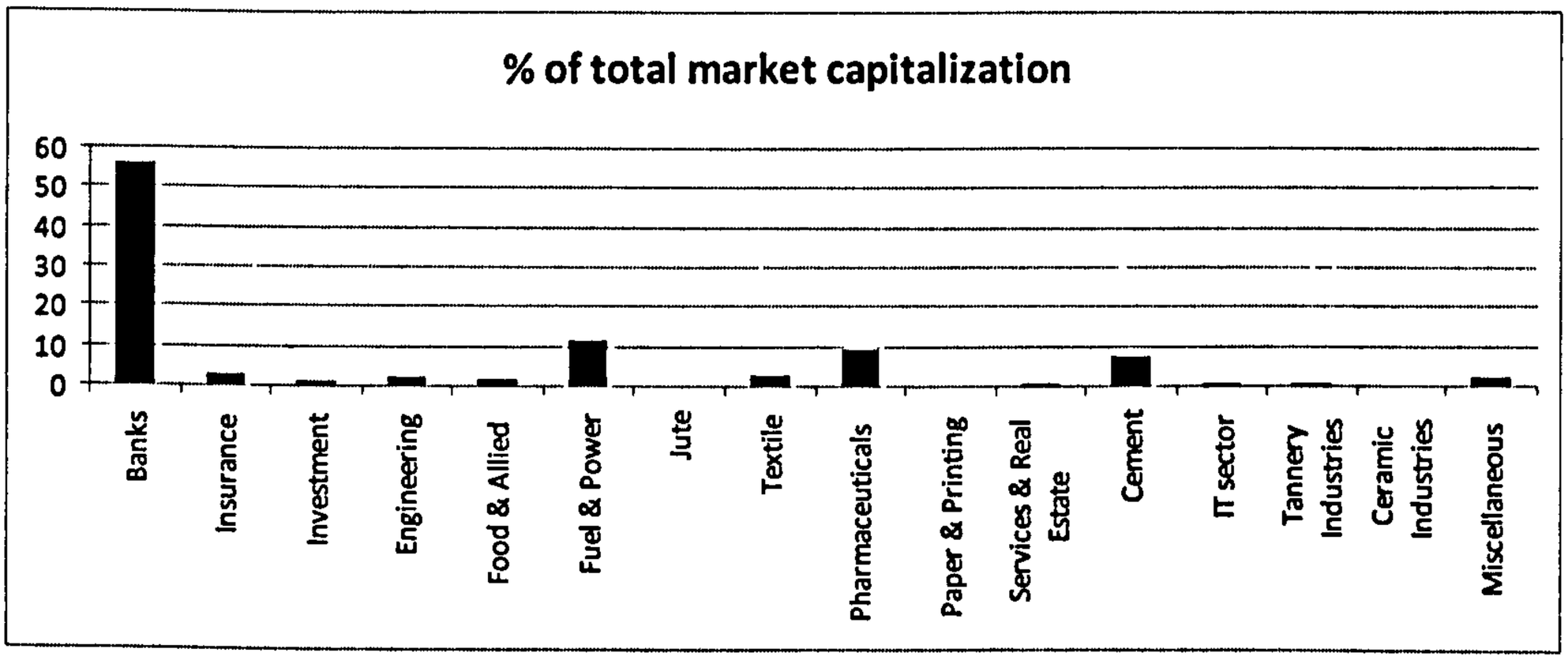
The firms listed on the stock exchange appear to be well-established, mature firms with good balance-sheet data. This is certainly true with respect to the Class A shares listed on the DSE, where companies regularly publish reports and accounting data along with

regular dividend payouts. One criticism therefore is that banking and stock market development arguably has a greater impact on growing and more financially constrained firms, so that this would present a lower bound for the beneficial impact of financial development. Future work should investigate more closely how firms of different sizes, maturity levels, and sub-sectors have been impacted by the financial development in Bangladesh.

Figure 3.9

Percentage of total companies and market capitalization





Source: Dhaka Stock Exchange *Monthly Review*, June 2007

Table 3.5

Market capitalization and total shares traded for top 20 companies

		Market capitalization Tk mn	% of total market capitalization
1	Square Pharmaceuticals	22,527.40	5.47
2	Lafarge Surma Cement	22,356.44	5.43
3	Power Grid Company of Bangladesh Ltd.	21,296.73	5.17
4	Rupali Bank	19,631.25	4.77
5	Prime Bank	18,268.25	4.44
6	Pubali Bank	16,138.50	3.92
7	Islami Bank	15,463.87	3.76
8	Dhaka Electric Supply Company	12,133.55	2.95
9	Southeast Bank	11,123.57	2.70
10	NBL	10,287.89	2.50
11	Uttara Bank	10,268.76	2.50
12	BRAC Bank Ltd.	9,120.00	2.22
13	Arab Bangladesh Bank	8,397.43	2.04
14	Export Import (Exim) Bank	8,365.28	2.03
15	Eastern Bank	8,303.29	2.02
16	Dhaka Bank	8,007.81	1.95
17	Summit Power Ltd.	7,771.34	1.89
18	Dutch-Bangla Bank	7,437.56	1.81
19	City Bank	6,929.01	1.68
20	Heidelberg Cement	6,480.96	1.57

		Shares traded Tk mn	% of Total shares traded
1	Power Grid Co.	2720.79	8.80
2	BRAC Bank	2358.47	7.63
3	Southeast Bank	2247.85	7.27
4	National Bank	1696.3	5.49
5	Square Pharmaceuticals	1652.2	5.35
6	Prime Bank	1508.56	4.88
7	Summit Power	1470.57	4.76
8	Dhaka Electric Supply Co.	1244.56	4.03
9	Arab Bangladesh Bank	1017.2	3.29
10	Premier Bank Ltd	985.44	3.19
11	Heidelberg Cement	928.74	3.00
12	Pubali Bank	897.81	2.90
13	United Commercial Bank	726.33	2.35
14	Square Textile	646.45	2.09
15	Exim Bank Ltd	637.34	2.06
16	Shahjalal Islami Bank	625.51	2.02
17	NCC Bank	544.76	1.76
18	Grameen Mutual One	513.91	1.66
19	LankaBangla Finance	437.17	1.41
20	One Bank Ltd	416.29	1.35

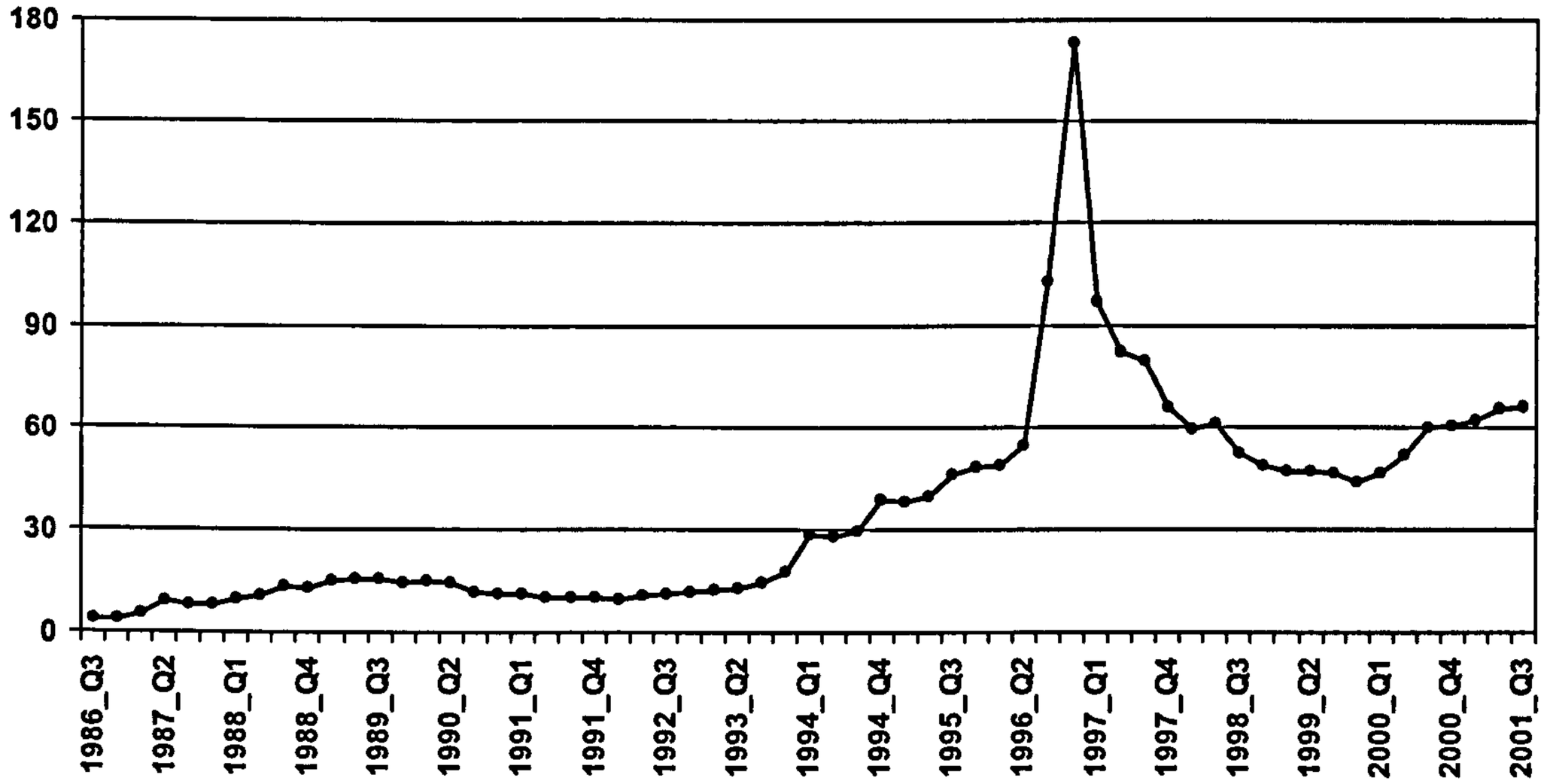
3.5.4 More on the 1996 stock market crash

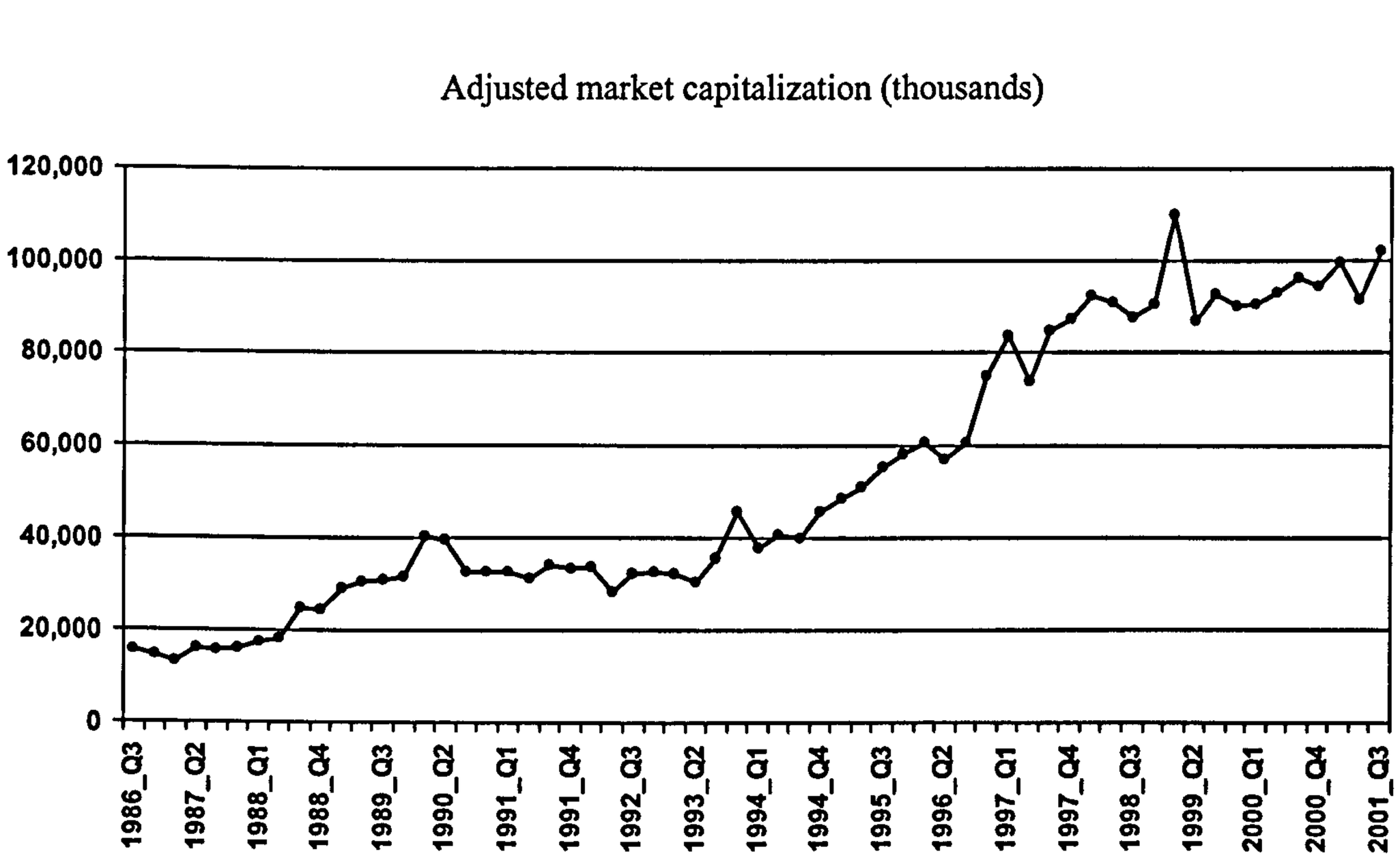
The stock market crash in December 1996 was mainly the result of market manipulation by a section of stockbrokers in collaboration with some other market participants (Report of the Committee formed by SEC, 1997). According to Ahmed (2000), the 1996 stock market crash was a disastrous bubble caused by unchecked investors euphoria and an absence of attention to the relation between stock price and economic and/or company fundamentals. In addition, the collusion between promoter/directors of the listed companies and a handful of unscrupulous broker-members may be responsible to be at work for manipulating share prices.

The impact of the 1996 crash can be seen in Figure 3.10 below. This graph shows the total market capitalization – the aggregate value of all listed securities on the stock exchange – and beneath it the *adjusted* market capitalization of the Dhaka Stock Exchange from 1986 to 2001. These years represent the respective years when the method of calculation for the main stock index calculation was changed. In order to give a consistent analysis of stock market development with regards to market capitalization we therefore restrict ourselves to this 15 year period. The adjusted market capitalization series was obtained by dividing the market capitalization by the actual stock index itself. The striking difference between the two graphs is immediately apparent. While the irrational exuberance of investors during the 1996-1997 stock market crash is obvious in the first graph, there is a more pronounced upward trend in the adjusted measure in the second graph. The pessimistic view of many spectators who base their reluctance on stock market potential for Bangladesh on standard measures of market development may therefore need to reassess their conclusions.

Figure 3.10

Market Capitalization and Adjusted Market Capitalization: 1986Q1 – 2001Q3





3.5.5 Are volatile episodes an argument against stock markets?

The fact that a stock market crash occurred in Bangladesh in 1996 should not automatically lead the reader to conclude that the stock market can have no growth-promoting role at all. Stock markets worldwide go through and continue to go through these volatile episodes. The real question is whether prolonged upward or downward trends in stock prices can have real effects on firms' capital investment and productivity levels[23]. Firms usually put much more emphasis on achieving successful IPOs – that is, they are concerned about the amount of capital they can raise when their shares are offered for the first time on the primary market. The volatile price movements observed on the secondary market would therefore probably be of little interest to firms' capital investment plans, as this simply represents trading by investors of shares of already issued stock. Regardless of how many times these shares are changing hands on the secondary market no new money is making its way back to firms. While it might be the case that firms in advanced capitalist economies may care a lot about their stock prices on the secondary exchange, for those firms in developing countries such an issue would not be of much concern.

However, if trading on the secondary market can be shown to affect the value that firms receive when their list their securities on the primary market, then they would likely care about prices and trading on the secondary market. The usual reason given is that if the firm's price-to-earnings (P/E) ratio – the price of the firm's share in relation to its projected earnings – increases, this is supposed to reflect more investor interest in the firm. Equity finance should then become increasingly cheaper for the firm, because if the firm issues more shares it is likely to receive more capital due to the higher price. In reality, the stock price (and any price reported in the popular financial press) is not as informative as it is often claimed. The key is investors' reaction to this information, which is reflected in their trading and which affects the probability of the existence of private information.

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[23] Evidence from Barro (1990) and Morck et al. (1990) suggest that the US stock market is more of a passive indicator for managers. Managers do not look at the stock price index for real investment decisions.

3.5.6 How relevant is market capitalization?

We have argued in Chapter 2 in favour of the view taken by Granger and Morgenstern (1970) regarding market capitalization (and indeed, regarding any indicator which represents secondary market development[24]). The basic premise is that due to the countless number of factors influencing investor opinion, any calculation which incorporates stock prices becomes unreliable. We suggested that even though this might be the case, it is still possible to use market capitalization series if the series is suitably adjusted. Our measure for turnover for instance divides through by 'rescaled' market capitalization. We have also used market capitalization (unadjusted) to compare across different sectors in the Dhaka Stock Exchange, as seen in figure 3.9. But this comparison is only made possible because the same flawed calculation behind market capitalization is essentially applied for all of the various sectors on the stock market.

Stock prices can be excessively volatile as they respond to a great many factors. The stock market index may be incapable therefore of signalling and responding to future growth opportunities alone. This reduces our confidence in applying the usual stock market indicators such as market capitalization and turnover ratios for examining the finance-growth relationship. Even if the movements of a stock index responded exclusively to future growth opportunities, they adjust so fast to the future expectations of those opportunities that no reliable trend for the purpose of the assessing the finance-growth relationship could result. An argument often made in favor of stock market indicators is that over the long term the aggregate stock market index does appear to reflect future economic activity. But even here some studies have shown that the relationship between stock prices and economic growth over time has broken down, particularly so in the recent period.

In addition, we have already seen that the stock price at any point in time is subject to a multitude of influences. Therefore deflating a stock index, while an obvious improvement, is still not an ideal method. Dividing measures of stock market value by a price index might allow one to see a broad trend of stock market growth. The excessive responsiveness of stock prices though would still remain. Why then are other indicators of stock market development inherently weak or lacking? The conventional measure of

[24] In contrast, indicators of *primary* market development such as the number of listed companies or total equity capital issued are more reliable measures of stock market development for economic growth.

stock market capitalization combines stock price movements with changes in the quantity of stock shares. While both price and quantity increases indicate larger stock market depth, it might be that the expansion which most accurately reveals a larger availability of funds for firm investment is that related to the quantity of shares and listed companies.

3.5.7 Which indicators measure stock market development?

What emerges from this discussion is that secondary market indicators cannot be solely relied upon in assessing the contribution of the stock market to economic growth. This is mainly due to the excessive and erratic movements of stock prices. A better way to assess the role of the stock market in development would be to focus more on the *primary* market, i.e. the number of listed companies and the total equity capital raised. Stock market capitalization if it is left unadjusted should not be used in empirical work. However, if it can be suitably adjusted then market capitalization may still be used (along with measures of trading activity). In any case, the number of listed companies will be the preferred measure of stock market development[25]. Primary market indicators – such as number of listed companies, total shares, and paid-up capital – are therefore the preferred indicators of stock market development. Secondary market indicators are not as essential as primary market indicators in terms of their impact on economic growth; nevertheless, secondary market indicators form a component of the stock market infrastructure. Primary and secondary markets are thus related.

3.5.8 A previous critique of the stock market in Bangladesh

Solaiman (2006)

Solaiman (2006) is a recent paper on the Dhaka Stock Exchange. The paper offers a detailed insight into the historical performance of the stock market in Bangladesh. Solaiman argues that the Bangladesh stock market has failed to achieve any significant growth since it first came into being in 1954. This according to him is mainly due to the weak legal and regulatory framework, the presence of too few active market professionals and foreign institutional investors, and an overall weak investor protection environment. There are thus many inefficiencies and problems in the financial sector of Bangladesh.

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[25] This indicator may need to be adjusted as well if de-listings occur over the period. In more developed markets one would have to adjust for the effects of mergers and acquisitions as well.

However, Solaiman's conclusion of insignificant growth in the stock market, while possibly justified when considering market capitalization as the measure of stock market development, is less convincing when considering *the number of listed companies* as the indicator of stock market development. In fact, one of the graphs he presents in his paper shows the number of listed companies displaying a continuous upward trend from 1976 to 2004, exactly like the graph we give above. But this fact is quickly dismissed by the author. While Solaiman presents an excellent historical background to the stock exchange in Bangladesh together with its laws, reforms and recent experiences, the fact remains that the paper offers no explanation for the year-on-year increase in the number of companies listing their shares on the stock market. It is this feature of financial development that needs to be accounted for. The answer may provide the key to appreciating the finance-growth effect in an environment where both banks and stock markets compete with as well as complement each other.

3.5.9 The need for a more developed stock market in Bangladesh

The existence of an equity market can serve to make the financial system more competitive and efficient. This can be important for a country like Bangladesh which does not have enough competition within the financial sector. Another source of inefficiency is the interlocking of banks and industrial groups in many developing countries, which creates privileged access to credit for companies belonging to groups but limited access and higher costs for those which do not. It would seem logical to expect that the cost of intermediation declines when new specialized financial institutions and a greater choice of investment media increase competition, thus increasing the efficiency of the financial system. In the case of Bangladesh, since the level of banking credit to the private sector may to some extent be directed towards certain 'elites' and others with political ties and connections, any further increase in the level of banking credit (within the context of such an 'inefficiently' operating banking sector) to the private sector may cause other smaller firms to be rationed out of the credit market completely. This might give an additional incentive for these firms to essentially 'try their luck' on the stock market, and hence generates a positive correlation between banking credit to the private sector and the total number of shares of listed companies. This is therefore another source of complementarity between banks and stock markets, though it is of a more different type than the one usually considered in the economic literature.

3.6 How can we improve the stock market infrastructure in Bangladesh?

3.6.1 Book building

Book building refers to the preliminary stage of an IPO, where underwriters attempt to carefully note the range for the future offer price. Underwriters then canvass potential investors (the "road-show") in order to learn about their demand for the IPO shares. Underwriters may be reluctant to fully adjust their pricing upward due to the need to keep IPO underpricing relatively constant. When underwriters revise the share offer price upward from the original range, underpricing tends to be higher. This extra underpricing might be necessary to induce investors to reveal their high demand for the IPO shares. A number of authors have recently called for more emphasis to be given to book building for IPO share issues. Sherman and Titman (2002) argue that book building incorporates an underwriter's network of regular investors and may benefit issuers by maximizing proceeds from an issue. Empirically, Cook et al. (2006) find support for the book building approach. Binay et al. (2007) argue that relationship participation aspects are important in the allocation and distribution of IPOs. Sherman (2005) offers a detailed review of book building versus auction mechanisms for IPOs.

3.6.2 The need for good governance and equities trading technology

Errunza (2001) lists a number of components of stock market infrastructure as representing the key preconditions for a well-functioning stock market. Good-quality accounting standards, well-defined property rights, a well-functioning legal system, credible contract enforcement, and properly qualified and trustworthy personnel are essential. In addition, quality, timely and orderly information flows may reduce instances of manipulation, public scandals and the consequent loss of confidence in the marketplace. Educating the individual investor about the long-run nature of securities investments, the risk and rewards of owning risky assets, and portfolio management should help to reduce the disadvantage that insiders are faced with compared to professional investors. Regulatory measures (e.g., deposit insurance, circuit-breakers, day-to-day monitoring) that minimize the risk of market collapse are desirable to build

investor confidence and prevent losses from nonmarket forces (e.g., fraud, manipulation).[26]

Green, Kilpatrick, and Murinde (2005) argue that markets with advanced trading technology, a functional regulatory system, and relaxed foreign investors' participation show high efficiency and low market volatility, although the direction of causality between efficiency and volatility varied across different markets in developing countries. Nguigi, Murinde and Green (2005) similarly argue that the main stock market institutional and policy reforms have included adoption of new trading systems, relaxation of foreign investment restrictions, expansion of stock market membership, strengthening of the legal and regulatory frameworks and reform of taxation policy. These authors claim that an efficient price discovery process, no excess volatility and liquidity provision at low costs can allow the stock market to contribute to the development process. Advocates of automation suggest that execution of trades is faster and less costly under computerized trading systems. Traders have access to broader information, including bid and ask prices, trades sizes and volumes, at lower costs. This would attract more investors and improve volume, liquidity, and better price discovery.

3.6.3 An adequate legal framework, effective oversight, and enforcement

An appropriate legal environment is necessary for the proper regulation and functioning of stock exchanges[27]. This is a framework for the rules, regulations and operations of the exchanges themselves. Company laws should contain comprehensive legal regime applicable to all securities (i.e. bonds, shares, derivatives, and hybrids) as well as to public corporations (i.e. those engaged in public offerings) with the main objective being the protection of investors in general, and minority shareholders in particular. Company law should also include proper take-over regulations that would make sure that all bids have fair terms (and, therefore, respect the equal rights of shareholders), are transparent

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[26] Khwaja and Mian (2005) find that brokers in Pakistan have colluded to artificially increase prices when they were low to attract positive feedback traders. Once prices rose, the brokers exited the market leaving the other traders to suffer the ensuing price fall. These manipulation rents ("pump and dump" schemes) accounted for almost half of total broker earnings. While such manipulative schemes are obviously a problem in developing countries, these pump and dump activities have also been reported for advanced markets such as those in the United States and Germany.

[27] Such factors are obviously important for the banks as well. See the previous discussion and critique of Beck and Rahman (2006)'s view regarding bank regulation and supervision. See also La Porta et al. (1997, 1998) for the importance of a well-functioning legal system in facilitating the operation of both markets and intermediaries.

and open to competition. Moreover, legal thresholds that would trigger mandatory bids or permit buy-outs of minority shareholders should be determined.

Another important pillar of effective oversight is enforcement. The regulator should be provided with comprehensive investigatory and regulatory powers. These include the power to obtain information, documents and records from persons involved in or relevant to the enquiry; to seek orders or to take other action; to impose administrative sanctions or to seek orders from courts; to initiate or refer matters for criminal prosecution; to order trading halts or other actions; to enter into enforceable settlements and to accept binding undertakings. The complex character of capital market transactions and the sophistication of many fraudulent schemes require highly skilled and specialized investigators, judges and courts. High disclosure standards, based on accounting and auditing standards that are of international acceptable quality, are needed to deter or reduce manipulative practices. A proper criminal financial law should be adopted to prevent or punish effectively illicit transactions that would endanger the fair and orderly functioning of stock exchanges. This includes the prohibition of direct and indirect self-dealing (insider trading), market manipulations, and spreading misleading information. It is important that companies indicate and publish what kind of governance rules and practices they adhere to. Finally, monitoring compliance with laws and regulations involves effective market surveillance (monitoring day-to-day trading activities).

3.6.4 Reducing cost of infrastructure on the stock exchange

The act of listing shares on a stock exchange is hardly costless[28]. There may be substantial commission fees, accounting requirements and regulations and so on. Easing these fees and requirements can help to encourage more companies to apply for a listing and thereby to obtain equity financing[29]. Thus developing countries can take action early on to alter their evolutionary growth paths, and one way is by actively promoting the stock market. A similar exercise would show the same conclusion applies to the banking

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[28] Costs of yearly auditing, certification, dissemination of accounting information, and stock exchange fees are approximately 3.5% of the gross proceeds of the IPO for Italy (Pagano et al., 1998) and 3% of gross proceeds for Korea (Chun and Smith, 2003). See Pagano (1993b) for an example of how prohibitive fixed costs in the stock exchange may lead to multiple equilibria.

[29] Relaxing the requirements in the financial markets is a necessary but not sufficient condition for economic growth. There would have to at least be effective regulatory oversight and accountability. The stock market crash of 1996-97 and the high level of non-performing loans of banks both suggest the need for good governance in the financial sector in Bangladesh. Without a sound prudential regulatory structure in place such financial policies are unlikely to prove effective in the long term.

sector as well. Bank regulation and soundness are hugely important for reducing the adverse consequences of bank runs and panics, solvency problems and other features of financial instability.

3.6.5 Promoting stock market development through privatization

The stock market in Bangladesh might be used as a means of depoliticizing the privatization process, by making it possible for large-scale ownership transfer of formerly state-run enterprises to take place. Local capital markets allow for local investors to participate and help alleviate concerns about foreign ownership of assets. Small investors can participate in large privatization through institutional funds or unit trusts, if capital markets have sufficiently development for such funds to exist. Finally, privatization through stock markets is one way to enhance diversity of ownership of resources in the economy. Capital market privatization, as opposed to an outright sale to an individual or a favoured group, promotes distribution of ownership, while simultaneously promoting risk sharing, liquidity externalities, and information disclosure and economic growth. However the post-reform experience in other countries such as those of the former Soviet Union demonstrates that widespread privatization policy by itself is not a guarantee for growth and stability.

3.7 Conclusion

In this chapter we have attempted to give a detailed description of the institutional background of the financial sector as it operates in Bangladesh. The financial sector has witnessed an increase in the size and activity of commercial banks. To some extent the stock market has witnessed growth in size and activity as well, though it is still much smaller relative to banks. Overall, the financial sector – both banks and the stock market – remains small in relation to the economy[30]. Problems due to connected lending in the private sector, weak regulation, and ineffective oversight have led to the continuation of corruption and manipulation in the financial sector. Not withstanding these negative

[30] As of early 2008, the latest figure on stock market capitalization / GDP in Bangladesh is approximately 10%. We have decided not to report statistics such as these in the main text, since we have good reason to distrust market capitalization as a suitable indicator of stock market development. See Chapter 2 and also graphs for market capitalization in this chapter for more explanation. The figure shown in this chapter for sector-wise market capitalization (3.8) in contrast is argued to be valid, but only because the same flawed calculation is essentially being applied to all sectors on the stock market. In the same ironic way, one could view the frequent international comparisons which are based on market capitalization as also being valid.

features of the financial system in Bangladesh, over a 25 year period indicators of financial development has displayed clear upward trends. We are motivated therefore to ask the following question: *what has been the impact of overall financial development on economic growth in Bangladesh*? Before we consider empirical analyses however we need to look more closely at the theoretical motivation.

CHAPTER 4

THE FINANCE-GROWTH NEXUS AND STOCK MARKET INFRASTRUCTURE

A theoretical overview of an encompassing structural framework

4.1 Introduction

This chapter presents an overall theoretical framework for the finance-growth nexus and stock market infrastructure. Broadly speaking, we are attempting to show that the literature (reviewed in Chapter 2) is able to justify why banks must have a key position in accelerating economic growth, and why the stock market exists to complement the banking sector. The stock exchange may also develop to some extent due to its own push for growth. In the context of Bangladesh, therefore, the main focus for policy should be on improving the overall health and stability of the financial system, where special emphasis is placed on strengthening banking supervision and other factors relating to bank development. At the same time, however, the equity market may be promoted and effectively regulated.

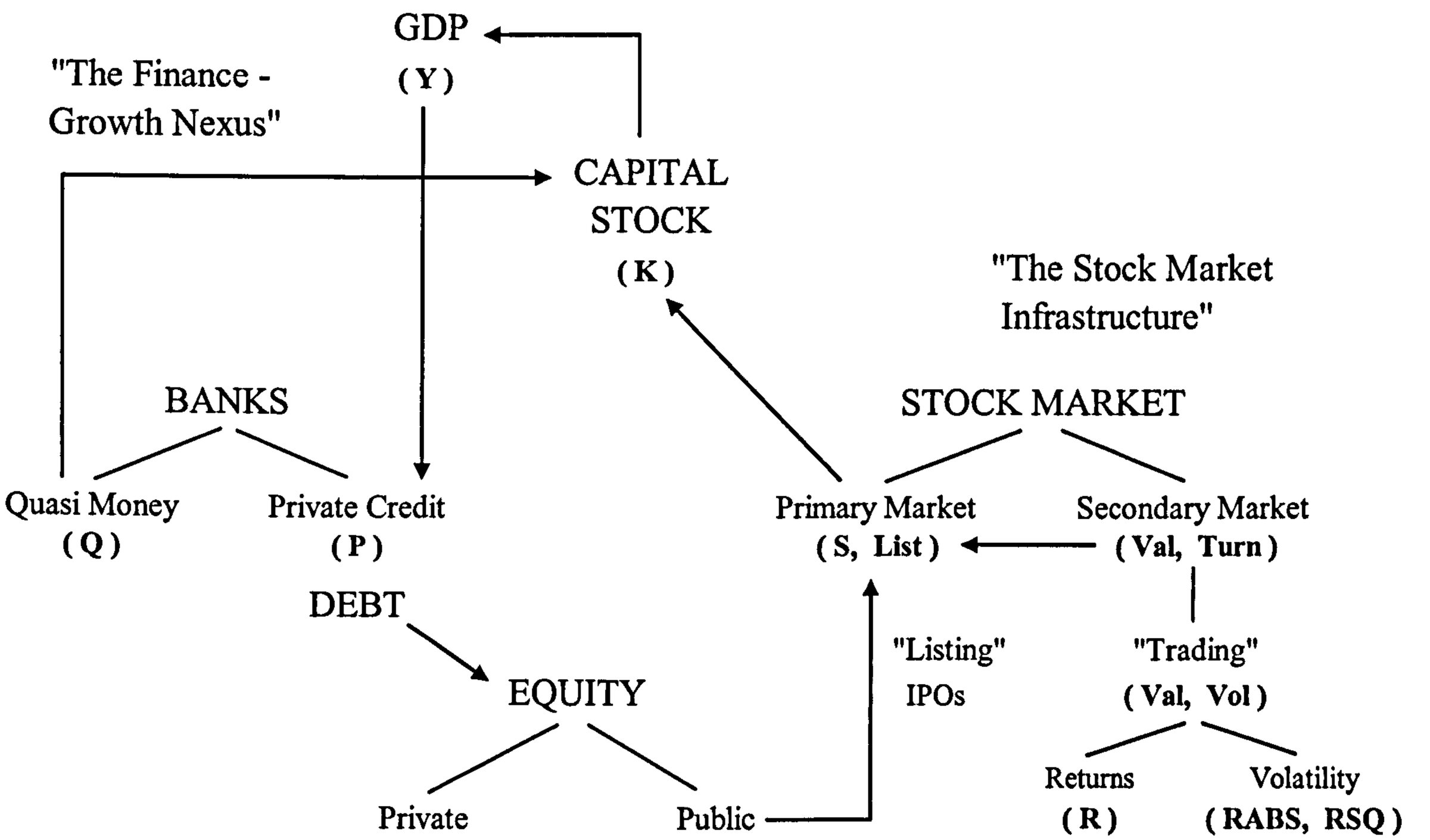
There are six theoretical models which we believe to be important[1]. The first three models represent the "finance-growth nexus" and the next three represent the "stock market infrastructure". *Model 1* is formed when the main insights of Greenwood and Smith 1997 (sections 1.7.1, 6.2, 6.7.1); Harrison, Sussman and Zeira 2004 (sections 1.7.2, 6.3, 6.7.2); and Besanko and Kanatas 1993 (sections 1.7.3, 6.4, 6.7.3) are combined or integrated. *Model 2* is formed when the main insights of Pagano 1993b (sections 1.7.4, 7.2, 7.3), Lamoureux and Lastrapes 1990 (sections 1.7.5, 8.2, 8.4) and Suominen 2001 (sections 1.7.5, 8.3, 8.4) are combined or integrated. When considered together, this framework is ultimately compatible with what we refer to as the '*entire picture*' and the

[1] Even though we have shown how the broad integration of these six individual theoretical models is accomplished, a more detailed formal specification is a challenge left for future work. Our contribution is to show why there is a need for such integration, both from a theoretical angle and given the clear message of our empirical findings for Bangladesh. Such integration seems reasonable since each of the three models described in *Model 1* constitutes a unique chain or effect in the finance-growth nexus, and likewise for the three models in *Model 2*, the stock market infrastructure. These two models therefore help to reconcile our empirical results with existing theory and thereby enrich knowledge on the finance-growth relationship. The findings in Chapters 6, 7 and 8 when considered in light of the integration of these models make a strong case for policy to encourage development of both banks and stock markets in a *structured* way.

'*five main effects*'. These two components essentially combine to make the finance-growth nexus and stock market infrastructure.

Figure 4.1

"The finance-growth nexus and stock market infrastructure"



To help make sense of this complicated chain of events, we present the most important diagram of the thesis in figure 4.1 above. It is entitled the "The finance growth nexus and stock market infrastructure". This diagram effectively combines all our theoretical hypotheses (*Model 1*: section 4.1, and *Model 2*: sections 4.2, 4.3) through the integration of the '*entire picture*' and the '*five main effects*' (section 4.4). It also provides some initial flavour of the empirical results for Bangladesh. Detailed description of the variables is dealt with in Chapter 5 while empirical results confirming this theoretical setup are shown in Chapters 6, 7, and 8.

4.2 Model 1: the finance – growth nexus

4.2.1 Liquidity and information: a role for both banks and stock markets

In Chapter 2 we have reviewed a number of theoretical arguments that explain how bank development leads to higher physical capital accumulation and economic growth. While the stock market also plays a role in contributing to growth we saw how it is usually viewed as responding to the forces of economic growth and to the forces of bank development[2]. The question which then arises is the following: are banks the only financial institutions which drive the finance-growth nexus, or can the stock market possibly have an impact too? And is the latter a direct effect or more indirect?

To try to resolve this issue we need to be specific about the way in which banks and stock markets help to 1) *enhance liquidity provision*; and 2) *enrich the flow of information.* Regarding (1) we have seen from the model by Greenwood and Smith (1997) that both banks and the stock market together help to enhance economic growth by reducing liquidity risk and thereby transforming more financial savings into physical capital investment. What we find is that incorporating the reasoning behind (2), the quantity and quality of information in the economy, is substantially lacking in the literature.

The expansion and enrichment in the quality or quantity of information – particularly in the context of developing countries – undoubtedly plays an important part in the finance-growth relationship. Problems involving information asymmetry in financial markets will become less severe when the quality or quantity of information flow is improved. Consider first the role of banks in this process. The information contained in the portfolios of commercial banks is by its very nature proprietary. This is the whole reason why banks are 'special' (see Fama, 1985). Their uniqueness stems from an in-depth knowledge of the borrower's behaviour, which is often amassed over a long period of time. Banks, because of their unique monitoring ability and knowledge position, are able to predict future deposit withdrawals (Diamond, 1984). It is not difficult therefore to think about how the activities of banks permit the production and utilization of large

[2] The link from banks to the stock market though provides an indirect mechanism for growth to impact stock market development. Growth affects banks, and banks in turn affect the stock market. This forms an additional chain in the finance-growth nexus.

amounts of information regarding borrowing firms in the economy. The collection of such information by banks should then reduce the intensity of information asymmetry between lenders and borrowers. Assuming that banks acted in the wider social interest, they would put this information to good use. Banks would choose the most productive projects, the ones most likely to succeed. Banks though are also concerned about their profits or franchise values. There is the possibility of losing their influence over borrowers if other competing banks or other financial intermediaries came into possession of their unique data. In other words, an agency cost could act to place an upper limit to the banks' role in the growth process.

How can stock market development possibly enhance the flow of information and improve liquidity in this economy? Let us refer to the key event of a new company listing on the primary stock market. Obviously the quantity of information is now greater after the listing than before the listing, because details such as company structure, balance sheets, and future plans of the company now become public knowledge. Furthermore, stock market trading allows for the scrutiny and dissemination of information through stock prices and other indicators. When there is a stock market present firms will also be continuously assessing whether or not to list their securities on the exchange. The act of listing shares on the stock market, of share trading, and more generally the whole regulatory process can therefore help to reveal additional information to agents. It is more likely that the flow of information, via the activities of both banks and stock markets, would now be of a higher quality than compared to a situation where only banks were present. The information flow in the presence of both banks and stock markets and the liquidity provision of the financial system is then improved. This has positive effects on economic growth. One of the contributions of this thesis is that we draw attention to the way in which banks and stock markets interact to alter the path of development. When we refer to the enhancement of information flow associated with the financial sector, we refer to an enhancement caused by the 'better' operation of the banks, the stock markets, and also all interactions that occur within the financial sector.

Banks, which are naturally interested in the profit-making aspects of their activities, react positively to improvement in the overall liquidity and informational environment. There is a higher likelihood that banks now will carry out their activities and extend credit more efficiently than before, which again leads to higher economic growth. Along with the

expansion in the level of bank activity, the Besanko and Kanatas (1993) model shows that there will be expansion in the amount of stock market activity since banks and stock markets are complementary in development. These forces can therefore be seen to have further 'knock-on effects' on the banks and stock markets, and further feedbacks from the overall growth process. The improvement in the information flow and liquidity provision essentially creates its own dynamic which pushes for continued improvement and evolution in the financial system. With a larger, more active, and more effective financial system, this will cause higher physical capital accumulation and growth. Combined with a reverse effect of economic growth on financial development, as seen in Harrison et al. (2004), we now have the foundation of an intuitively appealing description of the finance-growth nexus. *Finance leads to growth, growth leads to finance, and finance essentially leads to more finance.* This now completes "*Model 1*: the finance growth nexus". This foundation of the finance-growth nexus while present in the literature has not been viewed in an integrated framework.

The expansion in the quantity and quality of information together with the improved liquidity effect can now be seen to further accelerate the finance-growth relationship. While banks are 'special' with regards to their monitoring capabilities, stock markets also can reflect an enhancement and enrichment in the flow of information via the faster (and greater) dissemination of financial and accounting data. An expansion in both bank activity and stock market activity therefore means that the financial system is likely to be better placed to carry out its growth-accelerating activities. In addition to having a liquidity-enhancing effect on economic growth, stock markets can therefore play an information signalling role. It is argued that the stock market performs this information role not so much with respect to price-based measures – for example, market capitalization or the stock index[3] – but with respect to quantity-based measures[4] such as the *number of listed companies* that are on the stock exchange.

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[3] When market capitalization on the DSE is re-weighted by dividing by the stock index (see Chapter 3, figure 3.10), the resulting graph has a more pronounced upward trend. Our turnover measure also uses a re-weighted market capitalization series. Empirically Beck and Levine (2004) find that stock market size as represented by (unweighted) market capitalization is not useful in explaining economic growth. Rousseau and Wachtel (2000) on the other hand use a re-weighted market capitalization measure and find a positive impact to economic growth. We argue that the number of listed companies – in conjunction with market liquidity – is the preferred measure of size, activity, and performance for the stock market. This procedure may allow one to approach the 'true value' of the equity security listed and traded on a stock exchange.

[4] A similar conclusion is reached by Helwege and Liang (2004) who argue that differences between hot and cold IPOs are explained not by firm specific factors but more by the physical quantity of share issues.

The implication of *Model 1* in the context of Bangladesh is then the following. Bangladesh has a financial system that suffers from high transaction costs and information asymmetries. There is a culture of high default and non-performing loans, connected bank lending (which is often politically motivated), and bogus data which companies use to list and investors refer to for trades on the stock market. This has undoubtedly reduced the growth potential in Bangladesh. Despite all these negatives, or even because of them, policy can be designed to help target and promote the overall financial sector – *both banks and the stock market* – in order to improve economic performance in that country.

Bank-dominated debt finance has undoubtedly been pivotal in Bangladesh for enhancing physical capital accumulation. In contrast, the level of equity provision cannot be said to have had a direct impact on growth since the share of equity financing[5] for firm investment is small in comparison to debt finance. Nevertheless, Chapter 3 presented evidence showing that the stock market in Bangladesh has been growing. From the discussion above we expect to observe a positive amount of stock market activity along with a higher level of bank lending. Stock market development therefore exists alongside bank development and debt and equity are complementary. Both banks and stock markets are inter-connected via information and liquidity effects, and therefore both financial components should be linked to growth.

4.2.2 What effects should we observe when applying Model 1 to Bangladesh?

The finance-growth nexus (*Model 1*) shows how the financial system evolves and how finance is connected with the real economy. Bank development and stock market development both accelerate the rate of growth in the economy via the channel of enhanced liquidity provision. This direct growth-enhancing effect of the financial sector is captured through the Greenwood and Smith (1997) model. The testable proposition of this model is what we will refer to as the *finance-to-growth effect* (Chapter 6, section 6.5.3). The indirect growth-enhancing effects of the stock market can be more effectively

[5] There is a distinction between publicly listed equities which are traded publicly on the stock exchange and privately held equities which are traded off the exchange or rarely traded. While we have data on public trades, the latter type is very difficult to find. One possible solution to this problem is to assume that private and public firms grow at similar rates so that both are essentially reflective of broader equity development and trading in general.

captured through the Besanko and Kanatas (1993) model. Banks and stock markets are shown to coexist in equilibrium due to asymmetric information and moral hazard effects. The testable proposition of this model is the *banks-to-stock market effect* (section 6.5.5). Finally we argue that the Harrison, Sussman and Zeira or HSZ (2004) model provides the reverse chain in the nexus for Bangladesh: Economic growth encourages the entry of more banks into the financial sector which leads to financial deepening and therefore a higher level of bank credit. The testable proposition of this model is the *growth-to-finance effect* (section 6.5.4). Integrating the main insights of these three models explains how the financial sector in Bangladesh is connected to the real economy.

4.3 Model 2: the stock market infrastructure

4.3.1 Theory and application of Model 2 to Bangladesh

In order that we do not over- constrain stock market development in Bangladesh by only relating it to the evolution of the banking sector, we now discuss aspects relating to the stock market infrastructure.

The *Stock Market Infrastructure* describes another channel through which stock market activity may take place in Bangladesh. We argue that this represents an additional explanation for our theory of how the financial sector operates. A close inspection of the stock market can reveal that its development is related to the dynamics of its own specific features (i.e. infrastructure). That is, the stock market in a developing country like Bangladesh may now operate somewhat independently of the influence from either the growth process or the bank development process. These are important concerns for regulators in Bangladesh, since theory does not clearly justify why the stock market itself should even exist when the economy is still at a relatively low-level of income. Because the stock market infrastructure in *Model 2* provides the necessary justification for the existence and development of the stock exchange, the material in this section also provides indirect support for *Model 1*.

There are in fact two sub-models contained within *Model 2* which drive the stock market infrastructure[6]. Liquidity on the stock market is firstly theorized to be an important driver for stock market growth. The Pagano (1993b) model posits a unique mechanism which shows how stock market trading and the number of firms that decide to list their shares are related in equilibrium. This we call the *listing - trading* relationship. *Model 2A* is thus inspired by Pagano (1993b) who describes a process where trading externalities can result in a relationship between *listing* and *trading* on the stock exchange (the *listing-trading effect* – Chapter 7, section 7.3). The implication for the stock market in Bangladesh is that as more investors trade in the shares of companies, more companies will decide to issue and list their shares. This again promotes market liquidity and the cycle essentially keeps on repeating itself, moving the stock market to a preferred equilibrium with higher trading and higher listing.

Model 2B – the second sub-model of *Model 2* – is inspired by the Lamoureux and Lastrapes (1990) and Suominen (2001) models. LL (1990) allows the econometrician to test whether GARCH effects tend to disappear when trading volume (current or lagged) is included into the conditional variance equation (the *volume-volatility effect* – Chapter 8, section 8.4.4). The model is seen to be an empirical version of the implications of the 'mixture of distributions' hypothesis or MDH. However we argue that the Suominen (2001) model is effectively an updated version of the MDH approach. By explicitly using a market microstructure framework, Suominen shows GARCH-type effects are likely to remain *even after* trading indicators are incorporated into the model. We therefore interpret this model as saying that the overall fit and suitability of the GARCH (1, 1) framework is improved after trading variables are incorporated into the volatility specification. Moreover, trading volume itself carries predictive power for measures of stock price volatility. In other words there is a causal relationship between trading and stock returns or returns volatility (the *trading – stock return* effect – Chapter 8, section 8.4.6). Thus the collective insights of Lamoureux and Lastrapes (1990) and Suominen (2001) in *Model 2B* can improve the prediction of future price volatility.

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[6] Pagano (1993b) explains how both the primary market (where firms list shares) and secondary markets (where investors trade in shares) are connected. In contrast, Lamoureux and Lastrapes (1990) and Suominen (2001) consider volatility and trading dynamics on the secondary market only. The secondary market allows trading and stock price movements to occur but it is closely connected to the primary market (and vice versa).

4.4 The 'entire picture' and the 'five main effects'

In this section we argue that the 'finance-growth nexus and stock market infrastructure' (figure 4.1) described above allows both financial development and economic growth to occur in a supportive but controlled manner. Details of the integration of six theoretical papers together with the results from our three main empirical model specifications for the case of Bangladesh will be shown in Chapters 6, 7, and 8. Our aim in this section is to outline the encompassing framework and discuss some implications of the '*entire picture*' and the '*five main effects*' for the debate on financial structure.

As seen in the literature review in Chapter 2, theoretically and empirically many authors have argued that the financial structure[7] – the mix of banks (debt) and stock markets (equity) and other measures of size and activity of financial variables – appears to follow a distinct pattern. Firms will usually finance most of their capital investment through bank loans and retained cash earnings with equity finance playing a mostly inconsequential role. In addition, in the early stage of development banks are expected to be the sole providers of capital and stock markets may not even form until a threshold income level is reached. In this thesis however we intend to take a slightly different view. We shall attempt to show how the financial structure allows both banks and stock markets to ultimately matter for growth while still keeping to the main spirit of Miller-Modigliani and while still accepting the key position held by banks. This result is possible after considering the '*entire picture*' – a structural representation of the finance-growth nexus and stock market infrastructure – together with the '*five main effects*' – a set of relationships linking together banks, stock markets and growth. In later chapters it will be empirically confirmed for the case of Bangladesh.

[7] Technically we should also include corporate bonds here. However in Bangladesh there is no active bond market so we only need to specify bank debt and equity as the main financial variables for analysis. In the case of more advanced economies it is necessary to incorporate more the role of the loanable funds and money markets for commercial paper, which typically form a large part of the finance requirement of firms and banks alike. Note that in the Besanko and Kanatas (1993) model the authors consider debt and equity to be *equivalent forms* of non-intermediated finance. A model which may offer additional insights in this regard is Bolton and Freixas (2000). Intermediation costs are shown to make banks securitize some portion of their loans in the form of 'pass-through' certificates. This intermediation cost is passed onto the borrowers who must therefore trade-off the benefits of banks (loan restructuring and avoidance of inefficient liquidation) against such intermediation costs. Bonds and equity involve inefficient liquidation costs and informational dilution costs respectively, and this will result in some companies deciding to issue either bonds or equities depending on the riskiness of their cash flows.

4.4.1 Overview of the entire picture

The '*entire picture*' is best described as a blueprint that provides details of a structural model linking together growth, banks and stock markets. The motivation behind it is to justify why finding a connection between the financial and real sides of the economy would not be surprising. This realization will then make way for definition of the individual effects that together form the system – the 'finance-growth nexus and stock market infrastructure' (figure 4.1). We begin by considering the key position held by banks; then understanding why this allows a role for the stock market, and then understanding how both these financial components may lead to growth and how growth may feed back to the financial components. This completes *Model 1*: "*the finance-growth nexus*". A similar intuition completes *Model 2*: "*the stock market infrastructure*". The whole system of financial intermediaries and markets together combined with the link to the real economy thus allows proper identification of the '*five main effects*' – the individual effects which combine to form the encompassing structural model itself.

Banks are at the forefront of finance and play a number of vital growth-accelerating roles such as enhancing liquidity provision, better risk management, productive lending to the economy, and effective monitoring of projects of firms[8]. These qualities all increase the growth rate of output. Nevertheless, the impact of banks is partly determined (and constrained) by two factors. One is the growth rate of the economy itself, or a reverse growth-to-finance linkage: if there is low growth in the economy this means underlying demand for credit is weak, while higher growth means demand will be high. This means that while finance (credit) leads growth, growth must also lead finance, and that finance and growth are constrained by the very existence of a mutually supportive bi-directional relationship. Ultimately the financial superstructure is built around the real economy and is closely connected to the state of productive enterprise.

[8] In the recent global financial crisis of 2007-08 banks appeared to be less interested in restricting themselves to monitoring firms' investment projects and became more interested in the financing possibilities of firms' projects, and then the financing of those financing possibilities and so on. While such aggressive leverage was highly profitable for the banking industry initially, this increase in leverage ironically resulted in a fall in the quality of monitoring. This led to excessive and unsustainable credit risks being taken on by banks and their eventual collapse or near collapse. The lesson to be learned is that any leverage (if leverage is desired) should be spread across the financial system in some efficient way instead of building up in a few areas or even one area of the system (e.g. credit default swaps). The key point is that high leverage is not necessarily disastrous: it needs to be made compatible with the balance sheet of banks in particular and the structure of the financial sector and constituent mix of assets and products in general. In other words, central bank regulators need to ask the following questions: (i) How effective is the current finance-growth nexus and stock market infrastructure in the economy? (ii) Can anything be done to enhance the flow of funds from borrowers to lenders given the presence of such a structural framework?

The other source requires a careful look at the financial structure. Even accepting the key role played by banks in the economy, for the firm to be effectively monitored and to be given the correct incentives to choose productive projects, bank debt *must* be combined with some portion of non-intermediated finance (e.g. equity). Given such considerations the financial structure begins to matter. There could be an 'optimal'[9] financial structure or mix that is required in order for the financial sector to contribute to economic growth. The financial structure could in a sense *allow* the growth enhancing effects of banks. Without the financial structure correctly specified indicators of bank size and activity may fail to capture the true contribution of financial development in enhancing capital accumulation. Of course, banks can and do develop on their own and this is undoubtedly an important driver of growth. The key growth-promoting aspects of bank activities (monitoring, information and liquidity roles) will only be correctly identified, however, when the whole setup of financial markets and institutions is properly represented and assessed after imposing certain theoretical (and structural) relationships amongst the variables. Notice that the forces behind the stock market infrastructure are themselves likely to be constrained by the forces for economic growth and bank development, just as the banking sector and the growth process are constrained by their own associated forces.

It is because of the existence of these structural relationships linking together banks, stock markets, and economic growth that we need to appreciate the financial sector in a broader way if the goal is to assess the true contribution of finance for growth. Rather than downgrade and ignore equity markets because of their perceived insignificant role in capital financing, we need to do exactly the opposite and consider debt alongside equity. This therefore justifies an examination of the *overall* financial system using a variety of suitable financial indicators where possible. The variety of indicators is especially important since because of the constantly evolving nature of the financial structure

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[9] The term 'optimal' here is not just referring to an equilibrium point or even a number of separate equilibriums. Equilibrium refers to a situation where a system is "at rest". But in order to achieve this state of rest for a system, the individual components of the whole system will have to adjust to make it so. The same logic applies in the opposite direction: in order to achieve a state of rest for the individual components (the *five main effects*), the whole system (the *entire picture*, which comprises the individual components) will have to adjust. In other words, an optimal situation here can only occur if both the *entire picture* and *five main effects* are converging to making the system stable. If one can specify a suitable encompassing framework that works along these lines, it will now be more likely that the theoretical predictions and empirical results are correctly identified and assessed. Figure 4.1 when seen in this context is a visual representation of one such system: a growth-promoting 'Finance-growth nexus and stock market infrastructure' *which now has stability more or less built-in*. This allows a more accurate assessment of how and why finance matters for growth in any country, both developing and advanced.

(which nevertheless is evolving according to certain rules) it quite simply pays to have more than one measure of each variable.

4.4.2 Overview of the five main effects

Having now isolated the set of structural relationships between the financial and real sector in the form of the '*entire picture*', the econometrician can identify and correctly assess the '*five main effects*':

(i) *Finance – to – growth effect*;

(ii) *Growth – to – finance effect*;

(iii) *Banks – to – stock market effect*;

(iv) *Listing – trading effect*;

(v) *Volume – volatility* and *trading – stock return* effect.

- Banks, together with the stock market, accelerates economic growth;
- Economic growth encourages bank development;
- Banks and stock markets are complementary.
- Stock market listings and investor trading positively affect each other;
- Trading volume – price volatility dynamics are present.

These five effects manifest themselves as a number of structural relationships linking the financial sector to the real economy. Given the existence of these effects, the '*entire picture*' is then defined as a set of structured relationships. From this setup it therefore makes sense to refer to an optimal financial structure. This framework can now effectively highlight the interplay between banks, stock markets, and the growth process and it gives rise to unique combinations of bank loans, bank deposits, equity issuance, market liquidity, capital accumulation and economic growth – where all variables in question are changing according to a self-reinforcing system. "The finance-growth nexus and stock market infrastructure" is completely described by this system.

As the financial structure evolves to new conditions over time, this shows up in the form of financial development over all or only part of the financial sector. Some authors in the literature have argued that it is overall financial development which matters for growth.

Others point out that since indicators of bank size and bank activity are typically much larger than those for the equity market in growth regressions this would imply that banks are relatively more important and the stock market less important. Neither view on its own does enough justice to the insights developed here. In reality the truth lies somewhere in between these two views. According to our encompassing structural model, the financial system is supportive of economic growth but the financial structure – the mix of banks and stock markets itself – is endogenously determined. Banks, stock markets, and the real economy are all inter-linked. In such a system, banks may retain the top position while overall financial development continues to be important.

The encompassing framework presented here can permit regulatory policy to 'fine tune' (or kick-start) the system by focusing either on banks, on the stock market, or the laws and regulations governing the financial system and the real economy. The areas for focus would include those that were deemed to be suffering from "structural weakness" when seen in relation to the whole system as highlighted by the inter-locking relationships contained in the 'finance-growth nexus and stock market infrastructure' diagram (figure 4.1). In such instances, effective policy may push the economy onto a higher growth path. And as we will see below in sections 4.5 and 4.6, financial stability may also be achieved along with higher growth.

The setup of the system is flexible enough to allow for a degree of independent development in any particular financial component or sector even while at the same time being constrained by the system: to give one example, while banks act to accelerate physical capital accumulation, economic growth itself can stimulate more bank activity. This bi-directional relationship is mutually supportive between the two variables of banks and growth, and it is also mutually constraining. The analysis can be used to show a range of similarly endogenously determined effects represented by different specifications of variables. In the empirical sections of Chapters 6, 7, and 8, this representation will be shown to describe quite well the forces which connect finance and the economy in the case of Bangladesh.

4.5 Is our setup reconcilable with the features of Bangladesh?

The empirical findings for Bangladesh together with our analysis and interpretations will be shown to broadly confirm the implications of the theory. If these results had been confirmed for a highly developed country like the United Kingdom then there would be little doubt as to the relevance that finance had for growth. When the results are uncovered for a developing country like Bangladesh, however, the conclusions and policy implications are not so straightforward. Are we saying for instance that the stock market is equally as important as the banks for economic growth[10] in an economy with a weakly-regulated financial sector and unsophisticated institutional capacity?

Despite the relatively low measures of size, activity, and mix of both banks and equity markets, all financial variables that we use for Bangladesh have displayed clear upward trends (see Chapter 3) and empirical results are robust to a range of alternative specifications (see Chapters 6, 7, and 8). This suggests that the encompassing model here is able to capture the facts reasonably well. Take for example one of our main findings, which has been confirmed in many studies that also attempt to assess the relationship between financial development and economic growth. We find that banks in Bangladesh have been growth-promoting. This would seem to imply that measures such as bank size (broad money or deposits held at banks) and bank activity (lending to the private sector) are therefore likely to be growth-enhancing. But given the formulation of the structural model in figure 4.1, the banking sector's impact would now be restricted in order to promote that very same growth-enhancing effect. What we find therefore is that by structuring both banks and equity markets in a setup where greater emphasis is given to banks, the system will try to grow but at the same time constrain itself according to the parameters of the true encompassing model contained in the finance-growth nexus and stock market infrastructure.

The policy implication is then as follows. Credit investments should be undertaken predominantly by the banks. However, while regulation must be designed to help promote the ability of banks in increasing credit, it should also be designed to prevent banks from exceeding (or undersupplying as the case may be) their ability to invest

[10] Strictly speaking this is not totally correct since the stock market is shown to be positively impacted by the bank development variable in the ARDL modelling results. Nevertheless we need to counter the criticism made by other authors in the literature that the stock market in developing countries is simply not important at all for economic growth.

efficiently; likewise regulation should prevent banks from recklessly expanding (or recklessly curtailing) the universe of credit instruments at their disposal. Such a structured credit system would now essentially force banks to behave in the best interests of society while at the same time remaining profitable. Although stellar profits would not be realized, this more realistic level of profit would be acceptable in return for avoiding the possibility of near collapse of the markets as a result of a financial crisis. The system therefore would be stable, long-run profitable, and growth promoting.

In Bangladesh, the banks have been performing poorly yet they have still promoted growth to an extent because the universe of credit instruments is simply not as developed as in the United States or European countries. Thus the Bangladesh banks were not required to be so strongly regulated in order to contribute to economic growth. The price paid of course was a lower rate of growth than would otherwise have been possible, but nonetheless some growth did occur. The stock market now is an extra piece of the jigsaw which is needed to complete the picture. Stock markets are complementary to banks; thus when seen in a broader way both banks and stock markets matter for growth. Interestingly the stock market and other non-intermediated forms of finance in Bangladesh have now been emerging with greater presence in recent years, and policy makers are now realizing the need for a stronger regulatory framework. These regulators are in a unique position to encourage development in the financial structure via the appropriate mix of financial intermediaries and markets. The essential requirement is an understanding of the forces behind the '*entire picture*', the '*five main effects*', and the way these combine to form the "Finance Growth Nexus and Stock Market Infrastructure".

4.6 The 2007-08 Global Financial Crisis

The model here has been applied to Bangladesh but it can also be used to understand the global financial crisis of 2007-08. The most recent crisis came close to wiping out the banking systems of many countries. In the aftermath of unprecedented government plans for bank recapitalisations and even nationalisation many observers have tried to understand exactly what caused it all. Here we argue that our encompassing model may provide a basic foundation to help indicate where finance is excessively building up or where there is a lack of it. Therefore the model may help predict and explain banking

instability and financial crises and to reduce their damaging effects. Such a topic is currently high on the agenda of central bank regulators and policy makers. Andrew Large, former deputy governor of the Bank of England, for instance argues that a range of policy tools to limit the build-up of leverage is required:

> "What has been lacking is a framework for systemic scrutiny that "hard-wires" mechanisms for both sounding early warnings and providing the necessary architecture and instruments to produce a more effective response to the build-up of systemic pressures" [11]

From the finance-growth nexus and stock market infrastructure diagram in figure 4.1, financial development and economic growth can be seen to potentially occur through a range of variables: each variable being impacted by mostly complementary forces and relationships, and where all variables are constrained by the encompassing framework linking banks, stock markets and the real economy. Imbalances though are likely to occur when there is excessive growth realized in any individual source (or number of sources). While such imbalances will usually be automatically adjusted by the system (indeed such dynamics give rise to the empirical ARDL and GARCH specifications themselves), this likely introduces an element of financial instability into the analysis in addition to growth promotion.

It is interesting to define exactly what we mean by 'excessive' growth here. Clearly the credit boom, extreme asset price movements, and prolonged contraction in finance to recession-hit economies suggests an excessive build-up in a system which until recently seemed to work well. The explanations behind why the (mainly American and European) banks failed to predict or prevent the worst crisis in generations will no doubt be debated in the years to come. After reading this thesis, however, the reader should now be able to appreciate that finance is hugely important, and also that the economic and financial system is delicately balanced. While mistakes were made by all the banks concerned, the tipping point was the failure to properly understand the system described by the '*entire picture*' and the '*five main effects*'. Development and innovation should have been distributed out amongst the various components according to the nature of the structural relationships. By being highly concentrated in one area at the expense of others the system became unstable and the effects effectively were transferred globally. The

[11] "Central banks must be the debt watchdogs" – Financial Times, January 6 2009.

following observations follow on from this discussion regarding the structure of the financial system. Together they make a case for strengthening regulatory policy in all countries to achieve an optimum financial structure i.e. an appropriate mix of financial intermediaries, markets and institutions, in conjunction with credible central bank monetary and fiscal policy

4.6.1 How to achieve stable growth-promoting financial development?

a) Banks are the 'lifeblood' of the economy. Banks provide the essential flows of credit to firms, they accept deposits on behalf of investors, they monitor investment projects, and they provide liquidity to the financial system by predicting deposit withdrawals (see Greenwood and Smith, 1997; see Chapter 6). These activities all help to increase the proportion of financial savings transformed into productive investment (see Levine, 1997; Pagano, 1993a). Thus policies to improve bank development result in capital accumulation and economic growth in accordance with the predictions of endogenous growth theory.

b) The stock market also has a growth-promoting effect but it is primarily through the channel of a complementary banking sector. This is due to moral hazard effects on both the banks and the borrowing firms and these incentive considerations will create a role for non-intermediated finance such as equity and bonds (see Besanko and Kanatas, 1993; see Chapter 6). Bank development therefore needs to be assessed alongside the stock market, even where the latter may account for only a small proportion of capital investment. Banks always remain the drivers of growth due to their key roles. However, excessive bank development without some corresponding change in the rest of the financial sector and the economy in general will likely introduce more risk into the system. A suitable financial structure will therefore become essential for the economy both in terms of growth and in terms of stability.

c) Economic growth leads to a financial deepening effect as more and more banks lend and compete with each other to secure borrowers (see Harrison et al. 2004; see Chapter 6). Thus the growth process itself will stimulate bank development. Once again, this is another positive relationship that can be seen as a type of constraint: if

for whatever reason there is a boom in bank sector activities over and above the level predicted by the growth rate in the economy, this results in an imbalance and a higher probability of a credit crisis. Thus while finance accelerates growth, growth in turn determines finance.

d) The assets and liabilities of the banks need to be appropriately balanced. More bank loans will usually go side-by-side with more bank deposits. However, it is precisely their monitoring expertise which allows banks to be able to have less capital in reserve in order to meet withdrawal requirements (see part (a)). This permits the increasing use of leverage in the banks' balance sheet through derivatives, securitized financial products, and so on. Although such leverage may help to increase bank profits it also introduces greater risk into the financial system, particularly if other imbalances as noted before begin to take hold. This is exactly what might be avoided or at least might be reduced if private credit and quasi-money ("loans" and "deposits") keep broadly in line, although there will likely be an optimum level of each (and thus a spread) that leads to the highest attainable (and sustainable) growth rate in the economy.

e) If a banking crisis occurs, the level of bank lending will surely be depressed. If banks' claims on the private sector therefore falls or in the worst scenario collapses, the effect on the other side of the balance sheet will likely be a corresponding decline in bank deposits liabilities (the money supply). In order to avert an excessive downturn as a result of the fall in bank lending, the government could itself borrow from the banks either by direct borrowing or ensuring that banks buy substantial quantities of Treasury bills. By increasing its borrowing the government can ensure that the level of bank reserves improves while a wider recovery can be reconciled with a reduction in the private sector's indebtedness to the banks. However so long as economic growth is reduced as a result of the crisis this will continue to present difficulties for banks that are unwilling to lend to private borrowers given the weakened demand and lower prospects in the wider economy (economic growth itself determines private lending by banks, see part (c)). It is credit to the private sector that is one of the main growth-enhancing aspects of bank activities. Thus, while the government must act to ensure that the 'fire is put out', it

may have to work closely with banks to allow a "resumption of steady growth at a moderate rate of both lending to the private sector and bank deposits"[12].

f) The importance of local bank branches cannot be emphasized enough. The Harrison et al. (2004) model shows how economic growth has a financial deepening effect via bank branches and private credit. Additionally, focusing on the number of physical bank branches in a sense places yet another constraint on excessive bank lending (i.e. going beyond the threshold level required for sustainable economic growth). In developing countries, the amount of bank branches per 100,000 people is extremely important in order to promote the push for financial development and economic growth.

g) Market liquidity (investor trading) and the number of listed companies (initial public offerings or secondary offerings of shares) are essential drivers of stock market development (Pagano, 1993b; see Chapter 7). These two factors are measures of the secondary and primary stock market respectively, and should be promoted more or less in tandem if growth is to occur. Any policy must also be compatible with the supportive roles played by the banking sector and the overall economic growth process identified above.

h) While both trading volume and trading value dynamics are important for accelerating stock market development and for predicting volatility (Lamoureux and Lastrapes, 1990; Suominen (2001); see Chapter 8), our empirical results in Chapter 8 appear to show that trading value has greater effect. Trading value also forms a large component in determining commission fees and profits earned on stock exchanges worldwide from Dhaka to London. Market regulation and competition laws should therefore be formulated n a way that allows sustainable growth in trading activity (both in terms of volume and value) on the exchanges.

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[12] "Government must borrow from banks to create money" – Financial Times, December 31 2008.

Each of the points above is important for realizing a growth-promoting and financially stable system. However, suitable overall policy for effective regulation can only be achieved if they are all made compatible in the sense that the '*entire picture*' and the '*five main effects*' (i.e. *Model 1* and *Model 2*) now become part of one whole. This will result in a structural model. Finance would now be compatible with growth, banks would now be compatible with the stock market, and the stock market would now develop according to its own infrastructure. Adequate banking supervision and strengthening of the regulatory framework (under the influence of the central bank or other authority) could then be formulated around the parameters of the structural model presented in this thesis. If done properly, this would allow finance and growth to occur within a relatively sustainable and supportive system. Financial crises will never be averted, but if they occur their worst effects will be lessened. Moreover liquidity provision and monitoring levels of the banks will be ideally positioned to contribute to economic growth and financial sector development. Having a sustainable financial structure in place certainly goes a long way towards achieving economic growth and financial stability.

At the global macro level there is an argument for having an international regulator to oversee financial stability and banking supervision across member states. Supporting domestic banks may require international co-operation especially in the today's increasingly globally connected financial markets. However this cannot substitute for the need to establish the appropriate financial structures at the national or local level. Both local and global policy would thus need to be broadly in agreement. This in effect requires aggregating a number of '*entire pictures*' and '*five main effects*' across countries. There could then be a regulatory requirement to oversee the appropriate 'cross-layering' of various financial structures. Any policy recommendations would then be made based on features at the micro level i.e. the balance sheets of various individual financial institutions[13]. If the recommendations are also consistent with the macro circumstances in each country then the global outcome of the policy would likely be successful. This undoubtedly puts huge pressures on regulatory authorities, but the recent near collapse of entire banking systems has now likely brought such co-operation a step closer to reality.

[13] Current proposals include revision of the Basel II rules for capital adequacy in financial institutions to reflect the post-crisis landscape. Mark-to-market accounting methods are also being looked at for possible changes in order to price securities more in line with value versus liquidity needs. And even the 1933 Glass-Steagall Act which formally separated commercial and investment banking is again being looked at. Our suggestion is that each of these proposals needs be weighted using a structural modeling approach. Doing so will mean that the impacts are likely to be correctly assessed with better recommendations given.

There was a huge push for financial innovation and leverage in the recent crisis. This was supported by complex debt instruments such as mortgage backed securities and commercial property loans, and derivatives especially credit default swaps[14]. The lesson is that such aggressive forms of credit expansion and innovation must be balanced against the overall framework presented here in terms of structural modelling. Effective bank monitoring and intermediation should never be taken for granted. If a suitable balance can somehow be found then stability will be achieved while at the same time growth is accelerated. But if the system strays too far from the structured paths of financial development and economic growth (due to excessive funding requirements through the credit and money markets for example) then imbalances will be realized and this increases the risk and extent of any financial crisis for the real economy. The model here – comprised of a small number of key variables – manages to capture the connection between the financial sector and real economy together with implications for structural dynamics. We end by noting that despite the diverse range of financial products available to borrowers and lenders, and despite the incredible speed of financial expansion and innovation, it should largely remain the case that the encompassing model here continues to operate even if its implications are not always easy to spot.

4.7 Conclusion

In this chapter we have attempted to provide a theoretical overview of a structural framework that can show a set of inter-connected relationships linking together banks, stock markets, and growth. Such a framework is effectively built around two elements: the '*entire picture*' and the '*five main effects*'. Together these elements combine to produce the 'Finance-Growth Nexus and Stock Market Infrastructure' – a story of a bi-directional relationship between finance and growth in which both the financial structure and the process of development are endogenously determined. While some authors have attempted to uncover such a system through identifying the connection between the financial sector and real economy, these authors have only done so by considering parts

[14] At the time of writing the global financial crisis of 2007-08 had claimed another casualty. In November 2008 the US government was forced to intervene and extend guarantees to Citigroup to the amount of $300bn, effectively putting an end to that institution's aggressive leverage of its balance sheet. Citi was widely seen as an institution with plans to become a 'universal bank'. It offered a huge range of financial service products across the globe through integrating its divisions across corporate banking, retail banking, investment banking, brokerage, proprietary securities trading, mortgage and insurance. Ironically Citigroup plans to break up and return to traditional banking by focusing more on lending to corporate clients.

of that system in isolation. In contrast, we have tried to show how the individual pieces remain compatible even after being essentially integrated into one big piece. Moreover we have argued that such a strategy – structuring individual components together into a number of chains in the background of a larger framework – is precisely what is required to properly assess the contribution that finance has for growth (and vice versa). That is, the *entire picture* allows for the individual variables to operate, while the *five main effects* in turn drive the rest of the system.

In the context of Bangladesh one of the main insights of this section is that although banks remain the key providers of firm investment and capital accumulation, the nature of the financial structure (and thus the policy for bank development and stock market development) *will* matter for economic growth. The way in which banks and stock markets are developing and interacting measures the extent of the overall impact which finance has on growth. Even though banks matter more they do so only in the context of a well-functioning (and suitable) mix of intermediaries and markets. Such an 'optimal' financial structure ensures that some push for stock market development will occur despite banks retaining the top position. In fact, such an inter-connected picture of the financial sector and real economy implies that stock market development would be more indicative of bank development, though other forces play a role too. Banks and stock markets can therefore be viewed as complementary despite appearing to have separate and unique roles, roles which nevertheless tend to become increasingly connected over time.

The main relevance of this discussion for Bangladesh is surprisingly simple yet to date it has frequently been ignored by researchers. We need to view the financial sector in a much broader (and structured) way. Doing so accomplishes two things. The first – a noteworthy cause in itself – is to obtain more insights regarding the financial sector of a developing economy. The second is to be able to correctly observe the theoretical implications as they translate into the data and empirical results. It is therefore essential that we carefully and thoroughly investigate the issue if we are to reconcile the theory of financial development and economic growth.

The task of empirical analysis is then to confirm or reject our theoretical hypotheses for the case of Bangladesh, a subject we now turn to.

CHAPTER 5

DATA AND METHODOLOGY

5.1 Introduction

This chapter explains the data sources and measurements of the variables used for the empirical testing on the finance-growth nexus (*Model 1*) and the stock market infrastructure (*Model 2A and 2B*) for Bangladesh. It also presents the details behind the econometric methodology on time-series data analysis. We explain the background to the following topics: (i) Perpetual Inventory method (ii) Time Series analysis; (iii) Cointegration; (iv) Causality; and (v) GARCH volatility modelling. The material here is important in order to carry out the testing procedures using *Microfit* and *EViews* and to understand the results uncovered in chapters 6, 7, and 8 in light of our theoretical motivations.

Table 5.1

Summary of variables

Name of variable	Abbreviation	Start date	End date	Frequency	Observations
Real GDP per capita	Y	1980	2005	Annual	25
Real capital stock / output	K	1980	2005	Annual	25
Quasi-money / GDP	Q	1980	2005	Annual	25
Private-credit / GDP	P	1980	2005	Annual	25
Number of listed companies	S	1980	2005	Annual	25
Total number of listed shares	List	Jan 1990	Dec 2005	Quarterly	64
DSE index	Index	Sept 1986	Dec 2005	Quarterly	64
Market capitalization	MCap	Sept 1986	Dec 2005	Quarterly	64
Turnover	Turn	Jan 1990	Dec 2005	Quarterly	64
Volume of shares traded	Volume (Vol)	Jan 1990	Dec 2005	Quarterly	64
Value of shares traded	Value (Val)	Jan 1990	Dec 2005	Quarterly	64
DSE index	Index	Jan 1995	July 2007	Daily	3327
Stock return	R	Jan 1995	July 2007	Daily	3327
Absolute stock return	ABS	Jan 1995	July 2007	Daily	3327
Stock return squared	RSQ	Jan 1995	July 2007	Daily	3327
Volume of shares traded	VOL	Jan 1995	July 2007	Daily	3327
Value of shares traded	VAL	Jan 1995	July 2007	Daily	3327

5.2 Description of variables for Model 1: The finance – growth nexus

The sample period is at annual frequency from 1980 to 2005 for the finance-growth nexus investigation. The variables[1] which are in usual logarithmic form are as follows:

Y – Real GDP per capita (*economic growth*)
K – Real capital stock / output[2] (*economic growth*)
Q – Quasi-money / GDP (*bank development*)
P – Private credit / GDP (*bank development*)
S – Number of listed companies[3] (*stock market development*)

We use real GDP per capita and the real capital stock as the two income variables in this study. For financial development, or specifically bank development, we have two variables: quasi-money/GDP and private-credit/GDP. These are standard variables in the literature and they attempt to measure the size and activity of commercial banks[4]. Quasi-money is a 'broad' measure of money supply – it comprises time and savings deposits and thus measures the extent of liquidity provision by the formal financial sector and is an indicator of 'financial depth'. It is a broad measure of the money supply and is similar to M2. Even so, quasi-money may be preferable to M2 because it excludes the currency and the demand deposit components of the aggregate money supply. These two components of monetary aggregates are seen to represent the transactions demand for money rather than the asset demand.

Private-credit equals claims on the private sector by commercial banks. This measure isolates credit issued to the private sector as opposed to credit issued to the government or other public enterprises. Credit issued by banks represents the single most important source of financial funds for firms in developing countries. Many authors argue that credit allocation to the private sector in a preferred indicator of financial development since the private sector is assumed to be more productive than the government sector (King and Levine, 1993a). In the context of Bangladesh, some authors have argued that

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[1] All variables are obtained from the online databases of the IMF *International Financial Statistics* and the World Bank *World Development Indicators*.
[2] The capital stock series was calculated using the perpetual inventory method. Raw data is taken from the 'Gross capital formation' row of the IMF *International Financial Statistics* database.
[3] This measure ideally would be expressed as a fraction of all registered companies. However data for the latter were of poor quality with many years missing. IPOs are highly significant events in any case. See Bekaert et al. (2001) who finds a positive impact of the number of listed companies on economic growth.
[4] See King and Levine (1993a: p. 720-721) and Siddiki (1999) for a comprehensive analysis of various financial development indicators.

credit allocation to the private sector is highly politically motivated and that is based on political and social influences rather than on the productivity of projects (see Siddiki, 1999; 2002), and that private credit should therefore not be considered as a meaningful measure of financial liberalization[5]. Nevertheless, we still include private credit as an indicator of bank development in addition to quasi money. While we broadly agree with the financial liberalization critique in the institutional context of Bangladesh, the focus of the analysis here is more on financial development[6].

Notice that bank credit and quasi-money translates respectively into bank lending and bank deposit-taking, which again translates into the assets and liabilities sides of the banks' balance sheet. Thus the two indicators of bank development – private credit and quasi-money – are themselves intrinsically related. This is can be seen more clearly in the figure at the end of chapter 4 (the "entire picture"). Having two indicators of bank development will also be more appreciated after considering the empirical results, where it is seen that the two sides of banking – lending and deposit taking – have respectively different roles to play in the specifications.

To understand the importance of the interplay between loans and deposits consider the following description of bank activity. When the investor walks into a local bank branch and deposits money in his or her bank account, that investor is in fact making a loan to the bank. From the bank's point of view this deposit is treated as a liability with the added provision that the investor technically may if they so desire withdraw their money almost instantly. The bank will now use the investor's deposits (together with other deposits on the bank's book) as a basis for making loans of its own. These loans – which are regarded as assets to the bank – will now be large, compared to the initial levels of deposits – i.e. the bank is now *leveraged* – and the terms of the loans will usually operate over a long period. This is the method by which banks traditionally make their profit –

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[5] Financial liberalization and financial development are closely connected topics which are often used interchangeably in the literature. See Chapter 2 for more details. Financial liberalization generally implies the removal of restrictions such as administrative setting of interest rates and the allocation of credit facilities to preferred sectors. The focus of financial development is broader than that of financial liberalization. Financial development refers to an increase in the size and activity of financial institutions (banks and stock markets). Both financial liberalization and financial development stress the key role of the financial sector in enhancing economic growth.

[6] Given the overall institutional framework and corruptive forces working in Bangladesh, we believe the inclusion of private credit might be able to enrich the analysis by revealing more insights into the advantages and benefits as well as the deficiencies and shortcomings of the financial sector.

they borrow short-term funds to invest long-term while using their risk-expertise to correctly balance the need for short-term liquidity against the desire to fund profitable, long-term investment projects.

Banks will also make loans to firms across different corporate sectors in the economy, to other banks in the industry and other financial institutions, to a wide range of consumers and ultimately even to the government[7]. In this way an entire financial complex is created, hard-wiring the link between the banking system and the economy. While the sheer number of these interactions appears to be daunting, at the macro level they all eventually should show up conveniently in the form of two main bank variables: *quasi-money* and *private credit*. Broadly, these two variables respectively reflect the size and activity of 'loans' (assets) and 'deposits' (liabilities). Together they more or less constitute an economy-wide balance-sheet summary of the entire banking system. We therefore choose to use both *quasi-money* and *private credit* to investigate the impact of banking sector on economic growth in the case of Bangladesh.

The reader should now be able to notice even at this early stage how imperative it is capture both these bank variables for the analysis instead of only one variable if we are to correctly assess the effect of banks on growth. This constitutes the requirement for measuring the banking sector only. For the stock market and the growth process similar requirements will also apply. In the stock market it is the number of listed companies together with market liquidity which captures the contribution of the stock market in the development process. And for the growth process itself, it is the physical capital stock in addition to GDP per capita which correctly measures economic growth. In all cases, the variable/s to be chosen for analysis must be compatible with the 'structural requirements' of the system (i.e. the framework which appears good at explaining the internal workings of the system). Having a number of inter-twined cointegration relationships will do greater justice to the finance-growth nexus and stock market infrastructure. The key is to find a set of cointegrating relationships which together represents a larger system, so that

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[7] In response to the recent global financial crisis and credit crunch of 2007-08, and in order to lend again to pre-crisis levels, banks worldwide have actually needed to borrow from the government itself. This has led to an increase in bank reserves, and therefore to growth in the narrow (and broad) money supply. Again these dynamics point to a certain balance in the ratio of economy-wide assets to liabilities which plays a role in determining the level of financial stability (or otherwise). Steady growth in output requires growth in the rate of both lending to the private sector and bank deposits. This is largely confirmed in the empirical part to *Model 1: the finance-growth nexus* for the case of Bangladesh.

the individual variables are related while still retaining a level of independence. It is this flexible yet disciplined approach that is best suited to the requirements of our analysis.

The number of listed companies is a measure of the size of the stock market. Market capitalization is also a measure of stock market size and this indicator has been more widely used in empirical work. However, market capitalization suffers from the volatile and random nature of stock prices[8]. The number of listed companies is representative of primary stock market development, whereas market capitalization is more representative of secondary market development. While both are important, the primary market is where companies list their shares for the first time in the form of initial public offerings (IPOs) and it represents a direct transfer of capital funds from investors to producers. It is this component of stock market growth that we are mainly interested in. Primary market indicators are thus strong candidates for the preferred measure of stock market development. Of course, the secondary market might positively impact the primary market and vice versa; but it is the initial injection of new equity capital, mostly through IPOs but also by way of newly issued shares from already listed companies, which truly reflects the contribution of the stock market (see also Chapter 2).

5.3 Description of variables for Model 2A: The stock market infrastructure (I)

The sample period for the first part of the stock market infrastructure – the 'listing-trading' relationship – is at quarterly frequency from 1980 to 2005. The variables[9] which are in usual logarithmic form are as follows:

List: the total number of listed shares on the stock exchange

Volume: the total volume of all traded shares

Value: the total value of all traded shares

Turnover: total value of all traded shares / adjusted market capitalization

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[8] As an example, the aggregate market capitalization of the five leading equity markets in Southeast Asia in early 1997 stood at $837 billion. It then almost halved in the three years following the Asian financial crisis in US dollar terms. The fall from the global financial crisis of 2007-08 is expected to be even worse.

[9] Data on DSE stock indices, trading volume, and trading value at monthly, quarterly and daily frequency were obtained from the Research Department at the DSE. Monthly and quarterly data on market capitalization going back to 1986 were obtained from the Bangladesh Bank *Economic Trends*.

The total number of listed shares (*List*) is very closely related to the number of listed companies (*S*). Both are indicators of primary market development or listings. However, the latter indicator simply counts every company which is listed on the DSE – this figure is typically in the hundreds. The former indicator captures every single share which has been issued – this figure is typically in the millions. At quarterly frequency *List* is able to more accurately capture any increment in the growth in stock market development, whereas at annual frequency *S* is deemed to be suitable (and it is the only variable for stock market development that goes back to 1980). The three variables *Volume* (Vol), *Value* (Val) and *Turnover* (Turn) are indicators of market liquidity, or the ease with which shares can change hands in the secondary market.

5.4 Description of variables for Model 2B: The stock market infrastructure (II)

The second part of the stock market infrastructure investigates the dynamics of price changes and trading on the Dhaka Stock Exchange. Here we assess the volume-volatility effect and trading-stock return effect. We use a unique database of daily data from 1995 to 2007. The variables[10] which are in usual logarithmic form are as follows:

Index: the DSE stock price index,

R: the stock return

RABS: the absolute stock return

RSQ: the squared stock return

VOL: the volume of shares traded,

VAL: the value of shares traded.

Using the DSE index we construct the stock return, the absolute stock return, and the return squared. The stock return measures the daily return and the return squared measures unconditional price volatility. These measures based on the stock price are used in the Granger Causality tests and trading indicators (trading volume and trading value) to assess whether causal relationships can be shown to operate on the stock exchange. The stock return and trading variables are also used in GARCH or conditional volatility analysis. The two variables *VOL* and *VAL* are indicators of market liquidity, or the ease

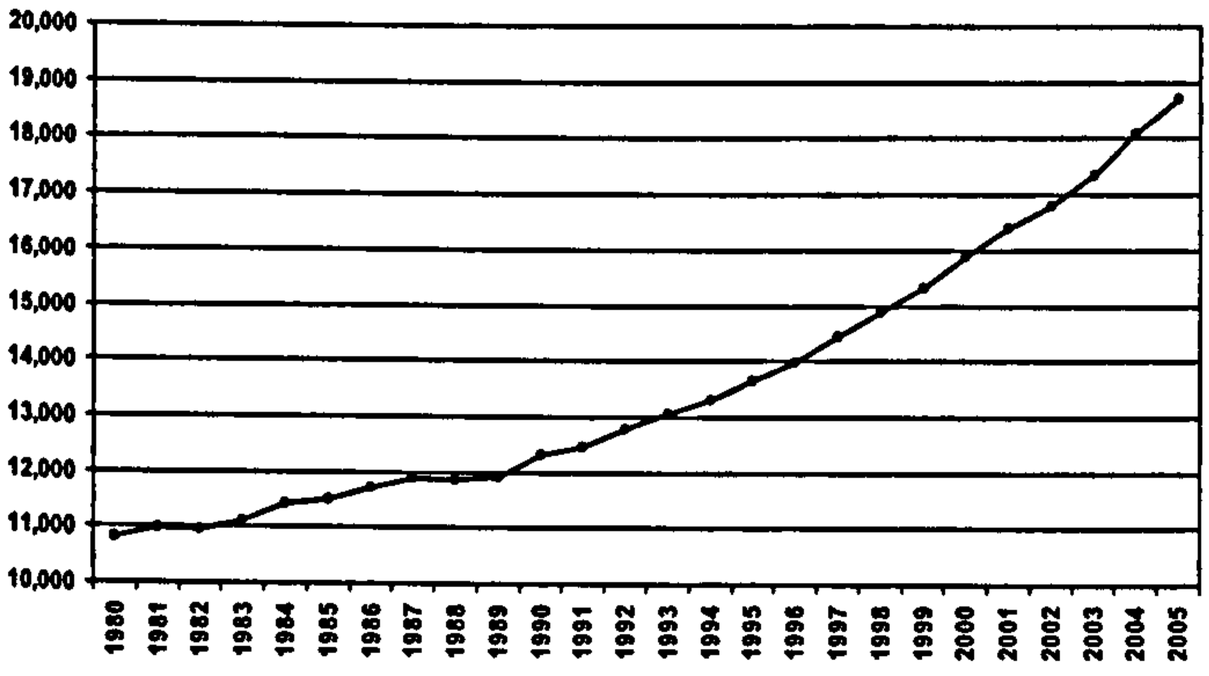
[10] All daily data (stock index, trading volume, and trading value) for the DSE in this section were obtained from a private investment company located in Motijheel, Dhaka.

with which shares can change hands in the secondary market – they are identical to the measures used at quarterly frequency except they are now at daily frequency. Value of shares traded is expressed in terms of domestic currency (taka).

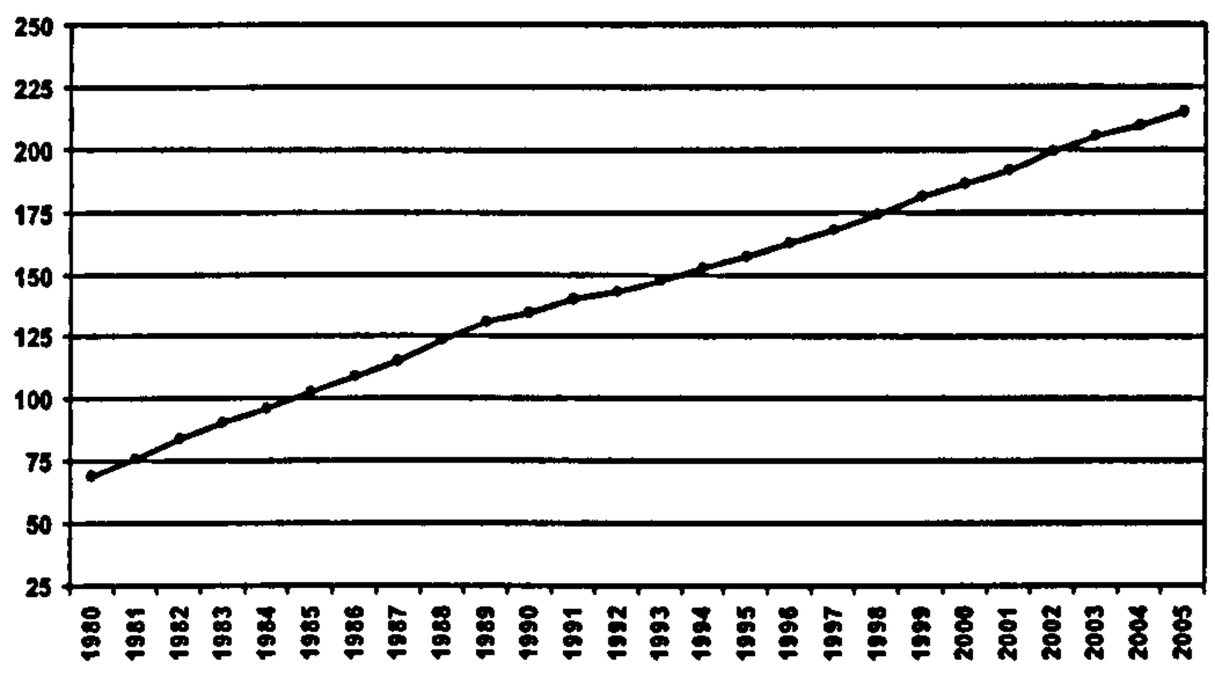
Figure 5.1

Graphs of real and financial variables: 1980-2005

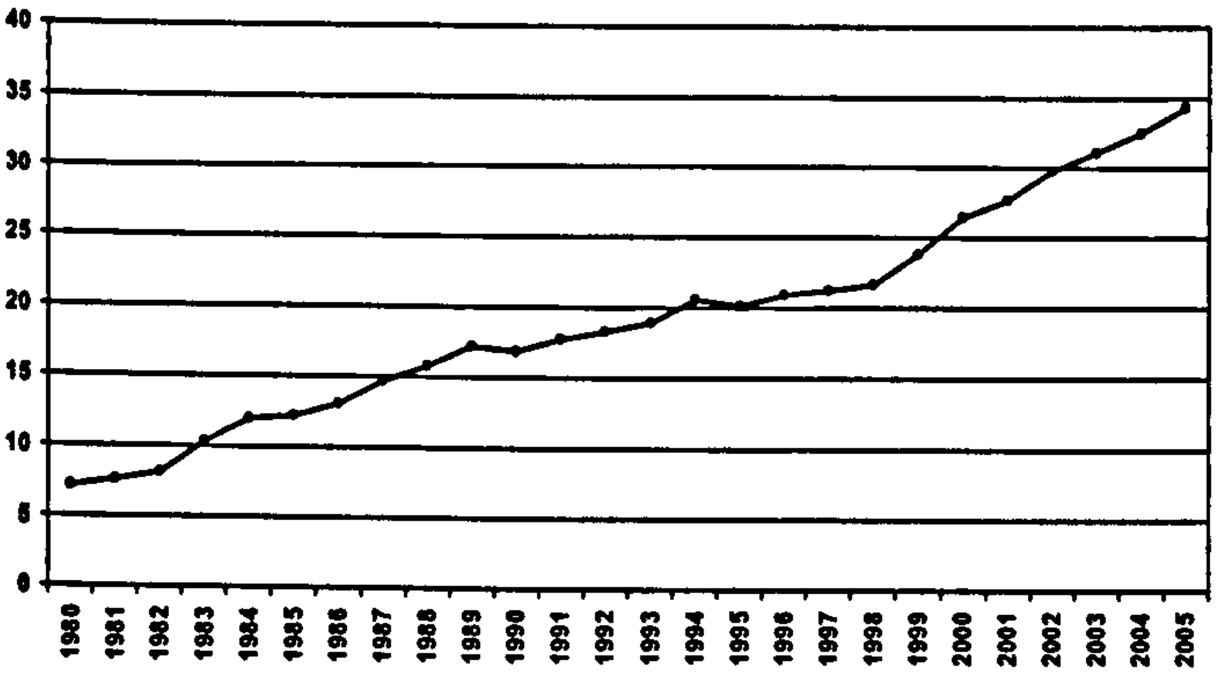
(a) Real GDP per capita



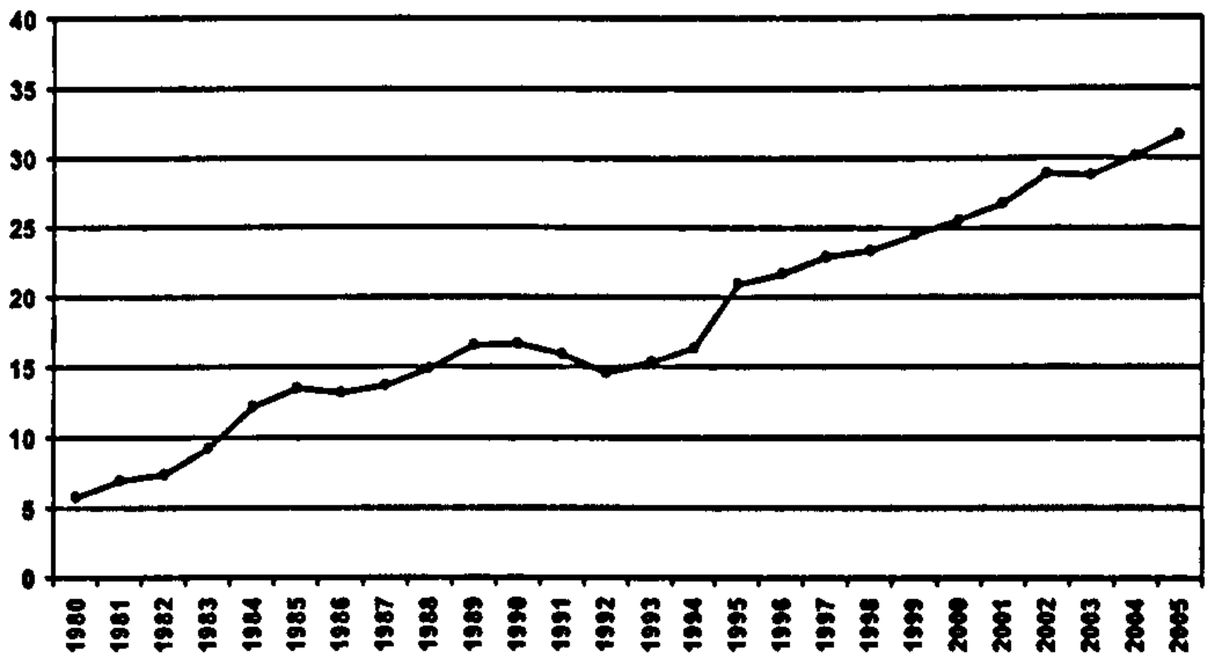
(b) Real capital stock / output



(c) Quasi-money / GDP



(d) Private-credit / GDP



(e) Number of listed companies

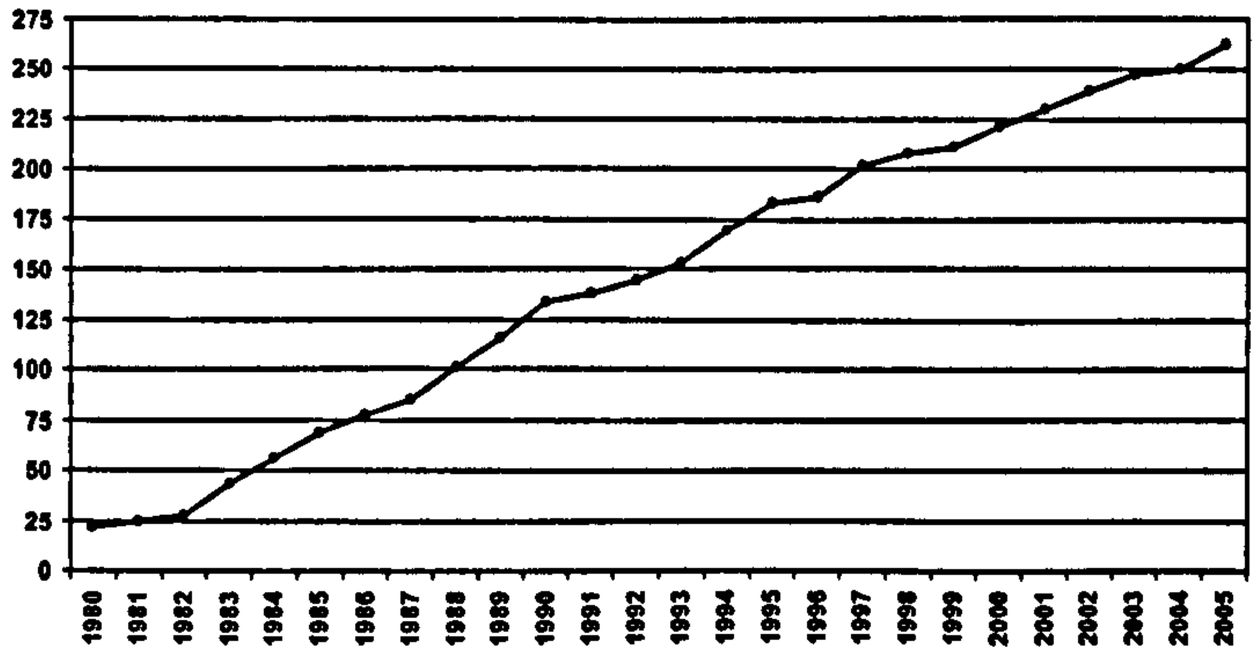
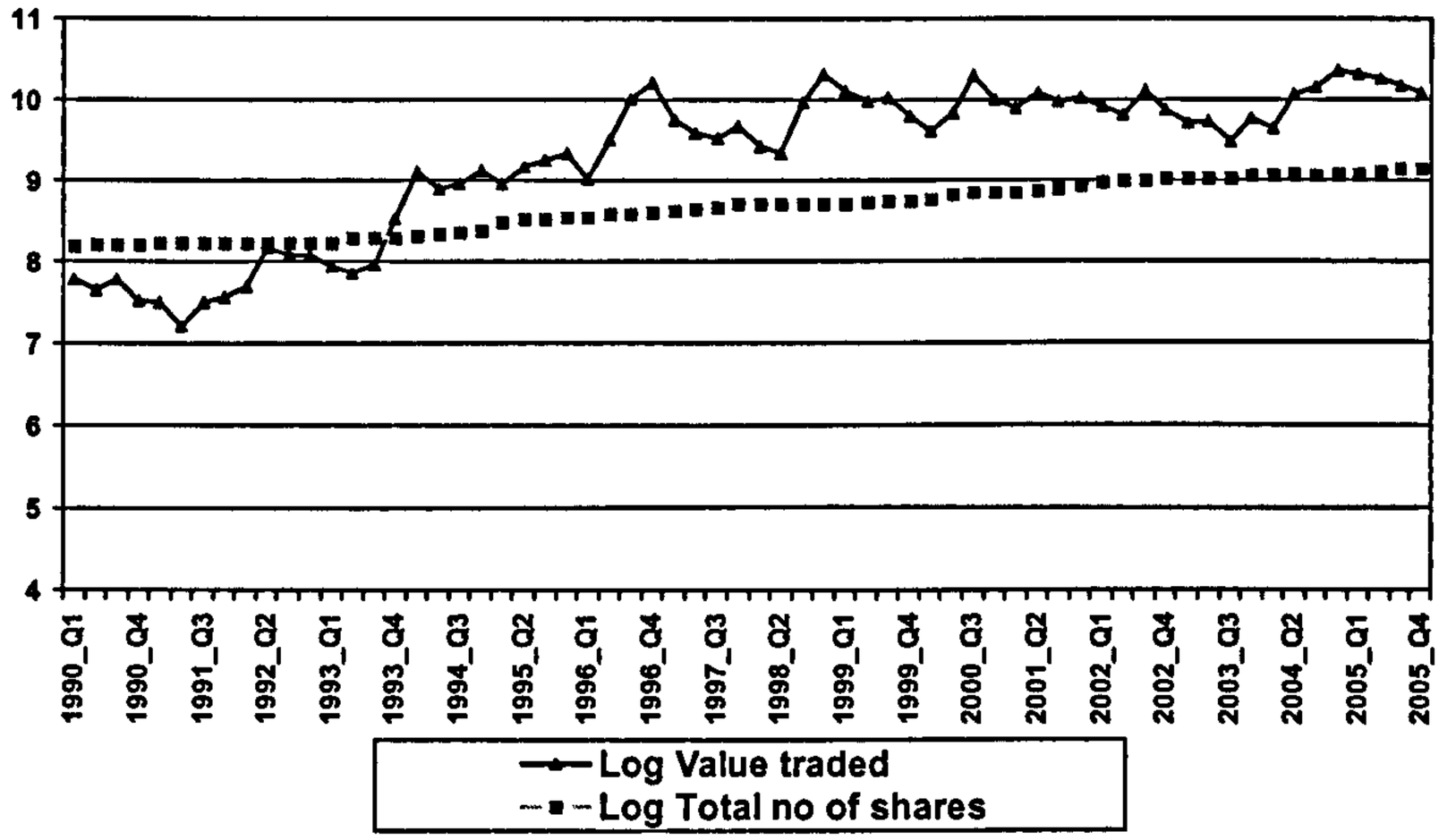


Figure 5.2

Stock market listing and trading value: 1990Q1 – 2005Q4



5.5 The Perpetual Inventory Method

In most developing countries there is a lack of relevant data of sufficient quality. The non-availability of a reliable capital stock series is of particular concern. Economists have resorted to a number of ways in attempting to construct estimates of a nation's capital stock. Perhaps the easiest and most popular is the *Perpetual Inventory Method* (PIM)[11]. The calculation is described in detail below.

The main idea behind the PIM is to form an equation linking net productive capital stock at the end of year t to gross investment in the same period via a depreciation rate and past values of the capital stock:

$$K_t = K_{t-1}(1-\delta) + I_t \qquad (5.5.1)$$

where

K_t = the net capital stock at the end of year t and at some base year price

[11] Studies which have used the perpetual inventory method include Beck et al. (2000), Benhabib and Spiegal (2000), and Arestis and Demetriades (1997).

I_t = gross investment during year t at the same base year price

δ = a constant depreciation rate (%)

The net capital stock (K_t) represents the cumulated depreciated value of the existing (gross) stock of capital. The depreciation rate (δ) allows for the fact that some of the capital assets comprising the capital stock deteriorate over time and may eventually become obsolete. Thus the K_t variable may be interpreted as the proportion of capital in a given year which is available for productive use today as well as in the near future.

Equation (5.5.1) is based on the following assumptions:

(i) Net capital stock at the end of year t equals the sum of all previous net investment:

$$K_t = \sum_{r=0}^{\infty}(I_{t-r} - IR_{t-r}) \qquad (5.5.2)$$

where IR_t = replacement investment of year t. Thus it is assumed that the capital stock is replaced when it gets depreciated.

(ii) Depreciated capital stock is assumed to be distributed geometrically over time with a constant depreciation rate (δ). This rate equals one divided by the lifespan of each past investment. Here, the lifespan is constant amongst all past investments:

$$IR_t = \delta I_{t-1} + \delta(1-\delta)I_{t-2} + \delta(1-\delta)^2 I_{t-3} + ... \qquad (5.5.3)$$

Substituting (5.5.3) into (5.5.2) we obtain

$$K_t = \sum_{r=0}^{\infty}[I_{t-r} - \delta I_{t-r-1} - \delta(1-\delta)I_{t-r-2} - ....] \qquad (5.5.4)$$

We also have

$$(1-\delta)K_{t-1} = (1-\delta)\sum_{r=0}^{\infty}[I_{t-r-1} - \delta I_{t-r-2} - \delta(1-\delta)I_{t-r-3} - ....] \qquad (5.5.5)$$

and by subtracting (5.5.5) from (5.5.4) we obtain

$$K_t - (1-\delta)K_{t-1} = \sum_{r=0}^{\infty}[I_{t-r} - \delta I_{t-r-1}] = I_t \qquad (5.5.6)$$

Therefore as in equation (5.5.1),

$$K_t = I_t + (1-\delta)K_{t-1}$$

The first task that confronts the researcher who wishes to use the PIM in constructing the capital stock series is how to estimate the initial value K_0. Having obtained this initial value, he or she could then use equation (5.5.1) and proceed to construct the entire series. An approach adopted by many authors is to obtain K_0 by assuming that it takes a value beginning at the start of a long history of national accounts data. Harberger (1978) for instance suggests deriving an initial estimate of the capital stock at year t_0 assuming that the country was at its steady-state capital-output ratio in that year. Alternatively an initial capital stock of zero can be assumed, although results in both cases have been shown to yield very similar results (see King and Levine, 1994[12]). The depreciation rate is usually determined arbitrarily at around 5%.

In this work we decide to adopt the PIM and specifically the Harberger (1978) approach for the calculation of the physical capital accumulation series for Bangladesh. That is, $K_t = I_t + (1-\delta)K_{t-1}$. The initial value of K_0 is the value in the year 1960 taken from the gross capital formation series of the IMF's *International Financial Statistics* online database, with subsequent capital figures also taken from the same source. We assume an annual depreciation rate of 5% for the capital stock and equation (5.5.1) is then used to compute the series.

5.5.2 Notes on using physical capital accumulation as the dependent growth variable

King and Levine (1993b) find that indicators of financial development are significantly positively correlated with the rate of physical capital accumulation. Beck, Levine, and Loayza (2000) use equation (5.5.1) and find that financial development results in higher

[12] King, R. and R. Levine (1994): "Capital fundamentalism, economic development, and economic growth", Carnegie-Rochester Conferences Series on Public Policy, 40, 259-292.

GDP growth, productivity, and physical capital accumulation. Benhabib and Spiegel (2000) use a version of the perpetual inventory method and their results suggest a positive role for financial development in encouraging physical capital accumulation as well as total factor productivity growth. The inclusion of physical capital accumulation growth in addition to GDP per capita and productivity growth has therefore been attempted by a number of different authors in the literature. The motivation seems to have been to demonstrate that the positive relationship between finance and growth continues to hold even when different variables are used. Such an approach is expected to increase our confidence behind the theory which predicts a positive *finance-to-growth* effect. The higher the number of positive results found through using alternative indicators, the more certain the reader becomes of the relationship.

5.6 Time series analysis

5.6.1 Regression

The main task of regression analysis is to establish the direction of causation between two (or more) variables. In a two variable case we want to know which variable is causing or affecting the other. We shall refer to variables as being either belonging to dependent variables or independent variables. The objective of empirical analysis is then to explain or predict the dependent variable given the independent or explanatory variable(s).

5.6.2 Time series data

A time series data set consists of observations on one or several variables over time *t*. Time series data are available in different frequencies, such as annual, quarterly, monthly, weekly, and daily. A key feature of time series data is the fact that observations are commonly dependent across time. In contrast to cross-section and panel data, in the case of time series we are required to be more careful in specifying the appropriate econometric model[13]. In addition, the fact that economic time series display trends over time has led to econometric techniques that attempt to address these features.

[13] In order to be sure of satisfactory properties of our estimators, we usually require the following: homoskedasticity (equal error variances, or no heteroskedasticity), serial independence (no correlation between errors, i.e. no autocorrelation), normality of residuals, and no miss-specification. Tests for these requirements are automatically reported in *Microfit* similarly in *EViews*.

5.6.3 Stationarity

A time series is said to be stationary when it has the following characteristics: (i) mean reversion; (ii) finite time-invariant variance; (iii) diminishing correlogram as the lag length increases. In other words, the mean, variance and covariance of the series are constant over time. Stationarity is important because if the series is non-stationary then all the typical results of classical regression analysis are invalid. Standard regressions in the presence of non-stationary series then have no meaning and may be 'spurious'. Shocks to a stationary time series in contrast are temporary; over time, the effects of these shocks will disappear and the series will revert to its long-run mean level. The long-term forecast of a stationary series will thus converge to the unconditional mean of the series.

5.6.4 Integrated series

Most economic and financial time series show trends over time. Such time series are non-stationary. To deal with this problem and in order to induce stationarity, we may difference the series. The first difference for instance of a series X_t is given by

$$\Delta X_t = X_t - X_{t-1}$$

If, after first differencing, a series is found to be stationary then the series is *integrated of order one*, and denoted I(1). If the series even after first differencing is found not stationary, then we need to take second differences. In general we might need to difference a series *d* times in order to induce stationarity.

5.6.5 Testing for unit roots

Dickey and Fuller (1979, 1981) devised a procedure to formally test for non-stationarity by testing for a unit-root. The augmented version of the test is the AR(1) model including extra lagged terms of the dependent variable in order to eliminate autocorrelation. The lag length is determined either by the Akaike Informaiton Criterion (AIC) or Schwartz Bayesian Criterion (SBC). Different versions of the test may be used depending on whether deterministic trends are detected in the data.

5.7 Cointegration

In this section we present the topic of cointegration, a recent time-series application to modelling long-run and short-run effects in a relationship which is thought to exist between economic variables.

Time series data which are frequently differenced in order to remove the presence of trends and to make the data stationary is not always ideal. Applying first differences of the variables leads to the loss of long-run properties, since the model in differences has no long-run solution. (A long run solution is one that has $Y^* = Y_t = Y_{t-1} = ... = Y_{t-i}$). The desire to have models which combine both short-run and long-run properties, and which at the same time maintain stationarity in all of the variables, has led to a reconsideration of the problem of regression using variables that are measured in their levels. The basic idea is that if there are economic time series that are integrated and of the same order (which means they are non-stationary), which we know are related (mainly through a theoretical framework), then we try to check whether we can find a way to combine them together into a single series which is itself non-stationary. If this is possible, then the series that exhibits this property is said to be cointegrated.

5.7.1 Cointegration and the error-correction mechanism

Suppose we have Y_t and X_t which are both I(1). If we then regress

$$Y_t = \beta_1 + B_2 X_t + e_t \qquad (5.7.1)$$

we will not get satisfactory estimates of $\hat{\beta}_1$ and $\hat{\beta}_2$. One way of resolving this is to difference the data in order to ensure stationarity of our variables. Therefore, after differencing we will have that $\Delta Y_t \sim$ I(0) and $\Delta X_t \sim$ I(0), and the regression model will be

$$\Delta Y_t = a_1 + a_2 \Delta X_t + u_t \qquad (5.7.2)$$

In this case the regression model will give us correct estimates of the $\hat{a}_1$ and $\hat{a}_2$ parameters and the spurious equation problem is solved. However, what we have from

equation (5.7.2) is only the short-run relationship between the two variables. Recall that in the long-run:

$$Y_t^* = Y_t = Y_{t-1} = ... = Y_{t-p} \tag{5.7.3}$$

so ΔY_t will give us no information about the long-run behaviour of our model. As economists are mainly interested in long-run relationships this is a problem. In order to resolve it, the concept of cointegration and error-correction is very useful.

Assume both Y_t and X_t are I(1). If there is the special case of a linear combination of these two series that is I(0), then Y_t and X_t are cointegrated. Thus, if this is the case the regression of equation (5.7.1) is no longer spurious, and it also provides us with the linear combination:

$$\hat{e}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_t \tag{5.7.4}$$

that connects Y_t and X_t in the long run.

5.7.2 The error-correction model (ECM)

If Y_t and X_t are cointegrated, by definition $\hat{e}_t \sim$ I(0). Thus, we can express the relationship between Y_t and X_t with an ECM specification:

$$\Delta Y_t = a_0 + b_1 \Delta X_t - \pi \hat{e}_{t-1} + u_t \tag{5.7.5}$$

which will now have the advantage of including both long-run and short-run information. In this model, b_1 is the short-run effect that measures the immediate impact that a change in X_t will have on a change in Y_t. π is the feedback or adjustment effect, and shows how much of the disequilibrium is being corrected. In other words, π measures the extent to which any disequilibrium in the previous period effects any adjustment in Y_t. Of course $\hat{e}_{t-1} = Y_{t-1} - \hat{\beta}_1 - \hat{\beta}_2 X_{t-1}$, and therefore from this equation we also have β_2 as the long-run response (which is estimated in equation (5.7.2).

5.7.3 ECM as a reparameterization of the ARDL model

The concepts of cointegration and the error-correction mechanism (ECM) are related. To understand the ECM it is useful to think of the ECM as a reparameterization of the linear autoregressive distributed lag (ARDL) model. Consider the following simple dynamic ARDL model describing the behaviour of Y in terms of X:

$$Y_t = a_0 + a_1 Y_{t-1} + \chi_0 X_t + \chi_1 X_{t-1} + u_t \tag{5.7.6}$$

where the residual $u_t \sim iid(0, \sigma^2)$.

In this model the parameter χ_0 denotes the short-run reaction of Y_t after a change in X_t.

The long-run effect is given when the model is in equilibrium where

$$Y_t^* = Y_t = Y_{t-1} = ... = Y_{t-p} \tag{5.7.7}$$

and

$$X_t^* = X_t = X_{t-1} = ... = X_{t-p} \tag{5.7.8}$$

It follows that

$$Y_t^* = a_0 + a_1 Y_t^* + \chi_0 X_t^* + \chi_1 X_t^* + u_t$$

$$Y_t^* (1 - a_1) = a_0 + (\chi_0 + \chi_1) X_t^* + u_t$$

$$Y_t^* = \frac{a_0}{1 - a_1} + \frac{\chi_0 + \chi_1}{1 - a_1} X_t^* + u_t$$

$$Y_t^* = \beta_0 + \beta_1 X_t^* + u_t \tag{5.7.9}$$

In other words, the long-run elasticity between Y and X is captured by $\beta_1 = (\chi_0 + \chi_1)/(1 - a_1)$. We assume that $a_1 < 1$ so that the short-run model (5.7.6) converges to a long-run solution.

Because both Y and X are not stationary, neither the short-run nor the long-run model can be estimated (therefore avoiding the spurious regression problem) while taking first-differences only; we do not have any information about the long-run solution. A more suitable approach for modelling this case is to take the ECM which is a reparameterization of the original (5.7.6) model:

$$\Delta Y_t = \chi_0 \Delta X_t - (1-a_1)[Y_{t-1} - \beta_0 - \beta_1 X_{t-1}] + \varepsilon_t \tag{5.7.10}$$

$$\Delta Y_t = \chi_0 \Delta X_t - \pi[Y_{t-1} - \beta_0 - \beta_1 X_{t-1}] + \varepsilon_t \tag{5.7.11}$$

To show that this is the same as the original model substitute the long-run solutions for $\beta_0 = a_0/(1-a_1)$ and $\beta_1 = (\chi_0 + \chi_1)/(1-a_1)$ to give:

$$\Delta Y_t = \chi_0 \Delta X_t - (1-a_1)\left[Y_{t-1} - \frac{a_0}{1-a_1} - \frac{\chi_0 + \chi_1}{1-a_1} X_{t-1}\right] + \varepsilon_t \tag{5.7.12}$$

$$\Delta Y_t = \chi_0 \Delta X_t - (1-a_1)Y_{t-1} - a_0 - (\chi_0 + \chi_1)X_{t-1} + \varepsilon_t \tag{5.7.13}$$

$$Y_t - Y_{t-1} = \chi_0 X_t - \chi_0 X_{t-1} - Y_{t-1} + a_1 Y_{t-1} - a_0 - \chi_0 X_{t-1} - \chi_1 X_{t-1} + \varepsilon_t \tag{5.7.14}$$

and by rearranging we get

$$Y_t = a_0 + a_1 Y_{t-1} + \chi_0 X_t + \chi_1 X_{t-1} + u_t \tag{5.7.15}$$

which is the same as for the original model.

When the two variables Y and X are cointegrated, the ECM incorporates not only short-run but also long-run effects. This is because the long-run equilibrium $Y_{t-1} - \beta_0 - \beta_1 X_{t-1}$ is included in the model together with the short-run dynamics captured by the differenced term. Another important advantage is that all the terms in the ECM are stationary and standard OLS regression is therefore valid. This is because if both Y and X are I(1), then ΔY and ΔX are I(0), and by definition if Y and X are cointegrated then their linear combination $(Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) \sim$ I(0).

A final important point is that the coefficient $\pi = (1 - a_1)$ provides us with information about the speed of adjustment in cases of disequilibrium. When long-run equilibrium holds, $(Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) = 0$. However, during periods of disequilibrium this term will no longer be zero and thus measures how far the system is from equilibrium. For example, suppose that due to a series of negative shocks in the economy (captured by the error term u_t) Y_t starts to increase less rapidly than what is consistent with (5.7.9). This causes $(Y_{t-1} - \beta_0 - \beta_1 X_{t-1})$ to be negative because Y_{t-1} has moved below its long-run steady-state growth path. However, since $\pi = (1 - a_1)$ is positive (and because of the minus sign in front of π) the overall effect is to boost ΔY_t back towards its long-run path as determined by X_t in equation (5.7.9). The speed of this adjustment to equilibrium is dependent upon the magnitude of $(1 - a_1)$. π is therefore the error-correction coefficient which tells us how much of the adjustment to equilibrium takes place each period, or how much of the equilibrium error is corrected.

5.7.4 How should we choose the lag structure?

The choice of lags to include in the econometric specifications needs to be done carefully. Including a higher number of lags will usually increase the scope and accuracy of any dynamic adjustments which are taking place between the variables in the regressions, and also can help to deal with problems such as autocorrelation, heteroskedasticity and any misspecification in the data. However, the trade-off here is that a large time span of data is needed. A number of selection criteria tools have been developed (e.g. AIC, SBC) which effectively try to balance the trade-off according to various requirements. Ultimately the econometrician has to make an informed decision based on the use of different tests and his or her own judgements on the quality of the data set together with the existing body of theoretical knowledge which is hypothesized to link the variables. The importance of the lag structure makes the ARDL cointegration method particularly appealing as we will now see.

5.8 Pesaran, Shin and Smith (2001) ARDL technique for Cointegration

This section describes the Pesaran, Shin and Smith (PSS) ARDL cointegration procedure, commonly known as the 'bounds-test'. This technique is particularly well-suited for assessing the finance-growth relationship (as well as the stock market infrastructure) because it allows an easy interpretation of the results in terms of independent and dependent variables. This is due to the fact that the PSS procedure tests for the existence of a long-run relation between y_t and a 'forcing variable' x_t[14]. The method is also well-suited for small sample sizes and does not require pre-testing the variables for the presence of a unit root. Finally, the PSS ARDL method is argued to be advantageous because it is able to correct for the problem of endogenous regressors and autocorrelation by inserting enough lags into the specification[15].

The theoretical literature on endogenous growth and financial sector development hypothesizes that the growth rate of output is a function of indicators of bank development and of stock market development. For example, if we assume that all of our financial variables are important we would have the following relationship[16]:

$$\log G_t = c + \alpha \log Q_t + \beta \log P_t + \chi \log S_t + u_t \qquad (5.8.1)$$

where c is a constant, G_t is the economic growth indicator (which represents either real GDP per capita, Y_t or real capital stock/output, K_t), Q_t is quasi-money/GDP, P_t is private-credit/GDP, S_t is the number of listed companies on the stock exchange, and u_t is a disturbance term.

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[14] While the PSS ARDL methodology is carefully formulated in terms of independent and dependent variables, the empirical results uncovered in Chapters 6 and 7 in fact reveal a variety of effects or relationships operating in the finance-growth nexus and stock market infrastructure of Bangladesh. We may go even further and claim that the main effects theorized to operate: the finance-to-growth effect, growth-to-finance effect, banks-to-stock market effect, and listing - trading effect *are exactly the same as those identified and isolated by the empirical analysis in Chapters 6 and 7.*

[15] The PSS ARDL cointegration technique for small sample sizes is arguably superior to other cointegration methods such as the Johansen (1988) method and Engle and Granger (1987) method. The latter two procedures are thought to require a longer span of time series data.

[16] This relationship can in fact take a number of different forms. Here we assume for ease of exposition that all variables are to be included. The PSS procedure on the other hand requires testing every possible combination of variables. Only when a particular specification is 'unique', and only when all diagnostic tests are passed can reasonable assessments then be made.

Following PSS, we apply the bounds test procedure by modelling the long-run equation (5.8.1) as a general vector autoregressive (VAR) model of order p, in z_t:

$$z_t = c_0 + \beta t + \sum_{i=1}^{p} \phi_i z_{t-i} + \varepsilon_t \qquad t = 1,2,3,...,T \tag{5.8.2}$$

where c_0 represents a $k+1$ vector of intercepts (drift), and β denotes a $k+1$ vector of trend coefficients. PSS further derive the following vector equilibrium correction model (VECM) corresponding to (5.8.2):

$$\Delta z_t = c_0 + \beta t + \Pi z_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta z_{t-i} + \varepsilon_t \qquad t = 1,2,3,...,T \tag{5.8.3}$$

The $(k+1)$ x $(k+1)$ matrices $\Pi = I_{k+1} + \sum_{i=1}^{p} \Psi_i$ and $\Gamma_i = -\sum_{j=i+1}^{p} \Psi_j$, $i = 1,2,...,p-1$ contain the long-run and short-run coefficients of the VECM. z_t is the vector of variables g_t and x_t respectively (small case letters denote logarithms). g_t is an I(1) dependent variable, and $x_t = [Q_t, P_t, S_t]$ is a vector matrix of 'forcing' I(0) and I(1) regressors not cointegrated amongst themselves with a multivariate identically and independently distributed (i.i.d) zero mean error vector $\varepsilon_t = (\varepsilon_{1t}, \varepsilon'_{2t})'$, i.e. a homoskedastic process (serially uncorrelated disturbances and constant variance-covariance matrices). In the case where u_t and ε_t are correlated, the above ARDL specification requires inserting enough lags of the forcing variable to endogeneise y_t. By doing this, one can simultaneously correct for the problem of endogenous regressors and for serial autocorrelation.

Assuming further that a unique long-run relationship exists among the variables, the conditional VECM (5.8.3) can now be written as:

$$\Delta g_t = c_0 + \beta t + \delta_{gg} g_{t-1} + \delta_{xx} x_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{p-1} \xi_i \Delta x_{t-1} + \varepsilon_{gt} \qquad t = 1,2,3,...,T \tag{5.8.4}$$

On the basis of equation (5.8.4), and again emphasizing that the number of variables to be eventually included is flexible at this stage, the conditional VECM can be specified as:

$$\Delta \log G_t = c_0 + \delta_1 \log G_{t-1} + \delta_2 \log Q_{t-1} + \delta_3 \log P_{t-1} + \delta_4 \log S_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \log G_{t-i} +$$

$$\sum_{j=1}^{q} \omega_j \log \Delta Q_{t-j} + \sum_{l=1}^{q} \varphi_l \Delta \log P_{t-l} + \sum_{m=1}^{q} \gamma_m \Delta \log S_{t-m} + \varepsilon_t \qquad (5.8.5)$$

where δ_i are the long-run coefficients, c_0 is the constant (drift), and ε_t are white noise errors. The long-run coefficients in this framework are seen to reflect the short-run parameters and thus, the effects of the lagged variables in the co-integrating relation (for details refer to PSS). The order of the distributed lag function on g_t is selected using either the Schwartz Bayesian Criterion (SBC) or Akaike Information Criterion (AIC)[17].

The null hypothesis is that of no cointegration (no levels relation). To test the null, an F test is performed in that the long-run coefficients (the δ_i's) in the above VECM (5.8.5) are jointly equal to zero. PSS calculated bounds for the critical values for this F-test statistic when the regressors are $I(0)$ and when they are $I(1)$. If the computed F statistic falls outside the critical value bounds, a conclusive decision results without needing to know the integration status of the regressors. Specifically, if the calculated F statistic is higher than the upper bound, then the null of no cointegration is rejected, irrespective of whether the variables are purely $I(0)$ or $I(1)$. If the calculated F statistic is below the lower bound, then the null cannot be rejected. Finally, the F statistic is inconclusive if the calculated statistic falls within the bound of the critical values. PSS have derived different sets for the bounds of the critical values for cases with constant and/or trend.

The F-test for the joint significance in the formulation where all financial variables were deemed important, for example, would take the following form:

$$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$$

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[17] The maximum lag length for the annual data in *Model 1* is three given that the sample size is 25 observations. The maximum lag length for quarterly data in *Model 2A* is 12 given that the sample size is 64 observations. The SBC and AIC point estimates in general are usually similar and suggest the same lag order. However, when one of the respective tests indicates a higher lag order than the other, then the higher order test will usually result in estimated standard errors that are smaller. In one case for the listing-trading relationship we use the RBS (R-bar squared) criteria.

against the alternative

$$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$$

The test is performed by first normalizing on the growth variable - say Y_t (real GDP per capita) which is denoted by $F(Y/Q,P,S)$ - and noting whether or not this F-value is greater than the critical F-value. Let us assume that the calculated F-value ($F(Y/Q,P,S)$) exceeded the critical F-value. This would indicate, at least initially, that quasi-money/GDP (Q), private-credit/GDP (P), and the number of listed companies (S) were important determinants for economic growth (Y). However, the existence of a *unique* co-integrating relationship can only be confirmed once we are sure that there only one dependent variable that is driven by what PSS refer to as the 'long-run forcing variables'. This means that we would have to additionally calculate $F(Q/Y,P,S)$, $F(P/Y,Q,S)$, and $F(S/Y,Q,P)$. These other three F-values cannot also be greater than the critical F-value. If they were then the co-integrating relationship would not be unique.

In the next step, after the unique long-run cointegrating relationship is verified, the conditional ARDL long-run model for Y_t can be estimated as:

$$\log Y_t = c_0 + \sum_{i=1}^{p} \delta_1 \log Y_{t-i} + \sum_{i=0}^{q1} \delta_2 \log Q_{t-i} + \sum_{i=0}^{q2} \delta_3 \log P_{t-i} + \sum_{i=0}^{q3} \delta_4 \log S_{t-i} + \varepsilon_t \qquad (5.8.6)$$

In the third and final step, we obtain the short-run parameters by estimating an error correction model associated with the long-run estimates:

$$\Delta \log Y_t = \mu + \sum_{i=1}^{p} \phi_i \Delta \log Y_{t-i} + \sum_{j=1}^{q} \omega_j \Delta \log Q_{t-j} + \sum_{i=1}^{q} \varphi \Delta \log P_{t-i} + \sum_{m=1}^{q} \gamma_m \Delta \log S_{t-m} + \pi\, ecm_{t-1} + \varepsilon_t \qquad (5.8.7)$$

In (5.8.7), ϕ, ω, φ, and γ are the short-run dynamic coefficients of the model's convergence to equilibrium, and π is the speed of adjustment from a shock in the previous period. The error-correction model describes how the system is therefore

adjusting in each period towards its long-run equilibrium. Since the variables are co-integrated, deviations in the short-run from this long-run equilibrium will feed back on the changes in the dependent variable in order to force the system back toward the long-run equilibrium state. The coefficient on the error-correction term is a measure of the proportion by which the long-run disequilibrium in the dependent variable is corrected each period.

5.9 Granger Causality

Causality in econometrics refers to the ability of one variable to predict (and therefore cause) the other. Suppose that two variables Y_t and X_t affect each other (with lags). The relationship between these variables can be captured by a VAR model. IN this case it is possible to have the result that (a) Y_t causes X_t, (b) X_t causes Y_t, (c) there is a bi-directional feedback (causality in both directions0, and finally (d) the two variables are independent. We now present the Granger Causality procedure in what follows.

In the Granger (1969) causality test, the procedure is to determine whether the inclusion of the causal variable significantly reduces the forecast error. An economic time series Y is said to be granger caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged X's are statistically significant. To test for causality between the X and Y series, we specify a bivariate k^{th} order VAR:

$$X_t = \sum \alpha_{1i} Y_{t-i} + \sum \alpha_{2i} X_{t-i} + V_t \qquad (5.9.1)$$

$$Y_t = \sum \beta_{1i} X_{t-i} + \sum \beta_{2i} Y_{t-i} + U_t \qquad (5.9.2)$$

The procedure uses only lagged values of both the causal and the dependent variable. The procedure is applicable if either (i) the variables are non-stationary and cointegrated; or (ii) the variables are non-stationary and not cointegrated, in which case the first difference is used.

A hypothesis of no causality is tested in a joint test that coefficients of the lagged causal variable are significantly different from zero.

Equations (5.9.1) and (5.9.2) provide the following four possible causal relationships

a) Unidirectional causality from Y to X exists if $\sum \alpha_{1i} \neq 0$ and $\sum \beta_{1i} = 0$.
b) Unidirectional causality exists from X to Y if $\sum \beta_{1i} \neq 0$ and $\sum \alpha_{1i} = 0$.
c) Bidirectional causality between X and Y if both $\sum \alpha_{1i} \neq 0$ and $\sum \beta_{1i} \neq 0$.
d) No causality is established between Y and X if both $\sum \alpha_{1i} = 0$ and $\sum \beta_{1i} = 0$.

The Granger Causality test then involves the following. First, estimate the VAR model given by equations (5.9.1) and (5.9.2). Then check the significance of the coefficients and apply variable deletion tests first in the lagged Y terms for equation (5.9.1), and then in the lagged X terms in equation (5.9.2). According to the result of the variable deletion tests (the F statistic for the Wald test on coefficient restrictions) we may conclude about the direction of causality based upon the four cases mentioned above.

5.10 ARCH-GARCH

Heteroskedasticity refers to a feature of the data series in which the variances of the error term are not equal. Error terms in such instances may be larger for some data points or ranges and smaller for others. Whereas the econometrician will typically wish to correct for such effects, the ARCH (autoregressive conditional heteroskedasticity) and GARCH (generalized autoregressive conditional heteroskedasticity) models attempt to replicate such patterns observed in financial data particularly. Large stock price moves for instance are usually followed by similar large stock price moves and likewise for smaller stock price moves, a phenomenon known as leptokurtosis or 'fat tails' in the returns distribution. The autoregressive feature is also apparent and price series of this sort are referred to as having a long memory, in which effects in the past have known effects on the future. The conditional volatility (or conditional variance) process can therefore be expressed and, if other assumptions are also met, this allows the econometrician to attempt future prediction of the price series.

The task then is to specify how the information contained in the stock price may be used to forecast the mean and variance of the return, conditional on past information. The

Engle (1982) stochastic ARCH process allows the conditional variance to change over time as a function of past squared errors, and it allows the conditional mean and variances to be estimated jointly. The GARCH (1, 1) model of Bollerslev (1986) with conditional normal distributions is the most popular ARCH specification in empirical research, particularly when modelling daily returns. This model is a weighted average of past squared residuals where the weights never go completely to zero. It provides an explanation of the following major stylized facts for daily returns: the distribution of returns is not normal; there is almost no correlation between returns for different days; and the correlation between the magnitudes of returns on nearby days is positive. In addition, it is often found that the volatility forecasts from this specification have similar accuracy to forecasts from more complicated specifications.

The general ARCH set-up makes use of trading periods indexed by t, returns r_t, relevant information I_{t-1} known at time $t-1$, a vector of parameters denoted by θ, conditional mean functions μ_t, and conditional variance functions h_t.

In the set-up with conditional normality assumed,

$$r_t \mid I_{t-1} \sim N(\mu_t, h_t) \tag{5.11}$$

with both μ_t and h_t functions of I_{t-1} and θ. The residual is

$$e_t = r_t - \mu_t \tag{5.12}$$

which has the conditional distribution

$$e_t \mid I_{t-1} \sim N(0_t, h_t)$$

The standardized residual is

$$z_t = \frac{r_t - \mu_t}{\sqrt{h_t}} \tag{5.13}$$

which has conditional distribution

$$z_t \mid I_{t-1} \sim N(0,1)$$

Equation (5.11) can be interpreted in two ways. First, it provides a way to use observed time series to calculate numbers μ_t and h_t at time $t-1$ and hence a specific conditional distribution for the random variable r_t. Second, equation (5.11) can be viewed as summarizing a stochastic process, formally defined by

$$r_t = \mu_t + h_t^{1/2} z_t, \qquad z_t \sim i.i.d.N(0,1) \tag{5.14}$$

The GARCH (p, q) model of Bollerslev (1986) generalizes the original ARCH (p) model of Engle (1982) by allowing the conditional variance to depend on the p most recent squared residuals and the q most recent conditional variances, thus

$$h_t = \omega + \sum_{i=1}^{p} \alpha_i e_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \tag{5.15}$$

The complete specification of conditional densities by (5.11) explains why ARCH models are a convenient way to model volatility. The product of conditional densities $f(r_t \mid I_{t-1}, \theta)$ can be maximized to provide an appropriate estimate of the parameters θ from a set of n observed returns $\{r_1, r_2, ..., r_n\}$. The product, as a function of ϑ, is

$$L(\theta) = f(r_1 \mid I_0, \theta) f(r_2 \mid I_1, \theta) .... f(r_n \mid I_{n-1}, \theta) \tag{5.16}$$

and its logarithm equals

$$\begin{aligned} \log L(\theta) &= \sum_{t=1}^{n} \log f(r_t \mid I_{t-1}, \theta) \\ &= \sum_{t=1}^{n} -\frac{1}{2}\log(2\pi) - \frac{1}{2}\log(h_t(\theta)) - \frac{(r_t - \mu_t(\theta))^2}{2h_t(\theta)} \\ &= -\frac{1}{2}\left[n\log(2\pi) + \sum_{t=1}^{n} \log(h_t(\theta)) + z_t^2(\theta) \right] \end{aligned} \tag{5.17}$$

Maximization of (5.17) provides the maximum likelihood estimate $\hat{\theta}$. This then describes a GARCH updating formula, where the weighted average of the unconditional variance, the squared residual for the first observation and the starting variance are used to estimate the variance of the second observation. This is then input into the forecast of the third variance, and so on. Eventually a whole time series of variance forecasts is

constructed. Ideally the series will be large when the residuals are large and small when they are small. The likelihood function provides a way to adjust the parameters ω, α, β to give the best fit. Diagnostic tests are offered by the computer package *EViews* to determine if the errors are constant mean and variance, for instance the Ljung box test with lagged autocorrelations and other statistics to assess model suitability.

For the GARCH (1, 1) example, I_{t-1} is the history of returns $\{r_{t-1}, r_{t-2}, ...\}$, μ_t is a constant value μ, $h_t = \omega + \alpha(r_{t-1} - \mu)^2 + \beta h_{t-1}$, and $\theta = (\mu, \omega, \alpha, \beta)'$. Let the distribution of the return for period t, conditional on all previous returns, be defined as

$$r_t \mid r_{t-1}, r_{t-2}, ... \sim N(\mu, h_t)$$

The residuals of the process are $e_t = r_t - \mu$ and the standardized residuals are

$$z_t = \frac{r_t - \mu}{\sqrt{h_t}} = \frac{e_t}{\sqrt{h_t}}$$

The formal definition of GARCH (1, 1) is then the following:

$$r_t = \mu + h_t^{1/2} z_t \tag{5.18}$$

$$z_t \sim i.i.d.N(0,1) \tag{5.19}$$

$$h_t = \omega + \alpha(r_{t-1} - \mu)^2 + \beta h_{t-1} \tag{5.20}$$

The main parameters to be estimated are ω, α, β. The weights are $(1-\alpha-\beta, \beta, \alpha)$, and the long-run average variance is $\sqrt{\omega/(1-\alpha-\beta)}$. The constraints $\omega \geq 0$, $\alpha \geq 0$, and $\beta \geq 0$ are required to ensure that the conditional variance is never negative. The GARCH (1, 1) stochastic process is stationary if $\alpha + \beta < 1$ (Bollerslev, 1986). The unconditional variance is then finite, the unconditional kurtosis (which can be infinite) always exceeds 3 (returns have more kurtosis than the normal distribution due to the fact that the unconditional distribution is a mixture of normals), and the correlation between returns on different days is almost zero. The model is styled GARCH (1, 1) where the notation in brackets refers to the lag structure. The first number refers to the number of autoregressive lags, or ARCH terms, while the second number refers to the number of moving average lags, or the number of GARCH terms. Therefore 1 previous squared

residual and 1 previous value of the conditional variance are used to define the conditional variance for period *t*. This method implies that the best predictor of the variance in the next period is a weighted average of the long-run average variance, the variance predicted for this period, and the new information in this period that is captured by the most recent squared residual. Calculations of conditional variances from the recursive definition of (5.20) are straightforward, providing an initial value is available for the first time period. The conditional variance depends on all previous returns, so that the covariance stationary GARCH (1, 1) process has an ARCH (∞) representation. This can be seen through repeated substitutions so that (5.20) can be rewritten as

$$h_t = \frac{\omega}{1-\beta} + \alpha(r_{t-1} - \mu)^2 + \alpha\beta(r_{t-2} - \mu)^2 + \alpha\beta^2(r_{t-3} - \mu)^2 + \alpha\beta^3(r_{t-4} - \mu)^2 + ...,$$

where it is assumed that the process has an infinite past history. This equation shows that the conditional variance for period t is a linear function of the past squared residuals $(r_{t-\tau} - \mu)^2$, $\tau > 0$, and that the weight given to past information diminishes as the lag τ increases. The conditional variance is an increasing function of each squared residual so that volatility clustering will occur. A high average for recent squared returns will make the conditional variance high so that a high squared return is more likely in the next period and vice versa for a low recent average.

Although the model is directly set up to forecast only one period ahead, based on the one-period forecast a two-period forecast can be made, and so on thereby constructing longer horizon forecasts. Ultimately the distant-horizon forecast is the same for all time period as long as $\alpha + \beta < 1$. This is the unconditional variance. Thus, GARCH models are mean reverting, conditionally heteroskedastic, but have a constant unconditional variance.

5.11 The volume-volatility relationship using GARCH (1, 1)

In order to test the volume-volatility relationship using the GARCH framework, variations of the following model are estimated using data on the daily stock returns of the composite price index of the Dhaka Stock Exchange and data of trading volume (or trading value) data. The basic GARCH representation is as follows:

$$r_t = \mu_{t-1} + \varepsilon_t; \qquad \varepsilon_t \sim IN(0, h_t) \tag{5.21}$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \tag{5.22}$$

where $\alpha_0 > 0$, and $\alpha_i, \beta_j \geq 0$ to ensure that $h_t > 0$. The sum of the coefficients α_i and β_j denote the degree of persistence in the conditional variance given a shock to the system. In particular, the sum should be less than 1 in order to have a stationary variance. As the sum tends to 1 the higher is the instability in the variance and shocks tend to persist instead of dying out.

The MDH suggests that volume/value has a role to play in the estimation of h_t. That is (5.22) is modified to:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} + \gamma V_{t-1} \tag{5.23}$$

where V is the trading volume (or trading value). In addition to current period V we also use lagged V as an instrument for contemporaneous volume to avoid the problem of simultaneity. Equation (5.23) models the variance of the unexpected returns as a GARCH process including the daily total volume of stocks traded as a proxy of information arrivals. According to the MDH $\gamma > 0$ and significant, and GARCH effects measured by the coefficients of α_i and β_j should diminish or disappear altogether from the formulation (5.23) if trading volume/value is serially correlated. The existence of autocorrelation in the volume time series is essential because the MDH implies that serial correlation in volume causes conditional heteroscedasticity in stock returns. The serial correlation structure of the trading volume can be analyzed using Ljung-Box statistics.

CHAPTER 6

MODEL 1: THE FINANCE-GROWTH NEXUS IN BANGLADESH

The finance-to-growth, growth-to-finance, and banks-to-stock market effects

6.1 Introduction

This chapter offers a theoretical and empirical examination of *Model 1*: "*the finance-growth nexus*" for the case of Bangladesh. In Chapter 4 we reviewed an encompassing structural framework; here we describe in detail three theoretical papers which combine to form the finance-growth nexus part of that system. These three models will be shown to lead to three main econometric specifications or effects: these are respectively the *finance-to-growth*, *growth-to-finance*, and *banks-to-stock market* effects. In doing this exercise we therefore seek to verify the following hypotheses:

6.1.1 Model 1 hypotheses: "The finance-growth nexus"

1) *Overall financial development matters for economic growth*

Both banks and the stock market accelerate growth in the economy.

2) *Economic growth matters for bank development*

Growth in the economy promotes a higher level of bank development.

3) *Banks matter for the stock market*

Banks and stock markets are complementary.

6.2 Greenwood and Smith (1997)

In Greenwood and Smith (1997) banks allocate resources to the place in the economic system where their social return is greatest. Banks provide risk sharing and liquidity so that agents may relocate their savings toward more productive investments by eliminating idiosyncratic risk. Banks therefore alter the social composition of savings in a way that helps to enhance capital accumulation. The equity market is shown to enhance growth more so that if only banks were operating whenever investors are sufficiently risk-averse.

The *key predictions* of GS (1997)[1] which we will attempt to test in our analysis for the finance-to-growth effect in Bangladesh are therefore the following:

(i) *Banks accelerate growth,*

(ii) *Both banks and equity markets further accelerate growth.*

The model

The economy consists of two-period-lived overlapping generations with a single consumption good produced using intermediate inputs according to a constant-returns-to-scale production function. Intermediate goods are produced using capital and labour as primary inputs. Each young agent i produces a quantity of intermediate goods at t denoted $x_t(i)$. Agent i produces this good using his own labour input $l_t(i)$ and a capital input $k_t(i)$. This agent, in turn, is endowed with one unit of labour, and only young agents are endowed with labour. Capital depreciates completely in production. The technology for producing intermediate goods is given by

$$x_t(i) = Ak_t(i)l_t(i)^{1-\partial} \tag{6.2.1}$$

Final consumption goods c_t, and the time $t+1$ capital stock k_{t+1} are produced using intermediate goods according to the technology

$$c_t + (k_{t+1}/R) = \left[\int_0^1 x_t(i)^\theta di\right]^{1/\theta} \tag{6.2.2}$$

with $\theta < 1$. One unit of current consumption is converted into R units of future capital.

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[1] While Greenwood and Smith (1997) are able to show how the equity market directly impacts growth, one of our criticisms of this model is that the framework does not allow the stock market to develop separately to bank development or the growth process. We therefore use only the first three propositions of the GS (1997) paper. That is we are only interested in the first model, the liquidity provision – growth accelerating model presented in pages 149 - 159 (sections 2.1 - 2.4.3) and Propositions 1, 2 and 3 of Greenwood and Smith (1997) which show how banks enhance growth and how both banks and equity markets matter for growth. We do not follow the authors' explanation for the endogenous emergence of financial markets, nor do we follow their specialization model: these additional models while illuminating have little relevance for our theoretical motivation regarding the finance-growth nexus.

All young agents at t have identical ex ante preferences. Letting c_j denote age j consumption by a representative individual (j =1,2), these preferences are given by the utility function

$$u(c_{1t}, c_{2t}; \phi) = -[(1-\phi)c_{1t} + \phi c_{2t}]^{-\gamma}/\gamma \qquad (6.2.3)$$

with $\gamma > -1$. The variable ϕ, in turn, is an individual specific, iid (across agents) preference shock. Its probability distribution is given by $\phi = 0$ with probability $1-\pi$ and $\phi = 1$ with probability π. Agents are assumed to make a savings (portfolio) decision before observing their realization of ϕ. There are two assets which can be held. One is capital. One unit of time t consumption placed into capital investment returns R units of capital at $t+1$. However, if this capital investment is interrupted at t, no capital or consumption is received. Alternatively, each young agents has access to a technology for storing consumption goods. One unit of consumption stored at t returns n units either later in period t (that is, if the investment is interrupted at that date) or at $t+1$. Producers of final consumption goods purchase a quantity $x_t(i)$ of intermediate goods from agent i at t, $i \in [0,1]$. Let $p_t(i)$ be the price charged for these inputs (in units of current consumption) by agent i. Since i is the only producer of $x_t(i)$, he is modelled as being imperfectly competitive – that is, he does not take $p_t(i)$ as given. Final goods producers, however, are assumed to take $p_t(i)$ as given. These producers choose a schedule of intermediate inputs $x_t(i)$ to maximize

$$\left[\int_0^1 x_t(i)^\theta di\right]^{1/\theta} - \int_0^1 p_t(i)x_t(i)di \qquad (6.2.4)$$

Young producers of intermediate goods obtain capital inputs in a competitive rental market, paying the rental rate ρ_t at t. Thus, young agent i chooses values for $x_t(i)$ and $k_t(i)$ to solve the problem

$$\max[p_t(i)x_t(i) - \rho_t k_t(i)]$$

subject to relevant constraints.

Savings behaviour

At the beginning of period *t*, young agents undertake their production, and earn an income of w_t. Young agents then decide how to allocate this income among the various assets available to them. A savings/portfolio decision must be made by each agent *before* ϕ is realized. This implies that no consumption (by young agents) will take place prior to making a savings decision, since it is not yet known by any agent whether young consumption will generate utility for them. After savings/portfolio choices are made, ϕ is realized for each young agent. Agents with $\phi = 1$ wait until old age to liquidate assets and then consume. Agents with $\phi = 1$ value only young consumption, however. Hence they liquidate all their assets at the end of period *t* and consume the proceeds.

Financial autarky

When young agents are financial autarkic, they store goods and accumulate capital on their own behalf. This is because all young consumption must be financed by storage. If these are agents are holding some capital and $\phi = 0$, this capital can no longer be rented (factor markets have closed) or sold, since there are no equity markets for transferring claims to ownership of capital. Moreover, if $\phi = 0$ old age consumption has no value, so it will be assumed that autarkic agents with $\phi = 0$ simply lose their capital investment.

Let s_t^a be goods storage by an autarkic young agent at t, and let K_{t+1}^a be the value, in current consumption of capital accumulation by this same agent. The return on goods storage is *n*, independent of when consumption occurs. The return on capital is zero if $\phi = 0$. If $\phi = 1$, for each unit of current consumption invested, *R* units of *t+1* capital is received. This can be rented for ρ_{t+1} per unit, so the return on capital invested between *t* and *t+1* is $R\rho_{t+1} = RA\theta$.

Then the problem of a young autarkic agent is to solve

$$\max_{c_{1t}, c_{2t}, s_t^a, K_{t+1}^a} -[(1-\pi)c_{1t}^{-\gamma} + \pi c_{2t}^{-\gamma}]/\gamma$$

subject to relevant constraints.

Define $q_t^a = K_{t+1}^a / w_t$ to be the fraction of an autarkic agent's portfolio held in the form of capital. An interior optimum can be shown to satisfy

$$q_t^a = Q^a(RA\theta) \equiv [\lambda(RA\theta) - 1]/\{[\lambda(RA\theta) - 1] + (RA\theta/n)\} \tag{6.2.5}$$

where

$$\lambda(RA\theta) \equiv [\pi(RA\theta - n)/(1-\pi)n]^{1/(1+\gamma)} \tag{6.2.6}$$

Banking

Banks take deposits (from young agents), invest in capital, and hold goods in storage. As noted previously, young consumption must be financed out of storage: from a bank's perspective, assets stored constitute reserves against 'early' withdrawals. Having accepted a deposit, a bank promises to pay a time t depositor who withdraws at t (one who has $\phi = 0$) r_{1t} per unit withdrawn. If the same agent withdraws at $t + 1$ (has $\theta = 1$), he receives r_{2t} per unit deposited. Suppose that at the time withdrawals occur, it is too late to undertake further goods storage. This implies that only agents with $\phi = 0$ withdraw early. Banks, then, can be viewed as announcing (r_{1t}, r_{2t}) pairs at t.

Banks are identified with generations. As banks anticipate that all young-period savings (here equal to w_t) are deposited, an active bank receives per person deposits of w_t. Let s_t^b denote (per depositor) goods storage by the bank and K_{t+1}^b denote (per depositor) capital investment by the bank.

Banks compete against each other for depositors. This competition implies that bank choices $(r_{1t}, r_{2t}, s_t^b, K_{t+1}^b)$ must be selected to maximize the expected utility of a representative depositor; that is, to solve the problem

$$\max -w_t^{-\gamma}[(1-\pi)r_{1t}^{-\gamma} + \pi r_{2t}^{-\gamma}]/\gamma$$

subject to the relevant constraints.

Define $q_t^b \equiv K_{t+1}^b / w_t$ to be the fraction of the bank's portfolio invested in capital.

The solution to the bank's problem can be shown to set

$$q_t^b = Q^b(R\rho_{t+1}) = Q^b(RA\theta) \tag{6.2.7}$$

where

$$Q^b(RA\theta) \equiv \eta(RA\theta)/[1+\eta(RA\theta)] \tag{6.2.8}$$

$$\eta(RA\theta) = \pi(RA\theta/n)^{-\gamma/(1+\gamma)}/(1-\pi) \tag{6.2.9}$$

The function $Q^b(-)$ describes savings behaviour when banks operate. $Q^b(-)$ is decreasing in γ ; that is, the more risk-averse agents are the less is saved in the form of illiquid capital. Also as $\gamma \to -1$ (as agents become nearly risk-neutral), $Q^b(-) \to 1$, so that all assets are invested in long-term capital. When $\gamma = 0$ (preferences are logarithmic), $Q^b(-) \equiv \pi$.

Proposition1.

(a) $Q^b(RA\theta) > Q^a(RA\theta)$

(b) $Q^b(RA\theta) > \pi Q^a(RA\theta)$ always holds.

Part (a) says that the improvement in risk sharing attained via intermediation results in a larger fraction of the 'risky asset' (capital) being held in the consolidated portfolio of banks and young savers.

Part (b) says that the proportion of saving maturing in the form of long-term capital must be unambiguously greater in the presence than in the absence of intermediation[2].

Equity markets

After each agent's value of ϕ is known at *t*, an equity market opens in which agents with $\phi = 0$ sell claims to capital in process to agents with $\phi = 1$ in exchange for claims to their storage. Let z_t be the number of units of storage that must be exchanged for a unit of capital (z_t is the relative price of capital at *t* in the equity market). Agents who know

[2] Recall that in autarky the fraction π of long-term investment projects will be lost.

equity markets will operate at t choose a storage level, s_t^e, and a capital investment K_{t+1}^e at t in order to solve the problem

$$\max -[(1-\pi)c_{1t}^{-\gamma} + \pi c_{2t}^{-\gamma}]/\gamma$$

subject to the relevant constraints

Let $q_t^e \equiv K_{t+1}^e / w_t$ be the fraction of a young agent's portfolio held in capital. The optimal choice of q_t^e satisfies

$$q_t^e = 1 \quad \text{if} \quad z_t > 1$$

$$q_t^e = 0 \quad \text{if} \quad z_t < 1$$

and $q_t^e \in [0,1]$ if $z_t = 1$

Equity market equilibrium

Young agents who must liquidate their long-term capital investment will supply this capital inelastically in the equity market. The supply of capital at t is therefore given by $(1-\pi)q_t^e w_t$. The demand for capital in this market is $\pi(1-q_t^e)w_t / z_t$ if $RA\theta/n > z_t$, and is zero otherwise. From this observation and (28), equity market equilibrium requires that $z_t = 1$, and:

$$(1-\pi)q_t^e = \pi(1-q_t^e)/z_t = \pi(1-q_t^e) \qquad (6.2.10)$$

Thus, $q_t^e = \pi$ if equity markets are active at t.

General equilibrium

Financial autarky

Under financial autarky, young agents invest $Q^a(RA\theta)w_t$ in capital. A fraction $(1-\pi)$ of this investment is liquidated before $t+1$ by agents who have $\theta = 0$. Hence only the fraction π of this investment translates into the time $t+1$ capital stock, k_{t+1}. Therefore,

$$k_{t+1} = \pi R Q^a(RA\theta)w_t \qquad (6.2.11)$$

since R units of date $t+1$ capital are received per unit of unliquidated capital investment at t. Substituting (10) into (30) yields the equilibrium law of motion for the (productive) capital stock:

$$k_{t+1} = (1-\theta)\pi RAQ^a(RA\theta)k_t \qquad (6.2.12)$$

Thus, the growth rate of the capital stock and output is

$$k_{t+1}/k_t = (1-\theta)RA\pi Q^a(RA\theta) \equiv \sigma^a \qquad (6.2.13)$$

Banking

When banks operate, no capital is liquidated prior to becoming productive. Hence all time t capital investment - $Q^b(RA\theta)w_t$ - translates into time t+1 capital and therefore

$$k_{t+1} = RQ^b(RA\theta)w_t = (1-\theta)RAQ^b(RA\theta)k_t \qquad (6.2.14)$$

The growth rate of the economy in the presence of banks is

$$k_{t+1}/k_t = (1-\theta)RAQ^b(RA\theta) \equiv \sigma^b \qquad (6.2.15)$$

Proposition 2

The growth rate of an economy with banks exceeds that of a financially autarkic economy

This follows from $Q^b(RA\theta) > \pi Q^a(RA\theta)$, as shown in Proposition 1.

Thus banks necessarily raise the rate of growth. This occurs for one or both of the following reasons: either banks shift savings into capital [if $Q^b(RA\theta) > Q^a(RA\theta 0]$, or at a minimum, they prevent 'premature' liquidation of capital [$Q^b(RA\theta) > \pi Q^a(RA\theta)$].

Equity markets

In the presence of an (active) equity market, a fraction π of savings is placed in capital investments, and none of these are liquidated 'prematurely'. Therefore

$$k_{t+1} = \pi R w_t = (1-\theta) RA \pi k_t \tag{6.2.16}$$

The growth rate of an economy with equity markets is given by

$$k_{t+1} / k_t = \pi(1-\theta) RA \equiv \sigma^e \tag{6.2.17}$$

Proposition 3

(a) $\sigma^e > \sigma^a$

(b) $\sigma^e > \sigma^b$ *holds if and only if* $\gamma > 0$

For the proof of this result see the appendix to Greenwood and Smith (1997).

An equity market increases the growth rate of an economy relative to autarky. An equity market increases the growth rate of an economy relative to banks if and only if agents are relatively risk-averse. In particular, in the presence of banks, the more risk-averse agents are the less of their savings is allocated to the capital investment. This effect, which is growth-reducing, is absent in the presence of equity markets. Thus growth is more rapid in the presence of equity markets if (and only if) agents are sufficiently risk-averse.

6.3 Harrison, Sussman, and Zeira (2004)

Harrison, Sussman and Zeira (2004) (HSZ) present a model of an information-based, monopolistically competitive banking system that shows the effect of economic growth on financial structure. We believe this model to be relevant for the case of Bangladesh, since in Chapter 3 the number of scheduled bank branches in Bangladesh were seen to have demonstrated a clear upward trend over time. In addition, the findings of Perera et al. (2006) imply that the Bangladesh banking sector is monopolistically competitive.

The *key prediction* of HSZ (2004) which we will attempt to test in our analysis for the growth-to-finance effect in Bangladesh is therefore the following:

(i) *Economic growth leads to bank development*

The framework of HSZ involves costly state verification or CSV (as in Townsend, 1979 and Gale and Hellwig, 1985), banks as delegated monitors (Diamond, 1984), and spatial competition (Salop, 1979). Monitoring costs are increasing with the distance between the bank and the borrowing firm. On the one hand, economic growth has a 'deepening' effect, which tends to decrease the cost of financial intermediation. When the economy grows, banks profit and new entry into the industry is promoted. As a result, the average distance between a bank and a borrowing firm falls, which then decreases the cost of financial intermediation[3]. On the other hand, monitoring is intensive in labour input. Economic growth raises labour costs, thus increasing the cost of financial intermediation. This is the *wage effect*. An empirical examination is required to find out which effect dominates. In their analysis of banks in the United States, the authors find that GDP per capita has a significant and large negative impact on the cost of financial intermediation.

The model

The economy is small, open, with overlapping generations and one physical commodity used for both consumption and investment. Each generation consists of a continuum of workers of size L and a continuum of potential entrepreneurs of size λL. Agents are risk neutral, live for two periods, and consume in the second period. Workers supply one unit of labour inelastically in the first period. Each entrepreneur can invest in a single project during period one, operate it in period two and derive utility $U = c - E$ where c is consumption in the second period and E is disutility of the effort necessary to become an entrepreneur. The utility of a potential entrepreneur who does not invest is zero.

Each project requires one unit of capital, invested one period ahead of labour. Capital depreciates fully after one period of production. Projects differ by location and by productivity, both of which are random variables. Projects are uniformly distributed along a circle with a circumference of length L. In case of success the project produces the following amount

[3] In order to apply the model to Bangladesh, we assume that this decreased cost of financial intermediation (due to higher economic growth) is accompanied by a higher volume of credit to the private sector.

$$y = g(l) + a \tag{6.3.1}$$

where y is output, l is labour input, g is a standard production function and a is a country specific productivity parameter. In case of failure the project has zero productivity. The probability of success is p and we assume that productivity and location are independent of each other. It is also assumed that they are independent across projects.

A young potential entrepreneur decides whether or not to become an entrepreneur. The entrepreneur then is assigned with a project and location is realized. One unit of capital is then invested in the project, which must be financed externally. At the start of the next period productivity is realized. If the project is successful the entrepreneur hires labour and produces output y. If the project fails the entrepreneur does not hire labour and does not produce. The realization of productivity, along with the number of workers employed is private information and is known to the entrepreneur only. However this information can be acquired by outsiders who engage in costly 'monitoring'.

Banks

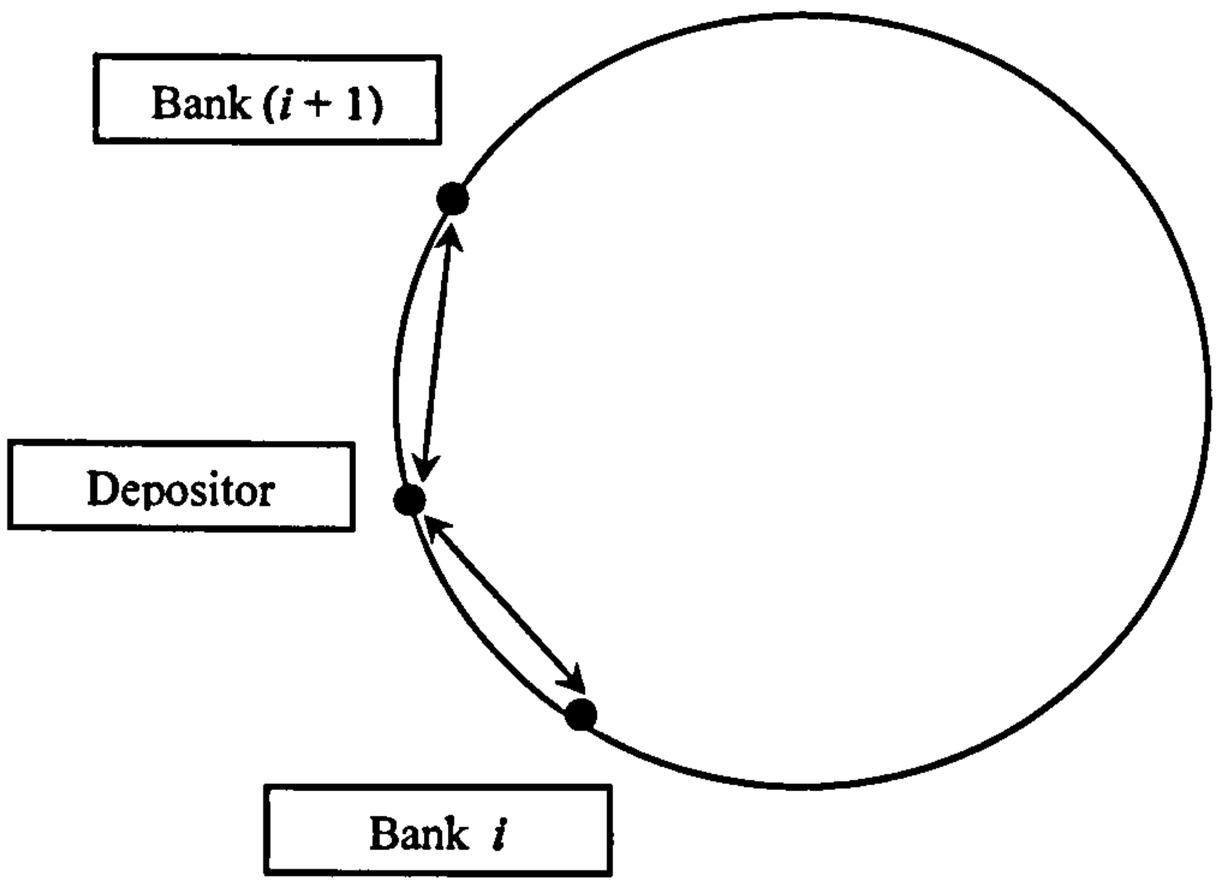
Banks take on the information acquisition role by becoming delegated monitors. The monitoring technology requires both capital and labour. Banks are set up by investing an amount of capital B. After this amount is invested the bank is located and starts operating by issuing deposits and extending credit. In the next period the bank collects repayments, monitors failing projects and repays the deposits. The bank's capital fully depreciates. Monitoring requires an amount $b(z)$ of labour per project, where z is the distance along the circle from the project of the bank. It is assumed that b is increasing in z. This assumption leads to the specialization effect.

Banks have some monopoly power over borrowers. All banks who compete for a project simultaneously submit a 'take it or leave it' offer to the entrepreneur, who chooses the best offer. This leaves a potentially considerable amount of rent to the bank. Unlike the credit market, the deposit market is perfectly competitive. Banks raise finance through one period riskless deposits. It is assumed that there is full capital mobility and the domestic deposit market is fully integrated in the world's market. The world's interest

rate is constant and equals r. The interest factor is $R = r + 1$. Note that although deposits are internationally tradeable, financial intermediation is nontradable, as banks must be located close to projects in order to economize on monitoring costs. Wages are small relative to the project's capital requirement, so that no small coalition of lenders can finance a project. To economize on monitoring by many lenders and to prevent free-riding, monitoring is delegated to a single agent, a bank. Moreover, by pooling together many independent projects, the bank avoids agency problems with its depositors. Finally, expectations are assumed rational.

Financial intermediation equilibrium

Denote the number of banks who enter in period t by N_t. This is a finite number due to the lumpiness of the setup cost of a bank. Assume that banks are located on the circle in equal distances from each other. Let $2d_t$ be the distance between each two neighbouring banks, namely $2d_t = L / N_t$. Consider now an entrepreneur who borrows from a bank in period t. The amount of repayment set in the debt contract I_t depends on the distance between the project and the two closest banks.



Each bank has a cost advantage within a distance of d_t, where they can undercut any offer made by its competitor. Hence, in Nash equilibrium, financing is supplied by the bank with the cost advantage, but according to the most favourable terms the competitor

can offer. Therefore, the equilibrium repayment for a project at distance z from the bank, $0 \le z \le d_t$, is

$$I_t(z) = \frac{R}{P} + \frac{1-p}{p} w_{t+1} b(2d_t - z) \tag{6.3.2}$$

The bank acts as a perfect price discriminator over the projects it finances. It extracts a high monopoly rent from projects nearby and breaks even on projects on the margin of its market segment.

Real Investment

Agents decide whether to become entrepreneurs before location and productivity are realized. In equilibrium the disutility from effort is equal to net expected profit given the perfectly forecasted next period wages. Namely:

$$p\left[a + \pi(w_{t+1}) - \frac{1}{d}\int_0^{d_t} I_t(z)dz\right] - E = 0 \tag{6.3.3}$$

where the function π is defined by

$$\pi(w) = \max_l [g(l) - wl] \tag{6.3.4}$$

and is a decreasing function of wages. The expected costs of financing a project are

$$\frac{p}{d_t}\int_0^{d_t} I_t(z)dz = R + (1-p)w_{t+1}\Psi(d_t) \tag{6.3.5}$$

where

$$\Psi(d) = \frac{1}{d}\int_0^{d} b(2d - z)dz \tag{6.3.6}$$

and is increasing with d. The equilibrium entry condition for entrepreneurs is

$$p[a + \pi(w_{t+1})] - R - (1-p)w_{t+1}\Psi(d_t) - E = 0 \tag{6.3.7}$$

Financial investment

The entry condition of banks is as follows. Let K_t be the amount of capital invested in real production in period t, which also equals the number of projects initiated. Let $k_t = K_t / L$ denote the density of projects on the circle, which is also the capital-labour ratio in the real sector. Expected profits of a bank consist of repayments from solvent projects minus monitoring costs of defaulting projects, minus deposit repayment. The entry condition for banks in period t is then

$$BR = 2pk_t \int_0^{d_t} I_t(z)dz - 2(1-p)k_t w_{t+1} \int_0^{d_t} b(z)dz - 2k_t d_t R = (1-p)k_t w_{t+1} \Phi(d_t) \qquad (6.3.8)$$

where Φ is $\Phi(d) = 2\int_0^d [b(2d-z) - b(z)]dz$

The left hand side of equation (8) is the bank's setup cost, while the right hand side is the bank's monopolistic rent, where Φ captures the bank's cost advantage in labour units in its market segment, namely the area between the curves in the figure below. Since Φ is increasing, the distance d_t between banks is uniquely determined by equation (6.3.8).

Labour market equilibrium

Entry to both the real and the financial sector therefore depends on future anticipated wages, w_{t+1}. Profit maximization leads to the standard first order condition: $g'(l) = w$, from which the demand for labour per project $l^d(w)$ is derived. The aggregate demand for labour in the real sector in period $t+1$ is $pK_t l^d(w_{t+1})$, and the aggregate demand for labour in the financial sector is $(1-p)N_t k_t 2\int_0^{d_t} b(z)dz$. In equilibrium the sum of the two demands equals supply L. The labour market equilibrium condition in period $t+1$ is therefore:

$$pk_t l^d(w_{t+1}) + (1-p)k_t \Theta(d_t) = 1, \qquad (6.3.9)$$

where Θ measures the average labour requirement for monitoring:

$$\Theta(d) = \frac{1}{d}\int_0^{d_t} b(z)dz \qquad (6.3.10)$$

Equation (6.3.9) uniquely determines the equilibrium wage rate as a function of investment in the real sector k_t and in the financial sector, represented by d_t.

Equilibrium

Period t equilibrium is characterized by three variables: the density of capital in the real sector, k_t, the distance between banks d_t, and the equilibrium wage rate in the next period w_{t+1}. Equilibrium is thus determined by three conditions: the entry condition to the real sector (6.3.7), the entry condition to the financial sector (6.3.8), and the labour market equilibrium condition (6.3.9).

The cost of financial intermediation

Harrison et al. (2004) construct a variable to measure performance of the financial system The cost of financial intermediation in period $t+1$, f_{t+1}, is the average cost of the bank per unit of lending. It includes setup and monitoring costs, but not the cost of deposits.

$$\textit{Cost of financial intermediation} = f_{t+1} = \frac{BR + 2(1-p)w_{t+1}k_t \int_0^{d_t} b(z)dz}{2k_t d_t} \qquad (6.3.11)$$

Substituting in equation (6.3.8) and deleting all time subscripts (which is possible since equilibrium is time invariant):

$$f = (1-p)w\Psi(d) \qquad (6.3.12)$$

Equation (6.3.12) reveals the two main effects of economic growth on the cost of financial intermediation. On the one hand, growth raises wages and that has a direct positive effect on the cost of intermediation. On the other hand, growth increase entry of banks and reduces the distance d. This has a negative effect on the cost of intermediation. Hence the wage and the deepening (specialization) effects have counteracting influences on the development on banks. To determine the effect of economic growth on the cost of financial intermediation, we derive the equilibrium distance between banks. Substituting the bank's entry condition (6.3.8) into labour market equilibrium (6.3.9) one obtains:

$$pl^d(w)+(1-p)\Theta(d)=\frac{(1-p)}{BR}\Phi(d) \qquad (6.3.13)$$

This equation defines a decreasing function $d=d(w)$. This is the deepening effect: as the economy grows and wages increase, more banks enter and become more specialized over a smaller market segment. To see both the wage effect and the specialization effect on the cost of financial intermediation, substitute $d(w)$ from equation (6.3.12) to obtain:

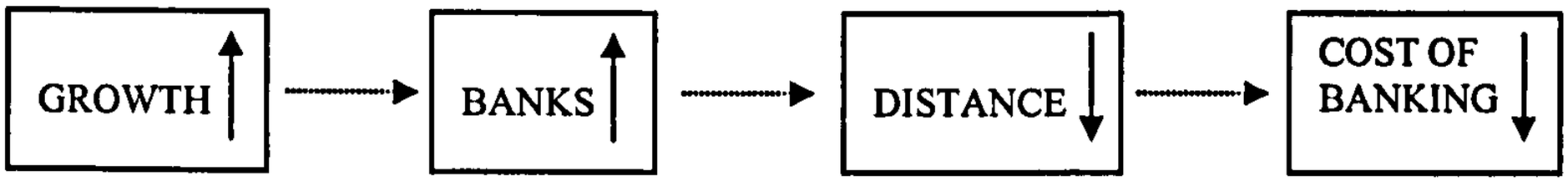
$$f=(1-p)w\Psi[d(w)] \qquad (6.3.14)$$

Equation (6.3.14) shows the ambiguous effect of economic growth on the cost of financial intermediation: the direct positive wage effect, and the indirect negative specialization effect. The cost of financial intermediation also affects the net profits of the entrepreneurs. Substituting (6.3.12) into the entry condition to the real sector (6.3.8) one obtains:

$$p[a+\pi(w)]-R-f-E=0 \qquad (6.3.15)$$

From this equation it can be seen that if the cost of financial intermediation rises, entrepreneurial profits fall and so does investment and output. A lower f on the other hand promotes entrepreneurial entry, which increase both output and wages.

The Indirect Negative Specialization Effect



The Direct Positive Wage Effect

The model of Harrison, Sussman, and Zeira (2004) therefore describes the causal relationship from economic growth to financial intermediary development in Bangladesh.

We only require that the reduction in financial intermediary cost is associated with a corresponding increase in the level of bank lending. This seems reasonable given that Bangladesh is operating at a relatively low-level of income, thus the greater reduction in intermediation costs due to more economic growth is likely to have a very strong effect on the level of credit that banks offer to firms.

6.4 Besanko and Kanatas (1993)

Besanko and Kanatas (1993) demonstrate how banks in equilibrium can coexist with stock markets. Although firms obtain funding from both these sources, it is the banks that perform special monitoring and credit roles which are highly important for influencing the decisions of firms regarding their effort level. In contrast, external financing – either through equities or bonds – reduces the entrepreneur's expected payoff, and consequently reduces entrepreneurial effort at improving the likelihood of project success. However, the equilibrium that is derived in fact allows for some role for the stock market because banks themselves are affected by moral hazard.

The *key predictions* of BK (1993) which we will attempt to test in our analysis for the banks-to-stock market effect in Bangladesh are then the following:

(i) Banks and stock markets are complementary

(ii) Banks help to promote the stock market

The implication is that bank operations may therefore encourage activity on the stock market. At the equilibrium, a marginal substitution of bank debt for equity will also raise the firm's stock price[4]. This suggests that even if further bank development should occur at the expense perhaps of equity market development, the stock exchange may still be approached by firms who desire a listing since each firm's value (given the bank's involvement) is now higher and therefore the potential price of equity financing is lower. Although Besanko and Kanatas (1993) do not formally model how stock market

[4] This occurs because as insiders maximize their own welfare rather than that of all stockholders, projects are financed in equilibrium with a level of bank credit that is less than that which maximizes the firm's stock price. More reliance on bank debt would increase bank monitoring, and this would increase entrepreneurial effort and thus the expected payoff of the project. However, as the model shows the level of bank credit is less than the optimum required to achieve the first-best level of entrepreneurial effort.

development occurs apart from the increased stock price, the very fact that bank development stimulates some aspect of the stock market infrastructure is all that we need in order to justify a relationship between banks and stock markets.

The trade-off between bank loans and outside financing is driven by the interplay of two moral hazard problems. There is a moral hazard problem due to the unobservability of the entrepreneur's effort decision. And there is a moral hazard problem due to the inability of the bank to contractually commit to monitoring. The conjunction of entrepreneurial moral hazard and bank moral hazard results in a unique interior optimal combination of bank debt and external capital that finances the entrepreneur's project. Entrepreneurial moral hazard creates a role for bank debt, while bank moral hazard creates a role for external[5] capital market financing (stock market listings).

The model

There are three groups of agents – ex ante identical entrepreneurs, perfectly competitive banks, and outside investors. All agents are assumed to be risk neutral. It is also assumed that a borrower is small relative to the overall size of a bank's loan portfolio, so that the failure of a given borrower cannot force a bank into default. At date 0, an entrepreneur secures financing for a risky project that requires an initial outlay of \$1. At date 1, the return is realized, the firm is liquidated, and investors and creditors are paid off. If the risky project is successful this yields $Q > 1$ and 0 otherwise. The entrepreneur has no initial endowment and must therefore secure financing for the project.

Let θ denote the probability of project success. This probability is determined by the expenditure of effort on the part of the entrepreneur. θ therefore is interpreted as the entrepreneur's effort, and it is unobservable by the market. Let $D(\theta)$ denote the nonpecuniary disutility of the effort required to achieve θ. Furthermore,

$$D(\theta) = \frac{\theta^2}{2\beta} \qquad \text{for} \quad \theta \in [0,1]$$

where $\beta > 0$.

[5] Given the two-point support of the entrepreneur's payoff, there is no difference between outside equity and outside debt, both of which are referred to as simply "outside" financing.

The first-best effort level θ^F maximizes

$$\frac{\theta Q}{r_f} - D(\theta) - 1 \tag{6.4.1}$$

where r_f is the riskless interest rate (1 plus the riskless rate). Expression (6.4.1) is now the net present value (NPV) of the project. Furthermore,

$$\theta^F = \begin{cases} Q\beta / r_f, & \text{if } Q\beta / r_f \leq 1, \\ 1, & \text{if } Q\beta / r_f > 1. \end{cases} \tag{6.4.2}$$

It is assumed that $Q\beta / r_f \leq 1$. The maximized NPV (strictly positive) of the project is:

$$NPV^F = \frac{\theta^F}{r_f} - \frac{(\theta^F)^2}{2\beta} - 1 = \frac{\beta Q^2}{2r_f^2} - 1 \tag{6.4.3}$$

Financing for the project can be obtained from either banks or outside investors (equity). If the entrepreneur uses equity, outsiders have a claim C on the net cash flows of the firm in the successful state. The market value of C at date 0 is denoted by E. While outsiders cannot observe θ, it is assumed that the market is characterized by rational expectations. Therefore in equilibrium, outsiders will correctly conjecture the equilibrium value of θ and correctly price the equity claim C.[6]

A credit contract from a bank specifies a loan amount B and a repayment obligation T. The difference between the bank and the stock market is that the bank has a comparative advantage at monitoring[7] and controlling the actions of the entrepreneur. The bank is assumed to be able to eliminate the moral hazard of the entrepreneur so that the entrepreneur undertakes the agreed upon level of effort (a level which will be determined in equilibrium).

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[6] This assumption seems highly debatable. From the literature review, we have reason to believe that the pricing process on the secondary market is subject to many influences that lie completely outside of the firm's operations. However it may be possible to interpret the equilibrium value in Besanko and Kanatas (1993) as referring to the *intrinsic value* of the firm, and perhaps to the price of newly issued equity. That is, investors in equilibrium are able to correctly price the firm in the primary market rather than in the market for already existing shares.

[7] See for instance Diamond (1984) and the literature review in Chapter 2.

In order to achieve the elimination of firm moral hazard, the bank faces a monitoring cost which is an increasing, convex function of the difference between the effort level specified by the bank (and actually undertaken) and the effort level the entrepreneur *would have* chosen in the absence of bank monitoring. This latter level of effort is the 'no-monitoring level of effort', and it will depend on the bank loan and the equity financing. Bank monitoring cost is then endogenously determined by

$$M(\theta-\theta_0)=\begin{cases}(\theta-\theta_0)^2/2m, & \theta\geq\theta_0,\\ 0, & \theta<\theta_0,\end{cases} \tag{6.4.4}$$

where θ is the effort level of the firm that is enforced by the bank, θ_0 is the no-monitoring effort level, and m is some positive constant. The difference $\theta-\theta_0$ is then the incremental effort induced by the bank through its monitoring. The expression in (6.4.4) says that monitoring costs of the bank is an increasing function of the increment $\theta-\theta_0$. This is to capture the idea that the bigger the gap is between the target effort θ and the entrepreneur's preferred effort θ_0, the more costly it becomes for the bank to force the entrepreneur to meet the target θ. The level of bank monitoring is therefore $\theta-\theta_0$. Higher values of the increment $\theta-\theta_0$ translate directly into higher bank monitoring activity. The bank's monitoring expenditures are *unobservable* to the outside market and to their parties such as courts. Thus, just as the entrepreneur is unable to contract to his effort, the bank is unable to contract upon its level of monitoring. The bank has to maximize its profit, given the loan size T and the repayment obligation B. Thus, while bank monitoring eliminates entrepreneurial moral hazard, the noncontractibility of a bank's monitoring expenditure creates a moral hazard problem that will limit the firm's reliance on bank loans which thereby limits the role of bank monitoring as a control mechanism in equilibrium. Because banks cannot commit to their monitoring intensity and firms cannot commit to their effort, this creates a role for (and therefore justifies the existence of) an outside stock market.

As all entrepreneurs are identical, the bank aims to maximize the expected profit per borrower, given by:

$$\frac{\theta T}{r_f} - M(\theta - \theta_0) - B \tag{6.4.5}$$

Once financing is greater or equal to the net investment requirement of \$1, and if the entrepreneur's expected utility from proceeding with the project is positive, the project is undertaken and the entrepreneur consumes $B + E - 1$[8]. Financing is secured and a bank expends resources on monitoring. This will determine the effort level θ. Recall that the monitoring cost for the bank of enforcing effort θ depends on the difference between θ and the no-monitoring level of effort θ_0.

Given the loans and outside financing contracts (T, C), the no-monitoring effort level is:

$$\theta_0^*(T, C) = (\beta / r_f)(Q - C - T) \tag{6.4.6}$$

and the profit-maximizing bank monitoring is then

$$\theta^*(T, C) - \theta_0^*(T, C) = mT / r_f \tag{6.4.7}$$

A bank's monitoring increases in its exposure T.

The equilibrium bank loan and external financial contracts $\{(B, T), (E, C)\}$ maximize the entrepreneur's utility subject to zero-profit conditions in the bank and outside market and the bank budget constraint that the loan plus outside funding covers the cost of the project. With the first-order conditions for θ and θ_0 impounded in the functions $\theta^*(T, C)$ and $\theta_0^*(T, C)$, this utility maximization problem can be stated as:

$$\underset{B,T,C,E}{\max imize}\, \theta^*(T, C)\left[\frac{Q - T - C}{r_f}\right] + (B + E - 1) - \frac{[\theta^* T, C)]^2}{2\beta} \tag{6.4.8}$$

subject to the relevant constraints.

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[8] In equilibrium this will not occur.

The competitive equilibrium in which the project is undertaken then has the following features (1993: Proposition 2, p. 223)[9]:

(a) The amount of bank debt B^* and the repayment obligation T^* are strictly positive.

(b) The amount of outside financing E^* and the outsiders' claim C^* are strictly positive.

(c) There is a positive amount of bank monitoring (i.e., $\theta^* - \theta_0^* > 0$).

(d) The total effort θ^* provided by the entrepreneur is strictly less than the first-best effort θ^F.

(e) The entrepreneur's budget constraint is binding in equilibrium.

(f) At the competitive equilibrium, substituting bank financing for outside funding at the margin increases the firm's stock price[10].

Parts (a) and (b) of Proposition 2 indicate that, in equilibrium, *the entrepreneur chooses an interior combination of bank debt and outside financing*. Parts (c) and (d) indicate that there is a positive amount of monitoring in equilibrium, but that the level of monitoring leaves the entrepreneur's effort short of the first-best level. Part (e) of Proposition 2 states that the entrepreneur issues just enough bank debt and outside claims to finance the project. Finally, part (f) of the proposition indicates that, at equilibrium, outside claimants would prefer that the firm issue more bank debt and repurchase an equivalent amount of outside claims. The entrepreneur does not do this, however, because the additional bank credit would result in more monitoring by the bank and consequently greater entrepreneurial effort. Because effort is personally costly to the entrepreneur, the equilibrium level of bank debt will be less than that preferred by the firm's outside claimants. Taken together, the results in Proposition 2 indicates that in a competitive equilibrium, the entrepreneur chooses an interior combination of outside financing and bank debt to minimize agency costs, subject to the budget constraint.

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[9] The proofs of the various Propositions in Besanko and Kanatas (1993) are omitted here. The reader is referred to the appendix of that paper for the details.

[10] We interpret this result as meaning that an "excessive" amount of bank debt in relation to equity finance can provide the necessary impetus for stock market development. In other words, even if firms are nearly 100% debt financed the stock market would still be active. Notice that the exact definition of 'stock price' in Besanko and Kanatas (1993) is left open: it could refer to the price on the secondary market for already existing shares or to the price which firms expect to get on the primary market when they issue new shares of stock. The basic idea though is that higher prices will encourage more companies to seek listings. The BK (1993) model is therefore very useful in justifying how a stock market can be present in a poor developing country.

It is because bank monitoring can eliminate *entrepreneurial moral hazard* that there is positive equilibrium bank debt in the model. This motivates the following question: why, if bank debt has such an advantage, does the entrepreneur not rely entirely on bank debt? The answer has to do with the role that *bank moral hazard* plays in the analysis.

Proposition 3 on p.225 of Besanko and Kanatas (1993) is:
If banks can contractually commit to monitoring (i.e., there is no bank moral hazard), then there exists a competitive equilibrium in which the entrepreneur finances the project entirely with bank debt.

Propositions 2 and 3 imply that it is the conjunction of entrepreneurial moral hazard and bank moral hazard that is crucial for Proposition 2 and confirms a unique interior optimal financing mix of bank and external finance. When a bank cannot contractually precommit to a particular level of monitoring, the firm will optimally seek to reduce the level of bank credit from total reliance. Firms will choose not to be entirely debt financed, which introduces a role for equity and therefore for stock markets. Besanko and Kanatas (1993) argue that it is unrealistic to suppose that banks can contractually precommit to their monitoring intensity. Therefore we are likely to observe some mix of bank debt and outside financing: *both banks and stock markets are complementary and coexist in equilibrium*. The model demonstrates how complementary forms of financing such as debt and equity effectively help to align the incentives of borrowers and lenders.

6.5 Empirical specifications of Model 1

6.5.1 Overview

The previous sections showed the details of three theoretical papers which each describe a unique chain in the finance-growth nexus. Financial development – a higher level of bank development and stock market development – is able to enhance economic growth (the *finance-to-growth* effect). Theory also justifies a second relationship which goes in the reverse direction: growth may be important for financial development (the *growth-to-finance* effect). And to assess the impact of various forms of financial structure theory suggests a third relationship showing how both banks and stock markets are complementary in economic development (the *banks-to-stock market* effect).

In this section we aim to empirically assess this structured finance-growth nexus. We shall investigate these relationships for Bangladesh over a 25 year period which has witnessed significant structural and financial policy reforms being implemented. A study which critically assesses the contribution of the financial sector to the development process is therefore essential in order to make effective central bank policy recommendations. To our knowledge such a study on the financial structure in Bangladesh does not currently exist. In addition to determining how financial development enhances growth, the question of what causes financial development itself becomes important. We theorize that the growth process can drive bank development. Finally, complementary forces are operating within the financial sector between banks and the stock market. The finance-growth nexus in other words represents a variety of channels which are inter-related.

We believe that such a finance-growth nexus described by these three models is therefore logically sound. We shall see that the empirical results exactly confirm the suitability of these models according to the ARDL cointegration methodology of Pesaran, Shin and Smith (2001). Importantly, the empirical results that are produced from this representation of the finance-growth nexus allow for easily interpretable policy implications in the context of Bangladesh: (i) Economic growth leads to bank development, (ii) bank development leads to stock market development, and (iii) both banks and the stock market promote economic growth. If central bank policy makers and other regulators in Bangladesh wish to achieve a higher rate of growth they would be well advised to consider the above three relationships which, individually and collectively, can be shown to drive the finance-growth nexus in that country.

6.5.2 The PSS ARDL cointegration technique

The Pesaran, Shin, and Smith (PSS) ARDL cointegration technique is carried out with the software package *Microfit* 4.1. As shown in Chapter 5, the main advantage of the PSS ARDL procedure is that it yields super-consistent estimates for small sample sizes. It can also be generally applied irrespective of whether the regressors are I(0) or I(1) and therefore avoids the pre-testing problems involved in standard co-integration analysis where classification of variables into I(1) and I(0) is required. The ARDL method does not suffer from problems of endogeneity and serial correlation by inserting enough lags into the specifications, and it can differentiate between dependent and explanatory

variables while simultaneously estimating the long- and short-run components of the model. The variables[11] which are in usual logarithmic form are as follows:

Y – Real GDP per capita (*economic growth*)
K – Real capital stock / GDP[12] (*economic growth*)
Q – Quasi-money / GDP (*bank development*)
P – Private credit / GDP (*bank development*)
S – Number of listed companies[13] (*stock market development*)

GDP per capita and the real capital stock (both at constant prices) measure economic growth. Quasi-money/GDP and Private-credit/GDP measure bank size and activity. The number of listed companies is a measure of the size of the stock market. For more detail on this measures see Chapter 5.

6.5.3 The finance-to-growth effect

In the *finance-to-growth effect*, we theorize that both the coefficients α_1 and α_2 (i.e. bank development and stock market development) are positive and significant. Thus the impact of higher financial development via the banks Q_t (quasi-money/GDP) and the stock market S_t (number of listed companies) leads to a higher rate of physical capital accumulation K_t. This is the main theoretical prediction of the Greenwood and Smith (1997) model. In the context of a developing economy like Bangladesh, the policy implication is a powerful one: higher levels of bank development and stock market development will enhance economic growth via the channel of the capital stock.

6.5.4 The growth-to-finance effect

In the *growth-to-finance effect*, we theorize that the coefficient on per capita income β_1 is positive and significant. This means that a higher rate of economic growth (now represented by GDP per capita, Y_t) will lead to bank development (now represented by

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[11] All variables are obtained from the online databases of the IMF *International Financial Statistics* and the World Bank *World Development Indicators*.
[12] The capital stock series was calculated using the perpetual inventory method. Raw data is taken from the 'Gross capital formation' row of the IMF *International Financial Statistics* database. We assume the following: 5% of the inherited stock of capital is retired each year; gross capital formation from national income accounts data is added each year to the inherited stock; and initial 1960 capital stock/GDP ratios were in a steady state with 1960 rates of investment being typical of previous years.
[13] This measure ideally would be expressed as a fraction of all registered companies. However data for the latter were of poor quality with many years missing. IPOs are highly significant events in any case. Bekaert et al. (2001) finds a positive impact of the number of listed companies on economic growth.

private credit/GDP, P_t). This chain in the finance-growth nexus means that in the process of economic development, bank development is itself stimulated. This is in accordance with the theoretical prediction of Harrison et al. (2004) where more growth in the real economy promotes greater entry into the bank sector and generally a higher level of private-credit will result. The connection between this effect and the previous effect is then the following: banks lead to growth, and more growth leads to further bank activity. But notice that the variables for growth and for banks are different in each case, thereby permitting the uniqueness of the autoregressive distributive lag (ARDL) cointegration method and allowing valid interpretations[14].

6.5.5 The banks-to-stock market effect

The *banks-to-stock market* effect (or the financial interaction effect), is identified in the third model and provides an interesting additional chain in the finance-growth nexus. The coefficient on private-credit/GDP P_t, χ_1, is expected to be positive and significant in the explanation for the number of listed companies S_t. That is, along with a higher level of bank development we expect to observe an increase in stock market development. This is the main theoretical prediction of Besanko and Kanatas (1993). While this can be interpreted as a causal relationship from banks to the stock market, more generally it implies that debt and equity are complimentary in the process of economic development. This reflects a variety of theoretical mechanisms at work in the financial and real sectors (see the earlier literature review). The important point is that a connection exists between banks and stock markets. Notice again that the bank development indicator in the *banks-to-stock market* effect is different to the bank development indicator in the *finance-to-growth effect*. However, bank credit and quasi-money translate respectively into bank lending and bank deposit-taking, which again translate into the assets and liabilities side of the bank balance sheet. Thus the two indicators of bank development – private credit and quasi-money – are themselves intrinsically related[15].

We believe that such a finance-growth nexus described by these three models is therefore logically sound. Later on we will see that the empirical results in fact do confirm the

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[14] The structural model as shown in the "finance-growth nexus and stock market infrastructure" diagram in Chapter 4 together with the explanation behind the ARDL empirical findings here will confirm this.

[15] As the famous saying goes, "loans make deposits". The implication here would be that bank activity could be self-sustaining so long as banks keep on lending and investors keep on using bank deposits.

suitability of these models according to the PSS ARDL cointegration methodology. Importantly, the empirical results that are produced from this representation of the finance-growth nexus allow for easily interpretable policy implications in the context of Bangladesh: (i) Economic growth leads to bank development, (ii) bank development leads to stock market development, and (iii) both banks and the stock market promote economic growth. If regulators in Bangladesh wish to achieve a higher rate of growth they would be well advised to consider the above three relationships which, individually and collectively, can be shown to drive the finance-growth nexus in that country.

6.6 Empirical results for Model 1

Throughout the preliminary ARDL stage the table below of critical values shall be used (see Pesaran and Pesaran, 1997: p. 478):

Table 6.1

Critical value bounds of the F statistic

Intercept and no trend: 99%				Intercept and trend: 99%		
k	I(0)	I(1)		k	I(0)	I(1)
0	11.935	11.935		0	16.133	16.133
1	7.057	7.815		1	9.063	9.786
2	5.288	6.309		2	6.520	7.584
3	4.385	5.615		3	5.315	6.414

Intercept and no trend: 95%				Intercept and trend: 95%		
k	I(0)	I(1)		k	I(0)	I(1)
0	8.199	8.199		0	11.722	11.722
1	4.934	5.764		1	6.606	7.423
2	3.793	4.855		2	4.903	5.872
3	3.219	4.378		3	4.066	5.119

Intercept and no trend: 90%				Intercept and trend: 90%		
k	I(0)	I(1)		k	I(0)	I(1)
0	6.597	6.597		0	9.830	9.830
1	4.042	4.788		1	5.649	6.335
2	3.182	4.126		2	4.205	5.109
3	2.711	3.800		3	3.484	4.458

The table below gives results for the possible existence of long-run cointegration using various combinations of our financial development and economic growth variables and using 3 lags for our sample period of 1980-2005[16].

[16] Three lags were justified in order to capture the entire dynamics of *Model 1*, particularly given the likelihood of endogenous regressors and autocorrelation in the specifications. Inserting the required number

Table 6.2 *F*-tests for Cointegration (*Model 1*)

F(Y/K,Q)	F(K/Y,Q)	F(Q/Y,K)	Cointegration relationship
1.785	0.891	7.348 **	F(Q/Y,K)t
1.874	1.624	0.309	

F(Y/K,P)	F(K/Y,P)	F(P/K,Y)	
4.017	2.824	5.529	
7.293 ***	5.175 **	7.621 ***	

F(Y/Q,P)	F(Q/Y,P)	F(P/Q,Y)	
9.854 ***	15.996 ***	7.477 **	
7.009 ***	16.734 ***	9.693 ***	

F(Y/P,S)	F(P/Y,S)	F(S/P,Y)	Cointegration relationship
11.285 ***	2.742	7.819 ***	
1.591	2.770	8.910 ***	F(S/P,Y)n

F(Y/K,S)	F(K/Y,S)	F(S/K,Y)	Cointegration relationship
7.821 ***	7.438 **	2.049	
4.908	8.802 ***	2.592	F(K/Y,S)n

F(Q/P,S)	F(P/Q,S)	F(S/P,Q)	Cointegration relationship
9.782 ***	1.074	1.741	F(Q/P,S)t
1.452	0.578	3.810	

F(K/Q, S)	F(Q/K, S)	F(S/K, Q)	Cointegration relationship
7.300 **	5.079	0.751	F(K/Q, S)t
0.790	5.472 **	2.409	F(Q/K, S)n

F(K/Q, P)	F(Q/K, P)	F(P/Q, K)	Cointegration relationship
4.6745	8.096 ***	2.496	F(Q/K, P)t
1.5151	1.681	1.249	

F(K/ P, S)	F(P/ K, S)	F(S/ P, K)	Cointegration relationship
35.019 ***	5.186	4.055	F(K/ P, S)t
19.012 ***	2.878	4.725	F(K/ P, S)n

In the above table the various sub-tables contain all possible variable combinations (within each 'grouping' of variables). The upper cell in each sub-table is the F statistic for cointegration with trend (t); the lower cell is the F statistic for cointegration with no trend (n). The PSS ARDL method identifies any "long-run forcing variables" in the co-integrating relationship between these variables. Any cointegrating relationship will only be unique if it flows in one direction i.e. only when a row has at most one cell with stars in it (denoting statistical significance).

*** 1% sig ** 5% sig * 10% sig

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of lags into the specifications can eliminate such problems (see also chapter 5). Using up to three lags is also satisfactory given that the number of variables eventually used in the final specifications is small. Finally our span of data (25 years) seems reasonable for a single country time series analysis. Results for two lags were performed and no suitable specification could be found (results available on request).

Table 6.2 *F*-tests for Cointegration (cont)

F(Y/Q)	F(Q/Y)		
3.081	3.009		
1.776	4.423		

F(Y/P)	F(P/Y)		Cointegration relationship
4.241	4.892		
2.169	6.833 **		F(P/Y)n

F(Y/S)	F(S/Y)		Cointegration relationship
12.214 ***	10.526 ***		
1.835	10.948 ***		F(S/Y)n

F(Y/K)	F(K/Y)		
3.388	1.496		
1.505	2.585		

F(K/Q)	F(Q/K)		
2.505	1.848		
0.524	1.152		

F(K/P)	F(P/K)		
12.263 ***	9.850 ***		
4.200	3.061		

F(K/S)	F(S/K)		Cointegration relationship
4.122	4.322		
0.683	6.664 **		F(S/K)n

F(Q/P)	F(P/Q)		Cointegration relationship
9.723 **	2.931		F(Q/P)t
1.440	1.541		

F(Q/S)	F(S/Q)		Cointegration relationship
8.151 **	1.426		F(Q/S)t
0.578	7.030 **		F(S/Q)n

F(P/S)	F(S/P)		Cointegration relationship
4.644	13.771 ***		F(S/P)t
1.586	16.874 ***		F(S/P)n

After determining the presence of possible cointegration, the next step is to formulate the respective long-run ARDL models. Table 6.3 below shows the results using SBC to determine lag length unless stated otherwise. Careful analysis of the long-run coefficients

and specification tests in this stage will determine whether the models are appropriate. In all 19 separate regressions were performed and only three managed to satisfy all the suitability criteria. They are model E2, model J, and model Q1. These have had their entire columns filled in red to respectively distinguish the various mechanisms at work in the finance-growth nexus: banks and stock markets lead to economic growth; economic growth leads to bank development, and the banks complement the stock market.

The three highlighted cointegrating relationships found in table 6.3 therefore constitute *Model 1*: "The finance-growth nexus". These three cointegrating relationships *are exactly the same* relationships or effects hypothesized to operate: that is, the cointegating relationships highlighted in red correspond one-to-one with the *finance-to-growth* effect, the *growth-to-finance* effect, and the *banks-to-stock market* effect.

Table 6.3

Estimated preliminary long-run coefficients from the ARDL models (*Model 1*)

Dependent variable	Model A F(Q/Y, K)t	Model B F(S/P, Y)n	Model C F(K/Y, S)n	Model D F(Q/P,S)t	Model E1 F(K/Q, S)t
GDP (Y)	2.4454	.48648	.76442		
	7.6021[.000]	.61391[.547]	4.9552[.000]		
Capital stock (K)	1.7146				
	6.3036[.000]				
Quasi money (Q)					.16974
					2.4149[.029]
Private credit (P)		.24262		.37398	
		.52857[.604]		1.7540[.100]	
Listed companies (S)			.23866	-.36784	.21935
			2.6493[.023]	-2.0064[.063]	5.3313[.000]
Constant	-11.9536	.017892	-1.4433	1.3608	1.4087
	-7.1635[.000]	.0064851[.995]	-3.3321[.007]	3.6990[.002]	19.6759[.000]
Trend	-.030223			.021149	.0053699
	-4.1095[.001]			3.4851[.003]	3.9317[.001]
F-test (for cointegration)	7.348	8.910	8.802	9.782	7.300
ARDL order	(2,3,2)	(2,0,1)	(3,3,3)	(1,3,0)	(1,3,0)
Adjusted *R*-Squared	.99600	.99643	.99993	.99329	.99927
DW statistic	2.7237	1.9108	2.2542	2.6290	1.6254
Serial correlation	5.4022[.020]	.030027[.862]	1.2680[.260]	3.2124[.073]	1.2773[.258]
Functional form	.098063[.754]	1.6411[.200]	9.7612[.002]	.072538[.788]	1.6004[.206]
Normality	.55612[.757]	4.4456[.108]	1.0329[.597]	1.4484[.485]	.28474[.867]
Heteroskedasticity	.0083881[.927]	.91045[.340]	.79844[.372]	.0033401[.954]	.79706[.372]
Error correction term	-1.3443	-.21115	-.13105	-.46703	-.49314
	-6.7730[.000]	-5.1080[.000]	-1.6654[.120]	-3.6885[.002]	-2.5482[.021]

Notes:
In the table above, the top row lists the dependent variable to be explained by the independent variable/s. For example, F(Y/Q)t denotes the F-test for the cointegrating regression (including a trend term) of GDP (Y) against quasi money (Q): put simply, we want to assess the impact of the bank deposits on economic growth. The leftmost column under the heading 'Dependent variable' lists various independent variables to be included in the possible cointergrating regressions. For every row of a given independent variable, each cell number within that row shows the coefficient on the independent variable in the regression: this coefficient denotes the size of the effect of the independent variable on the dependent variable. The cell beneath each coefficient is the t-statistic for usual statistical significance. The number immediately next to the t-statistic in brackets is the p-value i.e. the probability of rejecting the null hypothesis when it is true – we want this number to be as close to zero as possible in order to be confident that we can reject the null hypothesis of no significance. Stars denoting statistical significance are omitted for brevity in this table given that this is the preliminary stage of the ARDL cointegration method. We are looking for statistically significant long-run coefficients, a statistically significant error-correction term (to confirm the existence of the cointegrating relationship), and a reasonable Durbin-Watson statistic (approximately two). Also reported are tests automatically given in *Microfit* for model suitability: these are respectively the F-test for residual autocorrelation, the F-test version of the RESET test for miss-specified functional form, the chi-squared normality test for testing normality of residuals, and the F-test for heteroskedasticity. Only if these statistics are statistically insignificant can we be reasonably sure to have eliminated any possibility of miss-specification.

Table 6.3 (cont)

Estimated preliminary long-run coefficients from the ARDL models

Dependent variable	Model E2 F(K/Q, S)t	Model F F(Q/K, S)n	Model G F(Q/K, P)t	Model H F(K/ P, S)t	Model I F(K/ P, S)n
GDP (Y)					
Capital stock (K)		2.7176	1.5135		
		6.9111[.000]	1.7702[.097]		
Quasi money (Q)	.17153				
	2.8169[.014]				
Private credit (P)			-1.0643	.31960	.69265
			-1.6021[.130]	.70391[.490]	1.8793[.076]
Listed companies (S)	.22977	-.77951		-.025170	-.27429
	6.1608[.000]	-3.6145[.002]		-.075040[.941]	-.59240[.561]
Constant	1.3745		-1.3140	1.8490	2.1096
	20.6249[.000]	-2.8963	-.81230[.429]	4.3066[.000]	2.8545[.010]
Trend	.0054362	-7.4730[.000]	.030253	.0053885	
	4.6096[.000]		1.5882[.133]	.80769[.430]	
F-test (for cointegration)	7.300	5.472	8.096	35.019	19.012
ARDL order	(2,3,0)	(1,0,0)	(1,3,0)	(1,0,0)	(1,0,0)
Adjusted *R*-Squared	.99929	.99462	.99366	.99896	.99901
DW statistic	1.9864	2.1950	2.7266	2.2691	2.3583
Serial correlation	.0019606[.965]	.32212[.570]	4.1437[.042]	.59902[.439]	.82615[.363]
Functional form	3.4404[.064]	3.2085[.073]	.15198[.697]	3.2836[.070]	.53113[.466]
Normality	.073690[.964]	.48675[.784]	.18602[.911]	.0035253[.998]	.17155[.918]
Heteroskedasticity	1.0918[.296]	.73058[.393]	1.5073[.220]	2.3940[.122]	2.0290[.154]
Error correction term	-.56271	-.46653	-.28422	-.14007	-.073068
	-2.8013[.013]	-4.6746[.000]	-2.2845[.036]	-.87352[.394]	-1.4465[.164]

Table 6.3 (cont)

Estimated preliminary long-run coefficients from the ARDL models

Dependent variable	Model J F(P/Y)n	Model K F(S/Y)n	Model L F(S/K)n	Model M F(Q/P)t	Model N F(Q/S)t
GDP (Y)	1.9287	.95261			
	9.9190[.000]	2.9391[.009]			
Capital stock (K)			1.4082		
			9.7428[.000]		
Quasi money (Q)					
Private credit (P)				-.15228	
				-.69293[.497]	
Listed companies (S)					-1.4416
					-1.0998[.288]
Constant	-6.6925	-1.5787	-.82120	1.1736	4.0221
	-8.2646[.000]	-1.1565[.263]	-2.4977[.021]	5.2907[.000]	1.4775[.159]
Trend				.022958	.044797
				5.0857[.000]	1.8940[.076]
F-test (for cointegration)	6.833	10.948	6.664	9.723	8.151
ARDL order	(2,0)	(3,0)	(1,0)	(1,0)	(1,3)
Adjusted *R*-Squared	.97005	.99575	.99618	.98861	.99274
DW statistic	2.0666	1.9669	1.6001	1.4541	2.4990
Serial correlation	.12583[.723]	.9111E-3[.976]	.71350[.398]	1.9661[.161]	2.0405[.153]
Functional form	3.1172[.077]	2.5360[.111]	.6598E-3[.980]	3.4006[.065]	2.0405[.153]
Normality	5.2706[.072]	.49266[.782]	.036381[.982]	.92803[.629]	.43245[.806]
Heteroskedasticity	.45210[.501]	2.6629[.103]	1.4195[.233]	.33709[.562]	.42861[.513]
Error correction term	-.42687	-.23602	-.35349	-.47272	-.17639
	-4.6173[.000]	-8.8091[.000]	-7.0788[.000]	-4.5624[.000]	-1.4455[.167]

Table 6.3 (cont)

Estimated preliminary long-run coefficients from the ARDL models

Dependent variable	Model O F(S/Q)n	Model P F(S/P)t	Model Q1 F(S/P)n	Model Q2 F(S/P)n
GDP (Y)				
Capital stock (K)				
Quasi money (Q)				
Private credit (P)		.068576	.48604	0.37826
		.16486[.871]	2.6054[.018]	1.9806[.065]
Listed companies (S)	.69230			
	4.9796[.000]			
Constant	1.4417	2.0540	1.7187	1.8826
	7.1097[.000]	5.0760[.000]	6.5258[.000]	6.9503[.000]
Trend		.011666		
		1.1945[.249]		
F-test (for cointegration)	7.030	13.771	16.874	16.874
ARDL order	(3,1)	(2,1)	(2,1)	(3,2)
Adjusted *R*-Squared	.99611	.99661	.99654	0.99697
DW statistic	1.5210	1.9567	1.8732	1.9337
Serial correlation	1.4656[.226]	.0057552[.940]	.051928[.820]	.013403[.908]
Functional form	4.9620[.026]	.068867[.793]	1.7108[.191]	.43070[.512]
Normality	1.0139[.602]	3.8975[.142]	4.2063[.122]	2.8310[.243]
Heteroskedasticity	2.2358[.135]	.76888[.381]	1.0023[.317]	.37931[.538]
Error correction term	-.35000	-.22989	-.22057	-0.24012
	-6.0045[.000]	-5.9713[.000]	-5.7976[.000]	-6.0411[.000]

Table 6.4

Comments on model suitability criteria
Three models (E2, J, and Q1) are found to pass all suitability and diagnostic tests

	Brief model suitability comments
Model A	Model diagnostics weak. Explosive ECT, DW statistic excessively high.
Model B	Disregard due to cointegration in model J.
Model C	Disregard due to cointegration in model K, insignificant ECT, model diagnostics failed.
Model D	Weakly significant long run values, DW statistic excessively high.
Model E1	SBC version - DW statistic low, AIC result preferred.
Model E2	The finance-to-growth effect (AIC)
Model F	Disregard due to cointegration in model L.
Model G	Model diagnostics weak, insignificant long run values. DW statistic excessively high.
Model H	Insignificant long run values, insignificant ECT.
Model I	Insignificant long run values, insignificant ECT.
Model J	The growth-to-finance effect (SBC)
Model K	CUSUM stability tests weak.
Model L	DW statistic low.
Model M	Insignificant (and negative) long run values, DW statistic low.
Model N	Insignificant long run values, insignificant ECT, DW statistic excessively high.
Model O	Model diagnostics failed, DW statistic low.
Model P	Insignificant long run values.
Model Q1	The banks-to-stock market effect (SBC)
Model Q2	AIC version - CUSUM stability tests borderline.

The three highlighted cointegrating relationships which constitute *Model 1*: "The finance-growth nexus" are now isolated below in table 6.5 which is entitled: "Estimated ARDL long-run coefficients: The finance-growth nexus in Bangladesh, 1980-2005"[17].

[17] One suggestion that was made in the earlier draft was to try to isolate more clearly the linkage between the institutional setting of Bangladesh and the empirical results. This could for instance involve incorporating appropriately defined dummy variables in the empirical analysis that indicated the dates of important regulatory events or financial reforms. Nevertheless the critical issue for policy makers in Bangladesh is to recognize the importance of viewing the financial sector in a broader way. Our primary objective throughout this thesis is to demonstrate how banks, stock markets, and growth are inter-connected. Sharpening the results by introducing dummy variables or other methods though would be an interesting further extension to the main analysis and it is left for future work.

Table 6.5

Estimated ARDL long-run coefficients: The finance-growth nexus in Bangladesh, 1980-2005

Dependent variable	K/Q, S	P/Y	S/P
GDP (Y)		1.929 ***	
		9.919[.000]	
Capital stock (K)			
Quasi money (Q)	0.172 **		
	2.817[.014]		
Private credit (P)			0.486 **
			2.605[.018]
Listed companies (S)	0.230 ***		
	6.161[.000]		
Constant	1.375 ***	-6.693 ***	1.719 ***
	20.625[.000]	-8.265[.000]	6.526[.000]
Trend	0.005 ***		
	4.610[.000]		
F-test (for cointegration)	7.300 **	6.833 **	16.874 ***
ARDL order	(2,3,0)	(2,0)	(2,1)
Adjusted *R*-Squared	0.999	0.970	0.997
DW statistic	1.986	2.067	1.873
Serial correlation	0.002 [.965]	0.126 [.723]	0.052 [.820]
Functional form	3.440 [.064]	3.117 [.077]	1.711 [.191]
Normality	0.074 [.964]	5.271 [.072]	4.206 [.122]
Heteroskedasticity	1.092 [.296]	0.452 [.501]	1.002 [.317]
Error correction term	-0.562 **	-0.427 ***	-0.221 ***
	-2.801 [.013]	-4.617 [.000]	-5.798 [.000]

The first column in the table is the *finance-to-growth effect* where real capital stock/output is the dependent variable. This naturally is the most interesting specification as a large theoretical literature predicts a positive, one-way causal relationship between financial development and economic growth (see Levine, 1997; Greenwood and Smith, 1997). Both bank development (quasi-money/GDP) and stock market development (number of listed companies) have the expected positive signs and are statistically significant. However the size of both of the coefficients is relatively small, which is not implausible for a developing country. In Bangladesh, most of the nation's income goes towards supporting more pressing requirements for development and whatever resources are left then becomes available to the financial sector. Interestingly the contribution of the stock market (0.230) to growth is slightly higher than that of the banks (0.172). Note

however that banks themselves can help enhance stock market operations, in which case the stock market would represent an extension of bank development. This is shown in the third column where we find that the stock market is positively impacted by the private-credit/GDP ratio. In other words, some of the bank effect on growth may be working through the stock market variable. The stock market could also be developing in anticipation of future growth and it is this forecasting ability which might explain the connection between growth and lagged stock market development[18]. Another interesting observation is that while both banks and the stock market contribute positively to growth, the channel through which this occurs is physical capital accumulation.

The second column in table 6.5 is the *growth-to-finance effect* with private-credit/GDP as the dependent variable. Here real GDP per capita has a reasonably large impact on banks with a coefficient of 1.929. This finding is similar to Siddiki (2000) who finds that growth in per capita income is useful for predicting money accumulation in Bangladesh. This means that in the process of economic development, growth works to push for further development in the financial sector, and specifically through the channel of bank credit. This is the demand following hypothesis of Patrick (1966) and Robinson (1952); more recently, it is the hypothesis of reduced financial intermediation costs in the presence of higher growth in the economy (Harrison, Sussman and Zeira, 2004).

Finally the third column displays the *banks-to-stock market* effect. Banks (private-credit/GDP) have a positive impact on the stock market dependent variable with a coefficient of 0.486. This result shows how banks are supportive of the stock market in the long run, and we argue that this result also broadly shows how debt and equity are complementary in development. The model of Besanko and Kanatas (1993) is one way of understanding the implication of this result. However, a richer understanding and appreciation of the financial interaction effect is only obtained when it is understood in the context of integration with the other two effects identified above. All specifications pass the diagnostic tests for serial correlation, functional form, normality, and heteroskedasticity automatically computed by *Microfit*.

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[18] However this critique would be applicable to valuation-based measures of stock market development such as market capitalization which utilize forward looking stock prices – it is less applicable to the number of listed companies that list their shares for the first time.

6.7 Model 1: formal specifications and main results

Having achieved confidence in our results and isolated the three best relationships for the finance-growth nexus, we are now in a position to restate our chosen models by including all the ARDL model specifications. There is undoubtedly some repetition involved here, but the benefit of presenting the results in this way is that the reader can now be assured that the narrowed-down specifications are the correct ones for the analysis.

Main results for Model 1

Please note:

(i) *t*-statistics are reported in parentheses.

(ii) Each of the three chosen models now presented will have passed all diagnostic tests so we comment no further on suitability criteria.

6.7.1 The finance-to-growth effect

The following ARDL (2,3,0) model is selected using the Akaike Information Criterion (AIC):

$$K_t = \underset{(2.811)}{0.773^{***}} + \underset{(2.151)}{0.003T^{**}} + \underset{(2.871)}{0.628K_{t-1}^{***}} \underset{(-1.148)}{- 0.191K_{t-2}} + \underset{(3.502)}{0.199Q_t^{***}}$$

$$\underset{(-2.816)}{- 0.144Q_{t-1}^{***}} + \underset{(2.308)}{0.103Q_{t-2}^{**}} \underset{(-1.541)}{- 0.062Q_{t-3}} + \underset{(2.740)}{0.129S_t^{***}}$$

The static long-run model of the corresponding ARDL (2,3,0) for the capital stock can be written as follows:

$$K = \underset{(20.625)}{1.375^{***}} + \underset{(4.610)}{0.005T^{***}} + \underset{(2.817)}{0.172Q^{***}} + \underset{(6.161)}{0.230S^{***}}$$

The theoretical motivation in *Model 1* can now be seen to be present in empirical results for Bangladesh. The finance-to-growth effect established in the above specification suggests that in the long run banks and the stock market accelerate economic growth via

the channel of capital accumulation. The empirical investigation of the short-run dynamics is important for researchers and policy makers of Bangladesh, since theory does not provide any suggestion regarding the predictions of the signs and magnitudes of short-run effects. The advantage of the ARDL technique is that it allows assessment of the *long-run effects and short-run effects*, the latter which are captured by the error-correction models. Hence, we now show the error correction model (ECM) to examine the short-run dynamics of the model and to confirm the cointegrated relationship.

The EC representation of the ARDL (2,3,0) model can be written as follows:

$$\Delta K_t = \underset{(2.811)}{0.773^{***}} + \underset{(2.151)}{0.003T^{**}} + \underset{(1.148)}{0.191\Delta K_{t-1}} + \underset{(3.502)}{0.199\Delta Q_t^{***}} - \underset{(-1.014)}{0.041\Delta Q_{t-1}}$$

$$+ \underset{(1.541)}{0.061\Delta Q_{t-2}} + \underset{(2.740)}{0.129\Delta S_t^{***}} - \underset{(-2.801)}{0.563ECM_{t-1}^{***}}$$

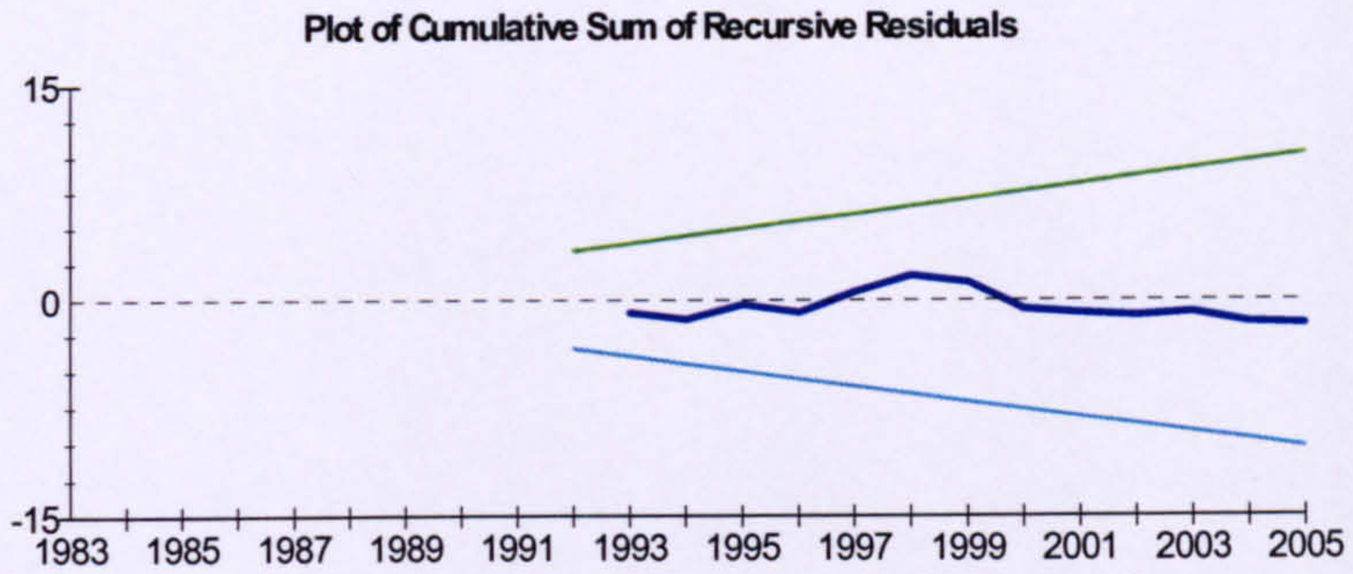
$$ECM_{t-1} = K_{t-1} - 1.375 - 0.005T - 0.172Q_{t-1} - 0.230S_{t-1}$$

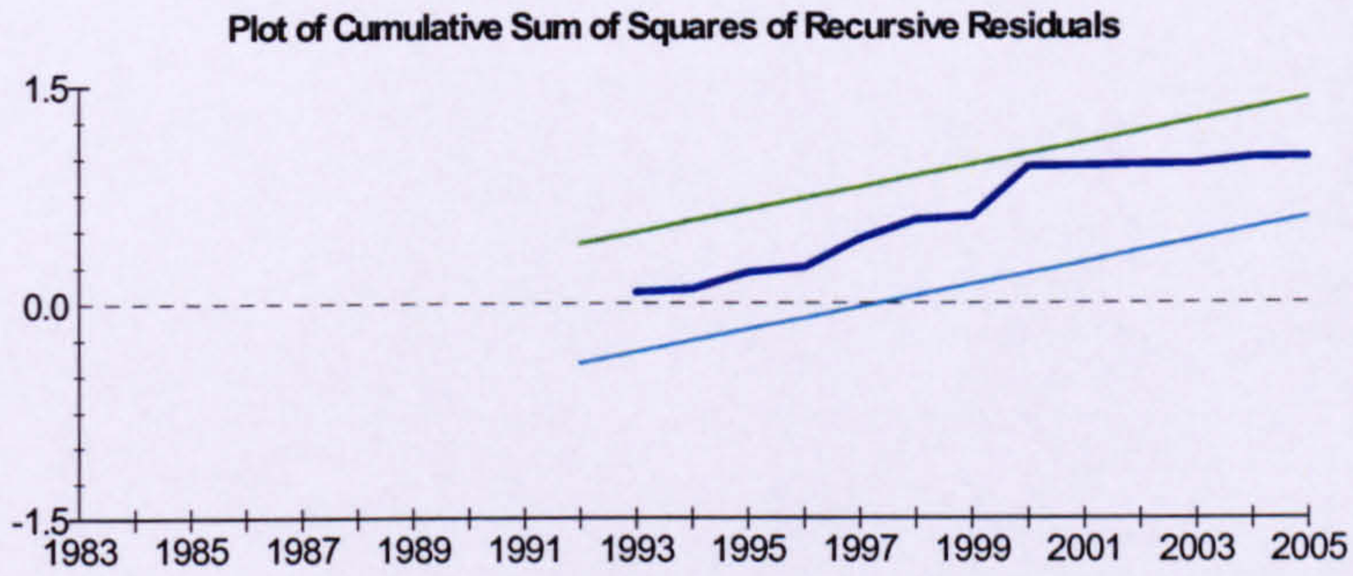
Tables 6.6, 6.7 and 6.8 below show these results for each of the various specifications of the finance-growth nexus as well as the CUSUM stability tests for general robustness.

Table 6.6

Error-correction model and CUSUM stability test: the finance-to-growth effect

Depedent variable	AIC (2,3,0) (K/Q, S)t
d Capital stock - 1 (ΔK_{t-1})	0.191
	1.148[.269]
d Quasi money (ΔQ_t)	0.199 ***
	3.502[.003]
d Quasi money - 1 (ΔQ_{t-1})	-0.041
	-1.014[.327]
d Quasi money - 2 (ΔQ_{t-2})	0.062
	1.541[.144]
d Listed companies (ΔS_t)	0.129 **
	2.740[.015]
d Constant (ΔC)	0.773 **
	2.811[.013]
d Trend (ΔT)	0.003 **
	2.151[.048]
ecm (-1)	-0.563 **
	-2.801[.013]
Adjusted *R*-Squared	0.826
DW statistic	1.986





ecm = K -.172*Q -.230*S -1.375*C -.005*T

Notes:
In the table above, the coefficients in each row show the short-run effects of the variables in the error-correction mechanism. These effects capture the signs and magnitudes of the short run dynamics of the cointegrating relationship identified in the long-run by the PSS ARDL method. The cell beneath each coefficient is the t-statistic for usual statistical significance. The number immediately next to the t-statistic in brackets is the p-value i.e. the probability of rejecting the null hypothesis when it is true – we want this number to be as close to zero as possible in order to be confident that we can reject the null hypothesis of no significance. Graphs for the CUSUM and CUSUM of squares tests are also included – these graphs demonstrate whether these functions of the residuals are within the critical bands or not. If they stay within the bands then this suggests that the model's parameters are stable.

*** 1% sig ** 5% sig * 10% sig

Table 6.6 lists the results for the finance-to-growth model specification. Quasi-money-to-GDP and number of listed companies at 1 lag both have positive signs and are significant at 0.199 and 0.129 respectively. The economics of the short-run results may be useful for

policy makers – they suggest a slow / moderate adjustment to shocks to the system in the previous year. The capital stock at 2 lags is positive although not significant. Quasi-money/GDP at lag 2 enters with a negative sign, however the magnitude of is quite small and statistically insignificant. Similar interpretation follows for quasi-money at lag 3. Importantly the error-correction term shows the correct negative sign, is highly significant, and suggests a reasonably quick adjustment back to the long-run equilibrium: approximately 56% of the disequilibrium in each period is corrected in the following period.

6.7.2 The growth-to-finance effect

The following ARDL (2,0) model is selected using the Schwartz Bayesian Criterion (SBC):

$$P_t = \underset{(-3.640)}{-2.857^{***}} + \underset{(5.108)}{0.892P_{t-1}^{***}} - \underset{(-2.141)}{0.319P_{t-2}^{**}} + \underset{(3.829)}{0.823Y_t^{***}}$$

The static long-run model of the corresponding ARDL (2, 0) for private credit/GDP can be written as follows:

$$P = \underset{(-8.265)}{-6.693^{***}} + \underset{(9.919)}{1.929Y^{***}}$$

The EC representation of the ARDL (2,0) model can be written as follows:

$$\Delta P_t = \underset{(-3.640)}{-2.857^{***}} + \underset{(2.141)}{0.319\Delta P_{t-1}^{**}} + \underset{(3.829)}{0.823\Delta Y_t^{***}} - \underset{(-4.617)}{0.427ECM_{t-1}^{***}}$$

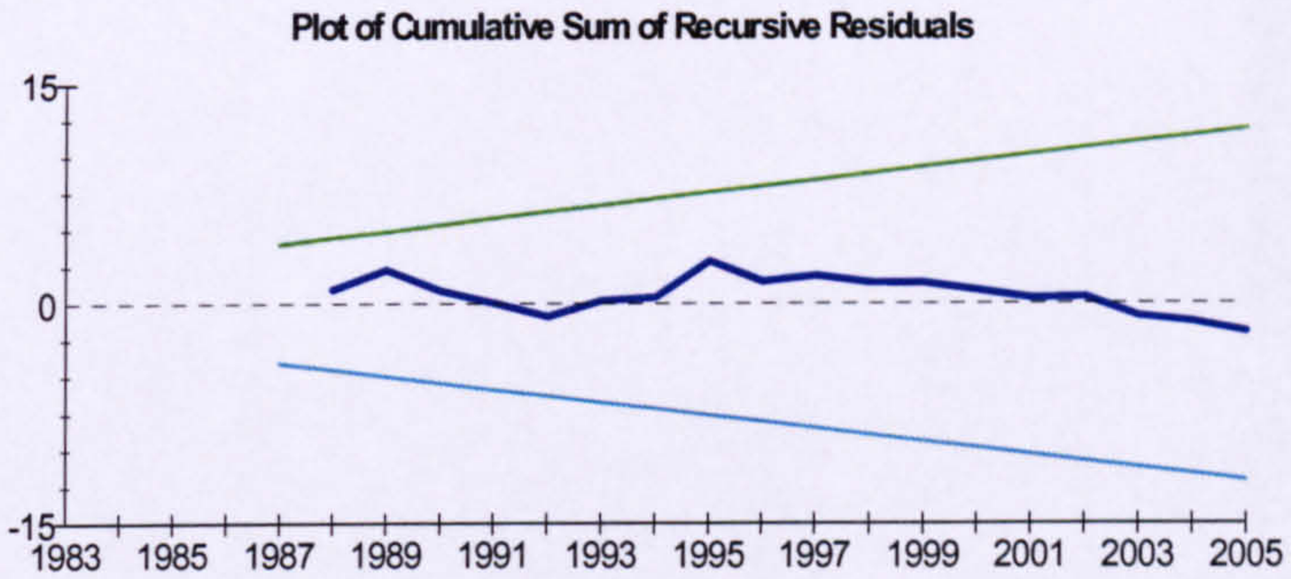
$$ECM_{t-1} = P_{t-1} + 6.693 - 1.929Y_{t-1}$$

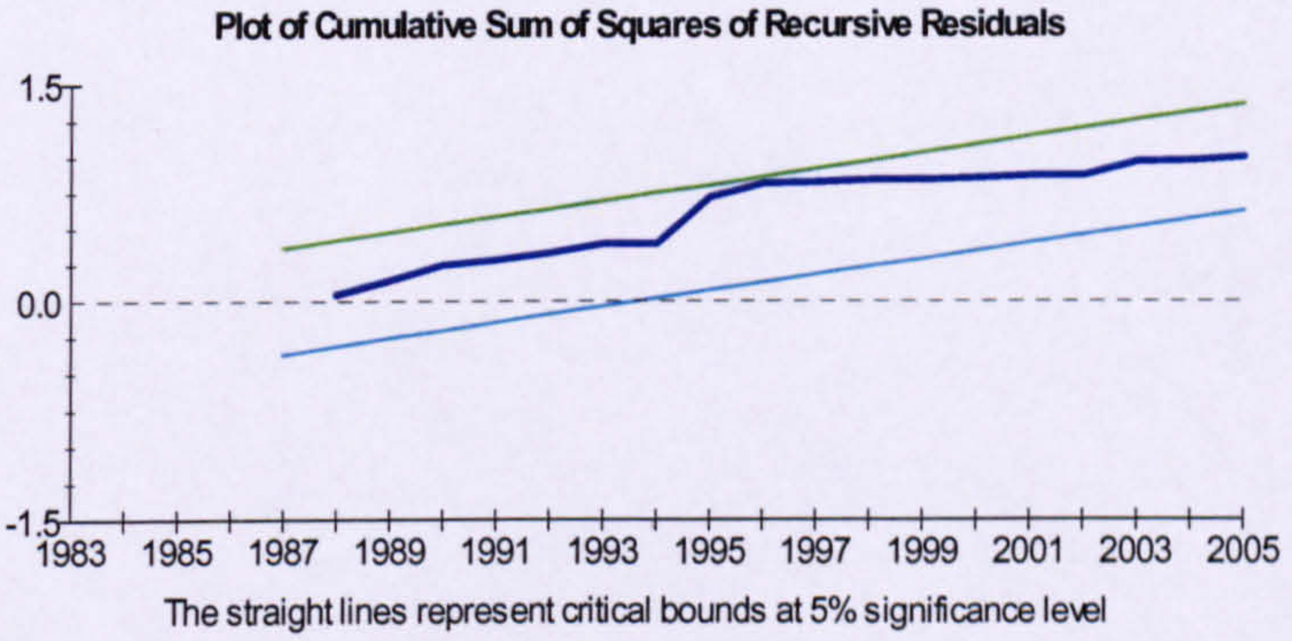
Table 6.7

Error-correction model and CUSUM stability test: the growth-to-finance effect

Depedent variable	SBC (2,0) (P/Y)n
d Private credit - 1 (ΔP_{t-1})	0.319 **
	2.141[.045]
d GDP (ΔY_t)	0.823 ***
	3.829[.001]
d Constant (ΔC)	-2.857 ***
	-3.640[.002]
ecm (-1)	-0.427 ***
	-4.617[.000]
Adjusted *R*-Squared	0.541
DW statistic	2.067

ecm = P -1.929*Y + 6.693*C





Although the body of work is thinner, theory also posits a reverse causal relationship from growth to finance. In table 6.7, real GDP per capita has a strong effect in the short-run on private-credit to GDP with a coefficient of 0.823. The error-correction term is negative, statistically significant, and suggests a reasonable correction to disequilibrium in the previous period (-0.427). Together with the long-run results, this suggests an important additional channel of the finance-growth nexus. Not only does finance lead to growth but growth can also lead to finance. The banking sector attempts to re-adjust to the situation in the real economy, and the real economy in turn is driven by financial development.

6.7.3 The banks-to-stock market effect

The following ARDL (2,1) model is selected using the Schwartz Information Criterion (SBC):

$$S_t = \underset{(9.921)}{0.379***} + \underset{(3.853)}{0.472S_{t-1}***} + \underset{(3.018)}{0.307S_{t-2}***} + \underset{(4.301)}{0.377P_t***} - \underset{(-2.780)}{0.269P_{t-1}***}$$

The static long-run model of the corresponding ARDL (2, 1) for the number of listed companies can be written as follows:

$$S = \underset{(6.526)}{1.719***} + \underset{(2.605)}{0.486P***}$$

The EC representation of the ARDL (2,1) model can be written as follows:

$$\Delta S_t = \underset{(9.921)}{0.379***} - \underset{(-3.108)}{0.307\Delta S_{t-1}***} + \underset{(4.301)}{0.377\Delta P_{t-1}***} - \underset{(-5.798)}{0.221ECM_{t-1}***}$$

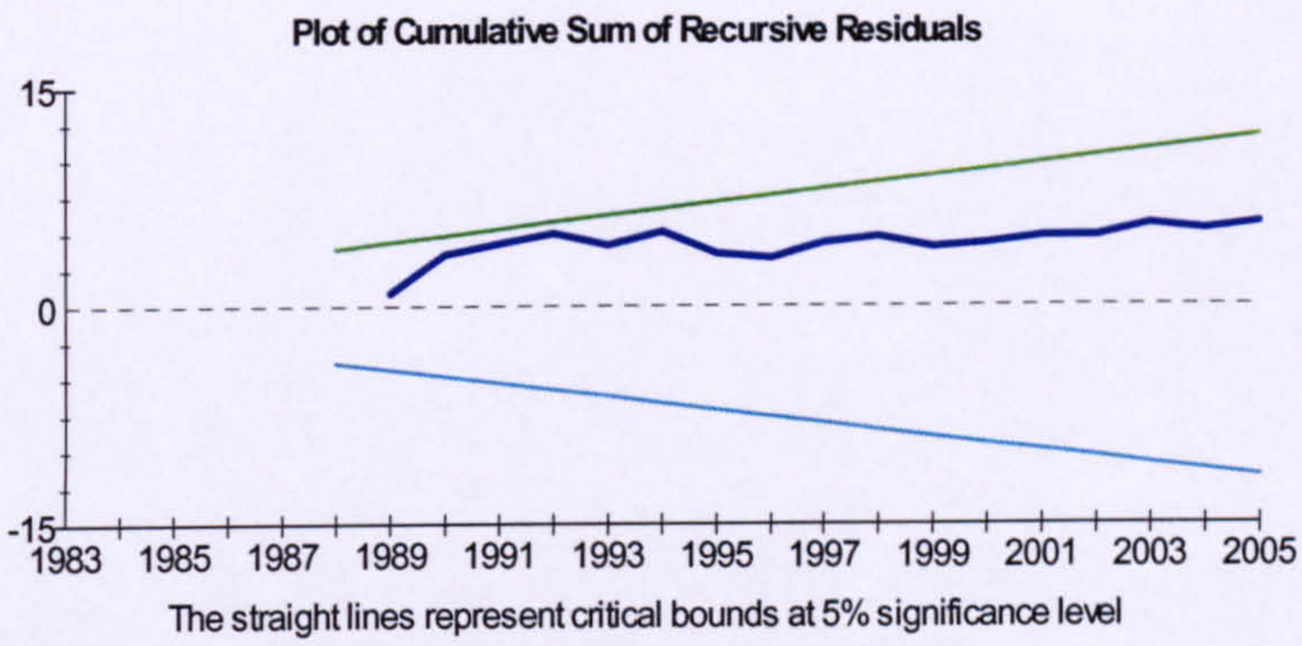
$$ECM_{t-1} = S_{t-1} - 1.719 - 0.486P_{t-1}$$

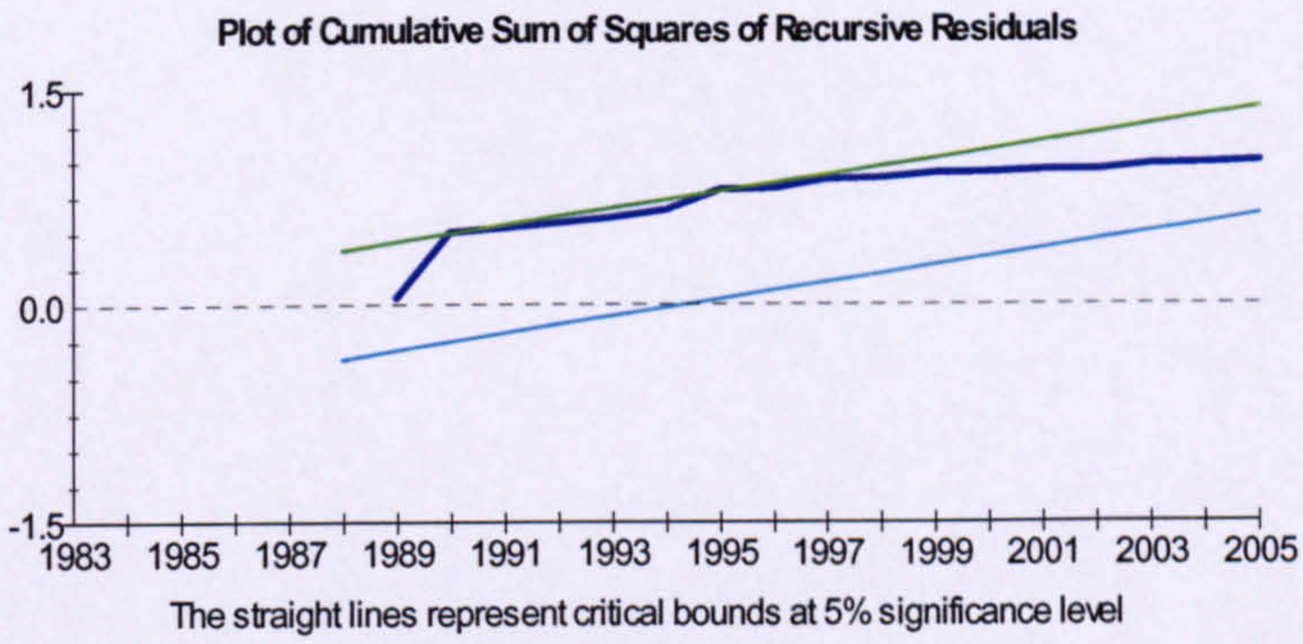
Table 6.8

Error-correction model and CUSUM stability test: banks-to-stock market effect

Depedent variable	SBC (2,1) (S/P)n
d Listed companies - 1 (ΔS_{t-1})	-0.307 ***
	-3.018[.007]
d Private credit (ΔP_t)	0.377 ***
	4.301[.000]
d Constant (ΔC)	0.379 ***
	9.921[.000]
ecm (-1)	-0.221 ***
	-5.798[.000]
Adjusted *R*-Squared	0.904
DW statistic	1.873

ecm = S -.486*P -1.719*C





The third channel of the finance-growth nexus in Bangladesh is the financial interaction channel, and table 6.8 gives the short-run results. Theory presents a number of reasons why indicators of banks and stock markets (i.e. debt and equity) are likely to be complementary. From the table we can see that the coefficient on the private-credit/GDP term is 0.377 and is significant. The stock market negatively adjusts to itself at 2 lags which suggests that stock market development may be impacted by other factors not modelled here[19]. The error-correction term is significant, negative and indicates a slow adjustment to equilibrium (-0.221). Overall this implies that bank development will bring

[19] In results presented in Chapter 7, *Model 2A*, the number of listed companies and the amount of trading on the stock market are found to be cointegrated for the DSE. This 'listing-trading' relationship (see Pagano, 1993b and the discussion in Chapter 4) is a supporting component of the finance-growth nexus. The main implication of this additional relationship is that the stock market in Bangladesh may be able to develop without being stringently tied to the overall growth process or to the process of bank development.

about stock market development. The low value of the error-correction term may be explained as follows. We have also seen that growth in GDP per capita leads to bank development, so it may be that growth indirectly influences the stock market. In addition, results to be presented later on in *Model 2A* will show that the stock market may be responding to its own infrastructure in the form of a listing – trading relationship. Yet it is also true that purely from the perspective of firm optimising behaviour a mixed debt-equity ratio is quite possible and that this may occur with or without any connection to economic growth[20]. Firms in other words are continuously assessing whether or not to issue new shares or shares of already existing stock to the public. Irrespective of the underlying reasons, both banks and stock markets in Bangladesh appear to be complementary and this agrees with results obtained in the literature by other authors[21]. However, these findings do suggest that the theoretical literature on the finance-growth nexus as it relates to the low-income developing countries together with financial policy initiatives of governments and agencies may be in need of a re-think. This is because the finance-growth nexus can be shown to represent a variety of channels which may in fact be inter-related.

6.8 Implications of results in the context of Bangladesh

The main contribution of this section is that we are able to find support for the financial development - economic growth relationship in Bangladesh. This result needs to be carefully interpreted in view of the poor overall institutional environment and other deficiencies in the financial sector. We offer the following comments. The first is that developing countries are often rapidly expanding, and a situation can emerge whereby firms find themselves constrained by the insufficient level of available financial funds. Financial provision can then take on even greater significance so that even if inefficiency exists in the system the positive finance-growth effect remains present. The second point is that while Bangladesh is a mainly bank-based system and banks are the main intermediaries and providers of finance, the stock market also represents an additional component of the financial sector. While both banks and the stock market in Bangladesh have faced difficulties in performing their respective roles, together they may have

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[20] See also the literature review in Chapter 2.

[21] Dermirguc-Kunt and Levine (1996, 2001) show that most stock market indicators are highly correlated with financial intermediary development.

helped promote growth via the operation of a better overall performing financial system. The reasons why both institutions matter though are complex. Theoretical work in this area has so far suggested greater liquidity provision as one way for both banks and stock markets to enhance growth. But a richer explanation would require tying in such a discussion with issues regarding information asymmetry and the flow of information through financial markets (see Chapter 4).

The third point is that while the physical capital stock[22] has been rising in Bangladesh, the link from financial development to GDP per capita has not been as strong. Indeed, the ARDL cointegration results in the empirical section show that financial development in Bangladesh enhances physical capital accumulation *rather than* GDP per capita. The finance-to-growth effect as shown here is both interesting and problematic at the same time. On the one hand, the capital stock is an alternative, complementary measure of economic growth. It could be that for a developing country the capital stock is somehow better able at capturing the growth enhancing effect of financial development via the specific channel of physical capital accumulation. The capital stock may also be capturing that portion of the total output which is technologically intensive. As a result we might find banks and stock markets to be well suited for enhancing this particular aspect of economic growth, rather than labour productivity which would depend more on an educated and flexible workforce.

On the other hand, the economy of Bangladesh is mostly driven by agricultural production and textile manufacturing industries. This suggests that a higher amount of physical capital investment may not be essential for such a country when other supporting supply and demand linkages are weak or even absent[23]. Another explanation is that there may have been a huge misallocation of funds so that the overall quality of the capital stock was adversely affected. Bangladesh in other words may not have been able to effectively utilize the higher stock of capital in the economy[24]. It remains the case however that the finance-growth relationship according to our results is positive and statistically significant in accordance with the main theoretical prediction of Greenwood

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[22] Other authors who have used physical capital accumulation in addition to GDP per capita for examining the finance-growth relationship include King and Levine (1993), Arestis and Demetriades (1997), Levine and Zervos (1998), Beck et al. (2000), and Benhabib and Spiegel (2000).
[23] Lack of necessary infrastructure (roads, transport etc) is a major obstacle cited by foreign investors.
[24] Corruption is prevalent in Bangladesh and many businesses report this to be a major problem.

and Smith (1997). Other avenues which might be looked at include trade liberalization and human capital development. New research suggests that these two factors are important for growth in Bangladesh in addition to financial development (Siddiki, 2002). Another line of inquiry might involve analyzing indicators of bank efficiency rather than of size and activity. Net interest margins and overhead costs could for instance be used.

The result that economic growth leads to bank development is unsurprising in the context of a developing country. More growth allows for a better adoption of technology which can support a larger and more effective financial intermediary sector. Banks will also naturally wish to extend their credit in relation to the increased profitable opportunities and higher demand in the economy[25]. This is the main theoretical prediction of Harrison et al. (2004). In this way growth can lead to finance and finance can lead to more growth, thus justifying the two-way causal relationship originally noted by Patrick (1966), Gurley and Shaw (1955) and Goldsmith (1969).

The banks-stock market interaction effect is complex. While it is partly driven by the overall growth process it is also driven by factors specific to the financial sector. Improved transaction and settlement techniques from the banking sector are necessary to cultivate stock market logistics and give credibility. Stock markets can stimulate increased information flows from companies, and as these information flows improve and accounting standards become more transparent, more investors may be encouraged to invest. Stock market listing criteria and reporting regulations may serve as a useful benchmark for improved corporate governance and transparency standards in the wider business community. The presence of a stock market in an economy can also help improve the overall business and investment climate and reinforces other elements of economic reform in a developing country. Demirguc-Kunt and Maksimovic (1995) find that the existence of an active stock market increases the debt capacity of firms, so that equity markets and financial intermediaries complement one another. An active stock market results in increased business for financial intermediaries, and improvements in the functioning of a stock market produce a higher debt-equity ratio for firms. Dermirguc-Kunt and Huizinga (2001) find that stock market development improves bank profits and margins. A final point is that banks can provide services such as equities underwriting.

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[25] This is also the position held by Robinson (1952) who famously argued that "where enterprise leads finance follows" (1952: p. 86).

6.9 Conclusion for Model 1

This section provides a first examination of the association between the structure of the financial system and the growth process in Bangladesh. As noted by Goldsmith (1969, p.400), financial development "accelerates economic growth and improves economic performance to the extent that it facilitates the migration of funds to the best user, i.e. to the place in the economic system where the funds will earn the highest social return". Using a relatively new cointegration technique – the Pesaran, Shin and Smith (PSS) ARDL bounds-testing procedure – we have found that both banks and the stock market enhance physical capital accumulation from 1980 to 2005. This *finance-to-growth effect* result agrees with the view that the financial sector is a key component for promoting growth in Bangladesh. In addition, GDP per capita is found to lead to higher bank development (*growth-to-finance effect*). And finally bank development itself results in higher stock market development (*banks-to-stock market* effect). *Model 1*: "the finance-growth nexus" therefore represents a set of inter-related variables that together capture the dynamic forces of the financial sector and its connection to the real economy.

CHAPTER 7

MODEL 2A: THE STOCK MARKET INFRASTRUCTURE (I) IN BANGLADESH

The listing-trading effect

7.1 Introduction

This chapter offers a theoretical and empirical examination of *Model 2A*: "*the stock market infrastructure* (I)" for the case of Bangladesh. In Chapter 4 we reviewed an encompassing structural system which was comprised of different theoretical models. Here we now describe in detail one particular paper which forms the first sub-model of the stock market infrastructure part of that system: the "listing - trading" relationship.

7.1.1 Model 2A hypothesis: The stock market infrastructure (I)

1) *Listing and trading are linked on the stock exchange*

7.2 Pagano (1993b)

The Pagano (1993b) model of stock market development relies on the role of market expectations in the presence of positive trading externalities. The model is able to show how a relationship can emerge between the number of firms listing securities on the stock market and the level of stock market trading by investors. If trading and liquidity are costly[1] this means that an entrepreneur who takes his firm public on the stock exchange increases risk sharing opportunities for others, letting them better diversify their equity portfolios. The flotation decision (i.e., whether or not to list shares on the stock market) is then positively correlated across entrepreneurs since other entrepreneurs can only diversify their portfolios if they also go public on the stock market themselves. Each entrepreneur not only gains when other companies float more shares, but also has a greater incentive to float his own company's shares as a result due to diversification benefits. Such a strategic complementarity implies that flotation decisions are positively

[1] These costs for example include legal and brokerage fees, costs due to certifying company balance sheets, and the under-pricing of IPOs.

correlated across entrepreneurs, and this therefore creates the potential for multiple equilibria in the number of listed (and traded) companies. Trading externalities in the stock market allow a single entrepreneur's decision to float his company's shares to increase the risk sharing opportunities for others entrepreneurs in the market.

The baseline model

In this baseline model the decision whether or not to float is unaffected by the entrepreneur's expectations concerning the corresponding decisions of the other entrepreneurs. There are $M+N$ individuals in the economy, indexed by $j=1,....,M+N$. The first M of these individuals are 'entrepreneurs': each of them is endowed with equity in a risky project, of which he is the sole owner – a 'family business', which carries the same index j as its owner. The remaining N individuals are 'ordinary investors', who are born with no risk capital, but with w_0 units of 'money' that can be invested in whichever stocks are traded on the market and in a safe asset with a gross return R.

Individuals live for two periods. In period 0, entrepreneurs choose if they want to float their shares, determining the menu of traded securities; then, conditional on this menu, both entrepreneurs and ordinary investors choose their optimal portfolios and trade accordingly on the stock exchange. In period 1, returns are paid to security holders: debt is paid off, and shares pay a liquidating dividend. Each company's shares are equal to its units of real capital, an exogenous number K_i for company i. A share in company i trades at price p_i and yields a gross return $\tilde{R}_i$, which is normally distributed with mean μ_i and variance σ_i^2. Returns are uncorrelated across companies. There are no restrictions on borrowing. Anyone can borrow any amount at the interest rate $r=R-1$.

To go public, each entrepreneur must pay a fixed cost c. If he does, he can sell any amount of his shares at the price it will command, and reinvest the proceeds of the sale on the market. If he chooses not to float, he will be unable to trade his shares at any price. All individuals in the economy have identical preferences, represented by a negative exponential expected utility function in terminal wealth $\tilde{w}_{1j}$ for individual j. Let k_{ij} denote the number of shares in firm i demanded by person j. The set of publicly

traded firms, ℓ^*, in endogenous, since it is determined by the equilibrium choices of the M entrepreneurs.

The choice problem of entrepreneurs consists of two sequential stages: the flotation choice and the portfolio choice. When he decides about flotation, entrepreneur j anticipates that a certain set of securities will be traded, that he will choose his portfolio optimally (given this set of traded securities), and that markets will clear. Moreover, he assumes that his decision about flotation of company j has no effect on the corresponding choices of other entrepreneurs. Thus, the problem must be solved by backward induction: first, one finds the optimal portfolio choice rule for an arbitrary set of traded securities; second, one determines the optimal criterion for the flotation choice, conditioning on optimal portfolio choice, thus pinning down the set of traded securities. If expectations are rational, the latter coincides with that assumed at the portfolio choice stage.

Now consider entrepreneur j at the moment he chooses whether or not to float his company's shares. He expects another T companies, forming a subset ℓ of the M companies, to go public, whether his own firm does or not. So he expects the set of traded companies to be formed by ℓ if company j stays private, or by the union of ℓ and company j if it goes public. Thus he anticipates his portfolio choice problem as

$$\text{Max E}\,[V(\tilde{w}_{1j})] = \text{E}\,[-Ae^{-b\tilde{w}1j}] \qquad A>0\ ,\ b>0 \tag{7.2.1}$$

subject to

$$\tilde{w}_{1j} = \sum_{i\in\ell}(\tilde{R}_i - Rp_i)k_{ij} + [(\tilde{R}_j - Rp_j)k_{jj} + Rp_jK_j - c]I_j + \tilde{R}_jK_j(1-I_j)$$

$$\text{for } j = 1,\ldots,M,$$

where I_j equals 1 if entrepreneur j floats his company, and 0 otherwise. For non-entrepreneurs, the problem instead reduces to maximizing (7.2.1) subject to

$$\tilde{w}_{1j} = \sum_{i\in\ell^*}(\tilde{R}_i - Rp_i)k_{ij} + Rw_0 \quad \text{for } j = M+1,\ldots,M+N$$

where the set ℓ^* results from the equilibrium decisions about going public. Thus, if the expectations of entrepreneur j are rational, ℓ^* equals ℓ if $I_j = 0$ and equals $\ell \cup j$ if $I_j = 1$. The assumption of normally distributed returns means that these problems can be restated as that of maximizing the mean-variance utility function:

$$\text{Max E } [U(\tilde{w}_{1j})] = \mathrm{E}(\tilde{w}_{1j}) - \frac{b}{2} \operatorname{Var}(\tilde{w}_{1j}) \tag{7.2.2}$$

The maximization problem of entrepreneurs can be written as

$$\begin{aligned}\text{Max E } [U(\tilde{w}_{1j})] = & \sum_{i \in \ell} (\mu_i - Rp_i) k_{ij} \\ & + [(\mu_j - Rp_j) k_{jj} + Rp_j K_j - c] I_j + \mu_j K_j (1 - I_j) \\ & - \frac{b}{2} \left(\sum_{i \in \ell} \sigma_i^2 k_{jj}^2 + \sigma_j^2 k_{jj}^2 I_j + \sigma_j^2 K_j^2 (1 - I_j) \right) \\ & \text{for } j = 1, \ldots, M\end{aligned} \tag{7.2.3}$$

and that of ordinary investors as

$$\begin{aligned}\text{Max E } [U(\tilde{w}_{1j})] = & \sum_{i \in \ell^*} (\mu_i - Rp_i) k_{ij} + Rw_0 - \frac{b}{2} \sum_{i \in \ell^*} \sigma_i^2 k_{ij}^2 \\ & \text{for } j = M+1, \ldots, M+N.\end{aligned} \tag{7.2.4}$$

For both problems, the first-order condition with respect to k_{ij} yields the same solution:

$$k_{ij} = \frac{\mu_i - Rp_i}{b\sigma_i^2}, \qquad j = 1, \ldots, M+N \tag{7.2.5}$$

If firm j is floated on the market, its shares trade at the equilibrium price

$$p_j = \frac{1}{R} \left(\mu_j - b\sigma_j^2 \frac{K_j}{M+N} \right) \tag{7.2.6}$$

The equity that the initial owner retains in his former company, k_{jj}, is given by (7.2.5).

Now consider the choice about going public. In this choice the owner takes the

corresponding decisions by other entrepreneurs as given, and anticipates that his portfolio choices will be made optimally, according to equation (7.2.5). To analyze the flotation decision, the equilibrium value of j's expected utility ($j = 1,....,M$) is obtained by substituting eqs. (7.2.5) and (7.2.6) in function (7.2.3). If his company stays private ($I_j = 0$), he gets

$$\mathrm{E}\,[U(\tilde{w}_{ij}) \mid j \text{ private}] = \frac{b}{2}\sum_{i\in\ell}\left(\frac{K_i\sigma_i}{M+N}\right)^2 + \mu_j K_j - \frac{b}{2}K_j^2\sigma_j^2 \qquad (7.2.7)$$

while if he decides that his company should go public ($I_j = 1$), his expected utility is

$$\mathrm{E}\,[U(\tilde{w}_{ij}) \mid j \text{ public}] =$$

$$\frac{b}{2}\sum_{i\in\ell}\left[\left(\frac{K_i\sigma_i}{M+N}\right)^2 + \left(\frac{K_j\sigma_j}{M+N}\right)^2\right] + \left(\mu_j - b\sigma_j^2\frac{K_j}{M+N}\right)K_j - c \qquad (7.2.8)$$

where the penultimate term captures the income effect of the sale of firm j's shares at the equilibrium price p_j in (7.2.6), and the last term is the fixed cost of flotation. The net gain for the entrepreneur is then

$$\Delta\mathrm{E}\,[U(\tilde{w}_{1j})] = \frac{b}{2}\left(\frac{K_j\sigma_j}{M+N}\right)^2 (M+N-1)^2 - c \qquad (7.2.9)$$

Since $M+N>1$, the first term is positive. Thus, if there were no flotation costs ($c = 0$), it would always pay to list one's firm on the market, sell it off and reallocate one's portfolio freely. Once flotation costs are introduced, this can change: if c is high enough, expression (7.2.9) turns negative. The risk-sharing gains from going public are increasing in the size of the company, K_j, and in its riskiness, σ_j^2.

Capital market imperfections and multiple equilibria

In the presence of capital market imperfections, the very fact that a company goes public can raise the demand for other companies' shares, and thus induce other unlisted

companies to go public, creating the potential for multiple equilibria[2]. Here we assume that trading shares is costly, i.e. the number of ordinary investors is not exogenous, since it results from the entry decisions of these investors. Let $n \in [0, N]$ denote the number of ordinary investors who decide to be active on the stock market, and f denote the fixed transaction cost that they pay to operate on the stock exchange. Note that f is an 'entry fee' to the stock market as a whole and not a cost paid to trade a single stock: it can be thought of as the cost of acquiring some familiarity with investing in stocks or finding a trustworthy broker. Entrepreneurs are assumed not to face transactions costs on the stock market. All entrepreneurs therefore trade in stocks should they wish to do so.

The problem of the h^{th} ordinary investor is

$$\text{Max E}\,[U(\tilde{w}_{1h})] = \left(\sum_{i \in \ell^{\cdot}} (\mu_i - Rp_i)k_{ih} - \frac{b}{2}\sum_{i \in \ell^{\cdot}} \sigma_i^2 k_{ih}^2 - f\right) J_h + Rw_0 \qquad (7.2.10)$$

$$\text{for } h = M+1, \ldots, M+N,$$

where J_h equals 1 if h enters the stock market, and 0 otherwise. For the flotation choice of entrepreneurs, the entry choice of investors is assumed to be taken before their portfolio decision, and conditioning on optimal behaviour in the portfolio choice. If investor h pays the fixed cost f, the equilibrium value of the investor's expected utility is

$$\text{E}\,[U(\tilde{w}_{1j}) \mid j \text{ enters}] = \frac{b}{2} T\left(\frac{K\sigma}{M+n}\right)^2 - f - Rw_0 \qquad (7.2.11)$$

$$\text{for } j = M+1, \ldots, M+N$$

whereas if the entrepreneur does not enter, it is equal to

$$\text{E}\,[U(\tilde{w}_{1j}) \mid j \text{ does not enter}] = Rw_0 \qquad (7.2.12)$$

Thus the net gain from entry for ordinary investors (n) is given by the first two terms of equation (7.2.11) – an expression decreasing in n. Setting it equal to zero, we obtain the value of n for which ordinary investors are indifferent between trading on the stock market and abstaining from it:

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[2] In Bangladesh this high interest in possible stock market growth is observed by the fact that nearly every new issue of equity announced is heavily oversubscribed by investors wishing to purchase the shares.

$$n = K\sigma\sqrt{bT/2F} - M \tag{7.2.13}$$

The equilibrium number of active investors is the largest integer smaller than this expression if $n > 0$, and equals 0 if $n < 0$. Thus, *the equilibrium number of investors is increasing in T: the larger the number of companies listed on the stock exchange (T), the greater the number of ordinary investors (n) who in equilibrium will be attracted to the stock market.*

The net gain to entrepreneur j from floating his company's shares is instead given by equation (7.2.9), upon replacing the variable N with n:

$$\Delta \mathrm{E}\,[U(\tilde{w}_{1j})] = \frac{b}{2}\left(\frac{K_j\sigma_j}{M+n}\right)^2 (M+n-1)^2 - c \tag{7.2.14}$$

which is increasing in n: the gain from going public for the entrepreneur is increasing in the number of ordinary investors (n) trading on the stock exchange. *Therefore, the total number of firms' listed shares is increasing in the number of investors trading on the stock market – i.e. there is a relationship between firm listings and market liquidity*[3].

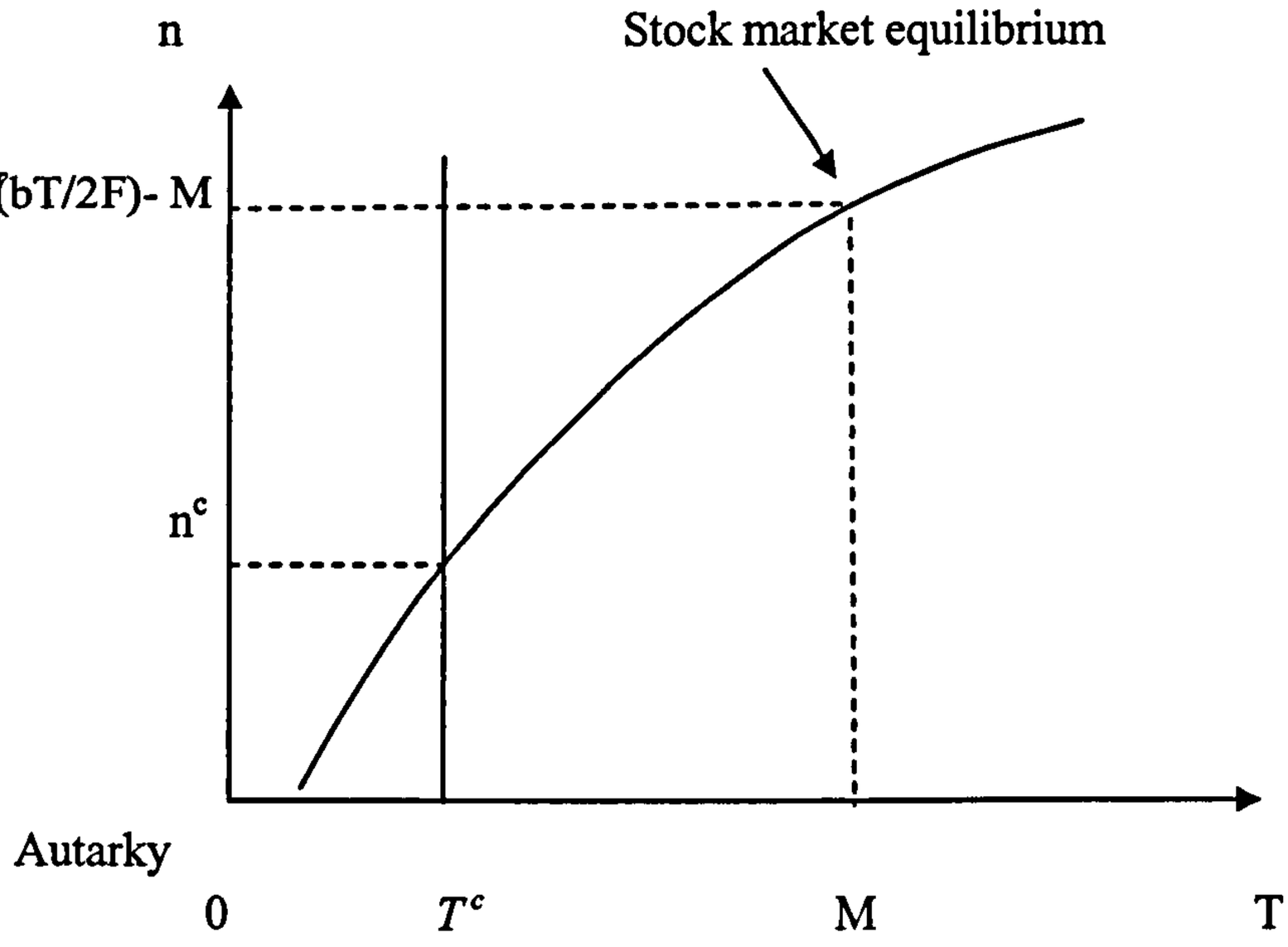
Setting (7.2.14) equal to zero and solving for n finds the number of ordinary investors n^c that makes entrepreneur j indifferent between going public and staying private. Substituting this into equation (7.2.13) obtains the number of companies that must be listed on the stock exchange in order to attract n^c investors:

$$T^c = \frac{2F}{b}\left(\frac{1}{K\sigma - \sqrt{2c/b}}\right)^2 \tag{7.2.15}$$

If $T^c \in (0, M)$, two equilibria exist. This situation is illustrated in Figure 1. If the number of companies expected to go public falls short of T^c, too few investors will be attracted to the stock market for any company to go public, and the stock market will not take off. Similarly, if people expect $T > T^c$, all the M companies will go public. In the figure, these two outcomes occur to the left and the right of the vertical T^c locus, respectively.

[3] The analysis of Pagano (1993b) seems to be driven by firm returns being uncorrelated. This is to provide a motive for diversification across companies.

Number of listed companies (n) and number of trading investors (T)



7.2.1 Application of Pagano (1993b) to Bangladesh

Although the Pagano (1993b) model is static in nature (the stock market may either settle at an equilibrium with a few public companies or at one with many public companies), the author argues that it can be iterated over time so that it gives more of a historical account of an economy's financial development. The application of the Pagano (1993b) model for Bangladesh is then the following. Despite its relatively small size in terms of GDP and market capitalization, Bangladesh has chosen to actively promote its stock exchange by encouraging more firms to list their shares. This has resulted in an upward trend in various stock market indicators, particularly the number of listed companies on the Dhaka Stock Exchange (DSE). Through the impact of positive trading externalities, the greater number of listed firms has led to gradually more and more firms that desire to list their own shares. Expectations may thus have converged in such a way that both stock market trading and firm listing levels have become increasingly related over a period of time. Importantly for Bangladesh, this period has coincided with technological advances on the DSE such as the introduction of an automated trading platform and more efficient

settlement procedures[4]. It has also coincided with significant institutional and regulatory improvements in the financial system such as the strengthening of oversight by the Bangladesh Bank and the Securities and Exchange Commission.

Due to a coordination failure among firms and investors a stock market may become trapped in a low liquidity, high risk equilibrium. Investors have opportunities to diversify their portfolios only if many firms go public. However, the equilibrium number of private initial public offerings (IPOs) may be lower than optimal. This is because each entrepreneur bears the full listing cost, but does not internalize the diversification benefits arising from an additional listing. If investors anticipate too few IPOs, they do not enter the equity market, which remains small and illiquid. A government policy that reduces fixed costs of either trading for investors or listing for companies could therefore push the stock market onto the preferred higher equilibrium. Some form of privatization policy for increasing the number of IPOs of state-owned enterprises (SOEs) may be tried.

Taken together, these points imply that the dynamics of company listings and investor trading as described in Pagano (1993b) allow for testable propositions in the context of a developing country like Bangladesh. This is of particular relevance in light of the institutional and regulatory innovations that have taken place, since these developments may have succeeded in coordinating the expectations of market participants to a higher, more preferred equilibrium.

7.2.2 Uncorrelated firm returns and risk diversification in Pagano (1993b)

The analysis of Pagano (1993b) relies partly on the assumption that firm returns are uncorrelated so that this strengthens the motive for diversification across companies. It is useful to briefly consider an example from standard financial theory on the benefits to diversification. This section is taken from Keith Cuthbertson's book *Quantitative Financial Economics*. We use it here to demonstrate why uncorrelated returns for securities are desirable from the point of view of stock market investors.

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[4] Majnoni and Massa (2001) for Italy and Sioud and Hmaied (2003) for Tunisia find that reforms such as automated trading systems and specialized intermediaries helped to enhance market liquidity and efficiency on the stock exchange.

To demonstrate in a simple fashion the gains to be made from holding a diversified portfolio of assets, the simple two-(risky) asset model will be used. Suppose the actual return (over one period) on each of the two assets is R_1 and R_2 with expected returns $\mu_1 = ER_1$ and $\mu_2 = ER_2$. The variance of the returns on each security is measured by $\sigma_i^2 (i = 1,2)$ which is defined as

$$\sigma_i^2 = E(R_i - \mu_i)^2 \qquad (7.2.1)$$

In addition assume that the *correlation coefficient* between movements in the returns on the two assets is ρ, $(-1 \leq \rho \leq 1)$ where ρ is defined as

$$\rho = \sigma_{12} / \sigma_1 \sigma_2 \qquad (7.2.2)$$

Hence $\sigma_{12} = \text{cov}(R_1, R_2)$ is the covariance between the two returns. If $\rho = +1$ the two asset returns are perfectly positively (linearly) related and the asset returns always move in the same direction. For $\rho = -1$, the converse applies and for $\rho = 0$ the asset returns are not (linearly) related. The 'riskiness' of the portfolio consisting of both asset 1 and asset 2 depends on the sign and size of ρ. If $\rho = -1$, risk may be completely eliminated by holding a specific proportion of initial wealth in *both* assets. Even if ρ is positive (i.e. between 0 and +1) the riskiness of the overall portfolio is reduced (although not to zero) by diversification.

Suppose for the moment that the investor chooses the proportion of his total wealth to invest in each asset in order to *minimise portfolio risk*[5]. Should the investor put 'all his eggs in one basket' and place all of his wealth either in asset 1 or asset 2 and incur risk of either σ_1^2 or σ_2^2, or should he hold some of his wealth in each asset and if so how much of each? Suppose that the investor chooses to hold a proportion x_1 of his wealth in asset 1 and a proportion $x_2 = (1 - x_1)$ in asset 2. The *actual* return on this diversified portfolio (which will not be revealed until one period later) is:

$$R_p = x_1 R_1 + x_2 R_2 \qquad (7.2.3)$$

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[5] For simplicity, the investor here is assumed not to be able to borrow or lend or place any of his wealth in a risk-free asset. When the risk-free asset becomes available the analysis leads to the CAPM.

The *expected return* on the portfolio (formed at the beginning of the period) is defined as:

$$ER_p = \mu_p = (x_1 ER_1 + x_2 ER_2) = x_1\mu_1 + x_2\mu_2 \qquad (7.2.4)$$

The *variance of the portfolio* is given by:

$$\begin{aligned}
\sigma_p^2 &= E(R_p - ER_p)^2 = E[x_1(R_1 - \mu_1) + x_2(R_2 - \mu_2)]^2 \\
&= x_1^2 E(R_1 - \mu_1)^2 + x_2^2 E(R_2 - \mu_2)^2 + 2x_1x_2[E(R_1 - \mu_1)(R_2 - \mu_2)] \\
&= x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\sigma_{12} \\
&= x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\rho\sigma_1\sigma_2 \\
&= x_1^2\sigma_1^2 + (1-x_1)^2\sigma_2^2 + 2x_1(1-x_1)\rho\sigma_1\sigma_2 \qquad (7.2.5)
\end{aligned}$$

We assume the investor is not concerned about expected return (or equivalently that both assets have the same expected return, so only the variance of returns matters to him). Knowing σ_1^2, σ_2^2 and ρ (or σ_{12}) the individual has to choose the value of x_1 (and hence $x_2 = 1 - x_1$) to minimise the total portfolio risk, σ_p^2. Differentiating (7.2.5) gives

$$\frac{\partial(\sigma_p^2)}{\partial x_1} = 2x_1\sigma_1^2 - 2(1-x_1)\sigma_2^2 + 2(1-2x_1)\rho\sigma_1\sigma_2 = 0 \qquad (7.2.6)$$

$$x_1 = (\sigma_2^2 - \rho\sigma_1\sigma_2)/(\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2) \qquad (7.2.7)$$

From (7.2.5) the total variance will be smallest when $\rho = -1$ and largest when $\rho = +1$. Calculations using different values of ρ between -1 and +1 can confirm this.

Even in the case where asset returns are totally uncorrelated, the portfolio variance can be reduced by adding more assets to the portfolio. To see this, note that for n assets (all of which have $\rho_{ij} = 0$) the portfolio variance is:

$$\sigma_p^2 = (x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + ... + x_n^2\sigma_n^2) \qquad (7.2.8)$$

Simplifying further, if all the variances are equal $(\sigma_i^2 = \sigma^2)$ and all the assets are held in equal proportions $(1/n)$ we have

$$\sigma_p^2 = \frac{1}{n^2}(n\sigma^2) = \frac{1}{n}\sigma^2 \qquad (7.2.9)$$

Hence as $n \to \infty$, the variance of the portfolio approaches zero. Thus, if uncorrelated risks are pooled, total risk is diversified away.

7.3 Model 2A: The listing – trading effect

7.3.1 Theoretical and empirical issues

We carry out the analysis for the 'listing – trading' relationship using two alternative specifications for trading. The first specification uses trading value (*Value*) as the proxy for market liquidity and the second uses an adjusted turnover ratio (*Turn*) as the proxy for market liquidity. The latter measure of turnover corrects for the bias introduced by market capitalization (*MCap*)[6]. The two models are the following:

$$List = \alpha + \beta Value + u \qquad (7.3.1)$$

$$List = \alpha + \beta \frac{Value}{MCap / Index} + u \qquad (7.3.2)$$

To observe the rationale behind the specification in (7.3.2), note that

$$MCap \equiv (TotalCompanies)\ \mathrm{X}\ (ValueOfCompanies)$$
$$\cong List\,(Index) \qquad (7.3.3)$$

and substituting this expression for *MCap* into (7.3.2), we get

$$List = \alpha + \beta \frac{Value}{List} + u$$
$$= \alpha + \beta Turn + u \qquad (7.3.4)$$

Equation (7.3.4) is an equivalent form of equation (7.3.2).

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[6] See also the literature review in Chapter 2 and the institutional review in Chapter 3 for more details on market capitalization and adjustments to this measure.

We expect equation (7.3.4) to be better at capturing the long-run effects, while equation (7.3.1) is better at capturing the short-run effects. This is because the turnover ratio in (7.3.4) measures trading in relation to the size of the stock market, while value traded in (7.3.1) measures the raw level of trading. Firms looking to list their securities (on the primary market) and investors looking to trade in those securities (on the secondary market) might prefer to use the turnover ratio more as an indicator of longer-term trends. The actual level of trading itself on the other hand more closely reflects the rapidly changing appetite for listing and trading on the stock market; these effects are predominantly short-run in nature. Both *Turn* and *Value* therefore are used to assess the listing – trading relationship.

7.3.2 Additional notes

We use complimentary indicators of trading for the Dhaka Stock Exchange for a number of reasons. Firstly, at any point in time only a subset of available stocks may have achieved a high enough reputation to be included in the investor's bundle of potential companies for trading. It is unrealistic to assume that all of the listed companies immediately achieve equal weightings in the investor's allocation decision. Given the poor environment facing investors in emerging markets like Bangladesh (e.g. high fraudulent behaviour, insider dealing, excessive volatility, etc), only with the passage of time will investor confidence likely be re-assured and the performance of firms be more established[7]. The exception is for 'grade A' listed companies such as commercial banks, pharmaceuticals, and energy companies. These large financial and industrial companies are relatively easy for market participants to evaluate.

Secondly, dividing the aggregate market capitalization by the overall stock index[8] in equation (7.3.2) might be able to purge the *MCap* indicator of miss-pricing effects and

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[7] These factors may partly explain why we observe fairly high lag orders in our chosen ARDL specifications. Pagano (1993b) assumes that returns are uncorrelated across companies (p. 1110). This assumption is needed for the diversification benefits which permit positive trading externalities. An interesting extension might be to introduce firm heterogeneity in terms of reputation and more risk-averse behaviour on the part of investors. Another extension might be to model different sectors on the stock market (e.g. banks, pharmaceuticals, retail sectors etc) in order to allow investors to rotate their funds when the need arises (see Freeman, 2003).

[8] See Rousseau and Wachtel (2000) who use an adjusted market capitalization measure and find that stock market development predicts future economic growth. See Levine and Zervos (1998) who find that (unadjusted) market capitalization is a poor predictor while the turnover as a market liquidity measure is a robust predictor of economic growth.

other 'meaningless' elements involved in the calculation of market capitalization[9]. In contrast, the problem is not thought to be nearly as severe for the trading measures. Value traded and volume traded are, respectively, nothing else than the prices and volumes agreed between buyers and sellers of stocks listed on the exchange. Therefore these measures are less affected by the severity of miss-priced calculations and other ill-effects. Finally, liquidity rather than market capitalization provides the incentive for information acquisition to analysts and traders in the financial markets.

7.4 Empirical results for Model 2A

Throughout the preliminary stage of the ARDL procedure the following table of critical values shall be used. For more details on the PSS ARDL technique see Chapter 5.

Critical value bounds of the F statistic

Intercept and no trend: 99%

k	I(0)	I(1)
0	11.935	11.935
1	7.057	7.815
2	5.288	6.309
3	4.385	5.615

Intercept and trend: 99%

k	I(0)	I(1)
0	16.133	16.133
1	9.063	9.786
2	6.520	7.584
3	5.315	6.414

Intercept and no trend: 95%

k	I(0)	I(1)
0	8.199	8.199
1	4.934	5.764
2	3.793	4.855
3	3.219	4.378

Intercept and trend: 95%

k	I(0)	I(1)
0	11.722	11.722
1	6.606	7.423
2	4.903	5.872
3	4.066	5.119

Intercept and no trend: 90%

k	I(0)	I(1)
0	6.597	6.597
1	4.042	4.788
2	3.182	4.126
3	2.711	3.800

Intercept and trend: 90%

k	I(0)	I(1)
0	9.830	9.830
1	5.649	6.335
2	4.205	5.109
3	3.484	4.458

Source: Pesaran and Pesaran (1997: p. 478)

We begin by testing all possible specifications before narrowing down to the final ARDL models. Table 7.1 below gives results for the possible existence of long-run co-integration using various combinations of our company listing and investor trading

[9] See Granger and Morgenstern (1970) and the literature review in Chapter 2 for more discussion.

variables and various lag lengths for our quarterly sample period of 1990-2005. F ( ) represents the version of the F-test for ARDL co-integration, the first variable in brackets being the dependent variable. The upper cell is the calculated F-statistic including a time trend, and the lower cell is the calculated F-statistic without the trend. A star (*) next to any F-value represents statistical significance at the 5% level. Specifically this means that the F-value is greater than the upper bound of the critical F-value as in Pesaran and Pesaran (1997), and therefore indicates the presence of a unique long-run co-integrating relationship between the variables. Uniqueness is confirmed by going through the cells in each row and ensuring that one star and one star only is present.

Table 7.1 *F*-tests for Cointegration (*Model 2A*)

4 lags

F(List/Volume)	F(Volume/List)	Cointegration
4.615	0.819	
1.258	1.445	

F(List/Value)	F(Value/List)	Cointegration
7.801 **	1.177	F(List/Value)t
2.705	1.766	

F(List/Turn)	F(Turn/List)	Cointegration
8.318 **	1.339	F(List/Turn)t
3.524	1.916	

5 lags

F(List/Volume)	F(Volume/List)	Cointegration
5.123	0.837	
1.433	2.144	

F(List/Value)	F(Value/List)	Cointegration
5.960	1.530	
1.518	3.066	

F(List/Turn)	F(Turn/List)	Cointegration
7.331 *	1.858	F(List/Turn)t
2.451	3.501	

6 lags

F(List/Volume)	F(Volume/List)	Cointegration
3.721	0.086	
0.627	2.366	

F(List/Value)	F(Value/List)	Cointegration
3.694	3.023	
0.827	3.696	

F(List/Turn)	F(Turn/List)	Cointegration
4.504	4.194	
1.425	4.862	

7 lags

F(List/Volume)	F(Volume/List)	Cointegration
5.843	0.110	
0.082	2.248	

F(List/Value)	F(Value/List)	Cointegration
3.782	2.736	
0.305	3.854	

F(List/Turn)	F(Turn/List)	Cointegration
3.840	4.301	
0.688	5.248 *	F(Turn/List)n

8 lags

F(List/Volume)	F(Volume/List)	Cointegration
3.869	0.328	
0.375	1.827	

F(List/Value)	F(Value/List)	Cointegration
4.542	1.482	
0.430	2.801	

F(List/Turn)	F(Turn/List)	Cointegration
4.503	2.648	
0.683	4.109	

9 lags

F(List/Volume)	F(Volume/List)	Cointegration
4.624	0.123	
0.238	1.225	

F(List/Value)	F(Value/List)	Cointegration
4.796	2.678	
0.489	1.951	

F(List/Turn)	F(Turn/List)	Cointegration
4.984	4.822	
0.883	2.504	

10 lags

F(List/Volume)	F(Volume/List)	Cointegration
6.069	0.217	
0.362	1.357	

F(List/Value)	F(Value/List)	Cointegration
6.763 *	2.153	F(List/Value)t
0.433	2.201	

F(List/Turn)	F(Turn/List)	Cointegration
6.300 *	3.309	F(List/Turn)t
0.973	2.464	

11 lags

F(List/Volume)	F(Volume/List)	Cointegration
5.784	0.283	
0.548	0.999	

F(List/Value)	F(Value/List)	Cointegration
6.925 **	2.396	F(List/Value)t
0.197	1.924	

F(List/Turn)	F(Turn/List)	Cointegration
6.209	3.491	
0.671	2.103	

The upper cell in each sub-table row is the F statistic for cointegration with trend (t); the lower cell in each row is the F statistic for cointegration with no trend (n). For this table and for the following tables on the listing – trading empirical analysis, the reader is referred to the previous tables of results on the finance-growth nexus in Chapter 6 should any explanation be required.

*** 1% sig ** 5% sig * 10% sig

When using *Value* and *Turn* as the proxy measure for trading, the F-tests in table 7.1 are able to detect a cointegrating relationship. In contrast, using *Volume* did not uncover any evidence for cointegration. These results at the first stage suggest that value-based indicators are more informative than volume-based indicators. We therefore choose the ARDL specifications with trading value (*Value*) and turnover (*Turn*) as the relevant measures for trading (market liquidity) in the explanation for listing (*List*) on the stock exchange:

$$\textit{The trading-to-listing effect: } List_t = \alpha_0 + \alpha_1 Value_t + u_t \qquad (7.4.1)$$

$$\textit{The trading-to-listing effect: } List_t = \alpha_0 + \alpha_1 Turn_t + u_t \qquad (7.4.2)$$

After determining the presence of possible co-integration, the next step is to formulate the respective long-run ARDL models. Table 7.2 and 7.3 below shows the results for both value traded and turnover using SBC, AIC and RBS[10]. Careful analysis of the long-run coefficients and specification tests in this stage will determine whether the models are appropriate. In all 20 separate regressions were performed for the turnover ratio and 21 separate regressions were performed for the value traded indicator. Only one specification for each trading variable managed to satisfy all the suitability criteria[11]; these specifications have had their entire columns filled in red to distinguish the effects of the turnover ratio and value traded.

[10] RBS is only included in the tables if it suggests a different lag structure to the AIC.
[11] The F-tests suggested some evidence of cointegration at 7 lags with turnover as the dependent variable. However no suitable ARDL specification could be applied. Results are available on request.

Table 7.2 Estimated preliminary long-run coefficients from the ARDL models (Value traded)

	4 lags		5 lags		6 lags		7 lags	
	SBC	AIC	SBC	AIC	SBC	AIC	SBC	AIC
	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)
Value traded	0.085	0.075	0.08538	0.075267	0.085522	0.075489	0.044505	0.075581
	3.723 [.000]	3.506 [.001]	3.8430[.000]	3.6385[.001]	3.8271[.000]	3.6221[.001]	1.4041[.166]	3.5837[.001]
Constant	7.483	7.5477	7.476	7.5396	7.4737	7.5366	7.765	7.5354
	43.670 [.000]	46.865 [.000]	44.7093[.000]	48.2538[.000]	44.1303[.000]	47.4971[.000]	30.4610[.000]	46.5530[.000]
Trend	0.013	0.014	0.013367	0.013821	0.013377	0.013829	0.01565	0.013833
	11.781 [.000]	12.996 [.000]	12.2578[.000]	13.5994[.000]	12.1925[.000]	13.5507[.000]	10.8018[.000]	13.4172[.000]
F-test (for cointegration)	7.801	7.801	5.960	5.960	3.694	3.694	3.782	3.782
ARDL order	(1,4)	(2,4)	(1,4)	(2,4)	(1,4)	(2,4)	(2,0)	(2,4)
Adjusted *R*-Squared	0.997	0.997	0.9969	0.99703	0.99675	0.99689	0.99603	0.99674
DW statistic	1.575	1.956	1.5692	1.9622	1.5655	1.9589	2.0347	1.9583
Serial correlation	3.707 [.447]	0.771 [.942]	3.9500[.413]	.88615[.927]	4.0595[.398]	.90288[.924]	6.5209[.163]	.92127[.921]
Functional form	0.742 [.389]	0.487 [.485]	.35449[.552]	.13358[.715]	.33282[.564]	.11770[.732]	5.9898[.014]	.11267[.737]
Normality	45.567 [.000]	40.285 [.000]	45.0269[.000]	39.9415[.000]	42.0657[.000]	37.1748[.000]	78.0885[.000]	34.5473[.000]
Heteroskedasticity	0.132 [.716]	0.217 [.641]	.14533[.703]	.22091[.638]	.21882[.640]	.31351[.576]	.96261[.327]	.43461[.510]
Error correction term	-0.270	-0.278	-0.27883	-0.28902	-.28065	-0.2911	-0.18283	-0.29179
	-4.252 [.000]	-4.465 [.000]	-4.3012[.000]	-4.5409[.000]	-4.1459[.000]	-4.3795[.000]	-2.6802[.010]	-4.2607[.000]

	8 lags			9 lags		
	SBC	AIC	RBS	SBC	AIC	RBS
	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)
Value traded	0.044925	0.076696	0.043114	0.043051	0.088359	0.046004
	1.3718[.176]	3.6057[.001]	2.4576[.018]	1.2416[.220]	2.5572[.014]	2.5441[.016]
Constant	7.7607	7.5229	7.7428	7.7798	7.4399	7.7134
	28.9702[.000]	45.4320[.000]	58.4540[.000]	26.8782[.000]	27.7660[.000]	55.8938[.000]
Trend	0.015646	0.01384	0.015184	0.01566	0.013822	0.015139
	10.7384[.000]	13.5453[.000]	19.0056[.000]	10.4683[.000]	27.7660[.000]	17.8863[.000]
F-test (for cointegration)	4.542	4.542	4.542	4.796	4.796	4.796
ARDL order	(2,0)	(2,4)	(8,4)	(2,0)	(1,9)	(8,9)
Adjusted *R*-Squared	0.99582	0.99657	0.99678	0.99559	0.99656	0.99679
DW statistic	2.0344	1.9603	2.0346	2.0311	1.6882	2.0524
Serial correlation	6.5369[.162]	1.0837[.897]	4.5225[.340]	6.5627[.161]	2.6403[.620]	8.7520[.068]
Functional form	6.1025[.013]	.077015[.781]	091062[.763]	5.9964[.014]	.10668[.744]	.16859[.681]
Normality	73.4847[.000]	32.1440[.000]	11.6863[.003]	68.9539[.000]	27.8123[.000]	4.7816[.092]
Heteroskedasticity	1.1710[.279]	.55152[.458]	1.0881[.297]	1.4513[.228]	.48725[.485]	.86087[.353]
Error correction term	-.18373	-0.29707	-0.40419	-0.18069	-0.19331	-0.39619
	-2.5965[.012]	-4.1834[.000]	-4.6494[.000]	-2.4818[.016]	-2.1097[.041]	-3.2244[.003]

	10 lags			11 lags		12 lags	
	SBC	AIC	RBS	SBC	AIC	SBC	AIC
	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)	F(List/Value)
Value traded	0.040935	0.046685	0.047898	0.037278	0.037845	0.027421	0.03343
	1.1414[.259]	2.9348[.006]	2.8559[.007]	.99638[.324]	3.3849[.002]	.69727[.489]	3.8311[.001]
Constant	7.8034	7.6985	7.6883	7.8409	7.7426	7.9384	7.7686
	25.7355[.000]	62.5479[.000]	59.4663[.000]	24.3661[.000]	89.8896[.000]	22.8181[.000]	114.1798[.000]
Trend	0.015635	0.015249	0.015199	0.015634	0.015611	0.015671	0.015757
	10.1913[.000]	21.7413[.000]	19.5085[.000]	9.9938[.000]	31.9475[.000]	9.9487[.000]	42.4257[.000]
F-test (for cointegration)	6.763	6.763	6.763	6.925	6.925	5.662	5.662
ARDL order	(2,0)	(8,4)	(8,9)	(2,0)	(11,9)	(2,0)	(12,9)
Adjusted *R*-Squared	0.99533	0.99652	0.99668	0.99504	0.99667	0.99479	0.99661
DW statistic	2.0254	2.0711	2.0886	2.0157	2.214	2.0262	2.1622
Serial correlation	6.5682[.161]	5.1081[.276]	11.1774[.025]	7.5286[.110]	11.8797[.018]	5.8108[.214]	8.7071[.069]
Functional form	5.8786[.015]	.062126[.803]	.028365[.866]	5.5627[.018]	.012500[.911]	4.6652[.031]	.0020173[.964]
Normality	63.8618[.000]	8.4895[.014]	3.9673[.138]	58.2575[.000]	5.3491[.069]	53.3622[.000]	2.0953[.351]
Heteroskedasticity	1.7810[.182]	.71443[.398]	.39208[.531]	2.1807[.140]	1.1956[.274]	2.5065[.113]	2.1214[.145]
Error correction term	-.17807	-0.4582	-.42951	-0.17605	-0.69806	-.17444	-0.91155
	-2.4153[.019]	-4.7797[.000]	-3.4045[.002]	-2.3649[.022]	-3.9641[.000]	-2.3444[.023]	-4.1711[.000]

Table 7.3 Estimated preliminary long-run coefficients from the ARDL models (Turnover)

	4 lags		5 lags		6 lags		7 lags	
	SBC	AIC	SBC	AIC	SBC	AIC	SBC	AIC
Dependent variable	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)
Turnover	0.80401	0.71437	0.80631	0.71898	0.81331	0.72852	0.81424	0.73273
	3.8257[.000]	3.5538[.001]	4.0390[.000]	3.7738[.000]	4.1508[.000]	3.8701[.000]	4.0916[.000]	3.8638[.000]
Constant	7.3074	7.3887	7.2958	7.3748	7.2831	7.3602	7.2817	7.3537
	34.5142[.000]	36.4398[.000]	36.0541[.000]	38.1535[.000]	36.3975[.000]	38.2383[.000]	35.5713[.000]	37.6461[.000]
Trend	0.013651	0.014027	0.013774	0.014143	0.013821	0.014174	0.013824	0.014189
	13.5841[.000]	14.5938[.000]	14.5593[.000]	15.6621[.000]	14.9947[.000]	16.0578[.000]	14.8472[.000]	16.0498[.000]
F-test (for cointegration)	8.318	8.318	7.331	7.331	4.504	4.504	3.840	3.840
ARDL order	(1,4)	(2,4)	(1,4)	(2,4)	(1,4)	(2,4)	(1,4)	(2,4)
Adjusted *R*-Squared	0.99718	0.99724	0.99712	0.9972	0.99701	0.99708	0.99686	0.99694
DW statistic	1.6125	1.9183	1.6183	1.9349	1.6081	1.9223	1.6044	1.9224
Serial correlation	2.9892[.560]	.48320[.975]	2.9720[.563]	.36179[.985]	3.1416[.534]	.43797[.979]	3.1025[.541]	.38344[.984]
Functional form	2.6937[.101]	1.9156[.166]	1.8855[.170]	1.1450[.285]	1.6992[.192]	1.0177[.313]	1.6845[.194]	.94594[.331]
Normality	36.5666[.000]	33.3961[.000]	36.1457[.000]	33.0120[.000]	33.6752[.000]	30.5487[.000]	31.3153[.000]	28.0430[.000]
Heteroskedasticity	.092630[.761]	.20307[.652]	.082452[.774]	.18329[.669]	.11677[.733]	.24239[.622]	.19490[.659]	.35172[.553]
Error correction term	-.26510	-0.27163	-0.27898	-0.2864	-.28812	-0.29497	-0.28863	-0.29783
	-4.4220[.000]	-4.5732[.000]	-4.5596[.000]	-4.7297[.000]	-4.4988[.000]	-4.6549[.000]	-4.3780[.000]	-4.5590[.000]

	8 lags			9 lags		
	SBC	AIC	RBS	SBC	AIC	RBS
Dependent variable	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)
Turnover	0.832	0.75447	0.46988	0.84818	0.776	0.49027
	4.1514[.000]	3.9864[.000]	2.4791[.017]	4.1232[.000]	4.0256[.000]	2.5301[.016]
Constant	7.2576	7.3241	7.5916	7.2367	7.2961	7.5638
	34.7658[.000]	37.1008[.000]	39.7433[.000]	33.3127[.000]	35.7946[.000]	38.0833[.000]
Trend	0.013836	0.014205	0.015202	0.013835	0.014206	0.015166
	15.1580[.000]	16.5462[.000]	18.9478[.000]	15.2763[.000]	16.8184[.000]	18.6121[.000]
F-test (for cointegration)	4.503	4.503	4.503	4.984	4.984	4.984
ARDL order	(1,4)	(2,4)	(8,4)	(1,4)	(2,4)	(8,9)
Adjusted *R*-Squared	0.9967	0.9968	0.99685	0.99652	0.99663	0.9967
DW statistic	1.6003	1.9299	1.9766	1.5913	1.9312	2.0602
Serial correlation	3.2506[.517]	.42511[.980]	4.1078[.392]	3.1541[.532]	.43623[.979]	8.8438[.065]
Functional form	1.5889[.207]	.83407[.361]	.37518[.540]	1.5305[.216]	.76496[.382]	1.1419[.285]
Normality	29.3232[.000]	26.0200[.000]	10.0511[.007]	27.1943[.000]	24.0198[.000]	3.8287[.147]
Heteroskedasticity	.25296[.615]	.41890[.517]	1.0569[.304]	.35380[.552]	.53535[.464]	.86830[.351]
Error correction term	-.29638	-0.30817	-0.38059	-0.30152	-0.31578	-0.39294
	-4.3386[.000]	-4.5512[.000]	-4.5507[.000]	-4.2740[.000]	-4.5117[.000]	-2.9641[.005]

	10 lags			11 lags			12 lags		
	SBC	AIC	RBS	SBC	AIC	RBS	SBC	AIC	RBS
Dependent variable	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)	F(List/Turn)
Turnover	0.89064	0.82139	0.51397	0.92077	0.85389	0.54556	0.91054	0.84869	0.35936
	4.4336[.000]	4.4101[.000]	3.0383[.004]	4.4903[.000]	4.5059[.000]	3.5281[.001]	4.2429[.000]	4.2800[.000]	3.7986[.001]
Constant	7.1817	7.2375	7.5257	7.1437	7.1968	7.4835	7.1564	7.2032	7.6595
	33.5874[.000]	36.4617[.000]	43.2153[.000]	32.4234[.000]	35.3059[.000]	46.1561[.000]	30.6992[.000]	33.4157[.000]	77.8122[.000]
Trend	0.013828	0.014196	0.015296	0.013818	0.014182	0.015239	0.013823	0.014184	0.015688
	16.1927[.000]	17.9959[.000]	22.3866[.000]	16.4549[.000]	18.3442[.000]	24.4903[.000]	16.1960[.000]	18.0824[.000]	42.9039[.000]
F-test (for cointegration)	6.300	6.300	6.300	6.209	6.209	6.209	5.226	5.226	5.226
ARDL order	(1,4)	(2,4)	(8,4)	(1,4)	(2,4)	(8,9)	(1,4)	(2,4)	(12,10)
Adjusted *R*-Squared	0.99639	0.99653	0.99666	0.99618	0.99634	0.99657	0.99589	0.99606	0.99639
DW statistic	1.5947	1.9584	2.0284	1.5829	1.954	2.0973	1.5809	1.9509	2.1155
Serial correlation	3.1299[.536]	.47066[.976]	5.7966[.215]	3.2811[.512]	.41537[.981]	11.0322[.026]	3.0229[.554]	.35244[.986]	10.0950[.039]
Functional form	1.0602[.303]	.35459[.552]	.0060144[.938]	.83696[.360]	.19810[.656]	.17818[.673]	.92711[.336]	.22899[.632]	.56150[.454]
Normality	23.7901[.000]	20.8277[.000]	6.9199[.031]	23.5921[.000]	20.7681[.000]	1.7206[.423]	21.9336[.000]	19.1390[.000]	1.2619[.532]
Heteroskedasticity	.18721[.665]	.26138[.609]	.55747[.455]	.20609[.650]	.25970[.610]	.19469[.659]	.35537[.551]	.42680[.514]	1.9369[.164]
Error correction term	-.31937	-0.33651	-.43877	-0.32741	-0.34584	-0.50268	-0.3256	-0.3448	-0.95012
	-4.4198[.000]	-4.7029[.000]	-4.8376[.000]	-4.4346[.000]	-4.7322[.000]	-3.5339[.001]	-4.3277[.000]	-4.6235[.000]	-3.9570[.000]

The two highlighted co-integrating relationships found in tables 7.2 and 7.3 constitute the listing-trading relationship and are isolated below in table 7.4 which is entitled: "Estimated ARDL long-run coefficients: The listing – trading relationship in Bangladesh, 1990-2005".

Table 7.4

Estimated ARDL long-run coefficients:
The listing – trading relationship in Bangladesh, 1990-2005

Dependent variable	List/Turn	List/Value
Turnover	0.491 **	
	2.530[.016]	
Value traded		0.033 ***
		3.831[.001]
Constant	7.564 ***	7.769 ***
	38.083[.000]	114.180[.000]
Trend	0.015 ***	0.016 ***
	18.612[.000]	42.426[.000]
F-test (for cointegration)	6.300	6.925
ARDL order	(8,9)	(12,9)
Adjusted *R*-Squared	0.997	0.997
DW statistic	2.060	2.162
Serial correlation	8.844[.065]	8.707[.069]
Functional form	1.142[.285]	0.002[.964]
Normality	3.829[.147]	2.095[.351]
Heteroskedasticity	0.868[.351]	2.121[.145]
Error correction term	-0.393 ***	-0.912 ***
	-2.964[.005]	-4.171[.000]

Notes:

(i) In the above table the *F*-test (for cointegration) reports the largest *F*-test value within the close proximity of the chosen lag order.

(ii) The *F*-test for cointegration in the model including turnover at 10 lags is borderline significant at the 10% level. We still choose to fit the ARDL specification with turnover in addition to the value traded ARDL specification because value traded at the same lag structure was also significant. Theoretically, turnover and value traded are equivalent measures of market liquidity (although turnover is seen as the most preferred measure out of all possible indicators – see Datar et al., 1998).

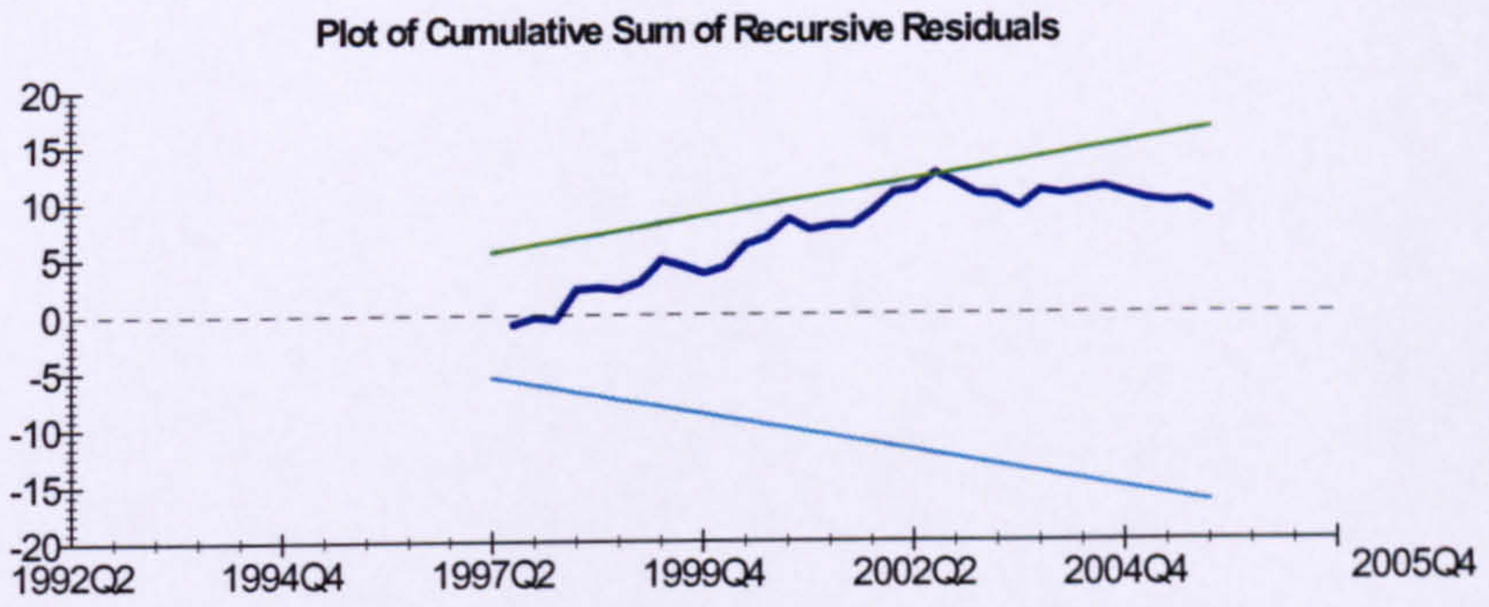
(iii) Nowhere is volume traded found to be significant in the *F*-tests. Value traded and turnover measures of trading are clearly preferred to volume traded. Lesmond (2005) finds a very similar result. The author shows that price-based liquidity measures outperform volume-based liquidity measures.

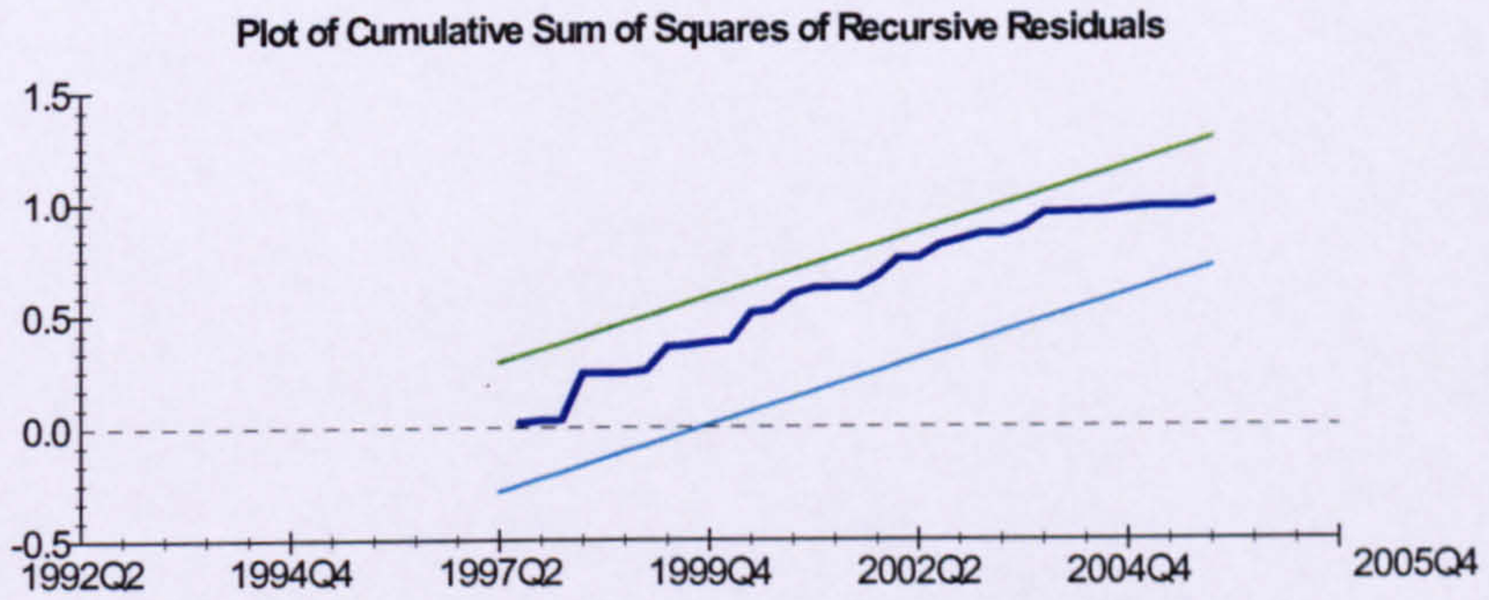
The first column in table 7.4 is the listing-trading effect when the *Turn* (turnover ratio) is used as the measure of trading, and the second column is the listing-trading effect when *Value* (value traded) is used. The magnitude of the turnover coefficient (0.491) is observed to be much larger than that for valued traded (0.033). This can be explained as follows. Turnover is a measure of market liquidity in relation to the size of the stock market. A higher turnover value means that trading has increased relative to the market capitalization of all firms listed on the stock exchange. Therefore the long-run impact of turnover for listing is very important. On the other hand, the value traded measure is simply the total value of all shares traded without any reference to the size of the stock market. While the long-run impact using this measure is also positive, it is not likely to be as great as for the turnover ratio. Nevertheless, the long-run coefficients for both measures of market liquidity are positive and statistically significant. Both specifications pass the diagnostic tests for serial correlation, functional form, normality, and heteroskedasticity automatically computed by *Microfit*. Notice that the two specifications were the only ones where residuals displayed normality.

Because of the high lag orders we omit presenting the formal specifications of the chosen ARDL models as we have done for the finance-growth nexus in Chapter 6. A glance at the tables is enough to establish the presence of a relationship between listing and trading on the stock exchange. We note here that while the PSS ARDL cointegration procedure is useful for determining a relationship in terms of independent and dependent variables, here it is not so essential to make the distinction. This is because the left-hand side and right-hand side variables in equations (7.4.1) and (7.4.2) respectively may be affecting each other (see Pagano, 1993b). Therefore our only concern is to verify the presence of cointegration in the system.

Table 7.5 Error-correction model and CUSUM stability test: Turnover

Dependent variable	RBS (8,9) (List/Turn)t
*d*Listed shares (-1)	0.323 *
	1.856[.072]
*d*Listed shares (-2)	0.043
	.269[.789]
*d*Listed shares (-3)	0.100
	.667[.509]
*d*Listed shares (-4)	0.125
	.883[.383]
*d*Listed shares (-5)	0.112
	.853[.400]
*d*Listed shares (-6)	0.001
	.007[.995]
*d*Listed shares (-7)	0.305 **
	2.288[.028]
*d*Turnover	-0.032
	-.358[.723]
*d*Turnover (-1)	-0.223 *
	-1.765[.086]
*d*Turnover (-2)	-0.253 *
	-1.918[.063]
*d*Turnover (-3)	-0.217 *
	-1.726[.093]
*d*Turnover (-4)	0.010
	.079[.938]
*d*Turnover (-5)	-0.056
	-.434[.667]
*d*Turnover (-6)	-0.016
	-.124[.902]
*d*Turnover (-7)	0.066
	.605[.549]
*d*Turnover (-8)	-0.146
	-1.485[.146]
*d*Constant	2.972 ***
	2.899[.006]
*d*Trend	0.006 ***
	2.877[.007]
ecm (-1)	-0.393 ***
	-2.964[.005]
Adjusted *R*-Squared	0.322
DW statistic	2.060



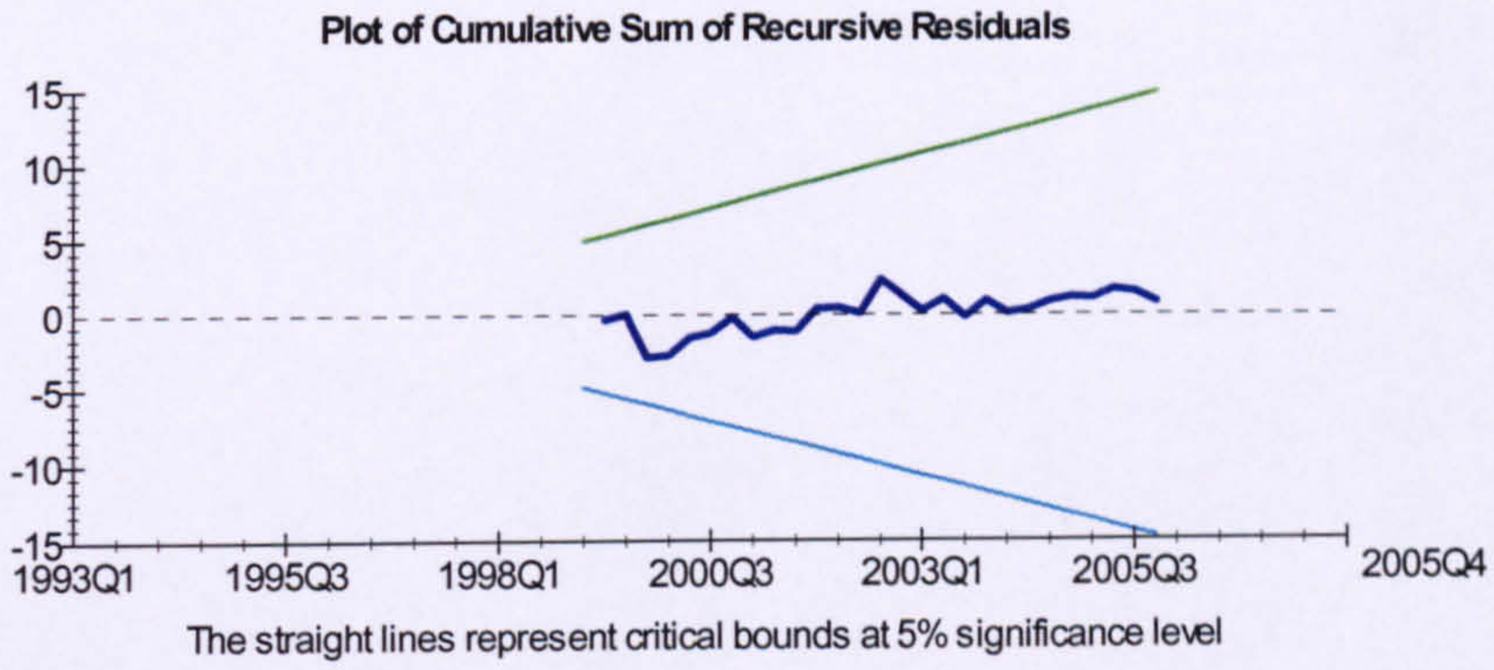


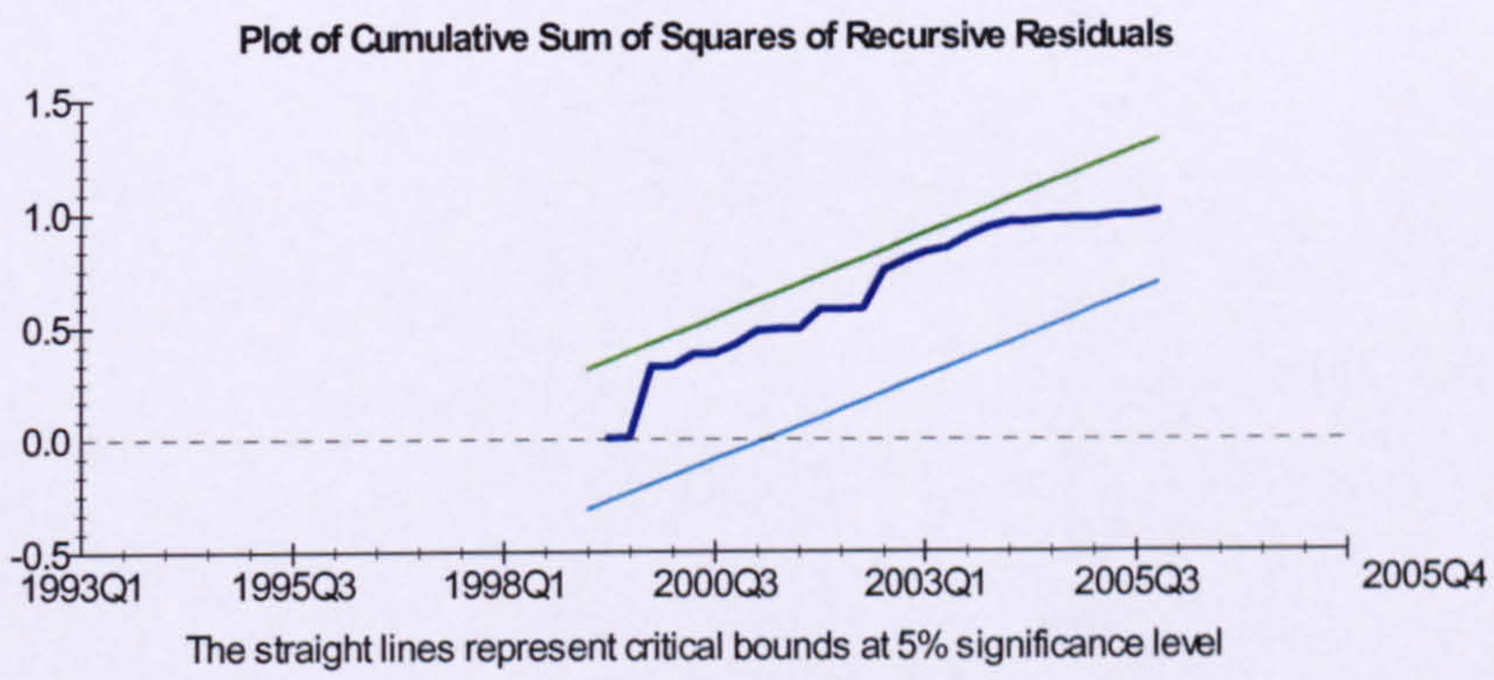
ecm = List -.490*Turn -7.564*C -.015*T

Table 7.6 Error-correction model and CUSUM stability test: Value traded

Depedent variable	AIC (12,9) (List/Value)t
*d*Listed shares (-1)	0.627 ***
	3.279[.003]
*d*Listed shares (-2)	0.390 **
	2.123[.042]
*d*Listed shares (-3)	0.381 **
	2.306[.028]
*d*Listed shares (-4)	0.319 **
	2.168[.038]
*d*Listed shares (-5)	0.362 **
	2.421[.022]
*d*Listed shares (-6)	0.216
	1.463[.154]
*d*Listed shares (-7)	0.541 ***
	3.657[.001]
*d*Listed shares (-8)	0.196
	1.290[.207]
*d*Listed shares (-9)	0.223
	1.420[.166]
*d*Listed shares (-10)	0.245
	1.684[.103]
*d*Listed shares (-11)	0.268 *
	1.738[.093]
*d*Value traded	-0.014
	-1.236[.226]
*d*Value traded (-1)	-0.044 ***
	-2.854[.008]
*d*Value traded (-2)	-0.051 ***
	-3.017[.005]
*d*Value traded (-3)	-0.045 ***
	-2.898[.007]
*d*Value traded (-4)	-0.023
	-1.420[.166]
*d*Value traded (-5)	-0.022
	-1.372[.181]
*d*Value traded (-6)	-0.017
	-1.142[.263]
*d*Value traded (-7)	0.006
	.481[.634]
*d*Value traded (-8)	-0.025 **
	-2.077[.047]
*d*Constant	7.082 ***
	4.156[.000]
*d*Trend	0.014 ***
	4.100[.000]
ecm (-1)	-0.912 ***
	-4.171[.000]
Adjusted *R*-Squared	0.409
DW statistic	2.162

ecm = List -.033*Value -7.769*C -.016*T





The error correction terms for the two trading indicators (turnover and value traded) are both negative and statistically significant which indicate that the cointegrating relationships are responsive and stable. Interestingly the magnitudes of the error correction terms are very different depending on which measure is used to represent investor trading. For the turnover ratio, approximately 40% of the disequilibrium in each period is corrected in the following period. For value traded, over 90% of the disequilibrium in each period is corrected. These results suggest that in the short-run a very quick adjustment process occurs for the raw value traded series rather than for the turnover ratio. In any case, these results indicate that the listing-trading relationship using either trading variable has been active for the Dhaka Stock Exchange.

The full error-correction models and CUSUM stability tests for *Turn* and *Value* are displayed respectively in tables 7.5 and 7.6. The ARDL order specified for the turnover ratio is (8, 9)[12]. Short-run estimates are only significant for listed shares at the 1st and 7th lags, and at the 1st, 2nd and 3rd lags for turnover. In contrast, the short-run effects are more consistent when using the value traded measure. The ARDL order specified for *Value* is (12, 9) and short-run estimates are observed to be nearly significant for all lags of listed shares, while for value traded around half the lags are significant. CUSUM and CUSUM squared tests reveal both turnover and value traded specifications to be stable; however value traded has slightly better stability features than turnover, mainly due to the higher lag order chosen by the AIC. Combined with the long-run results, these short-run results largely confirm the existence of the listing-trading relationship for the DSE, although caution should be given due to the short number of observations available.

7.5 Conclusion for Model 2A

This section empirically tested ARDL specifications for the *listing-trading* relationship for the DSE. The results suggest that as more trading occurs on the stock exchange more listing of shares by companies will be promoted on the stock exchange. The findings here should be of interest to financial analysts who would like to know more about the dynamics of stock trading and company listings in Bangladesh. Note that the total

[12] The ARDL results in table 7.3 also suggested (8, 9) for the *Value* specification. However the model was found to be unstable after observing the CUSUM graphs for stability. Results are available on request.

number of listed shares is nearly equivalent to the number of listed companies. The latter was found to be an important factor in addition to bank development for enhancing the physical capital stock (see previous section). This means that *Model 2A*, the stock market infrastructure, is not only important for describing stock market dynamics, but it is also an important contributing factor to *Model 1*: the finance-growth nexus in Bangladesh.

The main implication of the findings for *Model 2A* is that policies which reduce barriers associated with becoming active investors and lowering transaction costs for firms can therefore move the economy from a "bad" to a "good" equilibrium. Even in a low-income developing country such as Bangladesh, initiatives which help to promote stock market development may have positive effects on market expectations. Easing listing requirements, allowing faster and more reliable execution of trades, and an effective environment of rules and regulation will enhance confidence among market participants.

As a suggestion for future policy for financial market regulators in Bangladesh, more emphasis might be placed on the book-building process instead of the fixed-price method for IPO issuance. Busaba and Chang (2002) show that the bookbuilding process elicits much information from informed traders at the IPO stage by promising larger allocation of valuable stocks to investors who truthfully reveal their information and therefore reduces the impact that such informed traders have in the after-market trading. In contrast, the fixed-price method, that does not elicit such private information at the IPO stage, enables informed traders to use such information in the aftermarket at the expense of the uninformed. Another suggestion is for the government to consider selling off more state-owned enterprises through the stock market. Boutchkova and Meggison (2000) and Bortolotti et al. (2007) find that privatization IPOs can enhance market liquidity. Finally research has shown the positive effects of stock market liberalization on equity prices, the cost of capital, investment, and systemic liquidity (Henry, 2000; Stulz, 1999; Bekaert and Harvey, 2000). This suggests that Bangladesh may be able to experience further benefits in the process of becoming an increasingly liberalized equity market.

Additional policy implications of Model 2A

Can the stock market develop freely in Bangladesh?

In Chapter 6 we saw how stock market development is affected by the overall growth process and by the development of banks (*Model 1*). The findings in this chapter,

however, demonstrate that the stock market may also be able to develop somewhat independently of either of these two influences. According to *Model 2A*, therefore, action can be taken by the regulatory authority to promote the stock market. Such a policy will have an impact in addition to the effects from the overall growth process and from growth in the banking sector. This means that, while economic growth and bank development both affect for the stock market (see Chapter 6), the stock market is also developing according to the forces within its own infrastructure ("trading" and "listing"). And it is only when both banks and the stock market are considered that a positive effect of financial development on economic growth for Bangladesh is observed. We have thus identified a unique aspect of the infrastructure that operates within the stock exchange in Bangladesh and which fits in well with our previous results. *Model 2B* (in Chapter 8) presents additional insights into the stock market infrastructure by describing the relationship between trading volume and price volatility. These relationships are all important as they give credibility to the main objective stated at the very beginning of the thesis. We wish to show how both the finance-growth nexus and stock market infrastructure (the integration of *Model 1* and *Model 2*) is important in Bangladesh.

Additional methodological issues

Trading value or trading volume?

In light of the results for the *listing-trading* effect in Chapter 7, the results for the *volume-volatility* and *trading-stock return* effect in Chapter 8 reveal an interesting common feature. In all the possible specifications and tests that we perform trading *value* has a clear advantage over trading *volume*. For the GARCH analysis in Chapter 8, trading value demonstrates incremental predictive power over trading volume. And for the ARDL cointegration analysis in this chapter, incorporation of the trading value measure makes the model more stable and results in larger long-run coefficients

In support of the ARDL cointegration method

The results in this chapter are particularly reassuring because, just as for the chosen specifications and main results for *Model 1* (Chapter 6), there is *only one* cointegrating relationship out of a range of alternative specifications which is robust and which passes all suitability requirements of the ARDL cointegration method. All other combinations of variables failed to pass the criteria for model suitability.

CHAPTER 8

MODEL 2B: THE STOCK MARKET INFRASTRUCTURE (II) IN BANGLADESH

The volume-volatility and trading-stock return effect

8.1 Introduction

This chapter offers a theoretical and empirical examination of *Model 2B*: "*the stock market infrastructure* (II)" for the case of Bangladesh. In Chapter 4 we reviewed an encompassing structural system which was comprised of different theoretical models. Here we now describe in detail two particular papers which form the second sub-model of the stock market infrastructure part of that system: the "volume-volatility relationship" and the "trading-stock return" relationship.

8.1.1 Model 2B hypothesis: The stock market infrastructure (II)

1) *Trading activity indicators improve volatility forecasting*

Incorporating trading into a GARCH (1, 1) model improves the model.

2) *Trading and stock returns are causally related*

Trading can predict stock returns and returns volatility (and vice versa).

8.2 Lamoureux and Lastrapes (1990)

In the framework of Lamoureux and Lastrapes (1990) the authors test whether there are GARCH effects remaining after the conditional volatility specification expands to include the contemporaneous trading volume, which is a proxy for information arrival. They find that for individual stocks listed on the NYSE, volatility persistence falls significantly once contemporaneous trading volume is included in the conditional variance equation of a GARCH (1, 1) model. A simultaneity problem may bias such results however as contemporaneous correlations between volume and price data have been documented by various authors in the past (see Karpoff, 1987). One should therefore also examine the effects of lagged volume/value on returns to avoid the problem of simultaneity (the problem may arise when volume is in fact endogenous to the variance specification

equation). At the same time such a relationship can be seen as a test of informational efficiency. Knowledge of lagged volume can be used to predict future price variability.

Let the daily price change be the sum of the intra-day price changes, which depend on the number of information events m occurring in any one day and assumed random. That is, the price change is subordinate to the stochastic change of information arrival. For a given m the Central Limit Theorem implies that the daily price change is approximately normal with variance proportional to m. Thus, the conditional variance of the daily price change is considered to be an increasing function of the rate at which new information enters the market. As new information is unobservable, a proxy variable is required to account for it. Trading volume represented by the number of transactions or the value of trading may be used. Prices and volume/value will now have a joint response to information because the distribution of both is subordinate to the distribution of m.

Let the daily returns be:

$$r_t = \mu_{t-1} + \varepsilon_t; \qquad \varepsilon_t \sim IN(0,h) \tag{8.2.1}$$

where μ_{t-1} is the mean r_t conditional on past information. The unexpected price change in a day, ε_t, will be the sum of a number of intra-day price changes as given below:

$$\varepsilon_t = \sum_{i=1}^{m} \delta_{it} \tag{8.2.2}$$

where δ_{it} denotes the ith intra-day increment in day t and m_t is the directing variable, representing the stochastic rate at which information flows into the market. If δ_t is i.i.d. with mean zero and variance σ^2, and m_t is sufficiently large, then

$$\varepsilon_t \mid m_t \sim IN(0,\sigma^2 m_t). \tag{8.2.3}$$

GARCH may be explained as a manifestation of time dependence in the rate of evolution of intra-day price changes driven by m_t. Assume the daily number of information arrivals is serially correlated as shown by the autoregressive representation below:

$$m_t = b_0 + \sum_{i=1}^{k} b_i m_{t-i} + u_t \tag{8.2.4}$$

where innovations to the directing variable persist and u_t is white noise. By defining a variance term:

$$\Omega_t = E(\varepsilon_t^{\,2} \mid m_t) = \sigma^2 m_t \tag{8.2.5}$$

and substituting in the moving average representation of equation (8.2.4) we get an expression for the variance analogous to that of a GARCH model,

$$\Omega_t = \sigma^2 b_0 + \sum_{i=1}^{m} b_i \Omega_{t-i} + \sigma^2 u_t \tag{8.2.6}$$

From equation (8.2.6), the autoregressive structure of the mixing variable is translated into the conditional variance of ε_t, generating the typical GARCH structure. Time-varying volatility in returns of a stock index is attributed to time-varying news arrivals about the stock index. The more news arrivals about the stock index, the more investors will interpret the effects of the news differently and the more investors have an incentive to trade the index as their expectations on future returns diverge. Following this economic argument, GARCH behaviour in the stock index return process is generated by the serially correlated news arrival process m_t. As m_t is generally not observed, daily trading volume/value is proposed as a proxy for the directing variable. In this way equation (8.2.6) captures the persistence in conditional variance that may be picked up by GARCH models.

8.3 Suominen (2001)

The model by Suominen (2001) is a market microstructure model. The market is organized as a limit order market with two types of traders, informed speculators and liquidity traders. The arrival rate of private information to the market is stochastically changing over time. In equilibrium, traders on the stock market try to estimate the availability of private information by using past period's trading volume, which then determines their strategies. Trading volume therefore contains useful information (in

excess of that which is incorporated into the stock return) for predicting the volatility of stock returns. As soon as informed speculators receive new private information, they trade aggressively with it, which soon reveals the existence of private information to other market participants. This leads other traders to revise their estimates for both the value of the asset and the availability of private information. It is the latter which affects traders' behaviour: As the probability of the existence of private information increases, liquidity traders become wary and start posting more conservative limit orders. Initially, a higher probability of private information will attract more speculators to search for information, which increases the number of informed traders. However, since this influx makes liquidity traders more cautious, the number of informed traders may later decrease.

Importantly for our purposes, the Suominen (2001) generates (1) a *causal* relationship between trading volume and stock returns and returns volatility, and (2) a *conditional variance* which is very similar to a GARCH specification but which contains important differences to the standard GARCH framework. The causal relationship between trading volume and price variability arises because trading by informed investors reveals private information to the market which affects prices. The model also provides one explanation for the ARCH phenomenon of autocorrelation in price variability and the geometrically decaying autocorrelation in the returns series. The latter conditional variance result occurs because the evolution of conditional variance depends on trading volume.

The model

There are T periods, a safe asset, and a risky asset. Returns for the safe asset are normalized to zero. The firm can be engaged in one of two different activities, A or B, both of which are changing randomly over time: A becomes B with probability μ and B becomes A with probability ε. The state of the economy is then the firm's activity: $s_t \in \{A, B\}$. Both activities yield an identically distributed random return $\delta_t \in \{-1,1\}$ per period, where the probability that $d_t = 1$ is $1/2$. The only difference between the two activities is in the traders' ability to monitor them. Both μ and ε are assumed to be less than one-half: as the firm's activity is therefore not randomly distributed each day this assumption leads to some persistence in the firm's activity.

The risky asset payoff, F_T, is the sum of a fixed value $\overline{F} > 0$, and the periodic returns:

$$F_T = \overline{F} + \sum_{t=1}^{T} \delta_t$$

Both public and private signals may reveal δ_t to traders at time T. First, there is a public announcement a_t at the end of period t with probability ρ that reveals δ_t. With probability $(1-\rho)$ there is no public announcement. For the trading volume to contain information on future volatility beyond price changes, it is necessary that $0 < \rho < 1$.

Informed speculators

The large number of speculators can, in the beginning of each period t, observe a common signal z_t on period t return, δ_t, by exerting effort $e > 0$. e is assumed small enough so that in equilibrium some speculators always choose to become informed. The measure of informed speculators is denoted by n_t. These traders are "informed traders". It is assumed that $z_t \in \{\delta_t, 0\}$, and that the probability that z_t perfectly reveals δ_t, $\Pr\{z_t = \delta_t\}$, depends on the availability of private information. The availability of private information in turn depends on the activity chosen by the firm. Activity A is relatively easy to monitor; activity B is more difficult: When the firm is engaged in activity A, the availability of private information is high, and $\Pr\{z_t = \delta_t\} = \overline{\alpha} < 1$. When the firm is engaged in activity B, the availability of private information is low, and $\Pr\{z_t = \delta_t\} = \underline{\alpha}$, where $0 < \underline{\alpha} < \overline{\alpha}$. It is assumed that the the firm's activity is assumed not to be directly observable to any trader, whether they be a speculative trader or liquidity trader.

Liquidity traders

In addition to speculators, there is in each period t a measure of m of liquidity traders who either need to sell or buy the asset. The trading motives of these liquidity traders are exogenously given: each such trader i has a utility c_t from buying or selling one unit of the risky asset in that period. c_t is assumed independent across traders, and uniformly distributed between zero and one.

How the market operates

The limit order market operates in the following way. In each period, the opening price is set by the exchange at the expected value of the asset, conditional on all public

information. After this, different traders can submit limit orders to the market[1]. A computer, acting as a marketplace, first executes all limit orders that can be executed at the opening price. After this, in the case of excess demand (supply) at the opening price, the computer increases (decreases) the market price to the level of the lowest unexecuted asks (highest unexecuted bids), and executes all limit orders that can be executed at that new price. The process continues until no limit orders cross. The price that prevails after this process becomes the closing price of the trading period.

In each period $t \leq T-1$, the timing of events therefore is as follows.

i) The state of the economy $s_t \in \{A, B\}$ is realized. Speculators choose whether to pay e and obtain access to the informative signal z_t.

ii) The periodic innovation $\delta_t \in \{-1,1\}$ is realized. The informed traders observe a signal $z_t \in \{\delta_t, 0\}$.

iii) The stock exchange announces an opening price equal to the expected value of the asset, conditional on all public information.

iv) Traders submit limit orders (either one bid, one ask, or both) to the market, and the market clears according to the structure of the limit order market as above. All traders observe the entire sequence of prices and associated volumes of trade.

v) A public signal $a_t = \delta_t$ is released with probability $\rho \geq 0$.

In period T, the timing of events is similar except that, after trading, there is a public signal (a quarterly report) that reveals at δ_τ for $\tau \leq T$. After this, the firm pays $F_T = \overline{F} + \sum_{t=1}^{T} \delta_t$ as a dividend to all shareholders.

The public information set ψ_t contains the price and volume for all transactions executed in the previous periods as well as all public announcements. Denote by R_t the traders' estimate of the probability of state A in period t, given ψ_t, i.e., $R_t \equiv E[s_t = A / \psi_t]$. Similarly, denote by α_t the probability that the informed traders receive a signal $z_t = \delta_t$

[1] It is also assumed that each trader must pay a positive transaction cost but for the ease of exposition this cost is assumed to be arbitrarily close to zero.

in each period t, given ψ_t, i.e., let $\alpha_t = \underline{\alpha} + R_t[\overline{\alpha} - \underline{\alpha}]$. Let $F_T \equiv E[F_T / \psi_t]$ and $\delta_t \equiv E[\delta_t / \psi_{t+1}]$. Finally, denote by $q_t^{ask}(P,a)$ and $q_t^{bid}(P,b)$ the unconditional probabilities that an ask a or a bid b, respectively, is executed at a price P in period t.

The traders' objectives

The objective of all traders is to maximize their utility. Under the assumption that z_t is perfectly revealed in equilibrium, the maximization problem for an informed trader i in period t, after observing a private signal z_t can be written as

$$\max_{b,a} E\left[[F_T - P]q_t^{bid}(P,b) + [P - F_T]q_t^{ask}(P,a) / \psi_t, z_t\right] \tag{8.3.1}$$

A risk-neutral liquidity trader, on the other hand, maximizes the sum of his period t trading profit and his utility from trading. Therefore, the maximization problem for a liquidity trader i with a utility c_i from selling the asset is

$$\max_{b,a} E\left[[F_T - P]q_t^{bid}(P,b) + [P - F_T + c_i]q_t^{ask}(P,a) / \psi_t\right] \tag{8.3.2}$$

The maximization problem for a liquidity trader j with a utility c_j from buying the asset is

$$\max_{b,a} E\left[[F_T - P + c_j]q_t^{bid}(P,b) + [P - F_T]q_t^{ask}(P,a) / \psi_t\right] \tag{8.3.3}$$

An equilibrium exists when informed speculators maximize (8.3.1), the liquidity traders maximize (8.3.2), uninformed speculators choose not to trade, z_t is perfectly revealed through traders' actions, and the number of informed traders is such that

$$E\left[\max_{b,a} E\left[[F_T - P]q_t^{bid}(P,b) + [P - F_T]q_t^{ask}(P,a) / \psi_t, z_t\right] / \psi_t\right] = e \tag{8.3.4}$$

Equation (8.3.4) requires that the expected profits to informed traders be equal to their cost of information acquisition, e.

Equilibrium

Proposition 1

The following is a Nash equilibrium of the trading game: in period t, a measure n_t^* of speculators obtain access to a private signal z_t. After the exchange sets an opening price $P_t^0 = F_t$, these informed traders submit a bid and an ask with a limit price equal to $F_t + z_t$. A fraction c_t^* of liquidity traders with selling (buying) needs, where $0 < c_t^* < 1$, trade conservatively, and set their asks at $F_t + 1$ (bids at $F_t - 1$). The remaining fraction $(1 - c^*)$ of liquidity traders with selling (buying) needs trade aggressively, and set their asks at $F_t - 1$ (bids at $F_t + 1$). The closing price of period t is always $F_t + z_t$. The fraction of conservatively trading liquidity traders, c_t^*, is uniformly increasing in α_t. When e is small enough, the number of informed traders, n_t^*, is initially increasing, but later decreasing in α_t. The proof is given in the appendix (2001: p. 559).

If the aggressive limit orders are interpreted as market orders, Proposition 1 of the model shows that the proportion of limit orders by liquidity traders is increasing in the probability of private information, α_t. It will be seen eventually that market volatility is also increasing in α_t, implying that the amount of limit orders by liquidity traders is higher in more volatile markets.

The evolution of the number of informed traders and the trading strategies of the liquidity traders actually depends on the evolution of R_t, which was defined earlier as the probability of state A given ψ_t. By defining the conditional probability $\hat{R}_t = \Pr[s_t = A \mid \psi_{t+1}]$, and denoting by ω_t the period t trading volume, an application of Bayes rule shows the following gives:

$$\hat{R}_t = \begin{cases} \dfrac{\overline{\alpha} R_t}{\alpha_t} & \text{if } \omega_t > m(1 - c_t^*) \\ \dfrac{(1-\overline{\alpha}) R_t}{(1-\alpha_t)} & \text{if } \omega_t = m(1 - c_t^*) \end{cases}$$

and given the transition probabilities μ and ε between states A and B,

$$R_{t+1} = \hat{R}_t(1-\mu)+(1-\hat{R}_t)\varepsilon \;=\; \hat{R}_t(1-\varepsilon-\mu)+\varepsilon$$

These equations imply that, for all observed values of R_{t+1}, that R_{t+1}, the probability of state A in period $t+1$, given ψ_{t+1}, is higher than R_t if there is evidence of informed trading in period t, and is lower than R_t otherwise. The result is due to the fact that informed trading is more likely to occur in the event that the firm is engage in activity A as opposed to activity B.

Traders must use the *volume of trade* to correctly update their estimate of the state of the economy, which is the firm's activity or, equivalently, the probability of private information. The same information is not contained in the returns because the returns can also be non-zero due to a public signal. *Trading volume therefore helps separate private information arrivals from public information arrivals*. Given that there are autocorrelated changes in the probability of private information over time, trading volume contains useful information for different groups of traders beyond that contained in the returns. Both the state of the economy, i.e. private information and beliefs about it matter for trading volume. Private information, α_t, or the probability that there is informed trading, affects both the number of informed traders and the proportion of limit vs. market orders (conservative vs. aggressive limit orders) by liquidity traders.

Time-series predictions of Suominen (2001)

Proposition 2

The asset prices follow a martingale with respect to ψ_t: $E[P_{t+1} \mid \psi_t] = P_t$

Proposition 3

$\text{Cov}\,[(P_{t+1}-P_t)^2, \omega_t \mid \psi_t] \;>\; 0,$

$\text{Cov}\,[(P_{t+1}-P_t)^2, \omega_t] \;>\; 0,$

$$\text{Cov}\,[(P_{t+s+1}-P_{t+s})^2,(P_{t+1}-P_t)^2] \;>\; 0\,.$$

Proposition 3 establishes how *price variability and trading volume are positively correlated*, both unconditionally and conditionally. These results allow us to use Granger Causality methods to verify the predictive qualities of Suominen's model. The positive correlation between trading volume and price variability, both conditional and unconditional on the public information set, arises from the fact that the informed traders trade only when they receive (non-zero) private information, and that their trading carries information and affects prices.

The autocorrelation function for price variability is also positive and geometrically decaying. The reasoning behind this result is that the evolution of price variability depends on the evolution of the availability of private information. When the firm is engaged in activity A (which is relatively easy to monitor) the speculators receive private information with a higher probability and, since the private information is revealed through their trading, prices are more volatile than when the firm is engaged in activity B. When the availability of private information changes according to a two-state Markov process this means that the longer the time period between two return observations, the larger the probability that the firm has changed its activity during that time so that the availability of private information has changed.

Conditional variance in the Suomien (2001) model

Define by σ_t^2 the conditional variance, i.e., $\sigma_t^2 = \text{var}[P_{t+1} - P_t \mid \psi_t]$. Propositions 4 and 5 show that the conditional variance is positively autocorrelated and mean reverting, as is directly assumed in the GARCH literature (the proofs are found in Suominen (2001: p. 563-564)). Given that the conditional variance is a function of R_t, and since the updating rule for R_t depends on the current period's trading volume, *trading volume enters the evolution equation for the conditional variance.* When $0 < \rho < 1$, price changes are not sufficient statistics for predicting changes in the conditional variance; information on the volume of informed trading is needed. If this is not directly observable to econometricians, one might use information on both trading volume and price

innovations to estimate it[2]. When the probability of public information arrival is zero, i.e. when ρ is zero, the expression for the conditional variance in Suominen (2001) is very close to the evolution equation for variance typically assumed in the GARCH literature. In Suominen's model, when $0 < \rho < 1$ the volume of trade allows an econometrician to separate private information arrivals from public information arrivals and, given that there is autocorrelation in the private information arrival, he or she can better estimate the conditional variance as compared to what would be possible using data on prices alone.

8.4 Empirical results for Model 2B

The main objective of this section is to investigate stock returns, price volatility, and trading dynamics for the DSE. We first attempt to model the conditional volatility process on the Dhaka Stock Exchange (DSE) and thereby assess the '*volume-volatility*' effect. We then proceed to determine whether indicators of trading activity are causally related to indicators of stock returns and thereby ass the '*trading-stock return*' effect.

8.4.1 GARCH volatility analysis

Much of the empirical literature on asset price volatility so far has focused on the developed markets. For investors seeking opportunities in emerging markets the evidence regarding stock return behaviour is more limited. The DSE is one such frontier emerging market[3]. By October 2007 it had increased 75% year-on-end and was the second highest performing Asian market after China. Yet relatively little is known about the DSE and there is no volatility study to our knowledge that incorporates the dynamics of trading volume for this emerging market. A better understanding of stock market volatility in Bangladesh should therefore be of interest to domestic and international investors seeking profitable opportunities and lower risk exposure, and to regulators wishing to maintain an orderly environment in the marketplace. Confirming empirical results in the analysis of

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[2] Indeed our empirical results in this chapter show the suitability of trading *value* as opposed to trading *volume*. These findings therefore provide some justification for the use of trading value in order to estimate the extent of informed trading.

[3] JPMorgan recently named Bangladesh one of the "Frontier Five" markets for investing (April 2007). Bangladesh comprises part of the S&P Frontier Index of 22 countries. Goldman Sachs included Bangladesh in a list of the "Next 11" regions which have the greatest potential to follow China and India.

stock market data for the DSE would also give credibility to the theory used to justify the volume-volatility relationship within a market microstructure framework.

8.4.2 Data and preliminary results

Three variables are available: (1) the *DSE price index*, (2) *volume of shares traded* (trading volume), and (3) *value of shares traded* (trading value)[4]. Value of shares traded is expressed in terms of domestic currency (taka). Data are at daily frequency from 1st January 1995 to 30th June 2007 giving a total of 3327 observations and was obtained from the Research Department at the Dhaka Stock Exchange and also from one private investment company. We have chosen to do a sub-period analysis in addition to the full period analysis for two reasons. Firstly, splitting the data into two periods allows one to analyse the impact of policy reforms. With over 12 years of daily data we felt that this was permissible[5]. Secondly, on the 27th November 2001 the main index for the DSE was re-weighted and the method for calculating market capitalization of all listed companies was changed. The DSE 'All Share Price Index' (*DSI*) was replaced by a new DSE 'General Index' (*DGEN*). We have therefore chosen this date as the break-point in our data, yielding 1836 data points in the first period and 1490 data points in the second period. In order to perform the full period analysis we have had to re-scale the earlier data by using the newly weighted index as a base date and then shifting up the pre-break daily stock index series in proportion.

Returns series of the DSE index are calculated as the logarithmic first difference of the index, $R_t = [\log P_t - \log P_{t-1})]$. Figure 8.1 shows graphs of the DSE index, trading volume, and trading value time series from 1995 – 2007. Table 8.1 shows summary statistics for the percentage daily returns, trading volume, and trading value, while table 8.2 shows pair-wise correlations between various indicators.

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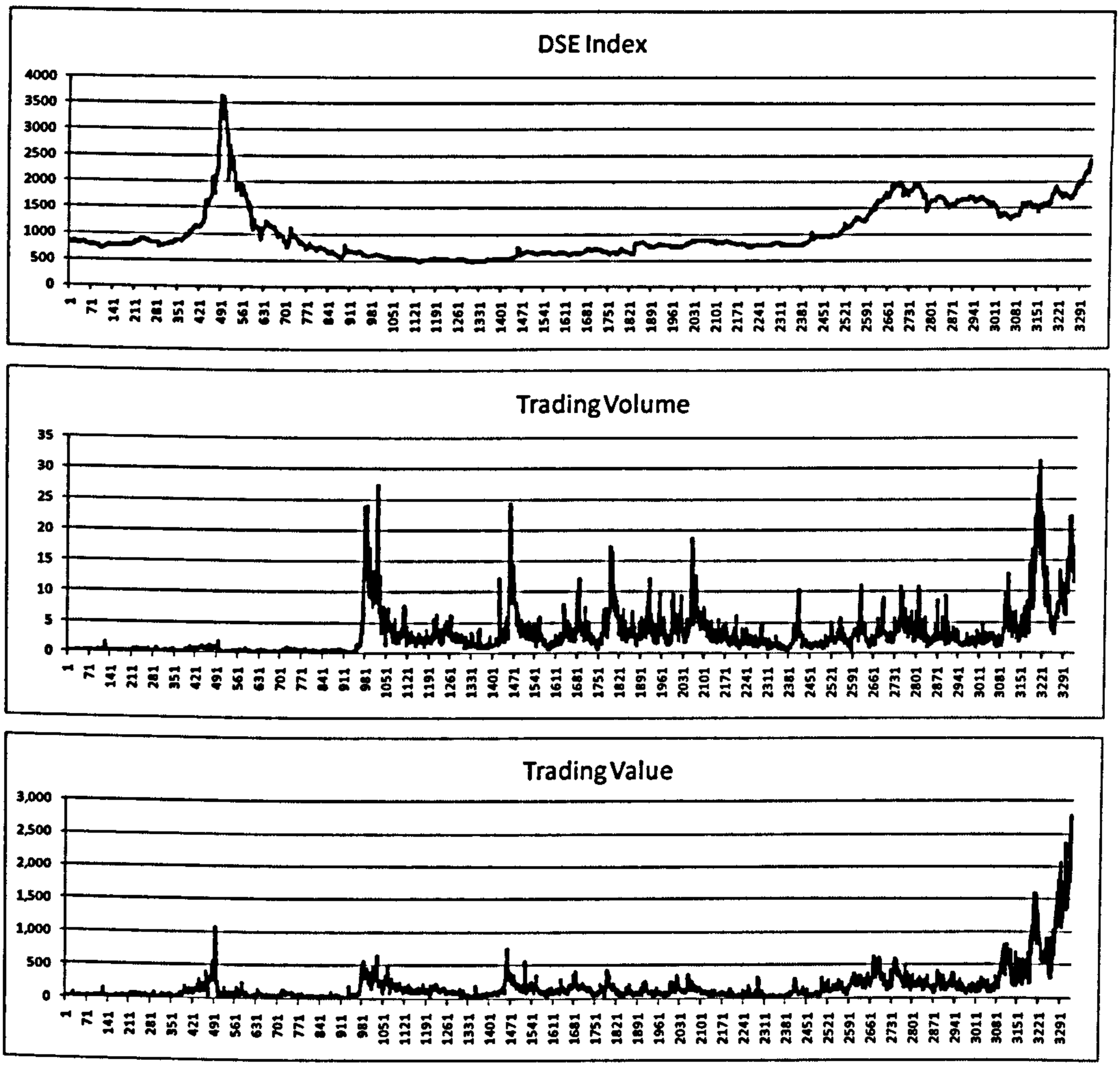
[4] For a description of these variables see Chapter 5.

[5] Granger and Morgenstern (1970, p. 5) argue that: "the stock market is possibly subject to changes in regulations, practices, general trends, so that the comparability of data over long periods might conceivably be impaired". It may be preferable therefore to use smaller samples when comparing stock market data.

Figure 8.1

DSE price index, trading volume, and trading value: 1995 – 2007



(NB: The scale for trading volume/value is in the millions)

From the top panel of figure 8.1, the returns series can be roughly split into three stages of development. In the first phase we observe quite a spectacular stock market boom and subsequent crash. In the second phase investors were recovering from the previous period and there was slow growth. In the third phase more of a positive trend in the index is apparent. The second panel of figure 8.1 shows the evolution of trading volume. Trading volume had displayed a relatively constant performance until late 1998 and again in 2000 when it rocketed after key IPOs were announced. Periodic bursts of trading volume have since been observed, and in June 2006 it has picked up once more. The third panel of figure 8.1 shows the evolution of trading value. Whereas trading volume did not

experience aggressive movement during 1996, trading value can be seen to locate the moment when the stock market boom of 1996 was in full swing. The two series appear to coincide during 2000, but overall trading value has been relatively maintained. Around June 2006, and just like trading volume, trading value dramatically increased. However, the two measures of trading activity have moved at different paces throughout the full sample period. In conclusion, indicators for the DSE have behaved erratically over the whole sample period of 1995-2007. Trading volume and trading value have moved together at times but at other times they have responded differently. This provides the motivation to further investigate returns, volatility, and trading activity on the DSE using econometric analysis.

Table 8.1a: Stock Returns

	1995 - 2007	1995 - 2001	2001 - 2007
Mean	0.035	0.000	0.078
Standard deviation	1.556	1.881	1.023
Maximum	30.367	30.366	5.928
Minimum	-22.204	-22.204	-7.095
Skewness	1.786	1.887	-0.101
Kurtosis	66.661	56.191	8.513
Jarque-Bera	563,576	217,527	1,889
$Q(12)$	128.71	73.407	53.256
$Q(24)$	164.78	99.487	76.974
$Q^2(12)$	628.41	336.95	643.16
$Q^2(24)$	658.36	349.30	701.41

Table 8.1b: Trading Volume

	1995 - 2007	1995 - 2001	2001 - 2007
Mean	3,027,963	2,157,008	4,100,142
Standard deviation	3,649,315	3,250,983	3,825,631
Maximum	31,165,616	27,301,699	31,165,616
Minimum	15,793	15,793	568,125
Skewness	2.888	3.121	2.999
Kurtosis	14.279	15.753	14.324
Jarque-Bera	22,261	15,423	10,195
$Q(12)$	25,947	14,056	11,165
$Q(24)$	40,740	21,910	17,130

Table 8.1c: Trading Value

	1995 - 2007	1995 - 2001	2001 - 2007
Mean	181,175,413	111,525,810	267,069,202
Standard deviation	257,769,297	101,953,002	349,625,068
Maximum	2,751,722,192	1,065,035,645	2,751,722,192
Minimum	3,623,463	3,623,463	16,912,342
Skewness	4.588	2.195	3.361
Kurtosis	29.913	11.438	16.004
Jarque-Bera	112,076	6,922	13,304
$Q(12)$	29,053	12,901	13,015
$Q(24)$	47,683	20,174	21,209

Table 8.2: Correlations

Correlation b/w	1995 - 2007	1995 - 2001	2001 - 2007
R and VOL	0.062	0.054	0.069
R and VAL	0.101	0.098	0.114
RSQ and VOL	-0.059	-0.042	0.152
RSQ and VAL	0.011	0.033	0.213
RABS and VOL	-0.073	-0.064	0.221
RABS and VAL	0.098	0.098	0.329
P and VOL	-0.114	-0.488	0.360
P and VAL	0.336	-0.103	0.798

RSQ is the squared returns series; RABS is the absolute returns series; VOL is the log trading indicator; VAL is the log trading value indicator; P is the log DSE price index.

Our data on the DSE returns in table 8.1a follow a leptokurtic distribution, a typical feature of high frequency data of asset returns. The skewness for the returns series for 1995-2007 is 1.786, while the kurtosis is 66.661. For the recent sub-period 2001-2007 these statistics are respectively -0.101 and 8.513. The drop in the kurtosis statistic in the second period, while still quite high overall, indicates that the DSE may have now become less prone to excessive investor behaviour and stock price manipulations as experienced in the 1996 market crash. The standard Ljung and Box (1978) portmanteau test statistics $Q(24)$ and $Q^2(24)$ (for the squared residual data) for up to 24^{th} order serial correlation in the recent period is 76.974 and 701.41 respectively. Under the null-hypothesis of conditional homoskedasticity, the statistic $Q^2(k)$ will have an asymptotic chi-squared distribution with k degrees of freedom. The Ljung-Box tests are highly significant and indicative of serial correlation. The high values of the Q^2 statistics suggest

the presence of conditional heteroskedasticity. This motivates the use of ARCH (GARCH) modelling which can deal with the clustering effect in price changes.

From the 1995-2001 period to the 2001-2007 period, the mean trading volume of all listed shares on the DSE increased by 90%. Over the same period, mean trading value increased by 139%. The data indicate that the DSE may potentially be on the brink of another rapid expansion. From 2006 to 2007, the mean trading volume and trading value on the DSE rose by 234% and 293% respectively. Extrapolating from the performance of one year is of course difficult and more time may be required to properly assess whether the market has longer-term potential for investors. There seems to be some signs however that the Bangladesh economy, although still in its infancy, may be on the verge of "taking off". Investors might well be advised to consider the DSE more carefully in the years to come.

Some further interesting points emerge from table 8.2. The correlations involving trading volume or trading value and measures of price movement have been quite low and even negative during 1995-2001. In the recent 2001-2007 period however all of these correlations have been positive. For instance, during 2001-2007 the correlation between squared returns and trading volume was 0.152, and the correlation between squared returns and trading value was 0.213. The correlation between returns / absolute returns / squared returns and trading value[6] has consistently been higher than that associated with trading volume: the correlation between trading value and the price index itself in the recent sub-period was extremely high at 0.798. This is more than double the correlation between trading volume and the price index. The fact that such a high correlation exists between trading value and the stock price index while the correlation is not as strong for trading volume motivates us to investigate these matters in greater detail.

[6] Value rather than volume may also be more closely related to price in a fundamental sense.

8.4.3 GARCH specifications

We first specify a benchmark GARCH (1, 1) model for the daily stock returns:

$$r_t = a_0 + a_1 r_{t-1} + \varepsilon_t$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

with r_t denoting the logged first differences of the DSE returns series, and $\varepsilon_t \sim N(0, h_t)$ denoting the unpredictable component of returns. The sum $(\alpha_1 + \beta_1)$ measures the degree of persistence in the conditional variance h_t. Following Lamoureux and Lastrapes (1990) we then incorporate either trading volume or trading value at current and lagged levels into both the conditional mean and conditional variance equations.

Table 8.3

GARCH testing combinations

Model	Conditional mean	Conditional variance
1	$r_t = a + b_1 r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$
2	$r_t = a + b r_{t-1} + c Vol_t + d Vol_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t + \chi_2 Vol_{t-1}$
3	$r_t = a + b r_{t-1} + c Val_t + d Val_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t + \chi_2 Val_{t-1}$
4	$r_t = a + b r_{t-1} + c Vol_t + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t$
5	$r_t = a + b r_{t-1} + c Val_t + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t$
6	$r_t = a + b r_{t-1} + d Vol_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Vol_{t-1}$
7	$r_t = a + b r_{t-1} + d Val_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Val_{t-1}$
8	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t + \chi_2 Vol_{t-1}$
9	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t$
10	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Vol_{t-1}$
11	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t + \chi_2 Val_{t-1}$
12	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t$
13	$r_t = a + b r_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Val_{t-1}$
14	$r_t = a + b r_{t-1} + c Vol_t + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t$
15	$r_t = a + b r_{t-1} + c Val_t + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t$
16	$r_t = a + b r_{t-1} + d Vol_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Val_{t-1}$
17	$r_t = a + b r_{t-1} + d Val_{t-1} + \varepsilon_t$	$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_2 Vol_{t-1}$

Whenever the sum $(\alpha_1 + \beta_1)$.is found to be less than one we test that particular model for restrictions on the coefficients using a Wald (LR) test procedure. The 'volume - return' relationship may be tested by the restriction $c = d = 0$, while the 'volume - volatility' relationship may be tested by the restriction $\chi_1 = \chi_2 = 0$. The highest log-likelihood statistic then indicates the preferred model, but note that other statistics reflecting standardized residuals and normality should also be used to determine suitability. According to the MDH, $\chi_1 > 0$ and/or $\chi_2 > 0$ and the GARCH effects measured by the coefficients α_1 and β_1 should diminish if trading volume or trading value is serially correlated. The sum of GARCH coefficients should be less than one to ensure that the model is stable and not explosive: if this does not hold then the conditional variance forecast tends to infinity as the forecast horizon increases[7].

8.4.4 Empirical findings for the volume-volatility effect

Figure 8.2: DSE Returns Series, 1995-2007

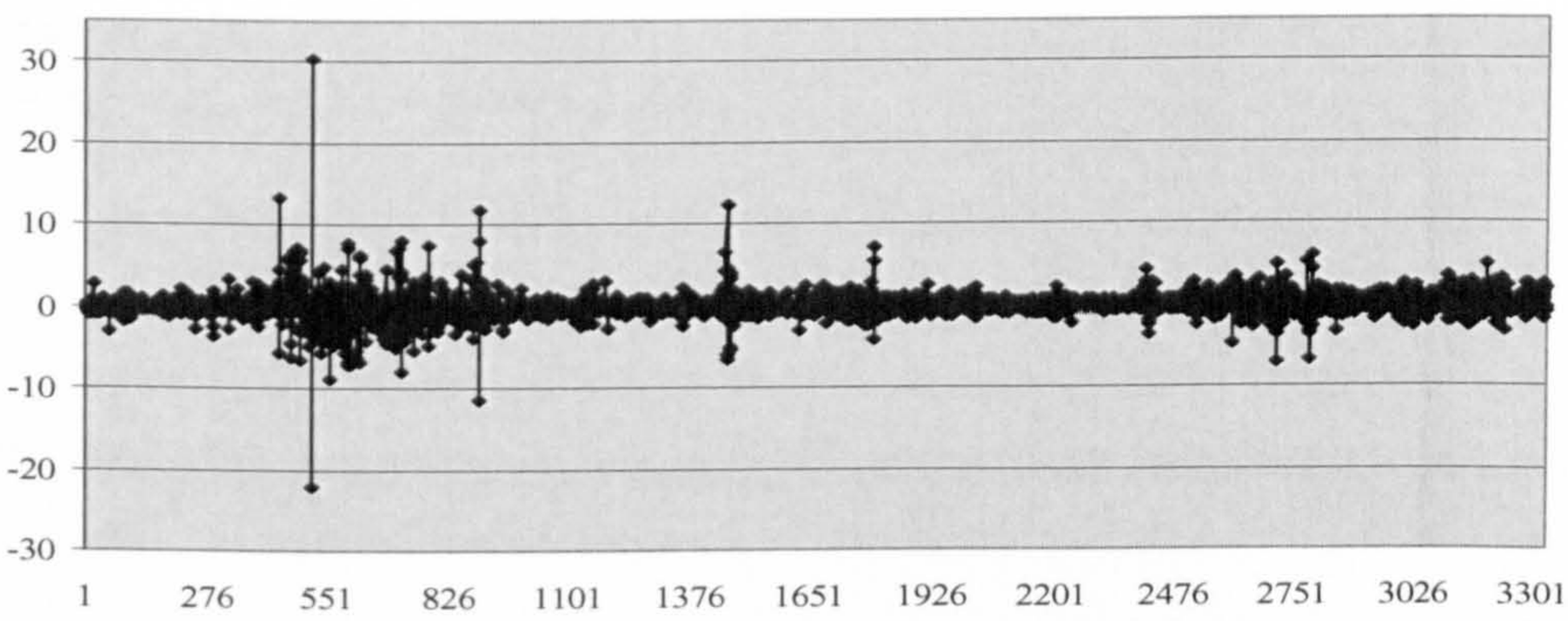


Figure 8.2 shows clustering effects in the DSE returns data. Table 8.1 reported statistics strong presence of serial correlation in both the trading volume and the trading value series. As suggested by the MDH the daily number of information arrivals is assumed to be serially correlated. The use of trading volume (or value) may be used as a proxy for the unobservable flow of information in a GARCH framework (Lamoureux and

[7] This special case of GARCH is known as integrated GARCH, or IGARCH (Engle and Bollerslev, 1986).

Lastrapes, 1990). The existence of autocorrelation in the volume/value series is essential because the MDH implies that serial correlation in volume/value is the source of the GARCH type effects in the stock return. The tables below report the GARCH results.

Out of the 17 possible modelling combinations, only three managed to satisfy the suitability criteria for the sum of GARCH parameters to be less than one. These are models 3, 8 and 11 and they have had their entire columns filled in red. We perform Wald tests on the restrictions in the coefficients of each model. The results of the *F* version of the test all reject the null that the coefficients jointly equal zero.

Model 3

$$r_t = a + br_{t-1} + cVal_t + dVal_{t-1} + \varepsilon_t$$
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t + \chi_2 Val_{t-1}$$

Model 8

$$r_t = a + br_{t-1} + \varepsilon_t$$
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Vol_t + \chi_2 Vol_{t-1}$$

Model 11

$$r_t = a + br_{t-1} + \varepsilon_t$$
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \chi_1 Val_t + \chi_2 Val_{t-1}$$

Table 8.4 GARCH modelling specifications :1995-2007

	Model 1	Model 2	Model 4	Model 5	Model 6	Model 7	Model 9	Model 10	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17
a	0.002	-0.064	0.014	-0.272	0.033	-0.023	0.002	0.002	0 003	0.002	0.014	-0.249	0.033	-0.007
	(0.469)	(-1.369)	(0.267)	(-2.736)	(0.603)	(-0.227)	(0.388)	(0.374)	(0.477)	(0.434)	(0.268)	(-2.462)	(0.627)	(-0.067)
b	0 190739	0.214619	0.192578	0.184915	0.192722	0.190509	0 192371	0.192324	0 190745	0.190883	0 190966	0 187013	0.191251	0.192209
	(14.197)	(14.006)	(12.740)	(12 468)	(13.124)	(13.262)	(14 023)	(14.067)	(13.588)	(13.667)	(12.586)	(12.793)	(12.912)	(13.649)
c		0.022	-0.002	0 035							-0.002	0.0317		
		(0.640)	(-0.230)	(2.776)							(-0.216)	(2.511)		
d		-0 012			-0 005	0.003							-0 005	0.001
		(-0.321)			(-0.570)	(0.251)							(-0.577)	(0.087)
α_0	0.003	0.020	0.014	0 001	0.016	0.007	0.014	0.016	0 002	0.007	0.002	0.014	0.007	0.016
	(12 673)	(7 412)	(6 664)	(0.298)	(7.237)	(1.781)	(6.709)	(7.292)	(0 630)	(1.823)	(0 633)	(6 449)	(1.822)	(7.269)
α_1	0.224	0.249	0.224	0.225	0.225	0.225	0.225	0.225	0.224	0.225	0.224	0.225	0.224	0.225
	(26.069)	(21.394)	(24.036)	(24.961)	(24.106)	(25.010)	(25.173)	(25.102)	(25.239)	(25.218)	(24.051)	(24.681)	(24.259)	(24.940)
β_1	0.802	0.753	0.804	0.802	0.804	0.803	0.804	0.803	0 802	0.803	0.802	0.804	0.803	0.803
	(177.381)	(114.286)	(169 971)	(175.468)	(168.624)	(175.799)	(174 829)	(173.612)	(176.961)	(177.549)	(171.707)	(173 141)	(172.574)	(172 051)
Sum	1.026	1.002	1.028	1.027	1.028	1.028	1.028	1.028	1.026	1.028	1.026	1.029	1.027	1.028
χ_1		0.070	-0.002	0.000			-0.002		0 000		0.000	-0.002		
		(17.571)	(-4.991)	(0.580)			(-5.022)		(0.263)		(0.252)	(-4 810)		
χ_2		-0.072			-0 002	0.000		-0.002		0.000			0.000	-0.002
		(-20 427)			(-5.681)	(-0.889)		(-5.717)		(-0 922)			(-0 932)	(-5 696)
LF	13459	13481	13463	13462	13464	13459	13463	13464	13459	13459	13459	13465	13459	13464
Kurt	11 687	13 799	11.151	11.914	11.05	11.569	11.193	11.126	11.725	11.565	11.686	11.333	11.482	11.128
$Q(12)$	114.47	98 479	113.19	113.79	113.74	113.91	112.91	112.83	114.43	114.49	114.71	112.13	115.49	112.63
$Q(24)$	140.71	124.81	139.5	141.17	140.08	140 15	139.25	139.2	140 66	140.78	140 91	139.38	141.75	138.98
$Q^2(12)$	9.1316	4.9583	9.8769	9.0482	9.8884	9.3241	9 8285	9 8269	9.0697	9.3041	9.1056	9.8503	9.3733	9.8314
$Q^2(24)$	13 873	6 7224	15.169	13.384	15.197	14 185	15.067	15.052	13.764	14.177	13 849	14 858	14.352	15.053

(Note: a is multiplied by 100; α_0 is multiplied by 10,000; χ_1 and χ_2 are multiplied by 10,000. t-statistics for significance are reported in brackets – stars are omitted for brevity as the GARCH (1, 1) coefficients are nearly always significant.)

Table 8.5: GARCH with trading 1995-2007

a	-0.150	-0.005	0.006
	(-1.505)	(-0.992)	(1.649)
b	0.201***	0.220***	0.226***
	(13.828)	(15.225)	(16.427)
c	0.002***		
	(6.861)		
d	-0.002***		
	(-6.147)		
α_0	-0.010**	0.028***	-0.056***
	(-1.983)	(8.874)	(-11.878)
α_1	0.239***	0.268***	0.287***
	(24.028)	(21.117)	(19.462)
β_1	0.758***	0.721***	0.646***
	(135.50)	(95.77)	(61.23)
Sum	0.997	0.989	0.933
χ_1	0.038***	0.090***	0.060***
	(23.598)	(14.439)	(8.166)
χ_2	-0.036***	-0.093***	-0.051***
	(-37.590)	(-16.264)	(-6.376)
LF	13481	13466	13404
Kurt	16.130	15.543	24.342
Q(12)	100.03	97.93	94.29
Q(24)	127.21	124.77	122.08
$Q^2(12)$	4.293	3.353	1.539
$Q^2(24)$	5.399	4.611	3.030

(Note: a is multiplied by 100; α_0 is multiplied by 10,000; χ_1 and χ_2 are multiplied by 10,000. t-statistics for significance are reported in brackets.)

*** 1% sig ** 5% sig * 10% sig

Table 8.6 Wald restriction tests

Restriction	$c = d = 0$	$\chi_1 = \chi_2 = 0$	$c = d = 0; \chi_1 = \chi_2 = 0$
Model3	F-statistic = 23.702***	F-statistic = 114309***	F-statistic = 103886***
Model8		F-statistic = 70919***	
Model11			F-statistic = 27123***

The GARCH models in table 8.4 are shown to be made stable (i.e. the sum of GARCH parameters $\alpha_1 + \beta_1$ is less than one) after indicators of trading were incorporated into the conditional variance specification. Squared standardized residuals[8] – indicating the presence or absence of autocorrelation – were also insignificant and the lowest in the three GARCH specifications (models 3, 8, and 11 – see table 8.5). Note that we are mainly focusing on the conditional variance equation and whether or not GARCH parameters and their associated statistics significantly changed before and after the inclusion of trading variables. The chosen models did not correspond to the model specifications where the log-likelihood value was highest or where kurtosis (i.e. non-normality) was lowest. Regardless, the chosen models were deemed to be more suitable since for all other specifications the sum $(\alpha_1 + \beta_1)$ was greater than one. For the three chosen specifications, the unconditional variance of the error term is properly defined.

According to the assumptions in Suominen (2001), trading itself will drive the volatility process. We might therefore expect the GARCH coefficients in the conditional variance equation to remain high and significant even after inclusion of trading activity indicators. Of course, it could also mean that our choice of the GARCH (1, 1) is not best suited. Suominen (2001) provides a closed-from expression for the conditional variance, and this is in many ways an updated version of the Lamoureux and Lastrapes MDH approach. While the Suominen (2001) conditional variance is similar to the standard GARCH formulation, the underlying theory is very different to the usual GARCH literature where trading dynamics are assumed exogenous. Nevertheless, we maintain that an analysis of volatility and returns prediction incorporating a GARCH modelling specification along the lines of Lamoureux and Lastrapes (1990) remains useful for the purpose of examining the Dhaka Stock Exchange since the model's parameters become stable.

[8] We are mainly interested in the conditional variance equation given the theoretical motivation of the MDH. In contrast, the standardized residuals $Q(12)$ and $Q(24)$ for the conditional mean equation remain quite high, although they are still lower compared to the benchmark model.

Table 8.7

GARCH with trading: Sub-period 1995-2001

		Model8	
a	0.427**	-0.019***	-0.024***
	(2.028)	(-3.970)	(-2.950)
b	0.127***	0.234***	0.141***
	(6.700)	(11.610)	(7.157)
c	0.001		
	(0.871)		
d	-0.001		
	(-1.578)		
α_0	0.351***	0.0415***	0.482***
	(7.819)	(7.230)	(9.796)
α_1	0.196***	0.355***	0.199***
	(16.043)	(14.040)	(15.723)
β_1	0.619***	0.665***	0.630***
	(32.835)	(45.888)	(35.680)
Sum	0.815	1.019	0.829
γ_1	0.085***	0.069***	0.095***
	(34.441)	(9.511)	(241.440)
γ_2	-0.124***	-0.074***	-0.150***
	(-15.821)	(-11.751)	(-24.284)
LF	7057	7202	7052
Kurt	30.598	24.693	28.679
$Q(12)$	123.09	65.25	103.60
$Q(24)$	151.81	84.65	131.02
$Q^2(12)$	3.179	1.475	4.009
$Q^2(24)$	6.852	2.127	8.208

Table 8.8

GARCH with trading: Sub-period 2001-2007

a	-0.293**	0.014**	0.015**
	(-2.152)	(2.245)	(2.111)
b	0.176***	0.183***	0.143***
	(6.724)	(7.826)	(6.199)
c	0.003***		
	(4.929)		
d	-0.002***		
	(-4.047)		
α_0	-0.116***	-0.005	-0.270***
	(-6.333)	(-0.606)	(-6.791)
α_1	0.191***	0.154***	0.157***
	(10.200)	(11.769)	(9.945)
β_1	0.725***	0.838***	0.604***
	(30.172)	(71.369)	(14.159)
Sum	0.916	0.992	0.762
γ_1	0.081***	0.101***	0.060***
	(31.941)	(71.945)	(8.198)
γ_2	-0.066***	-0.099***	-0.023***
	(-815.94)	(-1423.65)	(-2.318)
LF	6315	6286	6276
Kurt	4.518	4.562	4.334
$Q(12)$	28.511	36.117	40.516
$Q(24)$	48.997	58.323	61.917
$Q^2(12)$	7.596	9.706	23.870
$Q^2(24)$	24.216	24.080	48.344

Sub-period analysis in table 8.7 reveals that in the 1995-2001 period model 8 is no longer stable – the sum of the GARCH coefficients for model 8 now is greater than one. In the 2001-2007 period in table 8.8 model 8 just manages to remain stable. Overall this would suggest that model 8 is less preferred to models 3 and 11. It is interesting to note that model 8 contains the trading volume measure, whereas models 3 and 11 contain the trading value measure. Once again this demonstrates the additional benefit of using trading value as the proxy for market liquidity on the DSE rather than trading volume.

If a strict determination regarding model specification appropriateness is desired between models 3 and 11, preference might be given to model 3 since it achieves a slightly higher log-likelihood value. Model 3 also has lower Q and Q-squared values for residual

autocorrelation compared to model 11 in the recent 2001-2007 period[9]. However, in the recent sub-period model 11 is able to reduce the sum of the GARCH parameters more than model 3: the respective sums for model 3 and model 11 are 0.916 and 0.762. Although the sum of the GARCH parameters is still large and significant, model 11 reduces the sum by approximately one quarter. The volatility persistence features of the GARCH model remain even after including indicators of trading. While this suggests that the Lamoureux and Lastrapes (1990) methodology may not be well-suited to the Dhaka Stock Exchange in light of the small reduction in GARCH parameters, it is still the case that the GARCH model becomes stable once trading indicators are inserted into the conditional volatility specification for model specifications 3 and 11.

The Suominen (2001) model demonstrates that volatility persistence may continue to be observed in the presence of trading dynamics. Suominen (2001) specifies a closed form expression of the conditional variance where trading by informed investors drives the volatility process, and where trading itself is increasing and decreasing in momentum. This means that incorporating trading variables (either trading volume or trading value) into the GARCH specification will likely improve the model, no matter how the GARCH persistence parameters are observed to behave. However we are not aware of a testing procedure as attractive and straightforward as the Lamoureux and Lastrapes approach which can be extended using Suominen's framework and assumptions. Such issues are left for future research.

We conclude this section by arguing that value measures of trading may yield better predictive results than volume measures of trading. This suggests an additional avenue for future research into the volume – volatility relationship.

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[9] Model 3 may also be preferred since it contains trading value in both the returns and volatility equations, and trading value is be also found to more important than trading volume in the causality tests. Interestingly the Q and Q-squared values are higher in the sub-period 1995-2001 for model 3 than for model 11. This could be explained by the severity of the 1996 market crash episode.

8.4.5 Granger Causality

We wish to analyze '*trading-stock return*' effect, i.e. the causal linkages between returns or returns volatility and measures of trading activity on the stock exchange. An economic time series Y is said to be Granger Caused by X if X helps in the prediction of Y. A hypothesis of no causality is tested in a joint test that coefficients of the lagged causal variable are significantly different from zero. To test for causality between the X and Y series, we specify a bivariate k^{th} order VAR:

$$X_t = \sum \alpha_{1i} Y_{t-i} + \sum \alpha_{2i} X_{t-i} + V_t$$

$$Y_t = \sum \beta_{1i} X_{t-i} + \sum \beta_{2i} Y_{t-i} + U_t$$

The null hypotheses are the following:

Hypothesis 1: Trading volume does not Granger Cause stock returns

Hypothesis 2: Stock returns do not Granger Cause trading volume

Hypothesis 3: Trading volume does not Granger Cause absolute stock returns

Hypothesis 4: Absolute stock returns do not Granger Cause trading volume

Hypothesis 5: Trading volume does not Granger Cause return volatility

Hypothesis 6: Return volatility does not Granger Cause trading volume

Hypothesis 7: Trading value does not Granger Cause stock returns

Hypothesis 8: Stock returns does not Granger Cause trading value

Hypothesis 9: Trading value does not Granger Cause absolute stock returns

Hypothesis 10: Absolute stock returns does not Granger Cause trading value

Hypothesis 11: Trading value does not Granger Cause return volatility

Hypothesis 12: Return volatility does not Granger Cause trading value

Granger causality tests require the assumption that the variables in the system are stationary. We therefore need to test for the stationarity of stock returns, trading volume, and trading value data. The two ways to achieve stationary are by either detrending the series (trend-stationary processes), or differencing (difference-stationary or integrated or order one, I(1), process i.e. or unit root process).

Test for trends in the series together with unit root ADF tests for the unit root are carried out using *EViews*. Unit root tests for a range of different lag structures were performed with *EViews* choosing the most suitable lag length based on Akaike Information Criteria (AIC) or Schwarz-Bayesian Criteria (SBC) and a maximum lag length of up to 21 days. Results indicate that the null hypothesis that stock returns, trading volume, and trading value series are each nonstationary (i.e. have a unit root) are strongly rejected for various lag orders chosen. This confirms that all data series used in the empirical analysis are stationary. In any case, given the long time-span of daily data stationary series will usually be expected. Detailed test results are omitted and are available on request.

8.4.6 *Empirical findings for the trading-stock return effect*

We first consider the full sample period (1995-2007). Results for Granger Causality tests with two lags are presented below.

Table 8.9

Granger Causality testing: 1995-2007

Trading volume

Causality	F-value (p-value)	Reject / Accept Ho
VOL → R	25.566 (0.000) ***	Reject
R → VOL	2.938 (0.053) **	Reject
VOL → RABS	8.362 (0.000) ***	Reject
RABS → VOL	5.220 (0.005) ***	Reject
VOL → RSQ	17.403 (0.000) ***	Reject
RSQ → VOL	0.411 (0.663)	Accept

Trading value

Causality	F-value (p-value)	Reject / Accept Ho
VAL → R	4.119 (0.016) **	Reject
R → VAL	36.927 (0.000) ***	Reject
VAL → RABS	2.245 (0.106)	Accept
RABS → VAL	10.476 (0.000) ***	Reject
VAL → RSQ	10.264 (0.000) ***	Reject
RSQ → VAL	2.053 (0.129)	Accept

*** 1% sig ** 5% sig * 10% sig

In the top panel of table 8.9 trading volume is tested, while in the bottom panel trading value is tested. The results for both trading indicators for 1995-2007 are quite similar. Bi-directional causality between trading (volume or value) and measures of returns/volatility (returns, absolute returns, squared returns) is present, the exception being that trading value does not seem to Granger Cause absolute returns. Results are therefore largely supportive of the theoretical prediction of the Suominen (2001) model, namely that data on informative trading can help to predict future price movements on the stock exchange.

Granger Causality results for sub-periods 1995-2001 and 2001-2007 are reported below.

Table 8.10

Granger Causality testing: Sub-period 1995-2001

Trading volume				Trading value		
Causality	F-value (p-value)	Reject / Accept Ho		Causality	F-value (p-value)	Reject / Accept Ho
VOL → R	1.202 (0.301)	Accept		VAL → R	1.466 (0.231)	Accept
R → VOL	11.01 (0.000) ***	Reject		R → VAL	20.948 (0.000) ***	Reject
VOL → RABS	6.651 (0.001) ***	Reject		VAL → RABS	4.478 (0.011) **	Reject
RABS → VOL	2.173 (0.114)	Accept		RABS → VAL	4.873 (0.008) ***	Reject
VOL → RSQ	12.632 (0.000) ***	Reject		VAL → RSQ	9.924 (0.000) ***	Reject
RSQ → VOL	0.127 (0.881)	Accept		RSQ → VAL	1.425 (0.241)	Accept

Table 8.11

Granger Causality testing: Sub-period 2001-2007

Trading volume

Causality	F-value (p-value)	Reject / Accept Ho
VOL → R	1.313 (0.269)	Accept
R → VOL	23.038 (0.000) ***	Reject
VOL → RABS	5.231 (0.005) ***	Reject
RABS → VOL	3.532 (0.03) **	Reject
VOL → RSQ	2.212 (0.11) **	Accept
RSQ → VOL	3.064 (0.047) **	Reject

Trading value

Causality	F-value (p-value)	Reject / Accept Ho
VAL → R	3.385 (0.034) **	Reject
R → VAL	17.892 (0.000) ***	Reject
VAL → RABS	18.081 (0.000) ***	Reject
RABS → VAL	12.566 (0.000) ***	Reject
VAL → RSQ	6.99 (0.001) ***	Reject
RSQ → VAL	8.081 (0.000) ***	Reject

A comparison of the empirical results for both sub-periods (table 8.10 and 8.11) show differences with regard to the way that volatility is measured (returns, absolute returns, squared returns), and with regard to the way that trading activity is measured (trading volume versus trading value). In the first sub-period of 1995-2001, the results for both trading volume and trading value are very similar, which is the finding for the full sample period. There is evidence of bi-directional causality: both trading volume and trading value respectively Granger Cause both absolute returns and returns squared. Evidence of reverse causality from absolute returns to trading is now present for trading value only. There is no evidence that either trading volume or trading value Granger Causes stock returns[10], while stock returns Granger Causes both volume and value. Results are again supportive of the prediction of the model of Suominen (2001) which argues that trading measures can help predict subsequent price movements on the stock exchange.

In the recent period of 2001-2007, however, we see different results. There is again significant evidence of bi-directional causality, but trading value now has greater explanatory power. Trading value Granger Causes returns, absolute returns, and squared returns. These results are in accordance with the predictions of Suominen (2001). In

[10] The result of no causality between trading volume and stock returns may indicate improvement in market efficiency as investors now are more able to quickly arbitrage away any pricing inefficiencies.

contrast, the only causal relationship apparent when considering trading volume is that trading volume Granger Causes absolute returns. Trading volume does not granger cause returns or squared returns. Results when considering trading volume as the indicator of trading activity for the recent 2001-2007 period are therefore not as supportive of the Suominen (2001) model. These results highlight the predictive power of trading value.

The fact that different results for the recent period of 2001-2007 are obtained for trading value and trading volume indicates that investors have perhaps become more sensitive to the value of their trades than they are to the volume of their trades on the Dhaka Stock Exchange. Another explanation is that investors may have become more knowledgeable about the usefulness of trading volume. However, trading value still offers an advantage over trading volume and investors so far have not arbitraged this away. These results deserve to be investigated further.

8.5 Conclusion for Model 2B

This section has examined the dynamics of returns, trading and volatility for the Dhaka Stock Exchange (DSE) in Bangladesh. The findings here form part of *Model 2*: "The stock market infrastructure". A unique data set at daily frequency is used from 1995 to 2007 which includes both trading volume and trading value. In the full sample period trading volume and trading value enter significantly into the GARCH (1, 1) specification and the model's parameters become stable. The reduction in the sum of GARCH persistence parameters is negligible, apart from one case where trading value in the recent sub-period is found to reduce the sum by approximately one quarter. For the full-period we find bi-directional Granger Causality between trading volume and returns volatility, and bi-directional Granger Causality between trading value and returns volatility. In the recent sub-period however trading volume does not Granger Cause returns volatility, while trading values again Granger Causes returns volatility. The fact that different results for the recent sub-period are obtained for trading value and trading volume indicates that investors may be more sensitive to the value of trades than to the volume of trades on the DSE. Investors appear not to have arbitraged away the informational role of trading value. Important differences therefore exist between complimentary indicators of trading activity on the DSE, and this should be taken into consideration if any attempt at predicting stock returns and volatility is to be made.

CHAPTER 9
CONCLUSION

The work in this thesis has been guided by two main objectives. First, how has financial development enhanced economic growth? And second, what has been the process behind financial development? This study on Bangladesh has thus been motivated by the need to develop a deeper understanding and appreciation of the financial sector and its connection to the real economy. These issues have recently taken on critical importance as a result of the near collapse of credit markets and the depressed state of the global financial system in 2008-09. Determining how best to achieve growth-accelerating and sustainable finance is now the key issue occupying the minds of central bank regulators and others involved in formulating policy recommendations and development strategies.

9.1 The main contribution of the thesis

Using the example of Bangladesh this thesis makes a number of contributions to the literature on financial development and economic growth as well as to the literature on stock market infrastructure. Firstly, we have done an extensive literature review and a review of institutional aspects of the financial sector in Bangladesh. Secondly, we examine the theoretical predictions of three models by integrating them into one conceptual framework that we call *Model 1*: "*The finance-growth nexus*". Thirdly, we examine the theoretical predictions of three more models by combining them into another conceptual framework that we call *Model 2*: "*The stock market infrastructure*". When we explain Model 1 and Model 2 together with the empirical results, the story for financial development and economic growth is complete. An encompassing model emerges which can show how finance affects and is affected by growth and where the financial structure itself is evolving. In this setup the banks are essential to economic growth, economic growth is a main driver for the banks, both banks and stock markets interact to enhance economic growth, and the stock market is also driven by its own force for development.

What emerges is thus a complicated system containing a number of different but related variables that interact in a mostly positive and supportive way. In order to not have the system break apart we need to give a final layer to it. The blueprint which displays the

layout of the sub-models and their associated variables within this system is referred to as the '*entire picture*'. And the individual components which combine to make our encompassing model work are referred to as the '*five main effects*'.

Over the past three decades Bangladesh experienced gradual regulatory and structural changes as financial liberalization, financial development, and deregulation became key priorities of government policy (Bangladesh Bank, 2006). This priority reflects the pressure for a more liberalized financial sector and market-orientated economy by the World Bank, IMF and other agencies. Bangladesh has addressed the problems in its financial sector by attempting to ease various restrictions and by strengthening regulatory supervision. The country has attempted to improve the operation of its financial sector by enhancing the growth of banks to a large degree and the stock market to a smaller degree.

It is of huge interest to empirically assess the effects of such financial policy reform and structural change for the economy. No study to our knowledge currently exists for Bangladesh which examines these issues in relation to both bank activity and stock market activity. The analysis for the Dhaka Stock Exchange in particular is new to the field. We use the latest econometric time-series techniques (the Pesaran, Shin, and Smith (2001) cointegration procedure) and offer a critique of existing theoretical work on both the finance-growth relationship and the factors relating to stock market development.

Our findings are as follows:

9.2 Findings for Model 1: the finance-growth nexus

Bank development and stock market development help to accelerate economic growth in Bangladesh. A cointegrating relationship between physical capital accumulation, quasi-money/GDP and the number of listed companies is found in which the bank variable and stock market variable are the long run forcing variables in the relationship. The positive finance-growth relationship obtained in this work also agrees with the findings of previous researchers who find that indicators of banks and stock markets are important in explaining growth for various countries (both advanced and developing). There is a second cointegrating relationship, this time going in the reverse direction. With bank development now represented by private-credit/GDP and economic growth represented

by real GDP per capita, it is growth now which is observed to be the long-run forcing variable for banks. This highlights an additional chain in the finance-growth relationship for Bangladesh. Growth can drive the process of financial development. Finally, we find evidence of complementarity between banks and the stock market. A cointegrating relationship is found between bank development (private-credit/GDP) and the number of listed companies on the stock exchange. The long run forcing variable in this relationship is the bank variable. This result demonstrates the effect of financial interaction, or more broadly financial innovation. When seen in light of the previous results *Model 1*: the finance-growth nexus is now complete for the case of Bangladesh.

9.3 Findings for Model 2: the stock market infrastructure

ARDL cointegration tests for *Model 2A* reveal the existence of a relationship between the value of shares traded on the stock exchange and the number of listed securities. Such a relationship means that, even though banks and the growth process lead to stock market growth (as in *Model 1*), the infrastructure within the stock market itself can be stimulated by encouraging greater trading participation in the equity market. We note that it is only when trading *value* (or turnover) is used as the indicator of investor trading that a cointegration relationship is verified: when we use trading volume we cannot detect evidence for cointegration. We are also interested in examining in more detail the process behind stock market volatility in Bangladesh and the role that trading and information play via the market microstructure process. GARCH results in *Model 2B* show that incorporating trading activity results in conditional volatility models that are more stable. Except for one case, there was little reduction in the GARCH persistence parameters. This however may be explained by the fact that the conditional variance is *driven* by the trading dynamics. Granger Causality results also indicate that the stock return (and returns volatility) is somewhat predictable using trading indicators. In conditional volatility and causality tests, and like the ARDL results, trading value displays better effects than trading volume. This suggests that future work should focus on why value rather than volume of trade is well-suited in forecasting price behaviour on stock markets.

9.4 Banks and stock markets both matter in a developing country

In Bangladesh bank finance is essential for economic development. Banks help enhance liquidity of the financial system by transforming more savings into productive

investment. It can be shown that bank activities ultimately lead to an increase in physical capital accumulation and economic growth (Greenwood and Smith, 1997). Nevertheless, while bank debt is by far the more important source of corporate finance for firms, *there is still a role for equity*. How can this be for a developing country? The answer essentially involves the greater role of information in a liquidity provision setting. Although firms finance their projects mainly through bank loans, they will also issue some equity. By measuring stock market development[1] in Bangladesh, what we are in fact doing is measuring part of the overall contribution of finance for economic growth and thereby achieving a richer understanding of the way the financial system works.

In this way while firms allow themselves to be monitored by banks, because of bank moral hazard firms in equilibrium will not totally rely on debt finance and will issue some equity (or other non-intermediated finance, e.g. bonds). W*e are likely to observe a relationship between banks and the stock market*. More debt issued means that more equity is eventually issued as well. Equity here is more a by-product of the decision to take on more debt. This implies that the stock market might be capturing some portion of the bank effect on economic growth. It should be stressed here that realization of this fact should not reduce our appreciation for the role of the stock market in Bangladesh. The stock market rather is reflecting (or signalling) the influence of the banks. This analysis leads to a re-interpretation of the finance – growth nexus for a developing country, one in which banks play a key role but where equity (and the stock exchange) still remains a factor to consider.

The findings for *Model 2A* are important as they indicate that within the stock market infrastructure trading in shares is positively related to the number of listed securities. This means that even if the emphasis from a policy perspective is wholly on bank soundness and development, this may not totally hold back stock market development. As long as there are a growing number of firms that desire to list on the stock exchange and as long as there appears to be an increasing trend in the level of share trading, infrastructure

[1] Our approach has been to focus on the number of listed companies rather than strict price-based measures of stock markets (e.g. market capitalization) for assessing the role of the primary stock market in capital accumulation. For examination of the secondary stock market a superior approach is to use data on the value of trades rather than on volume of trades, and re-weighted market capitalization. Note however that both the primary and secondary markets represent the stock exchange so by using a range of relevant variables we are measuring different aspects of the same construct. This suggests the need to consider a range of indicators if analysis on the finance-growth nexus is to be useful.

dynamics can interact and lead to stock market development in Bangladesh. The results obtained from the conditional volatility and causality testing in *Model 2B* further reinforces our view that stock market development in Bangladesh is sustainable. The volume-volatility relationship and the wealth of results that it generates is a huge area in itself and should be of interest to financial analysts.

The results of *Model 1* and *Model 2* highlight the principal deficiency with policy in Bangladesh and in other economies at similar stages of development. A frequently cited criticism against the supposed positive contribution of the stock market for growth is that developing countries, first and foremost, need to improve the operation and overall soundness of their banking sectors, and that equity issuance along with the wider topic of stock market development is hardly an important matter for consideration. These criticisms are not baseless. Banks are highly instrumental in achieving economic growth, a point which we have repeated throughout this thesis[2]. The example of Bangladesh and the findings of this thesis certainly do not go against this view. What we find however is that the banking sector in Bangladesh has been growth-promoting while the stock market has also captured some of the growth-promoting features of the financial sector. It is this element which when combined with the bank development variable leads to the positive finance-growth relationship.

9.5 Have we resolved the issue of manipulation and corruption in Bangladesh?

The effects of manipulation and corruption in Bangladesh are arguably being captured to a degree in our empirical results. Bangladesh is often ranked as one of the most highly corrupt countries in the world and is thought to have one of the most ineffectively run bureaucracies in the world. How can we explain and justify our model formulations and any conclusions that we draw for the financial sector in light of this? Do we need to change any of our assumptions and motivations for examining financial development?

As described in Chapter 3 and also noted by other authors, it is quite likely that the picture in Bangladesh is being driven to an extent by commercial banks lending to connected or preferred groups, and to an extent by bogus companies attempting to list

[2] Interestingly given the state of the banking sector in today's environment many are now referring to the phenomenon of "casino-style banking" as being separate to "utility banking". Previously the emphasis was all on stock markets behaving like casinos. It appears that many people – economists included – are only just discovering what finance really means.

shares on the stock exchange or brokers trading in artificially-inflated shares. In terms of theory, asymmetric information analysis might be used to model the effect on the decisions of firms and investors if an environment of corruption and manipulation is assumed to operate. A detailed description of corruption and manipulation in an economy is beyond the scope of this work. Nevertheless we believe we can still say more based on our intuition and findings in what follows.

The effect of corruptive and manipulative practices in Bangladesh is so extreme and ingrained in the society that the whole economic system has likely been affected or influenced by such behaviour and incentives. This means that the same corruption and manipulation factors must apply to the financial sector as well. This is especially so given that the literature is now in near unanimous agreement that the real and financial sides of the economy are closely linked. Therefore whatever structural factors are in operation for the real economy, the financial system is likely to be influenced by identical factors. If we then assume that day-to-day activities in Bangladesh incorporate some form of malpractice, then given that such behaviour is endemic of the overall economic and financial system, *we are not therefore required to significantly modify our theoretical models nor should we be required to correct our empirical analysis*. The effects of corruption and manipulation are essentially 'washed out', since when all variables in the system are being driven by the same factor (e.g. corruption) there would then be no real need to radically alter any basic assumption or component of the model. Of course, this assumes (reasonably since it is Bangladesh) that such adverse effects are evenly spread across the system. If we were to assume instead that there were a greater number of differentiated groups, more disposable income and more sustainable growth – in other words as we allow the developing country to climb the ladder and become more developed and sophisticated[3] – then this adverse effects' spread would likely be less even. At that point it would be necessary to carefully construct the model given these more intricate features and reaction functions of firms and investors, and to make some attempt at correcting for these effects in the econometric specifications. Such requirements though are not thought to be essential for Bangladesh, at its current stage of development.

[3] As seen in the very first footnote of the thesis corruption and manipulation are known to occur in advanced capitalist systems as well.

The answer to the question stated in this section is therefore "yes". We believe that we have been able to deal with any effects arising due to manipulation and corruption for the analysis in Bangladesh, and hence we do not have to change any of our main assumptions. In any case, economic models that can adequately deal with such issues for the financial sector are to our knowledge entirely absent in the literature. This highlights an important area for future research.

9.6 Policy implications for Bangladesh

In terms of policy implications for Bangladesh, our most important finding is that finance leads to growth. The analysis should prove useful for central bank regulators and policy makers who wish to formulate an effective strategy for development. The first step of that strategy is to ensure that the banking system can perform its activities to the required standard. With regards to specific suggestions, in *Model 1* the ARDL cointegration results indicate that both quasi-money (bank development) and the number of listed companies (stock market development) are the long-run forcing variables for the real capital stock/output ratio. This means that ultimately it is the whole financial sector which accelerates the rate of growth. We have suggested the need for research to focus more on how financial development *jointly* enhances liquidity in the financial system *and* enriches the information flow via banks and stock markets[4]. In other words, banks and stock markets together may reduce the severity of transactional costs and informational asymmetry problems in financial markets leading to higher growth.

Our findings from *Model 1* together with the prevailing institutional environment of the financial sector in Bangladesh imply that bank development plays an essential role in capital accumulation. Banks are instrumental in achieving economic growth. When one looks at the stock market in Bangladesh, it has remained relatively small. Nevertheless, the stock market has also displayed growth: the number of listed companies (on the primary market) and measures of trading activity show upward trends over the sample period, largely mirroring the growth in the banking sector. It is noteworthy that the authorities in Bangladesh have recently taken steps to effectively regulate the financial sector. However, policy needs to proceed carefully. We have stressed that the financial structure – the mix of financial intermediaries and markets in the economy – matters

[4] In distressed periods the prices of assets may need to be 'marked-to-model' rather than 'marked-to-market'. This will require formulating an appropriate structural framework as we have done here.

greatly for development. At the very minimum, this realization justifies a closer look at the broader financial system[5] – and a closer look at each constituent financial component – together with an understanding of how the encompassing system is evolving. Strengthening the overall regulatory framework of laws and best practice in financial and corporate affairs together with credible monetary and fiscal policy are essential pre-requisites for any strategy to succeed. But while the encompassing model described in this thesis allows the economist to potentially identify the growth- and finance-enhancing effects (represented by the integration of *Model 1*, *Model 2A*, and *Model 2B*), it should not be forgotten that such a structural system also constrains itself given the same set of (inter-connected) relationships. This may have profound implications for policy success.

9.7 A need to re-assess the finance-growth relationship

In Bangladesh and other developing countries more emphasis should therefore be placed on a policy of *overall* financial development – banks and stock markets – rather than restrict the focus to the banking sector or the growth process. While this is largely in accordance with Levine (1997) and his supporters, our representation of the finance-growth nexus offers an interesting twist in the debate. The financial structure can be shown to be an intricate set of linkages between the real and financial sector, and it represents interacting forces between banks, stock markets, and the growth process. These new findings for Bangladesh and the need to integrate theory should hopefully motivate further research particularly in application to low-income countries. Stimulating the right mix of stock market development and banking development may result in an 'optimal' financial structure which is supportive of growth. Financial structure could indeed matter for growth, somewhat contrary to Levine (2002). The statement by Levine that: "there is no support for either the bank-based or market-based view" (p.398) may need some qualification. His conclusion that it is the overall level of financial development which matters for growth is exactly the same as ours. We however caution against the over-simplification of what can be shown to be a complex interactive process within the financial sector, with feedbacks from the real economy and growth process.

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[5] The 'kerb' markets and other unorganized forms of finance in Bangladesh may also be relevant here. The reader should also refer to the discussion in chapter 1 regarding micro finance. In a way, all these various financial services are important for achieving poverty alleviation and economic growth. Our contribution of *Model 1* and *Model 2* has been to demonstrate in detail how, theoretically and empirically, both commercial banks and the stock market have mattered in Bangladesh. Other forms of finance could similarly be shown to matter (or not as the case may be) and this is a promising avenue for future work.

Proponents of the functional approach to finance all appear to point to the same conclusion. Financial structure is not very useful in explaining differences across countries in terms of growth rates. What matters for economic growth is *overall* financial development, along with a supporting system of laws and regulations. Using the terminology of Levine and his supporters, a typical conclusion would be along the lines of: "it is just not banks or stock markets, but rather banks *and* stock markets which matters". What this thesis has done is to make clear that this summary hides a wealth of important information that is driving the finance-growth nexus and stock market infrastructure. In the case of Bangladesh, the *finance-to-growth*, *growth-to-finance*, and *banks-to-stock market* effects all play a role. In addition, the *listing-trading*, *volume-volatility*, and *trading-stock return* effects re-affirm and extend the findings.

We have therefore suggested a modification to the functional approach, which can be applied not just to Bangladesh but also to other countries as well. This modified approach says that the level of bank activity and the level of stock market activity are not mutually exclusive but instead may be jointly determined (even in a setup where banks are 'special' and perform key growth-accelerating activities). There is a complementary relationship between banks and stock markets which ultimately has an impact on economic growth. The message of the modified functional approach is that the financial structure can be shown to matter in addition to having a strong legal and regulatory framework in place so that the financial system can operate effectively.

A final but very important point is that a system such as ours which is structured in the manner shown will capture the forces for expansion but at the same time it also places limits on how far the individual components or variables within that system may grow. Should these variables expand or contract disproportionately in relation to the whole, then under normal circumstances the system should re-adjust by itself. But under conditions of financial crisis, depressed economic growth and high uncertainty this may no longer be the case. Central bank policy under these circumstances should look beyond the reliance on so-called "automatic stabilizers" like official interest rates and their impact on inflationary expectations. This is because confidence in the economy is only likely to be restored when the finance-growth nexus and stock market infrastructure is operating reasonably well according to an overall structural framework.

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