Stock Markets, Banks and Economic Growth

By

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The candidate confirms that the work submitted is her own and that the appropriate credit has been given where reference has been made to the work of others

Dedication

To My Father: Brahim

and

My Mother: Zohra

Declaration

This is to certify that this thesis is the result of an original investigation. The material has not been used in a submission for any other qualification. Full acknowledgement has been given to all sources used.

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Abstract

This thesis investigates the relationship between economic growth and financial development in developing countries over 1988-2001. Previous studies have generally used averaged data, for both developing and developed countries, and inappropriate estimation methods. In an attempt to reach some definitive conclusions, Generalised Method of Moments dynamic estimation is used with a newly collected panel of annual data to assess the relationship. The results show that while banks performance has a negative impact on growth, stock markets positively promote growth. To reach an overall conclusion about the impact of finance on growth and to solve the problems associated with the existence of multicollinearity among the different measures of financial development, principal components analysis is used to generate new comprehensive measures of financial development. In assessing the link between the new measures and financial development and growth, the results support the existence of an overall positive relationship. The thesis also examines the behaviour of interest rates in developing and industrialised countries using individual and panel unit root tests. The results are sensitive to the choice of the test, country and time unit.

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Chapter 1

Introduction

1.1. The Thesis

This thesis is about the relationship between growth and the development of stock markets and banks. This relationship has long been a topic of interest and debate and economists hold different views regarding the importance of the financial sector for growth. According to Khan (2000), Bagehot (1873) in his *Lombard Street: a Description of the Money Market* argues that the specific characteristics of the English financial market promoted the allocation of savings towards different long term profitable investment projects and the adaptation of new technologies that played an important role in promoting industrialization in England. Schumpeter (1912) also acknowledged the importance of banks in increasing economic growth by identifying the investment projects that implement innovative products and production processes. In contrast, numerous other economists believe that finance is relatively unimportant factor for economic growth. Lucas (1988) ignored the importance of finance for economic growth and believed that the role of finance in growth is over stressed (Levine, 1997. p 688). The role of finance in promoting growth is also ignored by development economists. Stern's (1989) survey of development economics does not mention the financial system even in his excluded topics. Furthermore, none of the leading development economists, including three Nobel Laureates (Hirschman, Rosenstein-Rodan and Tinbergen), consider finance as a factor in development (Chandavarkar, 1992).

Recent research, however, indicates that financial systems play a critical role in stimulating economic growth. A large number of studies, discussed in chapter 3, support the existence of a positive relationship between finance and growth (e.g. King & Levine 1993a, Levine *et al.*, 2000 and Rousseau & Wachtel, 2000).

1.2. Financial Development

In the literature the concept of financial development generally refers to improvements in the size, efficiency, pricing mechanisms and stability of the financial system. This, however, encompasses different methods and processes. Therefore, the notion of financial development is not precisely determined. It is a comprehensive concept that can be measured in different ways covering different aspects. Hence financial development is a complex notion that this thesis attempts to measure

1.3. The Motivation

Motivated by three main shortcomings in the literature on finance and growth, an attempt is made to investigate the relationship between financial development and economic growth. First, most of empirical studies on the growth and finance relationship suggest the existence of a uniform positive relationship. The impact of financial system development on the process of economic growth depends on how the system is set up, including the type of the established financial institutions, regulatory and supervisory laws and the effectiveness of government policies. Singh (1997) argues that financial sectors, even in developed economies, do not perform their role very well. Although, the financial sector's performance in developing countries is even worse since the legal framework is badly designed (Hermes & Lensink, 2000), its impact on economic growth is not debated in the current literature.

Second, the nature of the causal relationship between financial development and economic growth is far from settled. Mixed results are reported on whether financial development affects or is affected by economic growth (e.g. Ben M'rad, 2000 and Graff, 2002).

Third, in the recent literature, different variables have been proposed to measure financial development. But none of these variables could encompass the comprehensive concept of financial development.

In an attempt to solve these shortcomings in the recent literature, this study aims to examine the relationship between financial development and economic growth focusing mainly on developing countries. Following the literature, most of variables used in measuring financial development are collected and their importance for growth is tested using both cross-country regressions and advanced dynamic panel data techniques. New proxies for financial development are then formed using principal components analysis which involves the transformation of a given set of variables into a smaller set of uncorrelated variables so that most of the original information is preserved. Having recognized the importance of interest rates in the financial sector, this study also looks at differences in their behavior in developing and industrialized countries using both annual and quarterly data. To our knowledge, this study is the first to attempt measuring financial development using principal component analysis for developing countries and uses the annual new proxies in advanced dynamic panel data estimation, and comparing interest rate behavior in developing and industrialized countries.

1.4. Contents

Chapter 1 provides the introduction to the thesis. Focusing on the macroeconomic aspects, Chapter 2 examines different theoretical contributions of modeling economic growth. It explicitly considers finance in the growth process. It attempts also to determine a comprehensive notion of financial development. In reviewing the literature in chapter 3, no attempt will be made at a comprehensive review of the finance and growth relationship. Instead, this study focuses on the empirical literature related to cross-country growth regressions, time series analyses and panel studies of growth and finance. Chapter 4 describes the data and the methodology used in analyzing the link between financial development and economic growth. Chapter 5 examines the relationship using the traditional measures used in the literature as well as the new proxies, based on principal components, for financial development. It also provides a discussion of the different results, comparing them with the literature. This chapter is followed, in chapter 6, by an investigation of whether the behaviour of interest rates, as the important price in the financial sector, differs between developing and industrialised countries, and in particular in whether interest rates are stationary. Holding inflation constant, high interest rates reflect people`s time preferences as well as the risk related to financial assets.Also, a positive link exists between real interest rates and financial savings (Lynch, 1993). If more savings are transformed to productive investment via the financial system, more growth occurs in the economy. Interest rates movements should be efficiently determined in the financial market. Any controls or limits set to determine interest rates may slow economic growth and development. Hence the behaviour of interest rates is a very important element in studying the development of the financial system. The effects of temporal aggregation are also examined by using both annual and quarterly data. Finally, the conclusions and recommendations are presented in chapter 7.

1.5. The Contribution to Knowledge

This thesis advances the current literature in a number of ways. Firstly, it focuses entirely on developing countries. It uses annual, rather than averaged, data on traditional and new measures of financial development. The methodology used in Chapter 5 corrects for the estimation problems present in the literature. Also, in Chapter 6 it shows the sensitivity of interest rate behavior to the choice of countries, tests and time units. So far the following papers have been developed from the thesis:

- Saci, K & Holden, K. (2005). Evidence on Growth and Financial Development using Principal Components. (Being prepared for submission to Applied Economics)

- Saci, K., Holden, K & Giorgioni, G. (2005). A Comparison of Interest Rate Behaviour in Developing and Industrialised Countries (Being prepared for submission to Applied Financial Economics)

- Saci, K & Holden, K. (2005). Does Financial Development affect Growth? (Being prepared for submission to Applied Economics Letters)

These papers are available online on www.cibef.com/working papers.

Chapter 2

Theoretical Contributions

2.1. Introduction

The importance of the interactions between financial and the real sectors in the process of investment and growth has been stressed by recent research. Various contributions have been made by economists from different backgrounds with considerable differences in the interpretations of the links between the real and financial sectors. During the last fifty years theories have evolved significantly, moving from the view that growth is exogenously determined, and therefore governments can not influence it, to the view that economic growth is endogenous and hence institutions and policies matter. This chapter presents an overview of the current issues in economic research on the relationship between financial development and growth with a focus on the macroeconomic aspects. Section 2.2 presents the neo-classical view of economic growth as well endogenous growth theory. Section 2.3 explicitly includes the financial sector in the growth model. Keynesian and post-Keynesian views are examined in section 2.4 and the functions of the financial sector are analyzed in section 2.5. Finally, the notion of measuring financial development is examined in section 2.6.

2.2. Economic Growth Models

When economists refer to economic growth they usually imply a quantitative and a measurable increase in output that occurs in the economy (i.e. real GDP). The real GDP per capita of an economy is often used as an indicator of the individual's average of standard of living in that country. Economic growth is therefore an indicator of an increase in the average standard of living (World Bank, 2005). According to Gross (2001) and Binswanger (1999) there have been three main views in the development of economic growth modelling.

2.2.1. The Neo-classical Growth Model

According to Gross (2001) and Agenor & Montiel (1999), Solow (1956) proposed one of the most significant contribution in the growth literature. Solow's model is developed in an environment where prices are assumed adjusted (i.e., supply is equal to demand). The model assumes constant returns to scale (i.e. a doubling of inputs leads to a doubling of outputs) and decreasing marginal returns (i.e. adding extra capital while holding labour input fixed yields smaller increases in output). The model also assumes that aggregate output is produced in a Cobb-Douglas production function with three main factors: labour, capital and technology (Agenor & Montiel, 1999):

$$Y = AK^{\alpha}L^{1-\alpha}, \qquad 0 < \alpha < 1 \qquad (2.1)$$

where A measures the level of technology, L the number of workers employed in the production process and K the capital stock. Labour input grows at rate n whereas technology grows at rate g. A fixed fraction of output is assumed to be saved each period for capital accumulation. Capital accumulates according to:

$$\dot{K} = Ys - \delta K \quad 0 < s, \delta < 1 \qquad (2.2)$$

where Ys and δ denote saving and the rate of depreciation respectively. Capital stock, therefore, depends positively on savings (equals investment in a closed economy) and negatively on depreciation. When considering output per worker y, which equals (y =Y/L), it depends only on technology and capital per worker (k =K/L):

$$y = Ak^{\alpha} \text{ , } 0<\alpha<1. \qquad (2.3)$$

Assuming that A is constant over time, capital per worker accumulates as follows:

$$k = ys - (n + \delta)k, \quad 0 < s, \delta < 1 \qquad (2.4)$$

where s and n denote the propensity to save and the exogenous growth rate of population respectively.

According to Gross (2001), following (2.4), the change in capital per worker is determined by three variables: it is positively related to investment (saving) per worker and negatively related to population growth and depreciation. Capital per worker increases when investment is greater than the population growth rate plus the depreciation rate. That is, when the saving per worker is greater than the amount of investment needed to compensate for new workers and depreciation. If there is no investment (savings), capital per worker decreases as population grows. Substituting equation (2.3) in (2.4) and considering the growth rate of the capital per worker yields:

$$g_k = \dot{k}/k = sAk^{\alpha-1} - (n+\delta) \qquad \text{and} \qquad g_y = \alpha g_k. \qquad (2.5)$$

where g_y denotes the rate of growth of output per worker. For k to be constant, capital must grow at rate n, the same rate as population growth. There should always be new investment to match increases in the labour force. In the long run, capital and labour grow at the same rate and the ratio remain constant despite to savings rate Gross (2001). Extra units of capital per worker produce less and less according to decreasing returns to capital, while depreciation remains constant. Eventually, all savings will be used to replace the amount of existing capital lost due to depreciation. Growth is affected only in the short-run as the economy converges to the new steady state output level. In the long run the saving rate has no effect on the growth of capital.

The model also assumed that countries would converge towards the same steady state levels of per capita income if they have had similar production technologies, savings and population growth rates. Solow (1956) concluded that poor countries will grow faster than rich countries, but both will converge to the same level of per capita income since per capita growth in the steady state depends entirely on exogenous unexplained technological progress available to all countries. Therefore, all countries will grow at the same rate (Agenor & Montiel, 1999, chapter 17).

To summarize, according to Gross (2001), the main conclusion of the Solow's growth model is that once the steady state is reached, only exogenous technical progress or changes in demographic factors can affect growth. An increase in the saving rate or any policy change affecting the economy will increase the per-capita income but not long-run growth.

2.2.2. Endogenous Growth Theory

In the neo-classical growth model, growth is exogenous and unexplained, and it can increase only through progress in technology. That is, the source of growth is external to the model as compared to endogenous growth which is within the model. According to McCallum (1996), Lucas (1988), Rebelo (1991) and Romer (1990) developed models in which growth can be generated endogenously. Two main views were adopted. The first involves capital accumulation externality and the second relies upon the accumulation of human capital. The first view was developed by Rebelo (1991). He assumed that there were two types of factors of production: reproducible which can accumulate over time (i.e. physical and human capital) and non-reproducible, which are available in every period with the same quantity (i.e. land). This model is assumed to be according to a Cobb-Douglas function and all inputs are reproducible (Rebelo, 1991). Capital in Rebelo's (1991) model has a broader definition. It is not just machines and buildings but also human capital. Both human capital and physical capital interact in the production process with no decreasing returns to capital. The growth model suggested is the so-called AK model:

$$y = Ak \tag{2.6}$$

where, as before, k=K/L and A the technology parameter but α is set to one in (2.3). The production function is linear with constant returns to scale (Ribeiro, 2003). As in (2.5), the steady state growth of the capital stock per worker equals:

$$g_k = sA - (n + \delta) \tag{2.7}$$

With the steady growth rate per capita given by:

$$g_y = sA - (n + \delta) \tag{2.8}$$

This implies that the growth rate is positive and constant over time if $sA > n + \delta$ and that the level of income per capita rises without a limit. In contrast with the neo-classical growth model, this model allows an increase in the saving rate to positively affect per capita growth rate. Even if countries share the same technology and saving pattern, the model does not imply convergence between them (Agenor & Montiel (1999, chapter 17)).

The second attempt to endogenize growth relaxed the perfect competition assumption. In its model, it assumed an endogenous technical progress with externalities in the production (McCallum, 1996). Externalities take the form of accumulation of knowledge gained by firms (Romer, 1986) or by workers (Lucas, 1988). The first model assumes that more productive firms increase the average stock of knowledge of other firms. In other words, when a firm introduces an innovation in its production process, other firms in the same sector will also benefit from it. The rate of technological progress is influenced by knowledge and hence, is determined endogenously. The use of knowledge in the production process has increasing returns, and therefore, growth can be unlimited and determined endogenously (Klenow & Rodriguez-Clare, 2004). Lucas (1988), however, focused on the importance of human capital. Externalities take the form **of public learning.** That is the interactions between agents during the production process that increase the social returns to human capital compared to the private ones. Agents with more skill may raise the productivity of others involved in the same production process. Hence, the total productivity of the economy might be increased by accumulation of human capital with no decreasing returns. This is presented as follows:

$$Y = K^{\alpha}(hL)^{1-\alpha} \qquad (2.9)$$

where h represents human capital per person. The model assumes that human capital grows according to:

$$\dot{h} = (1-u) \qquad (2.10)$$

where u is the time spent working and $1-u$ is the time spent accumulating skills. A government policy that aims to increase the time individuals spend in training and gaining more skills results in an increase in the rate of economic growth (Jones, 2002). In this model there are two ways to save. A fraction s is saved for capital accumulation, as in Solow`s model, and a fraction q is saved to accumulate human capital. Steady state y, k and h grow at the same rate determined by the fractions s and q:

$$g_k = g_h = g_y = s^{\alpha} q^{1-\alpha} \quad (2.11)$$

Growth in this model is determined by the choice to invest in either physical or human capital. Governments can influence growth through policies that target changes in human capital or physical capital (Gross, 2001).

The conclusions of the presented models for growth can be summarized as follows:

- The Neo-classical model of growth does not allow savings to have an impact on economic growth, which is only affected by demographic or technological changes that occur exogenously. This model prevents government policies from influencing the growth process. The role of the financial system in promoting growth is completely neglected.

- By rejecting decreasing returns to scale, the AK model allows savings to increase the long run growth, which gives governments room to affect economic growth

- Externalities to the growth process take the form of knowledge or public learning. Growth depends on saving and the time spent on accumulating human capital in the production process.

Having ignored the function of money as a medium of exchange, models influenced by neo-classical thought did consider 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) (Binswanger, 1999.p 4).

The recent developments in endogenous growth literature stressed the importance of the interaction between the real and financial sectors. It examined how financial markets and intermediaries affect the growth process directly by transferring savings towards investment. The next section presents the model that introduces financial intermediation explicitly in the growth process.

2.3. Financial Development and Economic Growth

The growth models presented earlier do not have financial intermediation explicitly modelled. They imply that the entire fraction saved from aggregate output is directed to investment. This suggests the existence of costless transfers of savings towards investment (Gross, 2001). Financial intermediaries improve the efficiency of these transfers and direct them to increase capital accumulation and hence real output growth. According to Pagano (1993), the effect of financial intermediaries on growth can be considered in the AK model as in (2.6) but where a fraction $1-\phi$ of savings is lost due to financial intermediaries' intervention and only the fraction ϕ of savings is available for investment:

$$\phi s_t = I_t \qquad (2.12)$$

The steady-state growth rate with constant returns to scale as in Rebelo (1991) model equals:

$$g_y = A\phi s - \delta \qquad (2.13)$$

The fraction $1-\phi$ is taken by banks as the spread between lending and borrowing rates, and by securities brokers and dealers as commissions and fees in the form of profits from the provided financial services (Pagano, 1993). This fraction represents the transaction cost. The more efficient the transformation of savings into investment, the lower the loss of resources and the more savings are transferred to productive investments (Thiel, 2001). Equation (2.13) shows the different routes through which financial development may influence economic growth. Two main routes are identified: the effects on capital allocation and productivity $A\phi$ and the effects on the saving rate s.

2.3.1. The Effects on Capital Allocation and Productivity

The main function of financial intermediaries is to allocate funds to those projects with the highest marginal productivity. They collect information, process it and evaluate it to identify profitable investment projects. Also, they encourage entrepreneurs to invest in riskier but more productive technologies by providing the risk sharing function. According to Pagano (1993), this route has been examined by Greenwood & Jovanovic (1990). Their model differentiates between capital invested in safe low yield technologies or risky high yield ones. The latter are affected by two types of shocks: an aggregate shock that affects all projects in the same sector, and a project specific shock. With their large portfolios and processed information, financial intermediaries can identify the aggregate productive shocks and encourage their customers to select the most profitable investment projects. Hence, savings transferred through financial intermediaries are allocated more efficiently. The higher productivity of capital results in higher growth. Efficient allocation of capital can also be provided in financial market by giving profitable investment projects low financing costs and preventing less productive investment projects by imposing high costs of capital (Thiel, 2001). By providing liquidity, financial intermediaries facilitate the engagement of entrepreneurs who prefer liquid investment in illiquid but more productive projects. Financial intermediaries manage the liquidity risk of depositors and transfer most of their savings to investors. The fraction kept as liquid assets does not exceed the total expected withdrawals by depositors in liquidity shocks (Pagano, 1993). In terms of stock markets, selling shares can also be a way of securing liquidity. Portfolio diversification insures spreading risk over different uncorrelated sectors and allows agents to engage a proportion of their investments in riskier, more productive, projects. In sum, the capital allocated to productive projects is affected by the ability of financial intermediaries to evaluate information, share risk and provide liquidity provisions.

2.3.3. The Effects on Saving Rate

As presented in the previous section, endogenous growth models allow growth to be affected by savings. The recent growth literature has shown that the direction of the relationship is ambiguous due to the fact that financial development may reduce savings and hence growth. As financial markets develop, they offer agents better protection against liquidity and risks. With less uncertainty, savers may decide to lower their overall savings rate. Introduction of the insurance market reduces the need for precautionary saving. In an endogenous growth model, this reduction in savings decreases the growth rate and hence financial development may negatively affect growth. Also, households' borrowings in the form of consumer credit and mortgage loans may lead to a reduction in savings as current consumption depends more on available resources rather than permanent income (Pagano, 1993).

2.4. Keynesian and Post-Keynesians Perspective

This section borrows heavily on Binswanger (1999). Endogenous growth theory, as well as the neo-classical, assumes that financial development always promotes growth in the real sector. However, according to Binswanger (1999), Keynes (1936) and post-Keynesians[1] (1996) claim that financial development is not always accompanied by a positive increase in real productivity and it may even negatively affect the real sector. According to Binswanger (1999), productive investment projects are not always financed since investment is mainly determined by expectations in an uncertain environment. Financial assets can be saved but not used for real investment or consumption of goods and services. The financial sector, hence, allows savings that would not necessarily be transferred to promote real investment. As profit expectations change, more volatility and speculative bubbles arise in the economy. If financial assets offer high returns with less risk, investors turn into speculators. This can cause instability or even hinder the real

1 According to Binswanger (1999), the term Post-Keynesians refers to a particular school of thoughts in the Keynesian tradition. This school refused to accept the main assumptions of Monetarism and Neo-classical economic theory.

sector. Binswanger (1999) claims that a negative correlation between financial activities and growth is explained in the following hypotheses:

(a) The Crowding-out Hypothesis

When the government borrows, it increases the demand for funds and causes an increase in interest rates. When financial assets offer higher returns than real investment projects, more savings are transferred into financial assets. Thus, less funding is available for real investment. This harms capital formation and negatively affects economic growth. (Darrat, 2002)

(b) The Financial Dominance Hypothesis

If the economic fundamentals, such as interest rates and exchange rates, are increasingly determined by speculative financial activities, they could give the wrong signals about state of the economy. Therefore, the financial sector increasingly controls the real sector.

(c) The Casino Hypothesis

When speculative bubbles arise, prices in financial markets, especially stock markets, do not accurately indicate the economic reality. In this case, prices in financial markets are not determined by discounting expected future cash flows which should reflect all the available information about the fundamentals. They are affected by irrational behaviour of speculators, which makes them no longer reliable as, in the words of Keynes, "intelligence is devoted to anticipate what average opinion expects the average opinion to be" (Binswanger, 1999. p11). These conditions will increase the gap between the real and the financial sector and harm the growth process.

(d) The Short-Term Hypothesis

Financial markets prices tend to react rapidly to information affecting expectations. This causes more volatility, resulting in short-term losses or profits. Short-term speculators are attracted to these conditions as they want to make profits as quickly as possible. In making decisions about the performance of projects, managers will value short-term success in the market. Long-term investment is undervalued by managers as financial markets undervalues it. This harms long-term productive investments and hence growth.

(e) The Financial Instability Hypothesis

Minsky (1959) claimed that when the economy is booming, investors are encouraged to engage in more speculative activities. The increase in assets prices increases the investor's willingness to finance these activities through debt commitments which drives the interest rates high. More credit is used in financing speculative activities rather than real investment projects, resulting in a fragile financial structure. If the expected returns from the speculative activities do not exceed the debt, most speculators go bankrupt and the economy ends up in a debt deflation.

All these hypotheses establish a negative link between financial development and economic growth. This link is mainly characterized by the influence of speculation on the real economy. Therefore, financial development may have a severe negative impact on growth.

2.5. Financial Sector Functions and Growth: The Channels

As presented earlier in section 2.3, theory suggests that the costs of acquiring information and making transactions generate incentives for the emergence of financial markets and institutions. Distinct types and combinations of information and transition costs create different financial contracts, markets and institutions. When emerging to mitigate information and transaction costs, financial systems provide one fundamental function: they facilitate the allocation of resources, across space and time, in an uncertain environment (Merton and Bodie 1995, p.12). Levine (1997) breaks this into five basic functions:

- Mobilizing savings,
- Facilitating risk management,
- Allocating resources,
- Monitoring managers and exerting corporate control,
- Facilitating the exchange of goods and services.

(a) Mobilizing Savings

The mobilization of savings is the most important function performed by the financial sector. An individual saver may not be able or willing to completely fund a borrower. However, he prefers storing his money in a form of deposits for security and profit reasons. Financial markets and intermediaries accumulate savings from individuals and make them available for lending to investors or enterprises to finance their projects, hence encouraging public and private investments and promoting growth. In addition, the returns on savings can create riskless profits for the savers, which may increase their savings. They can also encourage the development and implementation of new technologies. McKinnon (1973) illustrated this with an example of a farmer who can not acquire particular equipment using his savings. He needs to access external financial recourses, provided by financial intermediaries, to buy it and increase his productivity. Therefore, the mobilization of savings enables the farmer to introduce a new technology that results in an increase in his income. By mobilizing savings, and increasing the availability of funds for investors, financial intermediation encourages investment in new technologies across the economy, which increases the overall productivity (Levine, 1997). Savings may also be mobilized to finance investment in education, which promotes the accumulation of human capital and hence increases economic growth (Lucas, 1988).

(b) Facilitating Risk Management

Levine (1997) focused on two types of risk: liquidity risk and idiosyncratic risk. Because of the uncertainties related to converting assets into purchasing power, liquidity risk emerges. The association between liquidity and economic growth arises because productive investments require long–term financial commitment. But savers are not willing to lose control of their savings for long periods and prefer to have the option to withdraw their savings, or move them into another investment opportunity. With a liquid capital market, savers can hold assets that they can sell quickly and easily if they seek access to their savings. Besides capital markets, financial intermediaries with large number of depositors can offer a mixture of liquid deposits to savers and undertake a mixture of liquid low-return investment and illiquid high-return investment. Hence, they provide complete insurance to savers while simultaneously facilitating long-term investment.

In addition to reducing liquidity risk, financial systems may also reduce the risks associated with individual projects and firms by diversifying risk. Investing in a single project is riskier than investing in many projects in different, uncorrelated, sectors. Moreover, risk diversification can also influence innovation. An increase in productivity requires the introduction of innovation in the production process which involves high risks because of uncertainty regarding the expected returns. By holding a diversified portfolio of innovative projects, stock markets and banks finance innovation and hence generate real growth (King & Levine, 1993c).

(c) Allocating Resources

The ability to get and process information has important growth implications. Individual savers are incapable of acquiring and processing information regarding firms, managers and market conditions. Since many firms and entrepreneurs will seek capital, financial institutions and markets have a wider experience and are better at identifying entrepreneurs with the most promising projects (Levine, 1997). Efficient allocation of capital results in higher growth. In developing countries, financial institutions may have limited information on investment projects since much of the economy is informal.

(d) Monitoring Managers and Exerting Corporate Control

Managers' information regarding the potential profitability of their projects is likely to be superior to the information provided to outside creditors and shareholders. Insiders may attempt to take advantage of this information to increase their earnings. This information advantage is eliminated by imposing monitoring and corporate control through the intervention of banks on behalf of their investors, the efficient separation of ownership from management in firms and the encouragement of take-overs of poorly managed firms (Khan, 2000 and Levine, 1997).

(e) Facilitating Exchange

The interactions between facilitating exchange, specialization, innovation and economic growth were the primary elements of Adam Smith's (1776) *Wealth of Nations*. He argued that workers are more likely to identify more efficient working methods and processes if they focus on one particular product. Hence, specialization of labour is the main cause of productive innovation. Further specialization necessitates more transactions. Since each transaction is costly, financial contracts that reduce transaction costs will promote greater specialization which in turn facilitates productivity gains and allows more technological innovation and growth. Therefore, financial agreements that facilitate exchange of goods and services or lower transaction costs facilitate productivity gains and growth (Levine, 1997).

2.6. Measuring Financial Development

According to Dfid (2004), there is no consensus on a single definition of financial development. The empirical studies reviewed in chapter 3 focus on different possible measures of financial development. Also, the meaning of financial development is quite comprehensive since it covers different mechanisms and processes through which the financial sector may develop. These could involve:

- The improvement in the efficiency of mobilizing savings towards real investment.
- The availability of more credit to innovative projects.
- The attraction of more savings in different forms.
- The improvement of the stability of the financial sector.
- The enforcement of law regarding investor's protection.
- The increase of the sophistication of financial services and products.
- The increase of public access to credit for investment purposes.
- The reduction of transactions costs.
- The availability of more accurate information regarding potential investment projects.

It is difficult, if not impossible, to find a single measure of financial development that would account for these different aspects. Therefore, the notion as well as the process of financial development are quite complex and far from being measured accurately. In chapter 4 the measurement of financial development based on the standard growth literature is examined.

2.7. Conclusions

The relationship between financial development and growth is not always positive as proposed by the neo-classical and endogenous growth theories. Speculation and the ambiguous effect of the saving rate suggest a possible negative association between finance and growth. Also, the comprehensive concept of financial development is not accounted for in the finance-growth literature. Some of the empirical studies that attempt to explain the link are reviewed in the next chapter.

Chapter 3

Literature Review

3.1. Introduction

During recent years the relationship between financial development and economic growth has received considerable attention in the literature on growth and development. Endogenous growth theory accepts that government policies can influence growth. Financial innovation and knowledge creation, the principal forces in growth literature, have focussed attention on the impact of financial development on economic growth. Concentrating entirely on the macroeconomic aspects, this chapter reviews some empirical studies that attempt to assess the relationship between growth and finance. In terms of estimation approaches these studies are divided into three categories: cross-country, time-series and panel studies. In section 3.2 the empirical literature relating to cross-country growth regressions is considered. These regressions are performed mainly using five-year averaged data. In section 3.3 legal origin variables are introduced in these regressions as dummy and instrumental variables to account for the impact of the legal system on finance and hence growth. Section 3.4 focuses on time-series analyses where annual data are used to assess the link in individual countries. Section 3.5 discusses panel studies that combine cross-section and time-series data of growth and finance. Finally, section 3.6 presents some conclusions on the empirical literature on financial development and economic growth.

3.2. Cross-Country Studies

3.2.1. Goldsmith (1969)

According to Levine (1997), the link between financial development and economic growth was first investigated more than thirty years ago. Goldsmith (1969) used the value of financial intermediary assets divided by GNP to measure financial development. Using data for 35 countries over the period 1860-1963, when available, Goldsmith (1969, p.48) concluded that: "*periods of more rapid economic growth have been accompanied, though not without exception, by an above-average rate of financial development*". The work of Goldsmith, however, has some important weakness:

- It did not control for other factors influencing economic growth such as initial income and education.
- The investigation used a limited number of observations in the form of decade averages for 35 counties (Wachtel, 2001).
- The size of financial intermediaries may not reflect the activity and development of the financial sector.
- The correlation between the size of the financial sector and economic growth does not imply causality.

3.2.2. King & Levine (1993a)

King & Levine (1993a) initiated growth studies with cross-country data sets that have become the benchmark for other studies (Wachtel, 2001). King & Levine (1993a) used four measures for financial development averaged over the period 1960-1989. These measures are:

- BANK: the importance of the role of banks (relative to the central bank) for allocating credit, [bank credit /(bank credit + central bank domestic assets)],
- PRIVATE: the ratio of credit allocation to private business to total domestic credit (excluding credit to banks),
- DEPTH: the liquid liabilities of the financial system [(currency + demand and interest-bearing liabilities of banks and non-banks)/GDP],
- PRIVY: the ratio of credit to private business to GDP.

They also used three growth indicators averaged over the same period:

- Real per capita GDP growth (i.e. economic growth),
- Real per capita capital growth (i.e. capital accumulation),
- Total factor productivity (TFP) growth (i.e. productivity growth).

Controlling for other variables affecting economic growth (i.e. income, education, political stability, and measures of monetary, trade and fiscal policy), they estimated the following regressions on a cross-section of 77 countries:

$$G(j) = \alpha + \beta F(i) + \gamma X + \varepsilon \qquad (3.1)$$

where F(i) represents each of the financial development indicators, G(j) represents the three growth indicators and X represents a set of conditioning variables to control for other factors associated with economic growth (e.g. income per capita, education, indicators of exchange rate, trade, fiscal, and monetary policy).

King & Levine (1993a) found a very strong correlation between each measure of financial development and each growth variable. To investigate whether growth results from financial development, they examined whether the value of financial DEPTH in 1960 predicts the three growth variables averaged over 1960-1989. King

& Levine (1993a) concluded that subsequent rate of economic growth, capital accumulation and productivity growth were well predicted by the initial level of financial development when controlling for income, education, and measures of monetary, trade, and fiscal policy (Levine, 1997).

Although the work by King & Levine (1993a) is considered an important move towards a clearer understanding of finance-growth interlink as it added more countries to the Goldsmith (1969) model, controlled for other factors affecting growth and constructed additional financial development measures, there were some weakness in their analysis. While DEPTH measures the size of the financial intermediary sector, it may not, however, be an accurate proxy for the performance of the financial system. Also, the existence of correlation between the financial and the growth variables does not always imply a causal link. In addition, they ignored the effect of the stock market on economic growth as well as the dynamic property of the relationship.

3.2.3. Atje & Jovanovic (1993)

Atje & Jovanovic (1993) were among the first to add the stock market to cross-country growth studies. They investigated whether stock market development affects economic growth. For 40 countries they used five-year averaged data over the period 1970-1988. They regressed GDP growth per capita (GY) on three variables: the growth of the labour force (GL), the lagged investment to GDP ratio (I) and the product of lagged values of all stock market trades to GDP with lagged investment (IS) or the product of the lagged credit extended by private and government banks to GDP with lagged investment (IB).

With the assumption that the firms' capacity does not change over time the following equations were estimated:

$$GY = \alpha_0 + \alpha_1 GL + \alpha_2 I + \alpha_3 IS + u \qquad (3.2)$$

$$GY = \alpha_0 + \alpha_1 GL + \alpha_2 I + \alpha_3 IB + u \qquad (3.3)$$

The results revealed that both the product of the lagged credit extended by private and government banks to GDP with lagged investment (IB) and the lag of investment (I) were not significant. However, the product of the lagged stock market activity and lagged investment (IS) was significant at the 5 per cent level. Atje & Jovanovic (1993) concluded that the stock market had a significant impact on economic growth. They were surprised that more countries are not developing their stock market as quickly as they could as a way of promoting their economic growth. It is noted, however, that the lag structure disappears with averaged data. Hence the results might be misleading.

3.2.4. De Gregorio & Guidotti (1995)

De Gregorio & Guidotti (1995) used a sample of 100 countries over 1960-1985 to assess the link between 6-year averaged GDP per capita growth and financial development. Financial development was proxied by credit to private sector over GDP averaged over the same period. Taking into account other economic aspects (i.e. education, income, government spending, investment rate, revolutions and coups per year and an index of assassinations), they found divergent effects of financial market development on economic growth between high- income and low- and middle-income countries. More specifically, they found that financial development had no effect on economic growth in high-income countries, while it had a strongly positive effect in low- and middle-income countries. Also, financial development insignificantly affected growth over 1970-1985 for the low-income sample. While they ignore the effect of stock markets on growth, De Gregorio & Guidotti (1995) concluded that financial development has a different effect on growth in different countries, time periods or stages of development.

3.2.5. Levine & Zervos (1996)

Building on the work by Atje & Jovanovic (1993), Levine & Zervos (1996) examined the link between stock market liquidity and national growth rates, accumulation rates and the rates of technological changes. Two measures of liquidity were chosen:

- The Value-traded Ratio (the total value of shares traded on a country's stock exchanges / GDP),
- The Turnover Ratio (the total value of shares traded on a country's stock exchanges / stock market capitalisation).

Both measures of liquidity are important since a small liquid market may have high turnover but a small value traded ratio. Levine & Zervos (1996) investigated the correlation between each liquidity measure and the three growth indicators. For 41 countries over 1976-1993, economic growth, capital accumulation and productivity growth were averaged over two sub periods and regressed on the initial values of the liquidity variables (i.e. the value traded ratio and the turnover ratio in 1976). Controlling for other measures affecting economic growth (i.e. income, education, political stability, and measures of monetary, trade and fiscal policy), the results showed that the liquidity provided by stock markets had a strong positive impact on economic growth. While Levine & Zeros (1996) consider stock markets in their analysis of the relationship between finance and economic growth, they had a limited total number of 79 observations. Also, they did not consider other components of the financial system or the issue of causality.

3.2.6. Demirguc-Kunt & Levine (1996)

Demirguc-Kunt & Levine (1996) also made progress in examining the link between stock markets and economic growth. According to Demirguc-Kunt & Levine (1996), Devereux & Smith (1994) and Obstfeld (1994) demonstrated that internationally integrated stock markets influence the allocation of capital, the long-run economic growth rate and saving decisions by facilitating risk sharing. Theoretically, greater liquidity and risk diversification have ambiguous effects on saving decisions. However, enhanced liquidity and risk diversification could decrease saving rates and slow economic growth. Demirguc-Kunt & Levine (1996) describe various stock market indicators (i.e. the market capitalisation ratio, the number of listed companies, the turnover ratio, the value-traded ratio, concentration, volatility and integration) and construct four aggregate indexes, that combine the information contained in the individual indicators, of overall stock market development using data on forty-four developing and industrialised countries from 1986 to 1993. The correlation coefficients among the stock market development indicators reported by Demirguc-Kunt & Levine (1996) were below 0.60. They claim that this suggests that the different indicators reflect different aspects of stock market development. Demirguc-Kunt & Levine (1996) concluded that Japan, the United States and the United Kingdom are the three most developed, whereas as Colombia, Venezuela, Nigeria and Zimbabwe are the most underdeveloped markets. The Demirguc-Kunt &

Levine (1996) indexes did not include any measures of banks, institutional or regulatory development. Thus, some caution is required when assessing the validity of their results.

3.2.7. Harris (1997)

Based on the work by Atje & Javonic (1993), Harris (1997) focused on 49 out of the 60 countries that had official stock markets in 1991. Using data averaged over 1980-1991, he regressed the growth of output per capita on current investment instead of the lagged investment used in the Atje & Javonic's model (i.e. equation (3.2)). Harris found that current investment is significant whereas the stock market effect was much weaker than that suggested by Atje & Javonic (1993). Harris (1997) related current values of variables without any lags. Therefore, it is not possible to investigate the dynamics of the relationship or reach any reliable conclusions on the direction of causality.

3.2.8. Trabelsi (2002)

Trabelsi (2002) used cross-country averaged data regressions for a sample of 69 developing countries during the period 1960-1990. The per capita GDP growth rate (G_y) is chosen as the indicator of economic growth. The explanatory variables in the growth equation are the initial real GDP per capita (Yi) (in logs), the secondary school enrollment rate (H) (in logs) as a proxy for human capital and the financial indicator is measured by the ratio of the total assets of the financial system to GDP (M3/Y). The basic growth equation is:

$$G_Y = \alpha_0 + \alpha_1 Yi + \alpha_2 H + \alpha_3 (M3/Y) + \varepsilon \qquad (3.4)$$

Trabelsi found that financial development affects positively economic growth in cross-country regressions using the ratio of broad money to GDP (M3/Y) as an indicator of financial intermediation. When other variables are included to account for other economic phenomena associated with growth (i.e. the ratio of government spending to GDP (GOVY), the investment ratio (IY), the openness rate of the economy (MPXY) measured by the ratio of exports plus imports to GDP and finally the rate of inflation (INF), using the consumer price index), the whole estimated model corresponds to the following equation:

$$G_Y = \alpha_0 + \alpha_1 \, Yi + \alpha_2 \, H + \alpha_3 \, (M3/Y) + \alpha_4 \, GOVY + \alpha_5 \, IY + \alpha_6 \, MPXY + \alpha_7 \, INF + \epsilon \quad (3.5)$$

When this equation was estimated, the coefficient on the financial development variable (M3/Y) became insignificantly different from zero, which raises the importance of other determinants of growth.

3.2.9. Graff (2002)

Graff (2002) examined the link between financial development and economic growth over 1970-1990 for 93 countries. Stressing the poor validity of the financial development indicators used in the existing cross-country studies, a three-stage research strategy was followed in order to assess the link empirically. The aim of the first stage was to construct a new proxy for financial development for a large number of countries. Graff (2002) claimed that the measures of financial development used in the literature, mainly measures of liberalisation and financial depth, reflect either monetary and credit volumes or a potential financial crash. Therefore, a reliable measure should be based on real inputs and a well-established macroeconomic theory. Graff (2002) suggested that the proportion of resources allocated to run the financial system, by keeping transaction costs low and mitigating informational asymmetry, is a good and comparable measure of financial development as it is less affected by minor changes in institutional regulations, domestic and international shocks and business cycles. The three indicators, considered by Graff (2002) were: (1) the share of work force employed in the financial system, (2) the share of the financial system in GDP and (3) the number of banks and branches per capita.

Admitting that all three variables are far from satisfactory, principal components analysis is chosen to transform them into reasonable measures of financial development. This procedure identifies the common variance of the three indicators and, if finance is well represented by the first principal component, uses its individual scores as a valid proxy for financial sources. Graff (2002) transformed the normalized variables into five-year averages values over 1970-1990. The principal components analysis was then applied to the resulting 465 x 3 matrix (i.e. three variables for 93 countries over 5 time periods). The first principal component explained 76.6 per cent of the overall variance whereas the second and the third components accounted for only 17.3 and 6.1 per cent respectively.

Having specified the financial measures, Graff's second step investigated the causal link between financial activity and economic growth. The two variables used are FD, the financial development-proxy, and per capita income, Y/L. The basic model is as follows:

$$FD_t = \alpha_0 FD_{t-1} + \alpha_1 (Y/L)_{t-1} + e_t \qquad (3.6)$$

$$(Y/L)_t = \beta_0 (Y/L)_{t-1} + \beta_1 FD_{t-1} + e_t \qquad (3.7)$$

where the lag of 1 period refers to the previous 5-year average value of the variable. The estimation of the parameters α_1 and β_1 reveals the structure of causation. If neither of the two is significant, there is no indication of causation in either direction. If both are, the model indicates mutual (bi-directional) causation. If only α_1 is significantly different from zero that implies unidirectional causation from Y/L to FD, which is consistent with the demand-following finance hypothesis, whereas the significance of β_1 only implies unidirectional causation from FD to Y/L, which is consistent with supply-leading finance as defined by Patrick (1966).

The third and the final step in Graff's empirical investigation questions the stability of the relationship between financial activity and economic growth over 1970-1990. The lags used range from 5 to 20 years and the equations were estimated in levels rather than differences. The results revealed that β_1 is highly significant in 7 of ten cases, and exceeds the 5% critical value in another case, while α_1 is significant at the 1% level only in one case. Therefore, the general picture is that though there are undoubtedly signs of bi-directional causation between finance and economic growth, significance is mainly found in favour of the supply-leading finance hypothesis with the possibility of structural difference between 1970's and the 1980's. However, Graff (2002) concluded that the finance-growth nexus is far from being a stable relationship.

This work by Graff (2002) developed the literature by trying to determine more reliable measures of financial development. However, the use of averaged data hides the events and the detailed changes that occurred in the chosen two decades.

3.3. Finance, the Legal Environment and Growth: Using Legal Dummy and Instrumental Variables in Cross-Country Studies of Growth

Financial services and activities are based on contracts and hence the country's commercial and company law plays a critical role in the development of the financial system. According to La Porta, *et al.,* 1998, legal scholars divide countries into four main categories: English, French, German and Scandinavian legal systems. The first is referred to as "common law" since legal rules were introduced by judges trying to solve particular legal problems. The second is based on the code written under Napoleon (in 1807). The German law was adopted after Bismarck's unification of Germany in 1897. These laws spread to other countries through colonization and imperialism (La Porta, *et al.,* 1998). The Scandinavian countries developed their own legal laws in the 17th and 18th centuries. These laws are different in terms of the protection given to secured creditors and shareholders compared to other claimants in corporate bankruptcy and in terms of law enforcement (Levine, 1998). Unlike French laws, Common Law gives both shareholders and creditors the strongest protection. German and Scandinavian laws are in the middle. How effective these laws are depends on how they are enforced. The enforcement of legal rules is very important for finance. Rules enforcement is the strongest in Scandinavian and German laws and the weakest in French laws. Common laws are in between. For 71 countries Levine et al., (2000) regressed financial intermediary development indicators, measured by the liquid liabilities of the financial system, the ratio of commercial bank assets divided by commercial bank plus central bank assets and the value of credits by financial intermediaries to the private sector divided by GDP, on the dummy variables for French, English and German legal origin using data averaged over 1960-1995 for a maximum of 71 observations. The omitted dummy was the Scandinavian origin. Controlling for the level of real per capita GDP, they concluded that countries with a German legal origin have better-developed financial intermediaries. Levine (1998) reached the same conclusion when he regressed financial development, measured by the value of loans made by commercial banks and other deposit-taking banks to the private sector divided by GDP, dummy variables for German, English and French legal origin using data averaged over 19976-1993 for 49 countries.

La Porta, *et al.,* (1998, p.5) claim, "The French and the German civil traditions, as well as the common law tradition, have spread around the world through a combination of conquest, imperialism, outright borrowing, and more subtle imitation". Since most developing countries obtained their legal systems through occupation and colonisation, the legal origin variables may be treated as exogenous instruments. According to Levine (2003), recent research uses instrumental variables to determine whether finance- growth relationship is driven by simultaneity bias. These variables help to explain cross-country differences in financial development without being directly correlated with economic growth. Besides using the La Porta, *et al.*, (1998) legal origin variables as dummies, Levine, *et al.*, (2000) used these measures as instrumental variables. They focused on a sample of 71 countries with data averaged over 1960-95 and include countries with laws from English, French, German, or Scandinavian origin. They estimate the following equation:

$$G(j) = \alpha + \beta F(i) + \gamma X + \varepsilon \qquad (3.8)$$

G(j) is real per capita GDP growth over the 1960-95 period. The legal origin indicators Z, are used as instrumental variables for the measures of financial development, F(i). X is the conditioning information set (i.e. income, education, the ratio of government spending to GDP, the openness to trade and the rate of inflation), and is treated as an included exogenous variable. Assuming that the instrumental variables (Z) are uncorrelated with the error term ε, Levine *et al.,* (2000) concluded that there is a strong connection between the exogenous components of financial intermediary development, proxied by the value of credits by financial intermediaries to the private sector divided by GDP, the ratio of commercial bank assets to commercial bank plus central bank assets, and the liquid liabilities of the financial system, and economic growth when using legal cross-country instrumental variables. Although, this analysis considers causality, it treats the other explanatory variables as exogenous. The empirical work of Levine *et al.,* (2000), however, does not simultaneously take into account the role of equity markets.

3.4. Time-Series Studies

Different time-series techniques have been used to examine the finance-growth relationship. Granger causality tests, cointegration tests and vector autoregressive (VAR) techniques are commonly used to investigate the strength and the direction of the relationship. Rather than using averaged data, these studies use mainly annual and quarterly and, rarely, monthly data, covering relatively longer periods of time when compared with cross-country data. The measures of financial development used are more specific as their choice is not based on cross-country availability. These studies examine in detail a single country or a few countries, allowing the relationship to vary across countries.

3.4.1. Jung (1986)

Jung (1986) investigated the time-series properties of the causal link between financial development and economic growth using Granger (1969) causality tests with annual data over 1953-1980. He measured financial development using the ratio of currency to the narrow money (M1) and the ratio of broad money (M2) to nominal GNP. Economic growth is proxied by the real per capita GNP. Jung (1986) selected 56 countries having at least 15 annual observations on all variables. For each country four regressions were estimated, two for each financial development measure. Jung (1986) found that the direction of causality frequently runs both ways. He also found evidence that developing economies have a supply-leading causality pattern (i.e. financial development precedes growth) more frequently than the demand-following pattern (i.e. growth induces an expansion of the financial system).

3.4.2. Chen, Chang & Zhang (1995)

Chen *et al.*, (1995) study was one among many studies that investigated the impact of foreign direct investment (FDI) on China's economic growth. Chen *et al.*, regressed the logarithm of GNP on the lagged domestic savings and the lagged foreign direct investment (both in logarithms) using annual data over 1968-1990. A positive and a significant relationship was found between foreign direct investment and economic growth. To test the hypothesis that FDI can replace or is just a complementary measure to domestic savings, they regressed the logarithm of domestic savings on the logarithm of FDI. FDI was found to be insignificant, suggesting that it can not replace domestic savings. Chen et al., (1995) concluded that FDI had contributed to China's economic growth by increasing resources of capital formation. However, it can not be considered as a substitute for domestic savings. The role of the banking sector and stock market was completely ignored in the empirical work.

3.4.3. Rousseau & Wachtel (1998)

Rousseau and Wachtel (1998) conducted time-series cointegration and vector error-correction model (VECM) tests between financial development and growth for five countries (i.e. United States, Canada, United Kingdom, Norway and Sweden) with annual data over 1870-1929 using more comprehensive measures of financial development. They used the assets of commercial banks and the combined assets of commercial banks and savings institutions for Norway and Sweden, and, for the rest of the countries, assets of commercial banks, savings institutions, insurance companies, credit cooperatives and pension funds. They found that the dominant direction of causality runs from financial development to economic growth with little evidence of feedback from growth to finance. Rousseau and Wachtel's (1998) study omitted the role of stock markets in assessing the link between finance and growth.

3.4.4. Ben M'rad (2000)

Ben M'rad (2000) studied the relationship between financial development and economic growth for six South Mediterranean countries (i.e. Egypt, Jordan, Lebanon, Morocco, Tunisia and Turkey) using annual over 1980-1998. Financial development is proxied by two indicators. The first indicator is the logarithm of banking deposits over nominal GDP. The second indicator of financial development is the logarithm of bank claims on the private sector over nominal GDP. Economic growth is proxied by the logarithmic change of real GDP per capita. The Johansen (1988) cointegration tests show the existence of a stable relationship between financial development indicators and real output in five out of the six countries of the sample. The causality tests using the ECM representation demonstrate highly country specific results. Mixed results are reported on the direction of causality. Bi-directional causality is found from financial development to economic growth in two countries out of the six. However, some caution is needed when examining these results since the number of observation is at most 32. Also, the role of stock market development is ignored in all the countries studied.

3.4.5. Arestis, Demetriades & Luintel (2001)

Arestis *et al.,* (2001) used a vector autoregression (VAR) framework and concluded that the studies that use cross-country growth regressions might have exaggerated the contribution of the stock market to economic growth. Taking quarterly data from five countries: USA over 1972:1-1998:1, UK for 1968:2-1997:4, France for 1974:1-1998:1, Germany for 1973:1-1997:4 and Japan for 1974:2-1998:1 the variables are: output, measured by the logarithm of real GDP; stock market development, measured by the logarithm of the stock market capitalization; banking system development, measured by the logarithm of the ratio of domestic bank credit to nominal GDP and stock market volatility, measured by an eight-quarter moving standard deviation of end-of-quarter change of stock market prices. The evidence from the UK and the United States suggests that financial development does not seem to promote long-run growth. The positive influence of the financial system on output in Germany, Japan and France confirms the view that bank-based financial systems are more capable of promoting long-run growth than market-based financial systems. The work of Arestis, Demetriades & Luintel (2001) suggests the financial structure should be taken into consideration when investigating the link between financial development and economic growth.

3.4.6 Caporale, Howells & Soliman (2002)

Caporale *et al.*, (2002) investigated the importance of the stock market's role in promoting long-run economic growth for seven countries (i.e. Argentina, Chile, Greece, Korea, Malaysia, Philippines and Portugal) with quarterly data over 1977:1-1998:4. They used the market capitalization ratio, which equals the value of listed shares divided by GDP, and the value traded ratio, which equals the total value of shares traded on the stock exchange divided by GDP, as proxies for stock market development. To measure financial development Caporale et al., (2002) used the ratio of bank deposit liabilities to nominal GDP and the ratio of bank claims on the private sector to nominal GDP. When causality tests were performed in a bivariate context (i.e. looking for causal links between particular proxies for financial development and economic growth) evidence of causality between domestic credit and economic growth was found in only two countries out of seven. When they tested for causality in a trivariate context (i.e. considering the dynamic interactions between financial development, stock market development, and economic growth) the picture changes dramatically and causality between financial development and economic growth was found in five cases out of seven. The multivariate results support the theory that well-functioning stock markets can promote economic growth and show the sensitivity of the estimation to omitted variables.

3.4.7. Hansson & Jonung (1997)

In a single country study, Hansson & Jonung (1997) examined the long-run relationship between finance and economic growth in Sweden with annual data over 1830- 1990s using tests of cointegration. They used total lending from the financial sector to the non-bank public per capita as a measure of financial development. They controlled for education, using the increase in years of schooling, and for technological innovation, using the number of registered patent applications. Both total investment per capita and per capita GDP were chosen as dependent variables. The results showed that the financial system had the largest impact on GDP in the period 1890-1939. These findings are consistent with studies indicating that the role of the financial system in promoting growth was significant during the early stages of economic development. In the full sample, the choice of control variables crucially affects the results and the positive impact of financial development on growth in the bivariate analysis arises because the financial variable acts as a proxy for investment. Hansson & Jonung (1997) ignored the role of the stock market when measuring financial development.

3.4.8. Kar & Pentecost (2000)

Kar & Pentecost (2000) tested the causal relationship between financial development and economic growth in Turkey using annual data over the period 1963-1995. The five chosen alternative proxies for financial development are: the ratio of money to income, the ratio of banking deposit liabilities to income, the ratio of private sector credit to income, the share of private sector credit in domestic credit and the ratio of domestic credit to income. Economic growth is proxied by the change in per capita GNP. All the variables are in logarithmic form and enter the Johansen (1988) cointegration analysis in levels. The empirical results showed that the direction of causality between financial development and economic growth in Turkey is sensitive to the choice of proxy used for financial development. Overall, however, growth seems to lead financial sector development in Turkey. It is noted that the time period is short and a maximum of 33 observations may not give reliable results in the cointegration framework.

3.4.9. Herriott (2001)

Herriott (2001) explored the connection between economic growth and the financial development in Switzerland using quarterly series over the period from June 1990 to December 1999. These series include the level of real GDP, market capitalization, two measures of stock market liquidity (i.e. stock market volume divided by market value and stock market volume divided by GDP) and M1 as a proxy for bank lending. Using cointegration analysis to assess the long-run relationships between growth and finance, Herriott (2001) concluded that both bank lending and volume stand out as variables that seem important in determining economic growth. However, as an indicator of financial sector size, M1 does not consider the allocation of capital and may not accurately reflect the provision of financial services in an economy.

3.5. Panel Data Studies

The main advantage of using panel data is the ability to exploit both the time-series and cross-sectional properties of the data. The second benefit is the ability to control for individual specific effects which are considered fixed or random. The analysis of pure cross-section data can neither identify nor control for such individual effects (Hausman & William, 1981). The traditional cross-country growth regression can be written as follows:

$$y_{i,t} - y_{t-1} = \alpha + \beta y_{i,t-1} + \gamma' X_{i,t} + \eta_i + \varepsilon_{i,t} \quad (3.9)$$

Where y is the logarithm of real per capita GDP, X represents the set of explanatory variables, other than lagged per capita GDP and including indicators of stock market and bank development, η is an individual country-specific effect that accounts for the omitted variables that are specific to the individual i, ϵ is the error term, and the subscripts i and t represent country and time period, respectively. The disturbance $\varepsilon_{i,t}$ is assumed uncorrelated with the exogenous variables in model and has a zero mean and constant variance. The individual effect, η_i, is assumed to be a time-invariant fixed or random variable distributed independently across individuals. When numerous individuals are observed, the random effect is more relevant. However, the fixed effect is preferred when observing a specific set of individuals such as countries that are not randomly selected (Harris & Sollis, 2003). One primary focus is the potential correlation between η_i and the included explanatory variables. In the presence of such correlation, both ordinary least squares (OLS) and generalized least squares (GLS) yields biased and inconsistent estimates of the parameters. The common technique used to overcome this is to remove the individual effects in the sample by transforming the data into deviations from the individual means. The OLS estimators of the transformed data, known as **Within-Groups (WG) estimators,** have two important shortcomings. First, all time-variant variables are omitted by the transformation. Second, the within-groups estimators are inefficient since they ignore variation across individuals in the sample. The first problem is more serious as it affects the estimation of the unknown coefficients of the time-invariant variables (Hausman & William, 1981).

Another issue results from the potential endogeneity of the explanatory variables. With regard to equation (3.9), the right-hand-side variables are endogenous to some degree since some empirical studies (see the previous section) argue that the relationship between finance and growth involves causality.

To control for the presence of unobserved effects, Arellano and Bond (1991) propose to first-difference the regression equation to remove the country-specific effect. First differencing, however, introduces a new bias, since by construction the new error term is correlated with the lagged dependent variable. To eliminate the potential biases and imprecision, Arellano & Bover (1995) and Blundell & Bond (1998) suggest estimating a generalized method of moments (GMM) system that uses instrument variables and combines the regressions in differences with regression in levels. This method will be used in this thesis (see chapter 4, section 4.2.4 for more details).

3.5.1. Levine, Loayza & Beck (2000)

Levine et al., (2000) used the GMM system estimator developed by Arellano & Bover (1995) and Blundell & Bond (1998) for panel data to assess the finance and growth relationship for 71 countries over 1960-1995. They used five-year averaged data for three financial intermediary variables to proxy the notion of financial development (i.e. the liquid liabilities of the financial system, the ratio of commercial bank assets to commercial bank plus central bank assets and the value of credits by financial intermediaries to the private sector divided by GDP). They used the logarithm of initial per capita GDP, average years schooling, government consumption, openness to trade, inflation and black market premium as conditioning information variables to control for other growth determinants. Economic activity is measured with total and per capita GDP growth rates. Although they ignore the role of stock market in financial development, Levine et al., (2000) find that financial intermediary development has a statistically significant impact on economic growth.

3.5.2. Rousseau and Wachtel (2000)

Rousseau and Wachtel (2000) extended the Levine & Zervos (1996) study of stock markets, banks and growth by using panel techniques to examine the relationship between stock markets, banks, and growth with annual observations from 1980-1995 for 47 countries. To measure stock market development they used stock market capitalization and total traded value, both deflated by GDP. As for intermediary development, they used the liquid liabilities (M3). To remove the country specific effect, they first differenced the equation as suggested by Arellano and Bond (1991) in their generalized method of moments difference estimator. Then, they estimated a trivariate VAR system that includes the differenced measures of economic activity (i.e. per capita real gross domestic product), bank and stock market development. The lagged levels of these variables were used as instruments. Although they considered both stock markets and banks in measuring financial development, Rousseau and Wachtel (2000) do not use the GMM system estimator that reduces the weak instruments bias associated with the Arellano and Bond (1991) first differenced estimator. Their results demonstrate the leading roles of banks and stock market liquidity in promoting economic growth.

3.5.3. Beck & Levine (2002)

Beck & Levine (2002) investigated the financial development and growth relationship using 5-year averaged pooled data consisting of 40 developed and developing countries over 1976-98. They used bank claims on the private sector by deposit money banks divided by GDP and the ratio of liquid liabilities M3 to GDP as empirical proxies of financial development. As is standard in the literature, to control for other potential determinants of economic the regression equation includes a set of control variables consisting of initial per capita output, the average years of schooling to control for human capital accumulation and one variable from the policy information set (i.e. average ratio of government consumption to GDP, the inflation rate or the average black market premium on foreign exchange). Applying the system GMM techniques developed by Arellano & Bover (1995) and Blundell & Bond (1998), Beck & Levine (2002) show the importance of both stock market development and bank development for economic growth.

3.5.4. Ben Naceur & Ghazouani (2003)

Ben Naceur & Ghazouani (2003) studied the relationship between financial development and economic growth in ten developing countries (i.e. Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and Tunisia) using annual panel data. They used the turnover ratio, value traded to GDP ratio and stock market capitalization to measure stock market development. To measure bank development, they used credit to the private sector. The regression also included a standard set of conditioning variables: the logarithm of initial income per capita, the ratio of exports plus imports to GDP, the inflation rate, the ratio of government consumption to GDP and the black market premium. Applying the first differenced Generalized Method of Moments (GMM) panel models developed by Arellano and Bond (1991), the results show that the relationship between bank development and growth is negative and significant when controlling for stock market development by using stock market capitalization over GDP as a measure of equity market development. For all the other regressions using value traded and turnover as indicators of financial market development, there is no association between economic growth and bank development.

3.5.5. Loayza & Ranciere (2004)

Loayza & Ranciere (2004) used the GMM system dynamic panel model with a pooled five-year averaged data set consisting of 74 countries over 1960-95. Of the 74 countries in the sample, 31 experienced at least one banking crisis. The dependent variable is the growth rate of GDP per capita. The measures of financial intermediation are liquid liabilities and private domestic credit, both as ratios to GDP.

As in the standard literature, the control variables are the initial level of GDP per capita, government consumption (as a proportion of GDP), the volume of trade (as a proportion of GDP), and the inflation rate. The results confirm the positive effect of financial intermediation on economic growth. However, the positive effect is statistically smaller for crisis than for non-crisis countries for both indicators of financial intermediation.

3.6. Conclusions

This chapter has reviewed a number of empirical studies of the relationship between financial development and economic growth. The focus of these studies is mainly on developed countries with less attention to the specific features of financial systems in developing countries. Moreover, the empirical measures of financial development refer to either banks or stock market development, and rarely to both. Overall, the literature, in assessing the linkage between growth and finance, is based mainly on cross-country regressions and time-series approaches. Cross-country analyses report, on average, positive and significant signs which are interpreted as evidence of a positive impact of financial development on economic growth, whereas time-series studies produce mixed results regarding causality between finance and growth. A growing body of more recent empirical work focuses on panel data techniques that appear to solve the estimation problems associated with cross-country studies. However, as with cross-country studies, the panel studies examined tend to use averaged data in examining the relationship. They demonstrate a strong positive association between the financial system and economic growth. This suggests that using annual data in panels is a promising way forward. The availability of time-series observations allows causality to be investigated, while pooling data from different countries increases the degrees of freedom in estimation. Also, the use of the system GMM techniques reduces the econometric problems associated with the investigation of finance and growth relationship. This approach will be researched in chapters 4 and 5.

Chapter 4

Methodology and Data

4.1. Introduction

The previous chapter focused on different studies that examine the link between financial development and economic growth. This chapter considers the methodological approach and data needed to provide evidence on this link. The empirical results are presented in chapter 5. Following the literature review our investigation of the relationship between financial development and economic performance will include both cross-sectional and dynamic panel elements. First, since the use of cross-sectional regressions has become a near-tradition in the analysis of growth, the link between financial development and economic growth using cross-sectional regressions with averaged data will be examined. This analysis tests whether the legal origin, as an exogenous component of financial development, helps to explain cross-country variations in the rate of economic growth. Second, having acknowledged the shortcomings associated with the use of cross-country regressions and averaged data, dynamic panel techniques, which control for unobserved country-specific effects, the endogeneity of explanatory variables and the use of lagged dependent variables, are used. Third, unlike the current literature, which focuses on samples that include developed countries or a mixture of developed and developing countries, the dynamic analyses in this study advance the current literature by focusing entirely on developing countries and by using annual data to assess the link between finance and growth. In a newly collected data set, different measures of financial development commonly used in the literature are described and considered. Finally, having identified significant correlations between the different chosen measures of financial development, a contribution to the literature is attempted by using new annual measures of financial development from principal component analysis.

The remainder of this chapter is concerned with the methodology and the data and is organized as follows: section 4.2 introduces the econometric framework and focuses on the estimation methods to be used in the empirical work. In section 4.3 the measures of financial development are explained and the data and their sources are described. The justification for the use of principal component analysis is set out in section 4.4 and the conclusions are presented in section 4.5.

4.2. Econometric Framework

This section describes the econometric methods that are to be used to assess the relationship between financial development and economic growth. First, a brief description of the generalized method of moments is given and the procedures for the cross-sectional regressions are set out. Then, the dynamic panel techniques are explained.

4.2.1. Generalized-Method-of-Moments (GMM)

Based on Johnston & DiNardo (1997), the method of moments uses sample values to estimate population values. For example, the population mean, μ, or the first moment of the distribution of a random variable X, is estimated by the sample mean ($m = \Sigma X_i / n$) and the second moment about the mean, or the population variance (σ^2), is estimated by $s^2 = \Sigma(X_i - m)^2/n$. Thus the method of moments uses **sample values** of moments to estimate the **population values** of moments. Notice that while m is an unbiased estimator of μ, s^2 is a biased estimator of σ^2. The Generalised Method of Moments (GMM) is based on the same principle but uses the assumptions made in the statistical properties of the model as the "population values". Consider the problem of estimating:

$$y_t = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_k X_{ki} + u_i \quad \text{or } \mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{u} \qquad (4.1)$$

(a) Ordinary Least Squares Estimation

Ordinary least squares estimation assumes X is uncorrelated with u and var(u) = $\sigma^2 I$ where I is the unit matrix. Therefore E(X'u) = 0 (this is known as the "orthogonality condition") or, since y - Xβ = u, we have E(X'(y-Xβ)) = 0 in the population. The formula for OLS replaces the population value β with the sample value b^{OLS} so that X'(y-Xb^{OLS})) = 0 to give the OLS estimator as $b^{OLS} = (X'X)^{-1}X'y$ and var(b^{OLS})= $\sigma^2(X'X)^{-1}$. Thus the orthogonality condition for the population values gives the OLS estimator for the sample (Gujarati, 1995).

(b) Generalised Instrumental Variable Estimation (GIVE)

Generalised instrumental variable estimation assumes that the **X** variables are correlated with the disturbances (**u**) so that OLS estimators are biased and inconsistent. The model is still **y** = **Xβ** + **u** with var(**u**) = σ^2**I** but **X** and **u** are correlated so **E(X'u) ≠ 0.** Assume that there is a matrix **Z**, consisting of instruments. These are variables which are correlated with the **X** variables but uncorrelated with **u.** That is, the orthogonality condition is now **E(Z'u)** = **0** or **E(Z'(y-Xβ))** = **0** and so concerns the instruments. It states that the disturbances, **u**, are uncorrelated with the instruments, **Z.** Typically, the instruments might be the constant, lagged values of the **X** variables and the time trend. The estimators from GIVE are: $\mathbf{b}^{GIVE} = (\mathbf{X'PX})^{-1}\mathbf{X'Py}$

where $\mathbf{P} = \mathbf{Z(Z'Z)^{-1}Z'}$ and the variance is $\mathbf{var(b^{GIVE})} = \sigma^2\mathbf{(Z'X)^{-1}(Z'Z)(X'Z)^{-1}}$ (Johnston & DiNardo, 1997).

(c) Generalised Method of Moments (GMM)

Generalised method of moments estimation assumes that the model is $\mathbf{y = X\beta + u}$ with $\mathbf{var(u)} = \sigma^2\ \Omega$ where Ω is the covariance matrix of $\mathbf{u}$ and also $\mathbf{X}$ and $\mathbf{u}$ are correlated so $\mathbf{E(X'u) \neq 0}$. The orthogonality condition is $\mathbf{E(Z'u) = 0}$ and so assumes that the disturbances, $\mathbf{u}$, are uncorrelated with the instruments, $\mathbf{Z}$. Estimation by GMM is a generalisation of GIVE with, basically, $\mathbf{P = Z(Z'Z)^{-1}Z'}$ replaced by $\mathbf{P^* = Z(Z'\Omega Z)^{-1}Z'}$. The matrix $\mathbf{Z}$ consists of instruments which are uncorrelated with $\mathbf{u}$. The estimators from GMM are: $\mathbf{b^{GMM} = (X'P^*X)^{-1}X'P^*y}$ and the variance is $\mathbf{var(b^{GMM})} = \sigma^2\mathbf{(Z'X)^{-1}(Z'Z)(X'Z)^{-1}}$.

Note that if $\Omega = \mathbf{I}$ then $\mathbf{P^* = P}$ so that GIVE and GMM are the same. Further, if $\mathbf{Z = X}$, so that also $\mathbf{E(X'u) = 0}$, then GMM is the same as OLS. These links are summarised in table 4.1. In practice, for GMM, the weighting matrix, Ω, is estimated from the moment matrix of the observed residuals (Johnston & DiNardo, 1997).

Table 4.1 Summary: Assumptions for different Generalized-Method-of-Moments methods

Method	Residuals Variance	Correlation of X and u
OLS	$\mathrm{var}(\mathbf{u}) = \sigma^2\mathbf{I}$	$\mathbf{E(X'u) = 0}$
GIVE	$\mathrm{var}(\mathbf{u}) = \sigma^2\mathbf{I}$	$\mathbf{E(X'u) \neq 0}$
GMM	$\mathrm{var}(\mathbf{u}) = \sigma^2\,\Omega$	$\mathbf{E(X'u) \neq 0}$

Finally, note that GMM is the most general method, with all the others being special cases of it.

4.2.2. Cross-Sectional Regressions

As mentioned earlier, the use of the cross-sectional regressions has become a tradition in the empirical analysis of growth (e.g. King & Levine, 1993a, Levine & Zervos, 1996 and Rousseau & Wachtel, 2000). In this study, pure cross-sectional analysis uses data averaged over 1990-2001, such that there are three observations per country (corresponding to four-year averages for 1990-3, 1994-7 and 1998-2001) giving a maximum of 90 observations. The basic regression, as used by Levine *et al.,* (2000), takes the form:

$$\text{Growth}_i = \alpha + \beta\text{Finance}_i + \gamma\,[\text{Conditioning Set}]_i + \varepsilon_i \qquad (4.2)$$

where the dependent variable represents real per capita GDP growth, Finance is a selected set of financial variables and Conditioning Set represents conditioning variables that account for other factors associated with economic growth[1]. As discussed in chapter 3, Laporta *et al.,* (1998) claim that a country's legal system is based on English, French, German, or Scandinavian legal origins. Since finance is based on contracts produced by the legal system, this has a profound impact on the level of bank and stock market development. Differences in laws protecting creditors and investors, efficiently enforcing contacts and maintaining the quality of accounting standards are due to differences in the origins of the legal system. The legal origin variables may be treated as exogenous as most countries obtained their legal systems through occupation and colonisation. Following Levine (1998), Levine *et al.,* (2000) and Laporta *et al.,* (1998), dummy variables for English, French and German legal

[1] Following Levine et al., (2000), natural logarithms of the regressors are used due to the potential nonlinearity of the relationship.

origin in the cross-country are to be used in the regressions to examine whether cross-country variations in the exogenous component of financial development explain cross-country variations in the rate of economic growth when controlling other determinants of growth. Table 4.2 presents the legal origin of the selected countries.

Table 4.2: Legal Origin Variables for the Selected Countries

Country	legor_uk	legor_fr	legor_ge
Argentina	0	1	0
Bangladesh	1	0	0
Brazil	0	1	0
Chile	0	1	0
Colombia	0	1	0
Cote d'Ivoire	0	1	0
Egypt	0	1	0
India	1	0	0
Indonesia	0	1	0
Israel	1	0	0
Jamaica	1	0	0
Jordan	0	1	0
Kenya	1	0	0
Malaysia	1	0	0
Mauritius	0	1	0
Mexico	0	1	0
Morocco	0	1	0
Nigeria	1	0	0
Pakistan	1	0	0
Peru	0	1	0
Philippines	0	1	0
South Africa	1	0	0
Thailand	1	0	0
Tunisia	0	1	0
Turkey	0	1	0
Korea Rep[2]	0	0	1
Sri Lanka	1	0	0
Trinidad and Tobago	1	0	0
Venezuela	0	1	0
Zimbabwe	1	0	0

[2] The dummy variable legor_ge might also be picking up a "South Korea effect".

4.2.3. Motivation for the Dynamic Panel Model and Annual data

Overall, the methodology used in the literature in assessing the linkage between growth and finance is based mainly on cross-country regressions and time-series approaches. One advantage of the former regressions approach is that they facilitate understanding the sources of varied patterns of growth across countries. Also, they assume that different countries possess similar financial system structures, hence facilitating international comparisons (Levine, 1997). However, these cross-country regressions do not allow different countries to demonstrate different relationships and they can provide misleading conclusions. Cross-country analyses report, on average, a positive impact of financial development on economic growth. The view that institutional features and country peculiarities are major factors in understanding the complexity of the relationship between growth and finance suggests that time- series techniques are likely to be more useful. Time-series studies allow a focus on the causality issue and the possibility of testing for the presence of cointegration between finance and growth. Most studies demonstrate mixed results regarding causality and seem to have short time series where the use of cointegration tests are known be unreliable (e.g. Ben M'rad, 2000).

Panel data sets possess several major advantages over cross-sectional or time-series data sets. They allow individuals to be heterogeneous. Panel techniques can explicitly control for the individual specific effect that cross-country regressions fail to account for. By combining time series of cross-sectional observations, panel data can give a large number of data points, increasing the degrees of freedom and reducing the collinearity among the explanatory variables associated with time series, therefore improving the efficiency of the econometric estimates (Gujarati, 2003).

Also, panel data allow the construction and the testing of more complicated behavioral models than purely cross-sectional or time-series data (Gujarati, 2003). Besides considering the cross-country relationship between financial development and growth, the effects of financial development on growth within a country over time are also taken into account. The panel approach offers advantages over ordinary least squares (OLS) regressions. In a pure cross-country regression, any unobserved country-specific effect becomes part of the error term, which may bias the coefficient estimates as explained in detail below (Hsiao, 2003). However, in a panel context, the unobserved country-specific effects are controlled for and hence omitted variables biases in the estimated coefficients are reduced. To that end, dynamic panel techniques are chosen to be used for this study.

The use of annual data in this study is motivated by skepticism surrounding studies that used averaged data to assess the relationship (e.g. King & Levine 1993a, Levine *et al.*, 2000, and Beck & Levine, 2002). Averaging clearly induces a loss of information. The wide-spread use of five-year averaged data, to remove the business cycle effect, has the effect of reducing variation in the sample by smoothing out shocks, reducing the number of observations used and distorting the lag-structure. Calderon & Liu (2003, p.327) used data averaged over five-years and claimed that: "we need to average data over 3–10 years to eliminate business cycle effects". It is not obvious that averaging over fixed-length intervals effectively eliminates business-cycle fluctuations. Also if the business cycle is not exactly five years the results can be misleading. The effects of such temporal aggregation are also considered in chapter 6.

4.2.4. GMM Estimators for Dynamic Panel Models

Following Levine *et al.* (2000), Beck & Levine (2002) and Rousseau & Wachtel (2000), the recently developed dynamic panel generalized-method-of-moments (GMM) techniques are used to assess the relationship between stock market development, intermediaries development and economic growth. These techniques control for unobserved country-specific effects, the endogeneity of explanatory variables and the use of lagged dependent variables. The traditional cross-country growth regression can be written as follows:

$$y_{i,t} - y_{t-1} = \alpha + \beta y_{i,t-1} + \gamma' X_{i,t} + \eta_i + \varepsilon_{i,t} \quad (4.3)$$

where y is the logarithm of real per capita GDP, X represents the set of explanatory variables, other than lagged per capita GDP and including indicators of stock market and bank development, η is an unobserved country-specific effect, ϵ is the error term, and the subscripts i and t represent country and time period, respectively. The dependent variable in equation (4.3) is the annual growth rate.

According to Levine *et al.* (2000), Rousseau & Wachtel (2000) and Beck & Levine (2002), when estimating equation (4.3), two main econometric issues are presented. The first one results from the presence of both a lagged dependent variable and unobserved time invariant individual-specific effects. Hsiao (1986) shows that eliminating the individual fixed effects in a dynamic panel data model will render the ordinary least squares (OLS) estimates biased and inconsistent. The right hand regressor y_{t-1} is correlated with the error term as $y_{i,t}$ is a function of η_i and so is y_{t-1}. This makes the OLS estimator seriously biased and inconsistent, even if the $\varepsilon_{i,t}$ are not serially correlated. The likely positive correlation between the lagged dependent variable y_{t-1} and the fixed effects η_i results in an upwards bias in the estimator of the coefficient of the lagged dependent variable (Hsiao, 2003).

The bias and inconsistency of the OLS estimator might therefore be reduced through the transformation which removes the individual effects by subtracting the means from each time series. The OLS estimator obtained from this transformed model is often called the **within- group** estimator (See chapter 3, section 3.5).

Let $\bar{y}_i = \sum_{t=1}^{T} y_{it} / T$, $\bar{y}_{i-1} = \sum_{t=1}^{T} y_{it-1} / T$ ((Hsiao, 1986, p.73), then $(y_{it-1} - \bar{y}_{i,-1})$ will be correlated with $\varepsilon_{it} - \bar{\varepsilon}_i$ even if ε_{it} are not serially correlated. This is because y_{it-1} is correlated with $\bar{\varepsilon}_i$ by construction, since the latter is an average containing ε_{it-1}, which is correlated with y_{it-1}. As N tends to infinity, these correlations do not go to zero. Nickell (1981) shows that the within- groups estimator gives an estimate of β that is biased downwards in short dynamic panels. Thus a consistent and unbiased estimate of β is expected to lie in between the OLS levels estimate and the within-groups estimate (Rousseau & Wachtel, 2000). In addition, the within- groups estimator can only be consistent if all the explanatory variables are strictly exogenous (Arellano & Bond, 1998).

The second issue results from the potential endogeneity of the explanatory variables. With regard to equation (4.3) the right-hand-side variables are endogenous to some degree since some empirical studies argue that the relationship between finance and growth involves causality (Levine *et al.*, 2000). So the endogeneity of the explanatory variables must be controlled for to avoid potential biases caused by simultaneity. To address these problems, Arellano & Bond (1991) propose the first-differenced GMM estimator. It consists of removing the time invariant individual-specific effects η_i. By first-differencing equation (4.3), equation (4.4) is obtained:

$$(y_{i,t} - y_{i,t-1}) - (y_{i,t-1} - y_{i,t-2}) = \beta(y_{i,t-1} - y_{i,t-2}) + \gamma'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (4.4)$$

First differencing the equation solves the first econometric problem by removing the country-specific effect. However, the new error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$ is correlated with the lagged dependent variable, $y_{i,t-1} - y_{i,t-2}$. To address this and the endogeneity problem, Arellano & Bond (1991) suggest the use of instrument variables. Here, $y_{i,t-2}$ or $y_{i,t-2} - y_{i,t-3}$ are both valid instrument for $y_{i,t-1} - y_{i,t-2}$ since they are highly correlated with $y_{i,t-1} - y_{i,t-2}$ and not correlated with $\varepsilon_{i,t} - \varepsilon_{i,t-1}$. Arellano (1989) shows that when using the lagged difference as an instrument, the estimator variances tend to be very large. Hence, he recommends using the lagged levels $y_{i,t-2}$ as instruments (Baltagi, 2005). By instrumenting with lagged levels only two periods are needed rather than three. The choice of the instruments should be based on prior knowledge from economic theory and previous empirical work (Arellano & Bond, 1991). The assumption that all the explanatory variables are strictly exogenous (that is, that they are uncorrelated with the error term at all leads and lags) is relaxed. Assuming the explanatory variables are predetermined (i.e., the explanatory variables are assumed to be correlated with future realizations of the error term and they may be affected by past and current growth rates), allows for the possibility of reverse causality, which according to the literature, is likely to be found in growth-finance regressions. If financial development causes growth, the error term in the growth equation is correlated with the financial variables. Under the assumptions that there is no serial correlation in the error term ε and that the explanatory variables X are predetermined, the instrument matrix can be extended to contain the lagged levels of the explanatory variables (Levine *et al.*, 2000). The following moment conditions apply to the lagged dependent variable and the set of explanatory variables:

$$E\left[y_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad for\ s \geq 2; t = 3, ..., T \qquad (4.5)$$

$$E\left[X_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0 \quad for\ s \geq 2; t = 3, ..., T \qquad (4.6)$$

Using these moment conditions, Arellano and Bond (1991) suggest a two-step GMM procedure. In the first step the error terms are assumed to be uncorrelated and homoskedastic across countries and over time. In the second step, the residuals from the first step are used to construct consistent estimates, thus allowing heteroscedasticity and dependence to account for more general situations. The GMM estimator based on these conditions is referred to as the *difference* estimator (Beck & Levine, 2002).

The difference estimator suffers from several problems. First, by first differencing, the cross-country dimension is lost and only the time-series dimension is exploited within countries. Second, Alonso-Borrego & Arellano (1996) and Blundell & Bond (1998) show that if the lagged dependent and the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for first differenced regressions which may produce large downward biased and imprecise estimates. Also, Monte Carlo experiments show that the weakness of the instruments in first-differenced GMM estimator performs poorly and produces biased coefficients particularly in small samples (Levine *et al.*, 2002).

To overcome the biases and imprecision associated with the first-differenced GMM estimator, Arellano & Bover (1995) and Blundell & Bond (1998) suggest estimating a system (SYS-GMM) that uses more instruments and joins the regressions in differences with regressions in levels. The instruments for the regression in differences are the *levels* of the lagged series, so that the moment conditions in equations (4.5) and (4.6) apply to this first part of the system. The instruments for the regression in levels are the lagged first *differences* of the corresponding variables. These require that although there may be correlation between the levels of the right-hand side variables and the country-specific effect in equation (4.3), there is no association between the *differences* of these variables and the country-specific effect. This assumption results from the following stationarity property:

$$E\left[y_{i,t+p}.\eta_i\right]=E\left[y_{i,t+q}.\eta_i\right]$$
$$and\ E\left[X_{i,t+p}.\eta_i\right]=E\left[X_{i,t+q}.\eta_i\right] for\ all\ p\ and\ q \qquad (4.7)$$

In the regression in levels, only the most recent difference is used as an instrument. Adding extra lagged differences would result in redundant moment conditions (Beck & Levine, 2002). Hence, the extra moment conditions for the second part of the system (the regression in levels) are:

$$E\left[(y_{i,t-s} - y_{i,t-s-1}).(\eta_i + \varepsilon_{i,t})\right] = 0 \; for \; s = 1 \qquad (4.8)$$

$$E\left[(X_{i,t-s} - X_{i,t-s-1}).(\eta_i + \varepsilon_{i,t})\right] = 0 \; for \; s = 1 \qquad (4.9)$$

Thus, the moment conditions for the differenced model with those for the levels model presented in equations (4.6), (4.7), (4.8), and (4.9) are joined in the Generalized Method of Moments (GMM) system procedure to produce more consistent and efficient estimates in the growth equation (Arellano & Bover, 1995 and Blundell & Bond, 1998).

To check that the system GMM estimator is consistent, two specification tests are proposed by Arellano & Bond (1991), Arellano & Bover (1995), and Blundell & Bond (1998). The first tests the hypothesis that no second order serial correlation is present in the differenced equation (by construction, the differenced error term is first-order serially correlated even if the original error term is not (Doornik *et al.*, 2002)). The second is a Sargan test of over-identifying restrictions, which tests whether the instruments are valid and not correlated with the error term. The acceptance of the null hypotheses of both tests confirms the consistency of the chosen model (Beck & Levine, 2002).

When applied to samples with a limited number of cross-sectional observations, both the first differenced and the system estimators perform poorly. When the number of instruments is equal to or larger than the number of cross-sectional units, this biases both the standard errors for the two-step estimators and the Sargan test downwards and might result in biased inference (Beck & Levine, 2002). Thus, the asymptotic inference from the one-step estimates might be more reliable. Following Beck & Levine (2002) and Rousseau & Wachtel (2000), this problem is addressed by, firstly, not including the control variables in the regressions, which reduces the number of instruments to less than the number of cross-sectional observations. Secondly, unlike Levine *et al.*, (2000), only the one-step GMM results are considered. This is because, although the Sargan test based on the two-step GMM estimator is heteroskedasticity-consistent (Doornik *et al.*, 2002), Monte Carlo evidence suggests that the one-step GMM estimator is less-biased and it produces more efficient and reliable estimates compared to the two-step GMM alternative even in large samples (Blundell & Bond, 1998, Rousseau & Wachtel, 2000, Bond *et al.*, 2001 and Doornik *et al.*, 2002).

To detect whether there are serious finite sample biases in the system GMM estimations, Doornik *et al.*, (2002) and Bond *et al.*, (2001) suggest comparing them to the within-groups estimator. Unlike Levine *et al.*, (2000), Rousseau & Wachtel (2000) and Beck and Levine (2002), who used the GMM estimation only, here the within-groups estimation is also performed for comparative purposes. The main difference is in the coefficient on the lagged dependant variable. A finding that the within-group estimate of the coefficient lies above the corresponding GMM system parameter estimate suggests that the GMM system estimates are seriously biased (Bond *et al.*, 2001).

In summary, our approach is to use both the within-groups and SYS-GMM estimation and to use the Sargan test and serial correlation tests to check the validity of the assumptions.

4.3. Data and Variables Definition

Financial sectors in most developing countries differ from those of developed countries. Capital markets offer a limited portfolio of assets and risk management tools. The secondary markets do not function well, which forces firms and institutions to seek financial resources from bank credit. High debts create major sources of instability. Moreover, the lack of available information regarding listed firms may generate misleading investment decisions, which affects the pace of capital accumulation. Government intervention and the existence of inadequate regulation in developing countries restrict the size and the functioning of financial markets (Bossone & Promisel, 1998). Taking into account the peculiarity of the financial systems in developing countries in studying the relationships among equity markets, financial intermediaries and the real sector, a panel data set is constructed with annual observations from 1988-2001. Since this study attempts to examine both stock markets and banks development and their impact on growth, the country and time periods selected are based entirely on the availability of data on stock market development variables in the different issues of the Standard & Poor's Emerging Stock Markets Factbooks, (1998), (2001), (2002), which present market capitalization and total value traded, among other variables, for as many as fifty three countries. No stock market data was covered prior to 1988. To be included in the selected sample of countries, there must be data for at least ten years. This leaves thirty countries[3] as the focus of this study giving 14 x 30 = 420 observations. To consider the cross-country dimension of data, two cross-section observations are lost in constructing lags and taking first differences resulting in a maximum of 360 observations.

4.3.1. Measuring Financial Development

Based on the literature, this study uses different proxy measures of intermediaries and stock market development.

(a) Measures of Financial Intermediaries Development

The level of financial services, the processing and evaluation of information, and transaction costs are commonly measured by the ratio of **Credit to Private Sector by Deposit Money Banks and other Financial Institutions to GDP (CPS)** (e.g. King and Levine 1993a, Levine & Zervos, 1996 and Beck *et al.,* 1999, Levine *et al.,* 2000). This measure distinguishes between the credit issued to the private sector as opposed to government and public enterprises. Private credit measures the ability of intermediaries to evaluate information and identify profitable investment projects and hence it gives an indication about the extent to which savings are transferred into investments. Higher levels of this ratio are interpreted as indicating lower transaction costs and higher levels of financial services and therefore greater financial intermediary development.

[3] Argentina, Bangladesh, Brazil, Chile, Colombia, Cote d'lvoire, Egypt, India, Indonesia, Israel, Jamaica, Jordan, Kenya, Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, South Africa, Thailand, Tunisia, Turkey, Korea Rep, Sri Lanka, Trinidad and Tobago, Venezuela and Zimbabwe.

To measure of the overall size of the financial intermediary sector, **the Liquid Liabilities to GDP ratio (LL)** is used (e.g. Goldsmith 1969, King & Levine 1993a, Andres *et al.,* 1999, Rousseau & Wachtel 2000, Rioja & Velv 2002, and Levine *et al.,* 2000). It indicates the level of the liquidity provided to the economy. As an indicator of size, this variable does not reflect the allocation of savings and may not accurately indicate the activity of financial intermediaries in an economy.

The Commercial-Central Bank Assets ratio (BA) equals the ratio of commercial bank assets divided by commercial bank plus central bank assets. It is used to indicate the extent to which the commercial banks versus the central banks transfer savings (e.g. Andres *et al.,* 1999, Levine & Demirguc-Kunt 1996, Levine *et al.,* 2000 and Rioja & Velv 2002). Commercial banks are thought to be more effective than central banks in mobilizing savings to productive investment projects, hence, an increase in this ratio indicates an expansion in the financial sector (Levine *et al.,* 2000).

To proxy the efficiency of the banking system, **the ratio of Private Sector Credit to Liquid liabilities (BS)** is used. Credit to the private sector pictures one side of the financial sector's balance sheet. Liquid liabilities represent the other receiving side. The ratio, however, indicates the degree of banks efficiency in transferring savings into private investment. The higher the ratio the more efficient banks are in allocating capital to investors (Lynch, 1994).

The financial system functions, explained in chapter 2, are derived from one central function, referred to by Merton and Bodie (1995, p28) as the "primary function" (i.e. resource transfer). The first two indicators of financial development mentioned earlier (i.e. CPS and LL) indicate the mechanism of the transfer. Liquid liabilities of the financial sector represent the resources transferred from the non-financial sector to the financial sector. Credit to the private sector, however, shows the extent to which resources are transferred back from the financial sector to the non-financial sector. As for who performs the transfer of resources and who receives them, the first and the third financial indicators (i.e. CPS and BA) suggest that the higher the credit given to the private sector by commercial banks, the higher the growth rate (Winkler, 1998).

(b) Measuring Stock Market Devêlopment

To measure stock market development, **Stock Market Capitalization to GDP ratio (MC)** is used (e.g. Rajan & Zingales 1998, Rousseau & Wachtel 2000 and Arestis *et al.*, 2001). Stock market size is expected to be positively associated with the market ability to allocate capital and manage risk. The problem with using stock market capitalisation, however, is that it indicates the total of listed capital, not the growth of listed capital (Rajan & Zingales 2000). Moreover, large markets are not necessarily active and taxes may prevent small but productive companies from being listed on the exchange (Demirguc-Kunt & Levine 1996).

The most used complementary measures of stock market size are market turnover (e.g. Demirguc-Kunt & Levine 1996, Levine & Zervos 1996, Rousseau & Wachtel 2000, and Beck & Levine 2002) and total value traded (e.g Atje & Jovanovic 1993, Levine & Zervos 1996, and Rousseau & Wachtel 2000). **The Turnover Ratio (TR)** indicates the trading volume of the stock market relative to its size and measures stock market liquidity. In emerging markets, an increase in liquidity is a good indication as it shows the importance and the credibility of the available information. Also, it indicates low transactions costs, which facilitate fund transfers and increase the number of firms and traded shares and hence, promote growth (Rousseau & Wachtel 2000).

Value Traded to GDP ratio (TV) is used to measure stock market activity. It measures trading volume relative to the size of the economy. As the product of market price and the number of shares traded it includes elements of both liquidity and size (Beck & Levine, 2002).

An additional measure of stock market development this study uses is **the Number of Listed Companies (NLC)**. The growth in the number of listed companies suggests rapid stock market development. This measure indicates also the degree of industry concentration where few companies dominate the economy. This may result in a lower competitive pressure and hence lower growth rates (Rajan & Zingales, 2000). This measure is not helpful where there are few listed companies and little activity in the stock market and in these circumstances TR or TV might be preferred.

To consider the structure of the financial system and determine the importance of its different components, the ratio of **Broad Money to Narrow Money (FS)** (or M3/M1) is used. Narrow money reflects the function of money a means of payments. Broad money, however, indicates the importance of the saving services. This ratio is a refection of a country's level of financial development. It should be positively related to growth if savings deposits increase more compared to payments transactions as the financial system develops (Lynch, 1993).

Besides the financial variables just mentioned, **Foreign Direct Investment to GDP ratio (FDI)** is also used. Foreign direct investment has an important role in influencing the economic growth of developing countries. It has been found that FDI has a positive impact on growth as it increases the total investment in the economy (Hansen & Rand, 2004). Also, it increases productivity in the host economy via the transmission of new technologies and management skills. Competition encourages the adoption and the implementation of these skills and technologies, and hence, improves the stock of human capital and growth. However, the domestic economy needs to achieve a certain level of human capital to be able to benefit from the inflows of new technologies and skills (Flexner, 2000).

It is worth noting that since all the variables considered in this section are used in the literature to account for the same concept (i.e. financial development) a significant correlation is expected between them. The use of new broader measures of financial development is required and that will be examined in section 4.4.

4.3.2. Measures of Economic Growth

To measure economic growth, two indicators are widely used in the literature. Capital accumulation and productivity growth (e.g. Levine & Zervos, 1996, and Levine *et al.,* 2000 and Rioja & Valev 2002) and the growth of per capita real gross domestic product (e.g. Hansson, & Jonung, 1997, Ghatak & Siddiki, 1999, Ben M'rad, 2000, Levine *et al.,* 2000, Beck & Levine 2002, and Boulila & Trabelsi, 2002). To measure economic performance, this study follows the majority of finance and growth studies by using **the Growth of Per Capita Real Gross Domestic Product (GY).**

4.3.3. Conditioning Information Set

Following Easterly *et al.*, (1997), Levine *et al.*, (2000), Trabelsi (2002) and Ben Naceur & Ghazouani (2003), when assessing the strength of the link between stock markets, intermediaries development and economic growth, other potential determinants of economic growth are controlled for in the regressions. In the policy conditioning information set the Logarithm of Initial Real GDP per Capita (LIIP) and the Level of Secondary School Enrolment (SE) are included to control for convergence and the level of human capital respectively. The conditioning set includes also the Ratio of Exports plus Imports to GDP (OPEN) as a measure of openness to international trade, the Inflation Rate (INF), as a proxy for macroeconomic stabilization since lowering inflation is the main objective of stabilization policy in developing countries, and the Ratio of Government Consumption Expenditure to GDP (GC) as a proxy for government size and a good indicator of credible and permanent fiscal adjustment (Easterly *et al.*, 1997).

In terms of data sources, this study relies primarily on the statistics from World Bank's Global Development and Finance &Word Development Indicators and the Standard & Poor's (S&P) Emèrging Stock Markets Factbooks of 1998, 2001 and 2002. All variables mentioned earlier are from the former source except the Number of Listed Companies (NLC) and the Turnover ratio (TR) and Inflation (INF) which are collected from the latter. The Commercial-Central Bank ratio (BA) is from Beck *et al.,* (1999) database. Prior to 1997, the levels of secondary school enrolment (SE) are from the Unesco Statistical Yearbook 1999.

4.3.4. Data Properties

Table 4.3 presents a detailed list of the abbreviations and the definitions, as well as the sources of the collected data.

Table 4.3: Description of the Variables

Variable	Description	Source
Credit to private sector (%GDP) **(CPS)**	Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment.	The World Bank Database
Liquid liabilities (M3) as % of GDP **(LL)**	Known as broad money, or M3. They are the sum of currency and deposits in the central bank (M0), plus transferable deposits and electronic currency (M1), plus time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), plus travellers checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents.	The World Bank Database
The Commercial-Central Bank ratio **(BA)**	Data on Commercial versus Central Bank are calculated using IFS numbers, using the following method: DBA(t) / (DBA(t) + CBA(t)) Where DBA is assets of deposit money banks (lines 22a-d) and CBA is central bank assets (lines 12 ad).	Beck et al., 1999
Banking system efficiency **(BS)**	Ratio of CPS to LL	The World Bank Database
Market capitalization of listed companies (% of GDP) **(MC)**	Market capitalization of listed companies is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year.	The World Bank Database
Turnover ratio (%) **(TR)**	Turnover ratio represents the total value of shares traded during the period divided by the average market capitalization for the period. Average market capitalization is calculated as the average of the end-of-period values for the current period and the previous period.	S&P Emerging Stock Market Factbook, 1998,2001 & 2002
Stocks traded, total value (% of GDP) **(TV)**	The total value of shares traded at end of period.	The World Bank Database
The Number of listed companies, Total **(NLC)**	The domestically incorporated companies listed on the country's stock exchanges at the end of the year. This indicator does not include investment companies, mutual funds, or other collective investment vehicles.	S&P Emerging Stock Market Factbook, 1998,2001 & 2002
The Log of Financial structure **(FS)**	Financial structure represents the ratio of broad money to narrow money. Broad money is the sum of money (IFS line 34) and Quasi money (IFS line 35).	The World Bank Database
Foreign direct investment, net inflows (% of GDP)(**FDI)**	Foreign direct investment represent net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows in the reporting economy.	The World Bank Database
Real GDP per capita growth (annual %) **(GY)**.	Annual percentage growth rate of GDP per capita based on constant local currency.	The World Bank Database.

Variable	Description	Source
Year of Initial Real GDP per Capita **(IIP)**	Initial values of gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant U.S. dollars.	The World Bank Database
School enrolment, secondary (% gross) **(SE)**	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers.	The Unesco Statistical Yearbook 1999 and The World Bank Database
Exports of goods and services (% of GDP) **(EX)**	Represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labour and property income (formerly called factor services) as well as transfer payments.	The World Bank Database
Imports of goods and services (% of GDP) **(IM)**	Represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labour and property income (formerly called factor services) as well as transfer payments.	The World Bank Database
Openness to international trade **(OPEN)**	Openness to trade is Export of goods and services (% of GDP) **(EX)** plus imports of goods and services (% of GDP)**(IM)**	The World Bank Database
Inflation, consumer prices (annual %) **(INF)**	Consumer price index (CPI) reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	S&P Emerging Stock Market Factbook, 1998,2001 & 2002
General government consumption expenditure (% of GDP) **(GC)**	General government consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defence and security, but excludes government military expenditures that are part of government capital formation.	The World Bank Database
legor_uk **legor_ge** **legor_fr**	English legal origin German legal origin French legal origin	La Porta et al.,(1998) and Levine et al.,(2002)

Table 4.4 and table 4.5 present data summary statistics for the four-year averaged data, for 1990 -1993, 1994 -1997 and 1998 - 2001 giving three observations per country, and annual data over 1990-2001 for the thirty cross-section countries

Table 4.4: Summary Statistics of Four-year Averaged Data over 1990-2001

	CPS	LL	BA	BS	MC	TR	TV	NLC	FS	FDI	GY
Mean	3.51	4.01	4.29	4.36	3.25	2.95	1.27	5.12	5.79	0.44	2.29
Median	3.43	3.84	4.40	4.30	3.34	2.78	1.28	5.20	5.80	0.59	2.30
Maximum	5.01	9.39	4.59	5.66	7.60	7.05	4.98	8.68	7.21	2.36	7.51
Minimum	1.42	2.63	0.83	3.47	0.07	-0.13	-3.59	2.77	4.88	-4.05	-2.78
Std. Dev.	0.71	1.10	0.51	0.37	1.09	1.35	1.71	1.18	0.53	1.15	2.47
Skewness	-0.17	3.58	-5.13	0.60	0.55	0.53	-0.36	0.48	0.39	-0.98	0.06
Kurtosis	3.07	17.63	32.19	4.28	5.39	3.69	2.95	3.44	2.91	4.83	2.23
Observations	90	90	90	90	90	90	90	90	90	90	90
Cross-Sections	30	30	30	30	30	30	30	30	30	30	30

In tables 4.4 and 4.5 logarithms are taken of each variable (except growth, for which the logarithmic rate of change is used).

Table 4.5: Summary Statistics of Annual Data over 1990-2001

	CPS	LL	BA	BS	MC	TR	TV	NLC	FS	FDI	GY
Mean	3.61	3.83	4.37	-0.22	3.11	2.77	1.26	5.27	1.19	0.20	2.06
Sum	1029	1093	1244	-63.36	886	790	359	1501	339	55.6	587
Median	3.53	3.83	4.43	-0.31	3.09	2.93	1.59	5.27	1.17	0.37	2.24
Maximum	5.11	4.91	4.60	1.12	5.80	6.16	5.44	8.70	2.65	2.51	12.84
Minimum	2.19	2.36	3.42	-1.30	-0.14	-0.92	-4.61	2.56	0.24	-5.30	-11.40
Sum Sq. Dev.	3838	4265	5445	59.07	3078	2690	1488	8324	489	494	5015
Std. Dev.	0.65	0.51	0.21	0.40	1.07	1.33	1.91	1.21	0.55	1.30	3.66
Skewness	0.23	-0.04	-1.69	0.60	-0.17	-0.20	-0.49	0.31	0.42	-1.34	-0.43
Kurtosis	2.53	2.52	6.46	4.22	3.17	2.66	2.84	3.35	2.85	5.71	4.01
Observations	285	285	285	285	285	285	285	285	285	285	285
Cross-Sections	30	30	30	30	30	30	30	30	30	30	30

Table 4.4[4] reveals considerable cross-country variation. For instance, the mean per capita growth rate (GY) for the sample is 2.29 per cent per annum, with a standard deviation of 2.47. The variability over four-year periods is less than when using lower frequency data (see table 4.5). This is due to the fact that averaging data has the effect

[4] The figures in the table are in logs, but the following discussion refers to percentage changes. The reader has to do exp(.) to get to the percentage.

of smoothing out shocks. The maximum growth rate is enjoyed by Thailand (7.5%) over 1990-1993 (see table 4.4), while Cote d'Ivoire and Zimbabwe suffer with a per capital growth rate of worse than –2.7 % per annum per cent over 1990-1993 and 1998-2001 respectively. There is a wide variation of bank and stock market development across the sample. While Korea had the highest Turnover Ratio (TR) of 1156[5] % of GDP in 1990-1993, Nigeria had the lowest Turnover Ratio of only 0.87 % in the same period. Malaysia's banks lent a maximum of 149% of GDP to the private sector (CPS) in 1994-97, while Nigerian financial intermediaries lent a minimum of only 4 per cent during the same period.

In table 4.5 the maximum growth rate is enjoyed by Jordan (12.8%) in 1992, while Thailand suffered with a per capital growth rate of -11.4 in 1998. This sharp decrease in Thailand's growth wasn't evident in the cross-country estimation with averaged data since Thailand average growth over 1998-2001 was -0.6.

[5] Recall that the figures shown in table 4.4-4.5 are in logs.

Tables 4.6- 4.7 present data correlations using averaged and annual frequency over the 1990-2001.

Table 4.6: Correlation Matrix of Four-year Averaged Data over 1990-2001

	CPS	LL	BA	BS	MC	TR	TV	NLC	FS	FDI
CPS	1.00									
LL	-0.09	1.00								
BA	0.23*	0.17*	1.00							
BS	0.50*	0.15*	0.18*	1.00						
MC	0.47*	0.27*	0.40*	0.40*	1.00					
TR	-0.06	0.54*	0.05	0.23*	0.23*	1.00				
TV	0.55*	0.01	0.22*	0.32*	0.59*	0.59*	1.00			
NLC	0.16*	-0.06	-0.05	0.03	0.20*	0.43*	0.57*	1.00		
FS	0.27*	0.33*	0.13	0.19*	0.31*	0.41*	0.40*	0.25*	1.00	
FDI	0.01	0.31*	0.27*	0.26*	0.37*	0.12	0.11	-0.21*	0.06	1.00
GY	0.06	0.25*	0.03	0.20*	0.04	0.29*	0.15*	0.07	0.24*	0.13

* Indicates significance at the 5% level ($r_c = 0.136$)

Table 4.7: Correlations Matrix of Annual Data over 1990-2001

	CPS	LL	BA	BS	MC	TR	TV	NLC	FS	FDI
CPS	1.00									
LL	0.79*	1.00								
BA	0.46*	0.37*	1.00							
BS	0.61*	0.07	0.28*	1.00						
MC	0.60*	0.49*	0.33*	0.35*	1.00					
TR	0.23	0.19*	0.32*	0.13*	0.25*	1.00				
TV	0.52*	0.41*	0.42*	0.31*	0.73*	0.80*	1.00			
NLC	0.12*	0.14*	-0.07	0.02	0.28*	0.55*	0.56*	1.000		
FS	0.38*	0.37*	0.32*	0.13*	0.30*	0.38*	0.47*	0.27*	1.00	
FDI	0.17*	0.06	0.02	0.19*	0.40*	0.03	0.24*	-0.06	0.05	1.00
GY	0.14*	0.07	0.16*	0.13*	0.13*	0.21*	0.22*	0.11*	0.15*	0.03

* Indicates significance at the 5% level ($r_c = 0.086$)

In terms of correlations of the averaged data in table 4.6, the different measures of stock market development (i.e. Stock market capitalization to GDP ratio (MC), the turnover ratio (TR), value traded to GDP ratio (TV) and the number of listed companies (NLC)) are generally significantly correlated with the highest being 0.59

for TR with TV, and 0.57 for TV with NLC. The measures of intermediaries' development are also correlated with the highest being 0.5 for CPS (credit to private sector) with BS (bank efficiency). For GY, only 5 out of the 10 correlations with the financial development variables are significant.

In terms of annual data in table 4.7, almost all of the correlations are significantly positive, with the highest being 0.803 for TR with TV, and 0.792 for CPS with LL (liquid liabilities ratio). This suggests that there is some redundancy of information provided by the ten variables. Also, it is well known that estimators based on least-squares methods can perform poorly when multicollinearity is present (see, e.g. Johnston and DiNardo, 1997 pp.88-9) possibly leading to incorrect inferences. In the next section we consider how to deal with this. For GY all the correlations with the financial variables are significant except with LL and FDI. However, it is also worth pointing out that for FDI, only 4 of the 9 correlations with the other financial development variables are significant, showing that there is some variation in the data.

As expected, a significant correlation is observed between most of the variables chosen to account for the notion of financial development. Moreover, all the collected variables are far from being adequate measures of the complexity of financial development. The next section attempts to solve the problem of multicollinearity and determine comprehensive measures of financial development using principal components analysis.

4.4. Principal Components Analysis

4.4.1. Motivation for Principal Components Analysis

For a study of finance and growth in a cross-country sample of thirty developing countries, the considered financial indicators might be far from satisfactory for the notion of financial development. Though published by distinguished institutions, the different financial development indicators may not be reliable. Frequently, the several footnotes reveal that the reported numbers are neither comparable across countries nor over time for a given country. Moreover, conceptual changes as well as retrospective recalculations appear in subsequent volumes without any prior notice (Graff, 2002 p.124). These calculation shortcomings impact on the measures considered, in the literature, the most valid. Therefore, a transformation of these single measures in a way that turns them into reasonably reliable, valid and broader measures for the notion of financial development is required. Motivated by the unreliability of financial indicators, the difficulty of finding variables that capture the comprehensive concept of financial development and the significant correlation found between the financial variables when examining data properties, this study constructs new measures of financial development. Following Graff (2002) and Creane *et al.* (2003), the principal components procedure is used to identify the common variance of the different financial development measures used in the literature.

It is common to find that at least some of the variables are correlated with each other in collected data sets. One result of these correlations is that there will be some redundancy in the information provided by the variables. Also, it is well known that the ordinary least squares regression coefficient estimator may perform poorly when there is near-perfect multicollinearity between the variables. The coefficients of the variables are not precise and standard errors of the ordinary least squares estimator can become infinite. This results in estimates that may have low probability of being close to the true values of regression coefficients (Gujarati, 2003). To eliminate multicollinearity and produce a more reliable prediction, principal components regressions is an appealing approach because it involves the transformation of a given set of variables into a smaller set of uncorrelated variables so that most of the original information is preserved. This procedure is attractive as there is some evidence that financial systems are becoming more correlated (Alexander, 2001). It is particularly useful when applied to data where only a few important sources of information are available. Also, principal components analysis deals with the data problem concerning missing observations, a common problem when dealing with developing countries, when the variable is correlated other variables in the dataset (Alexander, 2001).

4.4.2 Basic Concept of Principal Components Analysis

According to Dunteman (1989), the first principal component of ***R***, the correlation matrix, of an observed data set that has *n* observations on *p* variables, can be found as the weight vector $[a_{11}, a_{12}, a_{13}, \ldots\ldots a_{1p}]$ which maximizes the variance of

$$\sum_{i=1}^{p} a_{1i}x_i \text{ given that } \sum_{i=1}^{p} a_{1i}^2 = 1.$$

In this case x_i are standardized variables. The second principal component of ***R*** can be defined as the weight vector $[a_{21}, a_{22}, a_{13} \ldots\ldots a_{2p}]$ which maximizes the variance of

$$\sum_{i=1}^{p} a_{2i}x_i \text{ given that } \sum_{i=1}^{p} a_{2i}^2 = 1$$

The second principal component is linearly independent of the first principal component. The independence condition is specified by the constraint that

$$\sum_{i=1}^{p} a_{1i}a_{2i} = 0$$

Continuing to the last or *p*th principal component, the sum of the variances of the principal components is equal to the sum of the variances of the original variables. That is

$$\sum_{i=1}^{p} \lambda_i = \sum_{i=1}^{p} \sigma_i^2$$

Where λ_i is the variance of the *i*th principal component. The proportion of the variance in the original *p* variables that *k* principal components accounts for can be calculated as

$$\sum_{i=1}^{p} \lambda_i / p$$

where *k* is less than *p*. If the sum of the variances of the first few principal components is close to *p* then most of the information of the original variables is preserved by a few principal components which are linear independent transformations of the original variables (Dunteman, 1989). Obviously, all the variance within the dataset is explained when all the components are used. How many components should be selected is an arbitrary decision. However, there is a commonly used guideline to consider only the components with eigenvalues greater or equal 1. This is saying that unless a component extracts at least as much as the equivalent of one original variable, it has to be dropped. This criterion was proposed by Kaiser (1960) and is probably the one most widely used (Gray, 2002). The scores obtained from the analysis are to be used in the chosen GMM dynamic panel system to examine the relationship between growth and finance.

4.5. Conclusions

This chapter presented the methodology and the data to be used in examining the link between financial development and economic growth. For comparative purposes, this study will follow the traditional literature and use cross-country regressions with data collected for thirty developing countries. As they solve the estimation problems associated with cross-country regressions and gain advantages over time-series studies, GMM dynamic panel system techniques are chosen to assess the link between finance and growth using the different financial measures described earlier. Finally, principal components analysis is to be used to determine more accurate measures of financial development .The next chapter presents and discuss the results.

Chapter 5

Results and Discussion

5.1. Introduction

This chapter presents the results of the different chosen methods of investigating the growth - financial development relationship outlined in the previous chapter. In section 5.2 the data (see chapter 4 section 3) are four-year averages of annual data for 1988 to 2001 for 30 developing countries and the standard, cross-sectional regressions are estimated. The results highlight the importance of the legal origin variables in the finance-growth relationship. In section 5.3, a panel of annual data (1988 to 2001) for 30 countries is used for estimation. The method used is system GMM dynamic panel regressions which correct for the problems associated with the standard cross-sectional regressions used in the literature. As previously mentioned in chapter 4, within groups estimation is also carried out to detect whether there are serious finite sample biases in the system GMM estimations. In Section 5.4 dynamic GMM estimation is also used with the principal components of the financial development variables (as calculated in chapter 4) to reduce the effects of multicollinearity. Section 5.5 provides a discussion of the results. Overall, a positive link is found between the different measures of financial development and economic growth. The results reveal also a negative link between growth and bank development, measured by credit to the private sector or liquid liabilities of the financial sector, in developing countries.

5.2. Cross-Sectional Regressions with Averaged Data Over 1990-2001

As mentioned earlier in chapter 4 section 2, the use of averaged data, to eliminate the business cycle, in examining the relationship between finance and growth has become a near-tradition in the literature (e.g. King & Levine 1993a, Levine & Zervos, 1996, Rousseau & Wachtel 2000, Levine *et al.,* 2000 and Graff 2002). For comparative purposes, for the data in the present study, the relationship between financial development and economic growth is also investigated using four-year averaged data for thirty developing countries. To examine whether cross-country variations in the exogenous component of financial development explain cross-country variations in the rate of economic growth, only three dummy variables for legal origin, for the English, German[1] and French legal systems (legor_uk, legor_ge and legor_fr) are introduced (see table 4.2). In the selected sample of countries in chapter 4, no country adopts the Scandinavian legal origin. As discussed in chapter 4 section 2.2, they reflect cross-country differences in investor and creditor rights, accounting standards and the quality of contracts enforcement, and determine the legal environment of financial development and thus, economic growth. Relatively speaking, English law countries are the best at protecting investors, whereas the French civil law countries secure the least protection to investors. German civil law countries are in the middle. The English legal system has much better accounting standards than the French or German civil law. The latter, however, is the best at enforcing contracts (La Porta *et al.,* 1998). In the regressions in La Porta *et al.,* (1998) the omitted dummy was the English legal origin. Levine (1998) and Levine *et al.,* (2000), however, chose the Scandinavian origin to be their omitted dummy.

[1] German legal origin takes the value of one only for Korea Republic. However, the dummy could be picking up an East Asia effect or Korea effect.

There is no consensus over which dummy variable should be omitted. Since the French law provides the least investors' protection and is not as good as the English and the German laws in accounting standards and enforcement of contracts, it was chosen to be the omitted dummy (which is captured in the constant).

Table 5.1 presents the cross-sectional regressions of economic growth averaged over four years for the 1990-2001 period giving three observations per country. The dependent variable is growth of real per capita GDP (GY). Following Levine *et al.*, (2000) and Rousseau & Wachtel (2000), the regressions take into account other potential determinants of economic growth. Each of the reported regression controls for five effects: the initial income (IIP), the secondary school enrolment (SE), government consumption (GC), trade openness (OPEN) and inflation (INF). Each regression equation includes one of the alternative measures of financial sector development (following Levine *et al.*, 2000). The p-values of the coefficient estimates are reported in parentheses. The results of four diagnostic tests are included: for a normal distribution of the disturbances, for heteroscedasticity, for functional form and for the significance of the overall regression. It is also worth noting that here the results of the diagnostic tests are satisfactory for all the chosen specifications. Throughout this chapter logarithms of all the variables are used except growth and legal origin variables.

***Table 5.1*: *Financial Intermediation*, Stock Market and Growth: Cross-Section Regressions of Averaged Data 1990-2001**
***Dependent variable*: Real Per Capita GDP Growth**
Legal Origin Dummy variables

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	2.480 (0.453)	1.320 (0.700)	2.134 (0.541)	1.515 (0.730)	3.592 (0.334)	1.958 (0.559)	4.217 (0.232)	1.737 (0.638)	0.715 (0.850)	3.730 (0.310)
IIP	0.343 (0.394)	0.524 (0.179)	0.5597 (0.141)	0.5894 (0.129)	0.5636 (0.134)	0.4454 (0.254)	0.5212 (0.182)	0.43924 (0.260)	0.4227 (0.294)	0.48103 (0.263)
SE	0.41380 (0.628)	0.4456 (0.607)	0.283 (0.742)	0.2847 (0.756)	0.2650 (0.758)	0.1961 (0.824)	0.3187 (0.726)	0.35771 (0.677)	0.2756 (0.754)	0.50738 (0.559)
GC	-2.811 (0.000)	-2.632 (0.001)	-2.821 (0.000)	-2.497 (0.001)	-2.430 (0.001)	-2.4738 (0.001)	-2.638 (0.001)	-2.331 (0.002)	-2.3474 (0.002)	-2.517 (0.001)
OPEN	-0.1867 (0.725)	-0.069 (0.896)	-0.447 (0.449)	0.1484 (0.805)	-0.040 (0.940)	0.00246 (0.996)	-0.0754 (0.888)	0.16250 (0.764)	-0.0727 (0.890)	0.02514 (0.963)
INF	-0.062 (0.789)	-0.213 (0.325)	-0.106 (0.637)	-0.2049 (0.345)	-0.249 (0.235)	-0.201 (0.350)	-0.2019 (0.354)	-0.2032 (0.344)	-0.2189 (0.311)	-0.1905 (0.394)
CPS	0.8973 (0.120)									
LL		1.160 (0.132)								
BA			0.3385 (0.578							
BS				0.33318 (0.678)						
MC					0.17868 (0.580)					
TR						0.3362 (0.169)				
TV							0.2244 (0.194)			
NLC								0.1630 (0.543)		
FS									0.6367 (0.284)	
FDI										0.00847 (0.977)

Regressors (continued)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
legor_uk	2.921 (0.374)	1.859 (0.586)	2.783 (0.419)	2.068 (0.641)	4.136 (0.259)	2.461 (0.460)	4.688 (0.177)	2.205 (0.558)	1.208 (0.752)	4.187 (0.255)
legor_ge	11.749 (0.003)	5.814 (0.247)	10.747 (0.006)	10.154 (0.016)	10.861 (0.005)	8.260 (0.050)	10.566 (0.006)	11.179 (0.005)	9.446 (0.020)	10.721 (0.006)
No. observations	90	90	90	90	90	90	90	90	90	90
R^2	0.22317	0.22173	0.20209	0.2007	0.20206	0.21804	0.21594	0.20271	0.21014	0.22173
Normality test[3]	2.4692 (0.290)	1.359 (0.506)	2.520 (0.28)	2.5989 (0.27)	4 2.822 (0.24)	2.7000 (0.25)	3.152 (0.20)	2.132 (0.34)	1.457 (0.48)	1.6998 (0.427)
Hetero test[4]	0.853 (0.59)	0.854 (0.59)	0.891 (0.55)	0.99988 (0.45)	1.013 (0.44)	1.0726 (0.39)	1.329 (0.22)	0.852 (0.59)	1.251 (0.27)	0.75525 (0.69)
RESET test[5]	0.180 (0.67)	0.527 (0.46)	0.015 (0.90)	0.0309 (0.86)	0.024 (0.87)	0.4206 (0.51)	0.104 (0.747)	0.208 (0.64)	0.231 (0.631)	0.11943 (0.73)
Wald test for joint significance[6]	97.347 (0.000)	97.021 (0.000)	92.688 (0.000)	92.388 (0.000)	92.681 (0.000)	96.190 (0.000)	95.721 (0.000)	92.822 (0.000)	113.42 (0.000)	94.538 (0.000)

In the regressions the logarithms of all the variables are used, except for growth, where logarithmic rates of change are used.
P-values are reported in parentheses
[3] Based on Doornik and Hansen (1994). The null hypothesis is that the distribution of the residuals is normal.
[4] Based on White's (1980). The null hypothesis is that the variance of the residuals is constant.
[5] Based on Ramsey's (1969). The null hypothesis is that the functional form is correct.
[6] The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.

Overall, the results in table 5.1 show that the legal origin variables enter the regressions positively. Only the German legal origin is significantly associated with economic growth. These results confirm the finding of Levine (1998) and Levine *et al.*, (2000), who used 5-year average data for 49 and 71 countries respectively. This suggests that those countries that effectively enforce laws tend to grow faster than countries where contracts are less enforced. As it is difficult to change the legal origin, the results offer a support to reforms that ensure that investors have more confidence in the legal system and that their claims are enforced effectively.

Unlike the findings of Levine *et al.*, (2000) the cross sectional regressions results in table 5.1 demonstrate a positive but insignificant association between the ten measures of financial development and economic growth when controlling for initial income, schooling, inflation, government size and trade openness. These results confirm the findings of Trabelsi (2002) for 69 developing countries with data averaged over the period 1960-1990. Table 5.1 also indicates that although the alternative measures of financial sector development enter the regressions individually insignificantly, they enter the regressions jointly significantly as indicated by the p-value of less 0.01 on the Wald test for joint significance. For example, for Nigeria credit to the private sector (CPS) was 11.60 per cent of GDP over the 1990-2001 period, while the mean value for developing countries was 33.44 per cent of GDP. The results suggest that an improvement in credit to the private sector in Nigeria that brought it close to the sample mean would have increased real per capita GDP growth by about 0.95[2] percentage points per year. Similarly, if Korea had

2 Ln(33.44)-Ln(11.60)= 1.05. CPS coefficient is table 5.1 equals 0.897. The increase is calculated as 1.05*0.897=0.95.

increased its value of credit to the private sector of 6.22 to the sample mean, it would have grown more than 1.5 percentage points faster per year. This is large considering that growth only averaged about 2.29 per cent per year over this period. While these results should be viewed with care as averaged data is used and the individual coefficients are insignificant, they do suggest the existence of a positive link between financial development and economic growth.

While the estimated relation between the control variables employed in the existing growth literature (i.e. initial real GDP per capita (IIP), secondary school enrolment (SE), government consumption (% of GDP) (GC), openness to trade (OPEN) and inflation (INF)) and real economic growth is not entirely consistent across samples and estimation specifications, several patterns do emerge. First, the coefficient on general government consumption (GC) is significantly negative in all the specifications in table 5.1. As in Barro and Sala-i-Martin (1995), Bekaert *et al.,* (2001) and Beck & Levine (2002), high levels of government consumption (GC) are negatively associated with growth, suggesting that the instabilities or taxation associated with government consumption are harmful to economic growth. Government spending has also the effect of crowding out the private savings and investment (Berthelemy & Varoudakis, 1996). Second, the relation between trade sector openness and economic growth is generally negative but not significant. Exports may positively promote growth if they target new markets and allow the inflow of reserves that would eventually increase capital accumulation. Imports also have a positive impact on growth if they represent capital goods that would enhance the production process. However, openness also can negatively affect growth. The net effects can only be determined empirically (Allen & Ndikumana 1998, p14). Generally speaking the relationship between trade openness (OPEN) and growth is negative and statistically weak. This finding is consistent with Rodrik & Rodriguez (1999) who did not support the claim that trade openness may generate a higher growth rate (Gilbert, 2003). According to comparative advantage theory, for a country to benefit from specialization after trade openness, significant inter-sectoral reallocation of labour and capital must occur. Such reallocations need a sound financial system. In less-developed countries this process takes a long period of time in which the economy experiences job destruction, output losses and thus, low growth rates. Moreover, the adaptation to international markets can be very costly (Berthelemy & Varoudakis, 1996).

The relationship between inflation (INF) and economic growth is negative and insignificant. The traditional intuition is that high inflation harms economic activity by reducing investment in productive projects, which in turn slows economic growth (Beck & Levine (2002) and Allen & Ndikumana (1998)). Additionally, as in King & Levine (1993a) and Bekaert *et al.*, (2001), secondary school enrolment (SE) is generally positively and insignificantly related to economic growth. Finally, the relationship between initial GDP (IIP) is positive and statistically insignificant which is not in line with the convergence hypothesis, presented in chapter 2, that claims that in poorer countries growth is higher.

Overall, the cross-sectional regressions results support the hypothesis that there is a positive but insignificant link between different measures of financial development and economic growth in the developing countries. This might be due to the fact that averaged data has the effect of smoothing variation and not allowing sensible dynamic relationships to be estimated. While each of the equations in table 5.1 could be improved by deleting variables with insignificant coefficients this approach is not followed.

5.3. Dynamic GMM Panel Estimation Using Annual Measures of Stock Market and Banks Development

In an attempt to overcome the weaknesses associated with the use of averaged data, GMM panel estimation is performed with annual data. The cross-country regressions with averaged data offer some evidence of a positive association between financial development and economic growth which is consistent with the literature. However, there are two sources of inconsistency in the existing cross-country empirical work on growth. First, the incorrect treatment of the country-specific effect gives a possible omitted-variables bias. Estimating cross-country regressions assumes that such an effect is uncorrelated with the explanatory variables. This assumption is violated due to the dynamic nature of growth regressions. Second, there exists a strong theoretical argument that at least a subset of the right hand side variables should be treated as being endogenous.

To solve these problems, panel data and estimation by the General Method of Moments (GMM), as outlined in chapter 4 section 4.2.4, are used. The growth regressions are taken as a dynamic model in the growth of real per capita GDP. Second, first differences are taken to eliminate the individual effects. Third, GMM system estimation is used (SYS-GMM) that combines the regressions in differences with regressions in levels. For the regression in differences the lagged values of the levels variables are used as instruments while for the regressions in levels their first lagged differences are the instruments. While differencing removes the omitted variables bias, this estimation procedure eliminates the inconsistency arising from endogeneity of the explanatory variables and the weakness of the instruments bias caused by considering only the lagged levels of these variables as instruments. (See discussion in chapter 4 section 4.2.4). When the number of instruments is equal to or larger than the number of cross-sectional units, this biases the Sargan test downwards and might result in incorrect inferences. Thus, following Beck & Levine (2002) and Rousseau & Wachtel (1998) the control variables are not included in the estimated equations. They are only used as instruments, rather than following the standard practice of including them all at once in the estimation equation.

Following Beck & Levine (2002) and Ben Naceur & Ghazouani (2003), the estimation strategy is based on including in the regressions a measure of bank development and one of the different measures of stock market development (i.e. stock market turnover (TR), value traded over GDP (TV), stock market capitalization over GDP (MC) or the number of listed companies (NLC)). Note that the chosen bank development measures are the measures commonly used in the literature (i.e. credit to the private sector (CPS), the liquid liabilities to GDP ratio (LL) and the commercial-central bank ratio (BA)).

Following Doornik *et al.*, (2002), Within Groups (WG) estimates are used only to check whether the system estimates are consistent and not finite sample biased (see chapter 3, section 3.5 and chapter 4, section 4.2.4). Several specifications of the dynamic panel model are estimated and reported in tables 5.2-5.5. As in the cross-country regressions with averaged data, the dependent variable is growth of real per capita GDP (GY). Following Rousseau & Wachtel (2000), the lagged dependant variable is also included in the equations. The p-values of the coefficient estimates are reported in parentheses. The results of diagnostic tests for the joint significance of the variables (the Wald test), the validity of the chosen instruments (the Sargan test), and first- and second-order serial correlation are also given As explained in chapter 4 section 4.2.4 first-order serial correlation is expected to be present by construction. A full discussion of the results is presented in section 5.5.

Table 5.2: Growth, Stock Market Development and Credit Allocation

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	5.541 (0.008)	-	0.949 (0.003)	-	2.304 (0.271)	-	-2.547 (0.185)	-
GY(-1)	0.033 (0.783)	0.002 (0.981)	0.043 (0.711)	0.021 (0.852)	0.094 (0.450)	0.040 (0.737)	0.072 (0.552)	0.044 (0.706)
CPS	-1.16 (0.05)	-1.91 (0.087)	-0.368 (0.509)	-1.32 (0.153)	-0.737 (0.248)	-1.672 (0.116)	-0.367 (0.572)	-1.493 (0.157)
TV	0.893 (0.001)	1.016 (0.003)	-	-	-	-	-	-
TR	-	-	0.949 (0.003)	0.842 (0.030)	-	-	-	-
MC	-	-	-	-	0.720 (0.293)	0.672 (0.370)	-	-
NLC	-	-	-	-	-	-	1.080 (0.005)	0.624 (0.724)
No. observations	274	274	274	274	274	274	274	274
Wald test for joint significance[1]	12.05 [0.007]	8.824 [0.032]	11.49 [0.009]	4.775 [0.189]	2.022 [0.568]	2.813 [0.421]	10.61 [0.010]	2.118 [0.548]
Sargan test [2]	512.2 [0.551]	-	519.4 [0.462]	-	587.0 [0.435]	-	506.0 [0.627]	-
First order serial correlation test[3]	-3.181 [0.001]	-1.343 [0.179]	-3.160 [0.002]	-1.315 [0.189]	-3.391 [0.001]	-1.368 [0.171]	-3.361 [0.001]	-1.154 [0.248]
Second order serial correlation test[4]	0.6892 [0.491]	0.5494 [0.583]	0.5683 [0.570]	0.2154 [0.829]	0.9276 [0.354]	0.8009 [0.423]	0.6985 [0.485]	0.6298 [0.529]
R^2	-	0.16	-	0.14	-	0.12	-	0.11

The regressions also include dummy variables for the different time periods that are not reported.
Instruments include GY, control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991). P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

(a) Growth, Stock Market Development and Credit Allocation

The results for stock market development and credit allocation are given in table 5.2. The specification tests are satisfactory. The Sargan test confirms the validity of the chosen instruments. While first-order autocorrelation is expected there is no evidence of the second order serial correlation in those differenced residuals which exhibit a negative and significant first order serial correlation. Although it is important in the specification of the system GMM models, most of the empirical studies do not report the test for first order serial correlation (e.g. Beck & Levine, 2002, and Levine *et al.*, 2000). All the GMM system (SYS-GMM) estimates in table 5.2 seem consistent and not finite sample biased since the estimates of the coefficients on lagged dependent variable lie comfortably above the corresponding within-groups (WG) estimates. It is worth noting that the coefficients reported for the within groups estimation method have the same signs as the corresponding GMM system estimates.

The GMM system results in table 5. 2 column (1) show that the relationship between bank development, measured by credit to the private sector (CPS), and growth is negative and significant at the 5 per cent level, when using value traded over GDP (TV) as the measure of stock market development. This differs from the results obtained in table 5.1 where CPS has a positive but insignificant effect on growth. This difference might be due to the fact that unlike annual data, the use of averaged data in table 5.1 has the effect of hiding important events that influence the relationship between finance and growth. Besides, cross-country regressions do not control for unobserved country-specific effects and the endogeneity of explanatory variables. Hence, their results might be misleading.

The relationship between growth and TV in table 5.2 column (1) is positively significant at the 1 per cent level. When taking the turnover ratio (TR) as a measure of stock market development in column (2), this variable enters the regression positively and significantly at the 1 per cent level. Credit to the private sector (CPS) enters the regression negatively but not significantly. The results indicate that the liquidity of the stock market (measured by TR) positively and significantly affects growth when taking into account bank credit allocation which remains negatively related to growth. Column (3) shows that the link between bank credit allocation measured by credit to the private sector (CPS) and growth is negative but insignificant when stock market capitalization over GDP (MC) is the measure of stock market size. The stock market size (MC) enters the regression positively but insignificantly. Column (3) confirms the negative impact of credit allocation on growth. The number of listed companies (NLC) in column (4) affects economic growth positively at the 1 per cent level of significance while credit to the private sector (CPS) remains negative and insignificantly related to growth.

In all the above specifications the financial indicators (CPS, TV, TR and NLC) always enter jointly significantly at the 1 per cent level. In column (3), while both credit to the private sector (CPS) and stock market size (MC) coefficients are jointly insignificant, as indicated by the Wald test for joint significance.

Overall, table 5.2 shows that, in general, stock market development has a positive and significant impact on growth. This finding is consistent with the results reported by Beck & Levine (2002) and Rousseau & Wachtel (2000). However, unlike Levine *et al.,*

(2000) and Beck & Levine (2002) finding's, credit allocation (CPS) negatively and significantly affects growth when stock market activity (TV) is taken into account. It is worth noting that the samples of Levine *et al.,* (2000) and Beck & Levine (2002) included both developed and developing countries with averaged data over 1960-1995, 1976-1998 respectively whereas our sample includes developing countries only with annual data over 1988-2001. Also, this analysis uses the one step system GMM whereas Levine *et al.,* (2000) rely on the two-step system GMM which is known to be inconsistent and unreliable (see chapter 4, section 4.2.4). However, the results in table 5.2 confirm the findings of Ben Naceur & Ghazouani (2003) that credit allocation negatively affects growth in developing countries over 1979-1999. This result might be justified if the performance of the banking sector in developing countries is considered. A full discussion of the results is provided in section 5.5.

Table 5.3: Growth, Stock Market Development and the Size of the Financial Intermediaries

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	7.663 (0.005)	-	2.103 (0.405)	-	3.512 (0.189)	-	-2.02 (0.431)	-
GY(-1)	0.0182 (0.877)	-0.028 (0.794)	0.045 (0.687)	-0.005 (0.961)	0.0916 (0.459)	0.01 (0.934)	0.070 (0.554)	0.015 (0.894)
LL	-1.654 (0.008)	-5.792 (0.011)	-0.733 (0.282)	-5.227 (0.018)	-1.017 (0.083)	-5.65 (0.017)	-0.697 (0.369)	-5.597 (0.013)
TV	0.9712 (0.000)	0.998 (0.001)	-	-	-	-	-	-
TR	-	-	0.958 (0.002)	0.792 (0.038)	-	-	-	-
MC	-	-	-	-	0.7268 (0.240)	0.661 (0.329)	-	-
NLC	-	-	-	-	-	-	1.239 (0.001)	0.895 (0.537)
No. observations	274	274	274	274	274	274	274	274
Wald test for joint significance[1]	21.61 [0.000]	14.62 [0.002]	11.62 [0.009]	6.871 [0.076]	4.364 [0.225]	7.412 [0.060]	12.73 [0.005]	6.909 [0.075]
Sargan test[2]	518.1 [0.478]	-	546.2 [0.181]	-	600.7 [0.287]	-	506.2 [0.625]	-
First order serial correlation test[3]	-3.175 [0.001]	-0.8350 [0.404]	-3.113 [0.002]	-0.6207 [0.535]	-3.419 [0.001]	-0.8498 [0.395]	-3.341 [0.001]	-0.3636 [0.716]
Second order serial correlation test[4]	0.5952 [0.552]	-0.070 [0.944]	0.5491 [0.583]	-0.2299 [0.818]	0.8909 [0.373]	0.1079 [0.914]	0.6625 [0.508]	-0.055 [0.996]
R^2	-	0.20	-	□0.18	-	□0.16	-	0.16

The regressions also include dummy variables for the different time periods that are not reported.
Instruments include GY, control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991).
P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

(b) Growth, Stock market and the Size of the Financial Intermediaries

The results for the effects of the stock market and the size of financial intermediaries on economic growth are given in table 5.3. Again the diagnostic statistics are satisfactory, with the Sargan test accepting the choice of instrumental variables, and there being no second-order autocorrelation. The within groups (WG) results indicate that the GMM System estimates seem consistent and not finite sample biased.

The SYS-GMM results reported in table 5.3 column (1) show a significant negative link between the liquid liabilities of the financial system (LL) and economic growth at the 1 per cent level when using value traded over GDP (TV) for stock market activity. As in table 5.2, TV remains significant at the 1 per cent level and positively related to growth. When focusing on stock market liquidity by including the turnover ratio (TR) in table 5.3 column (2), the liquid liabilities ratio (LL) remains negatively but insignificantly related to growth while TR has a positive and a significant impact on growth at the 1 per cent level of significance as in table 5.2. In column (3) the liquid liabilities of the financial system (LL) is negatively and significantly related to growth at the 10 per cent level of significance when market capitalization to GDP ratio (MC) measures stock market size. As in table 5.2, MC positively but insignificantly affects growth whereas the number of listed companies (NLC) is again significantly and positively related to growth at the 1 per cent level of significance in column (4).

As with the credit to the private sector regressions in table 5.2, in all the specifications the size of the intermediaries (LL) negatively affects growth and the financial development variables enter jointly significantly, except when the stock market size (MC) is considered.

Overall, the results in table 5.3 confirm the earlier findings that stock market development has a significant positive impact on growth. Unlike most other empirical studies findings (e.g. Levine et al., 2000, Beck & Levine 2002, and Rousseau & Wachtel, 2000), the liquid liabilities of the financial sector (LL), measuring financial intermediary size, negatively and significantly relates to economic growth. Our findings agree with the results of Hsu & Liu (2002) that the size of financial intermediaries negatively affects growth in three developing countries over 1981 to 2001.

Table 5.4: Growth, Stock Market and Central and Commercial Bank Assets

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	-12.2 (0.227)	-	-18.02 (0.076)	-	-20.88 (0.021)	-	-31.77 (0.002)	-
GY(-1)	0.028 (0.816)	-0.022 (0.838)	0.031 (0.790)	-0.009 (0.934)	0.0648 (0.602)	0.009 (0.935)	0.023 (0.852)	0.011 (0.926)
BA	3.246 (0.161)	4.192 (0.275)	4.212 (0.07)	4.545 (0.211)	5.28 (0.01)	4.715 (0.191)	6.363 (0.01)	5.155 (0.132)
TV	0.581 (0.010)	0.891 (0.010)	-	-	-	-	-	
TR	-	-	0.718 (0.030)	0.833 (0.060)	-	-	-	-
MC	-	-	-	-	-0.024 (0.964)	0.378 (0.601)	-	-
NLC	-	-	-	-	-	-	1.245 (0.000)	0.844 (0.636)
No. observations	274	274	274	274	274	274	274	274
Wald test for joint significance[1]	20.98 [0.000]	13.99 [0.003]	17.33 [0.001]	10.70 [0.013]	12.11 [0.007]	2.227 [0.527]	35.66 [0.000]	4.176 [0.243]
Sargan test [2]	555.7 [0.116]	-	539.4 [0.240]	-	576.5 [0.556]	-	491.5 [0.784]	-
First order serial correlation test[3]	-3.275 [0.001]	-0.7152 [0.474]	-3.198 [0.001]	-0.6935 [0.488]	-3.349 [0.001]	-0.5796 [0.562]	-3.354 [0.001]	-0.3318 [0.740]
Second order serial correlation test[4]	0.6522 [0.514]	0.4983 [0.618]	0.5827 [0.560]	0.2078 [0.835]	0.7231 [0.470]	0.6674 [0.505]	0.5857 [0.558]	0.5621 [0.574]
R^2	-	0.16	-	0.15	-	0.12	-	0.12

The regressions also include dummy variables for the different time periods that are not reported.
Instruments include GY, control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991). P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

(c) Growth, Stock Market and Commercial Bank Assets

Table 5.4 gives the results for the size of commercial bank assets (i.e. commercial bank assets divided by commercial bank plus central bank assets) (BA). The diagnostic statistics are again satisfactory, with the Wald tests being significant (for the SYS-GMM equations), the Sargan test confirming the validity of the chosen instruments and where there is evidence of negative first order serial correlation there is no evidence of the second order serial correlation. Also the within groups (WG) results indicate that the GMM System estimates seem consistent and are not finite sample biased. The effect of commercial bank assets (BA) on growth is positive but the level of significance varies. With turnover value (TV) as the measure of stock market activity in column (1), BA is not significant but with stock market liquidity (TR) in column (2), market size (MC) in column (3) and number of listed companies (NLC) column (4), its effect is positive and significant at the 10, 1 and 1 per cent levels respectively. As in tables 5.2 and 5.3, the value traded ratio measure of stock market development (TV) and the number of listed companies (NLC) enter the regressions positively and significantly at the 1 per cent level. The liquidity of the stock market (TR) also enters the regression significantly at the 3 per cent level. The size of the stock market (MC), however, negatively but insignificantly relates to economic growth.

Overall, the commercial-central bank assets ratio (BA) positively and significantly relates to growth except when stock market activity measured by TV. As in table 5.2 and 5.3 stock market development positively and significantly promotes growth. Also, as in tables 5.2 and 5.3, bank and stock market development are always jointly significant for the system panel estimators used. This suggests that a trade-off between bank development and stock market development may not exist and that they are both important for economic growth (Beck & Levine, 2002).

Table 5.5: Growth, Stock Market and Bank Development, and Foreign Direct Investment

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)
Constant	2.461 (0.003)	-	2.674 (0.002)	-	2.698 (0.204)	-
GY(-1)	0.059 (0.666)	-0.020 (0.880)	-0.060 (0.677)	-0.070 (0.578)	-0.008 (0.996)	-0.024 (0.856)
FDI	0.114 (0.635)	0.211 (0.565)	0.0204 (0.994)	0.206 (0.537)	0.0526 (0.851)	0.103 (0.782)
TV	-	-	0.7475 (0.001)	1.113 (0.003)	-	-
CPS	-	-	-	-	-0.025 (0.963)	-1.922 (0.115)
No. observations	261	261	261	261	261	261
Wald test for joint significance[1]	0.4410 [0.802]	0.3396 [0.844]	12.24 [0.007]	10.09 [0.018]	0.0414 [0.098]	2.790 [0.425]
Sargan test[2]	574.1 [0.596]	-	468.7 [0.284]	-	512.5 [0.547]	-
First order serial correlation test[3]	-2.839 [0.005]	0.7659 [0.444]	-2.995 [0.003]	0.0219 [0.984]	-3.068 [0.002]	0.595 [0.552]
Second order serial correlation test[4]	1.093 [0.274]	0.8922 [0.372]	0.9232 [0.356]	0.5147 [0.607]	1.060 [0.289]	0.8078 [0.419]
R^2	-	0.11	-	0.15	-	0.12

The regressions also include dummy variables for the different time periods that are not reported.
Instruments include GY, FDI, control variables, and the considered measure of bank and stock market development

1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991).

P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

(d) Growth, Stock Market and Bank Development, and Foreign Direct Investment

To assess the impact of foreign direct investment (FDI) on growth, in table 5.5 the value traded (TV) is used to measure stock market development. As the product of market price and the number of shares traded, TV contains components of both liquidity and size. In emerging markets, an increase in liquidity is a good indication as it shows the importance and the credibility of available information (Rousseau & Wachtel, 2000). For the bank development variable, credit to the private sector (CPS) is used. This ratio is the most appropriate measure of bank development since it represents accurately the role of financial intermediaries in channelling fund to private sector and thus assessing the efficiency of investment and hence growth (Beck & Levine, 2002). The results reported in table 5.5 have satisfactory diagnostics and show that foreign direct investment (FDI) has a positive but an insignificant impact on growth when also considering stock market or bank development. As previously, the activity of the stock market (TV) enters the regression positively and significantly at the 1 per cent level in column (2). Credit to the private sector (CPS) enters the regression negatively but insignificantly as in table 5.2. The results that foreign direct investment positively but insignificantly affects growth agree with the findings of Zhang (2001) for 11 developing countries over 1957-1997.

5.4. Dynamic GMM panel Estimation Using Principal Components

As discussed in the previous chapter, the main reason for using principal components is to deal with the multicollinearity of the financial development variables and the difficulty of finding a measure that accounts for the comprehensive notion of financial development. In table 5.6 the principal components of the annual values of the ten chosen financial development variables reveal that this procedure reduces the data fairly well by delivering the first four principal components that account for 79 per cent of overall variance[3]. Logarithms of all the variables are used except growth.

Table 5.6: Principal Component Analysis of Annual Financial Development Variables over 1988-2001

Sample: 1 420										
Included observations: 387										
Excluded observations: 33										
Correlation of CPS LL BA BS MC TV TR NLC FS FDI										
	Com 1	Com 2	Com 3	Com 4	Com 5	Com6	Com 7	Com 8	Com9	Com 10
Eigenvalue	4.275	1.523	1.114	0.978	0.764	0.597	0.402	0.322	0.026	0.000
Variance Prop.	0.427	0.152	0.119	0.098	0.076	0.060	0.040	0.032	0.003	0.000
Cumulative Prop.	0.427	0.580	0.698	0.789	0.865	0.925	0.965	0.997	1.000	1.000
Eigenvectors:										
Variable	PC1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8	PC 9	PC 10
CPS	0.398	-0.316	-0.219	0.018	-0.344	-0.045	-0.254	0.026	0.007	-0.713
LL	0.330	-0.154	-0.302	-0.567	-0.232	0.083	-0.306	0.025	-0.003	0.547
BA	0.288	-0.184	-0.334	0.149	0.612	0.372	0.131	0.467	0.008	0.000
BS	0.235	-0.320	0.022	0.738	-0.270	-0.176	-0.031	0.011	0.015	0.439
MC	0.370	-0.173	0.310	-0.174	-0.134	0.231	0.646	-0.216	0.414	0.000
TV	0.435	0.205	0.231	0.036	0.070	0.190	0.052	-0.278	-0.770	0.000
TR	0.329	0.444	0.108	0.182	0.242	0.146	-0.488	-0.313	0.483	0.000
NLC	0.231	0.573	0.128	0.015	-0.364	-0.072	0.116	0.671	0.037	0.000
FS	0.309	0.127	-0.252	-0.102	0.309	-0.801	0.246	-0.127	0.021	0.000
FDI	0.106	-0.356	0.712	-0.190	0.265	-0.254	-0.303	0.304	0.002	0.000

[3] Higher than the overall variance reported by Graff (2002), which is 76.6%

The proportions of the variance explained by the first, second, third and fourth principal component are 42.7, 15.2, 11.9 and 9.8 per cent respectively. The rule of thumb, that those components with eigenvalues greater than one should be selected, suggests that the first three principal components should be used. However, here the fourth component has an eigenvalue of 0.978 and adds 9.8% to the explanation, and so is included in the estimation. While the interpretation of estimated principal components is, to some extent, speculative, the coefficients from table 5.6 and the correlations with the financial development variables in table 5.7 provide some guidance. The first vector has positive coefficients on all the variables, with the value traded of the stock market (TV), one of the measures of stock market activity, having the largest weight. The positive coefficients in the first principal component, PC1, suggest that this is a general, overall, measure of financial development. Also, PC2 has high positive weights for three stock market variables (NLC, TR, and TV) as well as financial structure (FS), and negative weights for the other variables, suggesting that this might be more related to stock market development. In PC3 the largest weight is for FDI, suggesting that this component is strongly influenced by this variable. For PC4 there is a large negative weight on the size of the financial intermediaries sector (i.e. LL, liquid liabilities as a proportion of GDP) and a large positive weight on BS, credit to the private sector as a proportion of LL, which measures the efficiency of the banking sector. Also, table 5.7 shows that growth of real GDP per capita (GY) is significantly correlated with PC1 but not with the other principal components.

Table 5.7: Correlation of First four Principal Components with the Financial Development Variables and Growth

	PC1	PC2	PC3	PC4
CPS	0.785*	-0.330*	-0.140*	0.043
LL	0.664*	-0.178*	-0.262*	-0.538*
BA	0.602*	-0.254*	-0.326*	0.141*
BS	0.448*	-0.348*	0.050	0.668*
MC	0.619*	-0.230*	0.210*	-0.022
TR	0.433*	0.497*	0.034	0.074
TV	0.577*	0.159*	0.095	-0.012
NLC	0.232*	0.516*	0.047	-0.084
FS	0.600*	0.138*	-0.259*	-0.113*
FDI	0.121*	-0.450*	0.520*	-0.161*
GY	0.233*	0.059	0.040	-0.011

* - Significantly different from zero at the 5% level. ($r_c = \pm 0.0954$).

Since they take into account 79 per cent of the overall variation in the financial development variables, the individual annual scores of the first four principal components (PC1 - PC4) are used as the new proxies of financial development. Unlike Graff (2002), who used the principal component scores of five-year average data in the framework of Granger causality, the new proxies of financial development are used in dynamic GMM estimation of the combined system estimator.

As previously, the dependent variable is growth of real per capita GDP. The p-values of the coefficient estimates are reported in parentheses. In table 5.8 the GMM system estimates seem consistent and not finite sample biased since the estimates of the coefficients on lagged dependent variable lie comfortably above the corresponding within-groups estimates.

Table 5.8: Growth and Financial Development Measured using Principal Component Analysis

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	3.883 (0.000)	-	3.912 (0.000)	-	3.759 (0.000)	-	3.801 (0.000)	-
GY(-1)	0.006 (0.954)	-0.036 (0.726)	0.009 (0.929)	-0.03 (0.745)	0.016 (0.876)	-0.015 (0.881)	0.023 (0.808)	-0.016 (0.876)
PC1	0.788 (0.000)	0.800 (0.040)	0.808 (0.000)	0.935 (0.007)	0.775 (0.000)	0.934 (0.005)	0.752 (0.000)	0.919 (0.000)
PC2	0.5167 (0.177)	0.658 (0.358)	0.531 (0.166)	0.580 (0.407)	0.559 (0.135)	0.726 (0.316)	-	-
PC3	0.413 (0.248)	1.259 (0.002)	0.405 (0.272)	1.165 (0.003)	-	-	-	-
PC4	0.321 (0.540)	0.593 (0.414)	-	-	-	-	-	-
No. observations	316	316	316	316	316	316	316	316
Wald test for joint significance[1]	75.58 [0.000]	14.80 [0.011]	74.20 [0.000]	14.91 [0.005]	71.98 [0.000]	9.947 [0.020]	45.43 [0.000]	7.166 [0.030]
Sargan test [2]	674.9 [0.201]	-	678.5 [0.182]	-	682.9 [0.159]	-	724.3 [0.376]	-
First order serial correlation test[3]	-3.297 [0.001]	-0.2599 [0.795]	-3.316 [0.001]	-0.4625 [0.644]	-3.313 [0.001]	0.1591 [0.874]	-3.352 [0.001]	0.2814 [0.778]
Second order serial correlation test[4]	0.6866 [0.492]	0.1202 [0.904]	0.7428 [0.458]	0.2272 [0.820]	0.7030 [0.482]	0.06237 [0.950]	0.7482 [0.454]	0.2109 [0.833]
R^2	-	0.17	-	0.16	-	0.13	-	0.13

The regressions also include dummy variables for the different time periods that are not reported
Instruments include GY, control variables and the scores of the first four principal components.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991). P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

Table 5.8 shows that the four principal components (PC1 - PC4) are positively linked to growth and the variables enter the regression jointly significantly with p value below 0.01 as indicated by the Wald test. The first principal component enters all regressions individually significant at the 1 per cent level while the other principal components are not individually significant. In all the specified regressions, there is evidence of the expected negative first order serial correlation and no evidence of the second order serial correlation. The Sargan specification test confirms the validity of the chosen instruments. Repeating the estimation dropping one insignificant principal component at the time gives the same overall results concerning the link between financial development and economic growth. The GMM system regression in column (4) confirms the overall findings that there is a positive association between financial development and economic growth in the developing countries.

To assess the strength of the link between financial development, measured by principal component analysis, and economic growth, other potential determinants of economic growth are now considered. To the ten financial development variables previously used to account for financial development, the conditioning variables (i.e. the initial real GDP per capita (IIP) to control for convergence, the level of secondary school enrolment (SE) to control for the level of human capital, the ratio of export and imports to GDP (OPEN) as a measure of openness to international trade, the inflation rate (INF) as proxy to macroeconomic stabilization and the ratio of government consumption expenditure to GDP (GC) as proxy for government size and credibility of fiscal policy) are all added. Since from table 5.9 there are significant correlations between PC1 - PC4 and the conditioning variables, the 10 financial development variables plus the 5 conditioning variables are now used in the calculation of new principal components.

Table 5.9 Correlations of Principal Components and the Conditioning Variables

	IIP	SE	INF	OPEN	GC
PC1	0.310*	0.575*	-0.215*	0.302*	0.258*
PC2	-0.166*	-0.137*	0.206*	-0.603*	-0.301*
PC3	0.174*	0.281*	0.077*	-0.046	-0.002
PC4	0.250*	-0.047	0.130*	-0.540*	-0.260*
IIP	1.000	0.310*	0.153*	0.018	0.044
SE	0.310*	1.000	0.007	0.140*	0.240*
INF	0.153*	0.007	1.000	-0.257*	-0.062
OPEN	0.018	0.140*	-0.257*	1.000	0.279*
GC	0.044	0.240*	-0.062	0.279*	1.000

* Significantly different from zero at the 5% level ($r_c = \pm 0.0954$)

The annual observations of the fifteen variables over 1988-2001 are transformed using principal component analysis to give the results in table 5.10. Again, the procedure reduces the data fairly well by delivering the first six principal components that account for 82 per cent of the overall variance.

Table 5.10: Principal Component Analysis of Annual Financial Development Variables and other Growth Determinants over 1988-2001

Sample: 1 420
Included observations: 355
Excluded observations: 65
Correlation of BA BS CPS FDI FS GC IIP INF LL MC NLC OPEN SE TR TV

	Com 1	Com 2	Com 3	Com 4	Com 5	Com 6	Com 7	Com 8	Com 9	Com 10
Eigenvalue	5.326	2.36	1.504	1.194	1.013	0.911	0.638	0.567	0.447	0.337
Variance Prop.	0.355	0.15	0.100	0.080	0.068	0.061	0.043	0.038	0.030	0.022
Cumulative Prop.	0.355	0.51	0.613	0.693	0.760	0.821	0.864	0.901	0.931	0.954
Eigenvectors										
Variable	FUL PC 1	FUL PC 2	FULP C 3	FUL PC 4	FUL PC 5	FUL PC 6	FUL PC 7	FUL PC 8	FULP C 9	FUL PC10
BA	0.254	-0.045	-0.136	-0.412	-0.365	-0.154	-0.369	-0.298	0.274	0.045
BS	0.211	0.087	0.194	-0.649	0.298	0.205	0.224	0.101	0.025	-0.069
CPS	0.341	-0.140	-0.156	-0.271	0.245	-0.011	0.272	0.115	-0.102	0.244
FDI	0.165	-0.176	0.529	0.236	-0.182	0.325	0.127	0.155	-0.209	-0.137
FS	0.263	0.163	-0.072	0.046	-0.155	-0.602	0.250	0.260	0.002	-0.607
GC	0.162	-0.272	-0.010	0.151	0.608	-0.131	-0.593	-0.038	-0.136	-0.246
IIP	0.284	0.156	0.437	-0.087	0.033	-0.178	-0.174	0.084	-0.315	0.113
INF	-0.144	0.300	0.288	0.130	0.372	-0.370	0.308	-0.531	0.118	0.179
LL	0.296	-0.254	-0.363	0.178	0.076	-0.183	0.172	0.068	-0.155	0.376
MC	0.345	-0.089	0.018	0.162	0.116	0.307	0.098	-0.263	0.477	-0.295
NLC	0.146	0.423	-0.287	0.282	0.191	0.225	0.044	0.354	0.184	0.087
OPEN	0.175	-0. 050	0.025	0.171	-0.153	-0.061	0.296	-0.265	-0.092	0.031
SE	0.293	0.054	0.347	0.196	-0.133	-0.197	-0.200	0.249	0.435	0.431
TR	0.248	0.404	-0.132	0.079	-0.196	0.113	-0.125	-0.273	-0.505	0.074
TV	0.365	0.240	-0.081	0.138	-0.034	0.217	-0.002	-0.316	-0.021	-0.112

As previously the logarithms of the variables are used.

The proportions of variance explained by the first six principal components are 35.5, 15.8, 10, 8, 6.8 and 6.1 per cent respectively. These are to be used in the estimation because even though the sixth component has an eigenvalue of 0.911 it adds 6.1% to the explanation of the variance. As in table 5.6, the first vector (FULPC1) has positive coefficients on all the variables except for inflation (which is expected to be negatively correlated with growth), with the value traded of the stock market (TV), the measure of stock market activity having the largest weights. The second vector has high positive weights on the number of listed companies (NLC) and the turnover ratio (TR), the measure of stock market liquidity. The third vector gives a high positive weight to initial income (IIP) and the fourth vector a high negative weight to the efficiency of the banking sector (BS) and the ratio of commercial bank assets to commercial bank plus central bank assets (BA). The fifth vector gives a high positive weight to government consumption to GDP ratio (GC) and inflation (INF), and the sixth vector gives a high negative weight to financial structure (FS) and inflation (INF). The regression results using the first six components (FULPC1 - FULPC6) are presented in table 5.11. As previously discussed, the dependent variable is growth of real per capita GDP. The p-values of the coefficient estimates are reported in parentheses.

Table 5.11: Growth, Financial Development and other Growth Determinants

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)
Constant	4.386 (0.000)	-	4.209 (0.000)	-	4.227 (0.000)	-
GY(-1)	-0.051 (0.637)	-0.059 (0.578)	-0.041 (0.699)	-0.0583 (0.579)	-0.035 (0.739)	-0.057 (0.583)
FULPC1	0.572 (0.000	0.589 (0.220)	0.572 (0.000)	0.923 (0.046)	0.582 (0.000)	0.938 (0.040)
FULPC2	0.491 (0.041)	0.370 (0.628)	0.484 (0.020)	0.487 (0.499)	0.498 (0.020)	0.492 (0.500)
FULPC3	-0.171 (0.480)	-0.332 (0.580)	-0.093 (0.694)	0.0692 (0.894)	-	-
FULPC4	-0.365 (0.243)	-0.138 (0.755)	-0.421 (0.222)	-0.151 (0.757)	-	-
FULPC5	-1.49 (0.001)	-1.60 (0.013)	-1.543 (0.000)	-1.971 (0.002)	-1.50 (0.000)	-1.93 (0.003)
FULPC6	0.792 (0.128)	1.07 (0.196)	-	-	-	-
No. observations	290	290	290	290	290	290
Wald test for joint significance[1]	59.59 [0.000]	14.26 [0.040]	48.55 [0.000]	15.00 [0.020]	44.76 [0.000]	15.02 [0.005]
Sargan test [2]	654.8 [0.999]	-	660.3 [0.999]	-	676.5 [0.996]	-
First order serial correlation test[3]	-3.001 [0.003]	0.1767 [0.860]	-3.036 [0.002]	0.08629 [0.931]	-3.026 [0.002]	-0.0175 [0.999]
Second order serial correlation test[4]	0.6456 [0.519]	0.1260 [0.900]	0.5696 0.569]	0.02695 [0.979]	0.6282 [0.530]	0.02912 [0.977]
R^2	-	0.19	-	0.18	-	0.18

The regressions also include dummy variables for the different time periods that are not reported
Instruments include GY, control variables and the scores of the first six principal components
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991). P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates.

In table 5.11 the combined GMM System estimates are consistent and not finite sample biased since the estimates of the coefficients on lagged dependent variable lie comfortably above the corresponding within-groups estimates. Additionally the diagnostic tests are satisfactory, with the Sargan test accepting the chosen instrumental variables, the expected first-order autocorrelation being present, and there being an absence of second-order autocorrelation. Initially, the first six principal components (FULPC1 - FULPC6) of the fifteen explanatory variables are used in the estimation and, as previously, the estimation is repeated dropping the insignificant principal components. The first principal component, which gives weight to traded value (TV), enters all GMM system regressions positively and significantly at the 1 per cent level. Second principal component, which gives importance to the number of listed companies (NLC) and the turnover ratio (TR) also enters the regressions positively and significantly at the 2 per cent and 5 per cent levels of significance. While the third and fourth principal component are never significant, the fifth principal component enters all regressions negatively and significantly at the 1 per cent level. This is expected since it gives high weight to inflation (INF) and government consumption to GDP ratio (GC) which is known to be negatively and significantly related to growth (Bekaert *et al.*, 2001). All the variables enter the regressions jointly significantly at the 1 per cent level as indicated by the Wald test. Thus table 5.11 confirms the overall positive relationship between financial development and economic growth when other growth determinants are taken into account.

5.5. Discussion

The goal of this study is to assess the relationship between stock market development, bank development, and economic growth. New variables and data periods are used to examine this relationship in developing countries. Annual data and system GMM techniques are employed to overcome the shortcomings identified in the reviewed literature. Within-groups estimation is carried out the check the validity of the results[4]. The findings of the empirical analysis using system GMM dynamic panel estimators conducted on thirty developing countries over 1990-2001 are reported. Using three alternative measures of bank development and four of stock market development, the data accept the proposal that there is a strong positive link between stock market development and economic growth after controlling for country specific effects, endogeneity, and problems associated with lagged dependent variables and weak instruments. (See chapter 4, section 4.2.4).

While empirical studies often find a positive link between credit allocation and economic growth, our dynamic panel results report a negative association between credit allocation and economic growth (see table 5.2). In our view, these findings are less controversial once the characteristics of the financial systems in developing countries are considered. During the past twenty years many developing countries wanted to liberalize their financial systems and reduce the role of the domestic government in the economy. The lack of sound financial regulation and supervision to protect the stability of the financial system during this process created a significant increase in financial fragility.

[3] When the GMM system and within-group estimation used log of initial income rather the lagged dependant variable as in Beck and Levine (2002) the same conclusions were found. However, the within-group

Although many developing countries have initiated regulatory reforms, these reforms have often not been appropriately or totally employed. There have also been problems relating to the implementation of regulatory rules, which have been invented to suit the legal environment in developed countries, in the financial conditions in developing countries where legal and accounting standards are weak. Also, the lack of skilful labour to undertake the supervision and the massive influence of the political regimes in shaping the financial environment are major issues in developing countries (Brownbridge & Kirkpatrick, 2000). As financial fragility increases, governments tend to intervene more. The traditional reason is that the governments do not want the public to think that the financial system can collapse and therefore they acknowledge their intervention to the public at the first sign of crisis. Banks may act on the assumption that the government will provide some degree of relief in the event of crises which result in massive over-lending. The expectation of support from governments explains the inefficient behaviour of banks. Besides their lack of skills, banks personnel will be even less careful in processing and evaluating credit applications and information. As a result they may end up with over-lending that is not necessarily accompanied by an increase in productive investment. This inefficiency of banks is likely to generate a reduction in economic growth (De Gregorio & Guidotti, 1995).

The above considerations suggest that the negative relationship between credit allocation and growth in developing countries comes from a negative effect on the efficiency of investment rather than its volume. Thus more financial intermediaries could be associated with high, but less efficient, investment (De Gregorio & Guidotti, 1995).

estimates of the initial income were above the corresponding GMM system estimates which indicates the

The results also included a negative relationship between the liquid liabilities of the financial system (LL) and economic growth (see table 5.3). LL is the ratio of broad money to GDP. Broad money consists of currency held outside the bank system plus interest-bearing total deposit liabilities of banks and other financial institutions. An increase in the ratio could mean either an increase of currency held outside the banking system or deposits. The first situation is likely to occur in developing countries where, for the most part, broad money is currency held outside the banking system (King & Levine, 1993b, and Morisson, 2000). Financial intermediaries have the functions of providing liquidity (or transactions) services and saving opportunities (credit allocation or portfolio management) to those requiring funds. The second aim is important in order to promote investment and consequently growth. These functions are not necessarily related. Thus, an increase in financial system liquidity could be mainly related to the first function of the financial system and not to the second. Therefore it can be argued that a high level of liquid liabilities is a sign of financial under-development while a low level of liquidity is the result a high level of financial development which encourages agents to increase their savings (De Gregorio & Guidotti, 1995).

Overall, the results also suggest a positive but not always significant link between growth and the ratio of central and commercial bank assets (BA) (see table 5.4). Commercial banks play a major role in the financial sectors in most developing countries. Their assets often account for over 80 per cent of the systems' total assets. The insignificant link may be explained if the high level of concentration and the weak competition between banks is taken into account. Commercial banks deposits are generally

existence of small sample biases (see appendix tables 5.12 -5.15) allocated to the government or to short-term investment projects undertaken by large public enterprises. Credit evaluation and information screening skills are far below the standards and need considerable improvements (Chatterji, 2001).

In our results, the foreign direct investment ratio (FDI) appears to have a positive but an insignificant impact on growth (see table 5.5). Blomstrom *et al.*, (1994) argue that developing countries need to meet a certain level of technology and human capital accumulation before they can benefit from foreign direct investment FDI. Moreover, these inflows to developing countries are often encouraged by government promises rather than by a favourable investment environment motivated by an efficient financial sector (Dooley, 1994). Also, a moral hazard is caused by the financial intermediaries with weak regulation and performance. In developing countries the liabilities of such intermediaries are generally guaranteed by the government. They tend to process credit requirements poorly and use their funds in speculative and risky investments. Foreign creditors are often not affected by these inefficiencies since they are secured by government promises. Foreign direct investment would not significantly affect growth if domestic banks use the capital inflow to finance unproductive projects (Bailliu, 2000).

Overall, the above considerations suggest that developing countries experience significant banking sector problems. This is mainly due to the lack of efficiency, the inappropriate regulation and supervision framework and the massive governments' intervention.

In our attempt to account for the comprehensive concept of financial development, the different measures of financial system development were brought together in the framework of principal components analysis. The effects of multicollinearity have been reduced by using this technique. Reducing the variables from ten to four, this technique has the advantage of looking more at overall financial development rather than bank or stock market development individually. The results show that financial development does promote growth. This suggests that both banks and markets are important for growth and supports the view that countries with better-developed financial systems tend to grow faster. These results are confirmed when principal components analysis was used with the ten financial development variables plus five variables considered to be important for growth and the general state of the economy. Although this finding may lead some to conclude that overall financial development matters for growth, it is difficult to identify the specific components of the financial system most closely associated with, or harmful for, economic growth.

Appendix 5.1: Results with IIP

Table 5.12: Growth, Stock Market Development and Credit Allocation.

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	5.98 (0.039)	-	-0.968 (0.728)	-	-2.67 (0.374	-	-6.290 (0.072)	-
IIP	0.012 (0.971)	8.713 (0.040)	0.317 (0.379)	8.603 (0.042)	0.9477 (0.007	9.28 (0.036)	0.638 (0.090)	11.12 (0.022)
CPS	-1.15 (0.045)	-2.462 (0.061)	-0.436 (0.384)	-1.911 (0.103)	-0.831 (0.195	-2.357 (0.072)	-0.484 (0.397)	-1.961 (0.111)
TV	0.926 (0.001)	0.9813 (0.009)	-	-	-	-	-	-
TR	-	-	0.953 (0.003)	0.749 (0.049)	-	-	-	-
MC	-	-	-	-	0.334 (0.673	1.076 (0.146)	-	-
NLC	-	-	-	-	-	-	1.080 (0.007)	-2.233 (0.182)
No. observations	299	299	299	299	299	299	299	299
Wald test for joint significance[1]	12.52 [0.006]	11.95 [0.008]	11.52 [0.009]	8.472 [0.037]	8.925 [0.030]	6.867 [0.076]	10.08 [0.018]	8.078 [0.044]
Sargan test [2]	494.7 [0.752]	-	495.7 [0.742]	-	523.0 [0.419]	-	471.8 [0.923]	-
First order serial correlation test[3]	-2.225 [0.026]	0.4103 [0.682]	-2.204 [0.028]	0.5728 [0.567]	-2.289 [0.022]	0.6503 [0.515]	-2.262 [0.024]	0.8764 [0.381]
Second order serial correlation test[4]	0.4703 [0.638]	1.324 [0.186]	0.3431 [0.732]	1.046 [0.296]	0.3973 [0.691]	1.611 [0.107]	0.3425 [0.732]	1.750 [0.080]
R^2	-	0.16	-	0.14	-	0.13	-	0.13

The regressions also include dummy variables for the different time periods that are not reported
Instruments include GY, the control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991).
P-values are reported in parentheses. SYS-GMM is one step GMM estimates and WG is within group estimates.

Table 5.13: Growth, Stock Market Development and the Size of the Financial Intermediaries

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	9.819 (0.013)	-	0.0167 (0.996)	-	-1.801 (0.631)	-	-6.055 (0.089)	-
IIP	-0.193 (0.557)	10.20 (0.039)	0.3573 (0.256)	10.34 (0.035)	0.860 (0.015)	10.96 (0.035)	0.6174 (0.057)	12.97 (0.022)
LL	-1.7199 (0.014)	-6.120 (0.012)	-0.752 (0.249)	-5.574 (0.019)	-0.8145 (0.211)	-6.259 (0.016)	-0.674 (0.347)	-5.86 (0.026)
TV	1.044 (0.000)	0.933 (0.003)	-	-	-	-	-	-
TR	-	-	0.949 (0.004)	0.6652 (0.051)	-	-	-	-
MC	-	-	-	-	0.280 (0.710)	1.094 (0.101)	-	-
NLC	-	-	-	-	-	-	1.226 (0.005)	-2.20 (0.083)
No. observations	299	299	299	299	299	299	299	299
Wald test for joint significance[1]	19.62 [0.000]	15.54 [0.001]	14.96 [0.002]	8.328 [0.040]	10.61 [0.014]	8.491 [0.037]	12.13 [0.007]	7.974 [0.047]
Sargan test [2]	498.2 [0.716]	-	516.3 [0.500]	-	528.4 [0.355]	-	470.4 [0.930]	-
First order serial correlation test[3]	-2.211 [0.027]	0.3642 [0.716]	-2.201 [0.028]	0.6050 [0.545]	-2.278 [0.023]	0.6183 [0.536]	-2.258 [0.024]	0.8917 [0.373]
Second order serial correlation test[4]	0.4611 [0.645]	0.6523 [0.514]	0.3387 [0.735]	0.5403 [0.589]	0.3760 [0.707]	0.7750 [0.438]	0.3352 [0.737]	0.8522 [0.394]
R^2	-	0.20	-	0.18	-	0.18	-	0.18

The regressions also include dummy variables for the different time periods that are not reported
Instruments include GY, the control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991).
P-values are reported in parentheses. SYS-GMM is one step GMM estimates and WG is within group estimates

Table 5.14: Growth, Stock Market and Central and Commercial Bank Assets

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)	SYS-GMM (4)	WG (4)
Constant	-11.20 (0.208)	-	-18.3 (0.050)	-	-24.29 (0.003)	-	-32.65 (0.000)	-
IIP	-0.341 (0.494)	4.573 (0.294)	-0.289 (0.588)	4.83 (0.260)	0.447 (0.397)	5.024 (0.248)	-0.358 (0.560)	6.426 (0.205)
BA	3.693 (0.163)	5.674 (0.074)	4.862 (0.081)	6.343 (0.038)	5.621 (0.018)	6.082 (0.043)	7.180 (0.008)	5.821 (0.048)
TV	0.6715 (0.001)	0.7808 (0.037)	-	-	-	-	-	-
TR	-	-	0.774 (0.024)	0.727 (0.086)	-	-	-	-
MC	-	-	-	-	0.380 (0.484)	0.551 (0.416)	-	-
NLC	-	-	-	-	-	-	1.3464 (0.000 □	-1.290 (0.435)
No. observations	299	299	299	299	299	299	299	299
Wald test for joint significance[1]	24.98 [0.000]	15.21 [0.002]	16.63 [0.001]	13.73 [0.003]	18.02 [0.000]	6.332 [0.097]	35.76 [0.000]	5.616 [0.132]
Sargan test [2]	546.0 [0.182]	-	528.3 [0.356]	-	520.7 [0.447]	-	471.3 [0.925]	-
First order serial correlation test[3]	-2.251 [0.024]	0.1826 [0.855]	-2.233 [0.026]	0.2695 [0.788]	-2.274 [0.023]	0.3948 [0.693]	-2.288 [0.022]	0.5357 [0.592]
Second order serial correlation test[4]	0.4456 [0.656]	1.034 [0.301]	0.3740 [0.708]	0.7856 [0.432]	0.3076 [0.758]	1.253 [0.210]	0.3843 [0.701]	1.273 [0.203]
R^2	□-	0.16	□-	0.16	-	□0.14	□-	□0.14

The regressions also include dummy variables for the different time periods that are not reported
Instruments include GY, the control variables, and the considered measure of bank and stock market development.
1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.
2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.
3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation
4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991). P-values are reported in parentheses.
SYS-GMM is one step GMM estimates and WG is within group estimates

Table 5.15: Growth, Stock Market and Bank Development, and Foreign Direct Investment.

Regressors	SYS-GMM (1)	WG (1)	SYS-GMM (2)	WG (2)	SYS-GMM (3)	WG (3)
Constant	-3.895 (0.146)	-	2.494 (0.336)	-	-3.418 (0.222)	-
IIP	0.852 (0.020)	6.512 (0.103)	-0.023 (0.947)	5.922 (0.138)	0.964 (0.017)	9.187 (0.032)
FDI	0.0624 (0.807)	0.439 (0.234)	0.108 (0.641)	0.3915 (0.249)	0.0397 (0.879)	0.3172 (0.373)
TV	-	-	0.7404 (0.001)	0.9680 (0.011)	-	-
CPS	-	-	-	-	-0.376 (0.423)	-2.36 (0.071)
No. observations	285	285	285	285	285	285
Wald test for joint significance[1]	6.595 [0.037]	5.921 [0.052]	14.63 [0.002]	14.84 [0.002]	6.724 [0.081]	7.631 [0.054]
Sargan test [2]	514.6 [0.981]	-	531.5 [0.934]	-	500.0 [0.994]	-
First order serial correlation test[3]	-2.019 [0.043]	0.2010 [0.841]	-1.985 [0.047]	-0.2801 [0.779]	-2.020 [0.043]	0.2603 [0.795]
Second order serial correlation test[4]	0.3868 [0.699]	0.7657 [0.444]	0.5168 [0.605]	0.5681 [0.570]	0.3887 [0.698]	0.7025 [0.482]
R^2	-	0.11	-	0.16	-	0.13

The regressions also include dummy variables for the different time periods that are not reported

Instruments include GY, FDI, the control variables, and the considered measure of bank and stock market development

1 The null hypothesis is that none of the variables are worth including and the alternative is that some variables are needed.

2 The null hypothesis is that the instruments used are valid and not correlated with the residuals.

3 The null hypothesis is that the errors in the first-difference regression exhibit no first-order serial correlation

4 The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (listed as m2 in Arellano & Bond, 1991).

P-values are reported in parentheses.

SYS-GMM is one step GMM estimates and WG is within group estimates.

Chapter 6

A Comparison of Interest Rate Behaviour in Developing and Industrialised Countries

6.1. Introduction

The previous chapter presented the negative impact of the massive government intervention in the economy in developing countries. Recently, these countries attempted reforming their financial system through the liberalisation of interest rate movements. This might imply that there are differences in interest rate behaviour between developing and developed countries.

The interest rate is one of the most influential variables in monetary policy and in the financial sector is. Monetary policy, as a part of government policy, may influence growth through inflation and hence nominal interest rates. Goods and services and labour in the economy are valued in money prices determined by supply and demand. When prices and wages change this signals to workers, investors and consumers to change their behaviour. Sound monetary policy provides correct and clear price signals. Inflation, however, creates price uncertainty that might lead to a misallocation of resources which would lower economic growth. Information about price variability might not be shared equally between economic agents. Hence, they are uncertain about how fast the authorities will react to stabilize prices (Crawford & Kasumovich, 1996). High inflation tends to lower the return on work. If workers learn that prices have increased by more than their wages, they might prefer to work fewer hours. This causes labour supply to decrease. According to the endogenous growth theory presented in chapter 2, this might lower human capital and hence growth (Mboweni, 2000). However, when inflation is low, governments tend to lower interest rates which results in higher borrowing. This, in turn, promotes more investment projects and hence more growth. Efficient financial markets smooth the process of adjustment to changes in expectations. Hence, the nominal interest rate should adjust to changes in expected inflation (Lynch, 1993). According to Crowder & Hoffman (1996, p. 102), "nominal interest rate is the sum of the constant real rate and expected decline in the purchasing power of money". In other words, the nominal interest rate is the sum of real interest rate and inflation. Hence the behaviour of the nominal interest rate might give predictions about future inflation. This is commonly referred to as the Fisher effect. For testing such effect, Mishkin & Simon (1995, p. 223) claim that "any reasonable model of the macro economy would surely suggest that real interest rates have mean-reverting tendencies which make them stationary." This assumption has been used as the base of many macroeconomic models such as the capital pricing models of Lucas (1978) and Hansen and Singleton (1982) where the real interest rate and the consumption growth rate are both assumed stationary (Rapach & Weber, 2004). The question of whether nominal interest rates are stationary or have a unit root is controversial. As Gil-Alana (2004, p.265) states, "Theoretically, it is impossible for interest rates to follow a unit root process because this would imply that the series can tend to infinity, with no bound on its movement." However, if long-term and short-term interest rates, or the nominal rate and the expected inflation rate, are to move together in the long run (so that they are cointegrated) then they must be non-stationary. This is relevant for the Fisher effect where a permanent change in the expected rate of inflation has no long-run effect on the level of the real interest rate. For such an effect both expected inflation and the nominal interest rate must be I(1) and cointegrated.

There is an implication in the literature that the behaviour of financial markets in developed and developing economies is the same. This chapter examines whether nominal interest rate behaviour differs in developing and industrialised countries, and in particular in whether interest rates are stationary or non-stationary. While there are theoretical reasons for expecting nominal interest rates to be stationary, there is widespread evidence that in developed economies interest rates are non-stationary. Here a series of unit-root tests are applied to data from 19 developing countries and 10 industrialised countries, both as individual series and in panels. The effects of temporal aggregation are examined by using both annual and quarterly data. The balance of the evidence supports the view that nominal interest rates are non-stationary and that the choice between quarterly and annual data is important.

The question considered is whether the interest rate is stationary or has a unit root. That is, whether interest rates are I(0) or I(1). If interest rates and inflation are both I(1), the long-run Fisher hypothesis, that a 1% increase in inflation will be accompanied by a 1% increase in interest rates, can be tested by checking for cointegration. However, if only one of interest rates and inflation is stationary, they cannot be cointegrated, and so the long-run Fisher hypothesis is rejected. While the possibility that the interest rate is I(d), where $0 < d < 1$, has been explored by, for example, Tsay (2000) and Gil-Alana (2004), here consideration is limited to the I(0)/I(1) dichotomy, because of limited number of observations and lack of appropriate software.

The focus of this study is on whether there are important differences in the behaviour of interest rates in developing and in industrialised countries. Unlike in chapters 4 and 5, where the data were annual for 1988 - 2002 for 30 countries, here the more extensive IMF data set can be used. A second focus is on whether the results of the various unit-root tests, for a particular set of data, are in agreement. While different tests have been proposed for individual series and panels, there is little empirical evidence on their comparative performance with the same data set. Also considered is the phenomenon of temporal aggregation: that is, whether the results are the same when the data are quarterly or annual. In section 6.2 the effects of temporal aggregation are considered, with the detailed derivations in Appendix 6.1, and in section 6.3 the literature on units roots for interest rates is discussed. In section 6.4 the various unit-root tests are outlined, both for individual series and for panel data. The methodology and data are described in section 6.5, and the results reported in section 6.6. Section 6.7 presents the conclusions.

6.2. Some Effects of Temporal Aggregation

While it is well known that the choice of the time unit in economics is important (see Engle and Liu, 1972, Rossana and Seater, 1995, Taylor, 2001, Chambers, 2005) this literature has had little impact on empirical practice. Here the specific case of the use of annual and quarterly data on interest rates is considered, and whether evidence from such data helps to resolve some of the contradictions in the literature (discussed in section 6.3 below). The approach adopted in this section is to examine the effects of temporal aggregation with a random walk, and then with an AR(1) model. The notation is, assuming that there are A annual observations and 4A quarterly observations,

x_t = quarter t observation on an interest rate, with $t = 1, \ldots 4A$

X_n = year n observation on an interest rate, with n = 1,...A

It is assumed that the 4A quarterly observations are middle-quarter values and that the A annual observations are averages of the four quarterly values:

$$X_n = (x_{4(n-1)+1} + x_{4(n-1)+2} + x_{4(n-1)+3} + x_{4(n-1)+4})/4 \quad (6.1)$$

$$= (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4$$

where n = 1, ... A.

This is illustrated in table 6.1.

Table 6.1 Linking the Quarterly and Annual Series

Time	Quarterly Series	Annual Series
Year 1 Q1	x_1	
Q2	x_2	$X_1 = (x_1 + x_2 + x_3 + x_4)/4$
Q3	x_3	
Q4	x_4	
Year 2 Q1	x_5	
Q2	x_6	$X_2 = (x_5 + x_6 + x_7 + x_8)/4$
Q3	x_7	
Q4	x_8	
Year 3 Q1	x_9	
Q2	x_{10}	$X_3 = (x_9 + x_{10} + x_{11} + x_{12})/4$
Q3	x_{11}	
Q4	x_{12}	
Year 4 Q1	x_{13}	...

6.2.1. Temporal Aggregation for a Random Walk

Initially it is assumed that the quarterly variable, x, follows a random walk so that

$$x_t = x_{t-1} + u_t \qquad (6.2)$$

where u_t is assumed to be white noise

i.e. $E(u_t)=0$, $E(u_t^2)=\sigma^2$, $E(u_t u_{t-j}) = 0$ for all t and $j \neq 0$ (6.3).

From (6.1), the aggregate variable X is given by

$$X_n = (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4 \qquad (6.4)$$

It is shown in Appendix 6.1 that aggregating the quarterly model (6.2) to annual data gives

$$X_n = X_{n-1} + U_n \qquad (6.5)$$

where $U_n = [u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]/4.$ (6.6)

Also, $E(U_n) = 0$

and $E(U_n^2) = 2.75\sigma^2$, (6.7)

which is a constant, since the cross-product terms $E(u_t u_{t+s})=0$ for $s \neq 0$ and $E(u_t^2)= \sigma^2$ for all t.

Similarly, $E(U_n U_{n-1}) = 0.625\sigma^2$ (6.8)

which is not zero. Thus while U has a mean of zero and a constant variance, it has a first-order autocorrelation coefficient of

$$\rho_1 = E(U_n U_{n-1}/U_n^2) = 0.625\sigma^2/2.75\sigma^2 = 0.23. \qquad (6.9)$$

The conclusion is that if the quarterly series follows a simple random walk, the annual series, consisting of averages of the quarterly values, has a first-order autocorrelation coefficient of 0.23. However, if there is positive autocorrelation in the u terms, it is clear from the derivation of (6.7) and (6.8) that the cross-product terms will be positive, increasing the size of the first-order autocorrelation coefficient above 0.23.

In Working (1960) the general case of the average of a simple random walk with m observations is considered and, as m tends to infinity, the first-order autocorrelation tends to the value 0.25. Notice that if interest rates follow a day-by-day random walk, the annual average will include about 260 observations and the first-order autocorrelation coefficient will be close to 0.25.

When the higher-order autocorrelations are considered they are all found to be zero for the simple random walk. For example, from (6.6)

$$E(U_nU_{n-2}) = E([u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]\,[u_{4n-14}+2u_{4n-13}+3u_{4n-12}+4u_{4n-11}+3u_{4n-10}+2u_{4n-9}+u_{4n-8}]/16)$$

gives only cross-products which are zero so that $E(U_nU_{n-2}) = 0$.

Now a characteristic of a first-order moving-average or MA(1) process is that the first-order autocorrelation coefficient is non-zero and the other autocorrelations are zero. (see, e.g. Johnston and Di Nardo, 1997, p.176). The implication is that a pure random walk for quarterly data aggregates up to an MA(1) model for annual averages.

6.2.2. Temporal Aggregation for an AR(1) Process

The assumed AR(1) model for the quarterly variable, x, is

$$x_t = \beta x_{t-1} + u_t \qquad (6.10)$$

where $0 < \beta < 1$, so that the process is stationary, and u_t is assumed to be white noise, as in (6.3). From (6.1), the aggregate variable X is given by

$$X_n = (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4 \qquad (6.4)$$

As previously, the detailed derivations are in Appendix 6.1. From using (6.10) in (6.4) the resulting annual model is

$$X_n = \beta^4 X_{n-1} + U_n \qquad (6.11)$$

where $U_n = [\beta^3 u_{4n-6} + (\beta^3+\beta^2)u_{4n-5} + (\beta^3+\beta^2+\beta)u_{4n-4} + (\beta^3+\beta^2+\beta+1)u_{4n-3} + (\beta^2+\beta+1)u_{4n-2}$

$$+ (\beta+1)u_{4n-1} + u_{4n}]/4 \qquad (6.12)$$

Here, if U happened to be white noise then (6.11) would be an AR(1) process and so the properties of U are to be examined next.

Assuming that the u_t satisfy the assumptions (6.2) then it is easily shown that $E(U_n) = 0$ since $E(u_t) = 0$ for all t. Similarly, the variance of U is given by the following (ignoring the cross-product terms which are zero)

$$E(U_n^2) = [\beta^6+(\beta^3+\beta^2)^2+(\beta^3+\beta^2+\beta)^2+(\beta^3+\beta^2+\beta+1)^2+(\beta^2+\beta+1)^2+(\beta+1)^2+1]\sigma^2/16$$

which is a constant and depends on the value of β.

Similarly, $E(U_nU_{n-1}) = [\beta^5 + 2\beta^4 + 4\beta^3 + 2\beta^2 + \beta]\sigma^2/16 \qquad (6.13)$

which is not zero. Thus while U has a mean of zero and a constant variance, it has a first-order autocorrelation coefficient

$$\rho_1 = E(U_nU_{n-1}/U_n^2) \qquad (6.14)$$

which depends on the value of β. In the special case of the random walk, $\beta = 1$ and the value of ρ_1 is 0.23, as above in (6.9). Examples of other values are, if $\beta = 0.9$, $\rho_1 = 0.2249$ and if $\beta = 0.1$, $\rho_1 = 0.0265$.

More generally, $E(U_nU_{n-s}) = 0$ for $|s|>1$ and Chambers (2005) proves that (6.11) is a first-order autoregressive-moving average or ARMA(1,1) process. That is, if the quarterly series is an AR(1) process and aggregation to annual data takes place using averages of the quarterly values, then the annual series will follow an ARMA(1,1) process. These results have implications for testing for unit roots.

6.3. Unit Root Tests

6.3.1. Single Series Unit Root Tests

The starting point in testing whether a series, y_t, has a unit root is the simple AR(1) process

$$y_t = \rho y_{t-1} + u_t \qquad (6.15)$$

where u is assumed to be a white noise error term as in (6.3) above. The series y has a unit root if $\rho = 1$, and in this case y follows a simple random walk. If $-1 < \rho < 1$, y is stationary and follows an AR(1) process. In the **Dickey-Fuller test** (Dickey and Fuller, 1979) (6.15) is transformed by subtracting y_{t-1} to give

$$\Delta y_t = \beta y_{t-1} + u_t \qquad (6.16)$$

where $\beta = (\rho - 1)$. The null hypothesis that y is non-stationary is tested by the tau statistic (using the "t"-ratio for β) and the tables in Dickey and Fuller (1979). The alternative hypothesis is that y is stationary, and the null hypothesis is rejected if the estimated tau value is sufficiently negative.

This test has been generalised in different ways. First, the null hypothesis that y follows a random walk can be replaced by a random walk with drift, which results in

$$\Delta y_t = \beta_1 + \beta y_{t-1} + u_t \qquad (6.17)$$

or a random walk with drift around a deterministic trend

$$\Delta y_t = \beta_1 + \beta_2 t + \beta y_{t-1} + u_t \qquad (6.18)$$

where t is a time trend. In each case the null hypothesis is $\beta = 0$ and the alternative is $\beta < 0$. The critical values are found in the various tables in Dickey and Fuller (1979).

The second way of generalising the test is to replace (6.15) by an AR(2) process:

$$y_t = \rho y_{t-1} + \rho_2 y_{t-2} + u_t \qquad (6.19)$$

and subtracting y_{t-1} gives

$$y_t - y_{t-1} = (\rho-1)y_{t-1} + (\rho_2 y_{t-1} - \rho_2 y_{t-1}) + \rho_2 y_{t-2} + u_t$$

$$\Delta y_t = (\rho + \rho_2 - 1)y_{t-1} - \rho_2 \Delta y_{t-1} + u_t \qquad (6.20)$$

That is, the AR(2) process adds an extra term, Δy_{t-1}, to the equation and note that the coefficient on y_{t-1} is different from in (6.16). This equation is used for the **Augmented Dickey-Fuller test** (Said and Dickey, 1984) or ADF test, and special tables are needed for testing significance of the coefficient on y_{t-1}. This test is easily generalised to any order of AR process by adding extra lags of Δy_t. Usually this is to remove any autocorrelation in the estimated equation and end up with white noise residuals. The resulting equation, for a random walk with drift around a deterministic trend, has the form

$$\Delta y_t = \alpha + \delta t + \beta y_{t-1} + \Sigma \varphi_j \Delta y_{t-j} + u_t \qquad (6.21)$$

In section 6.2 above it was shown that temporal aggregation could result in an AR(1) process with quarterly data having an ARMA(1,1) process at the annual level. While the ADF test was proposed to deal with autocorrelation, since its purpose is to make the residuals white noise, it should also deal with any moving-average terms present.

The **Phillips and Perron (1988) test**, or PP test, uses a non-parametric approach to dealing with serial correlation in unit-root testing. Equation (6.16) (or a variation on it) is estimated and the t-ratio modified to avoid biases due to serial correlation. The PP statistic has the same asymptotic distribution as the ADF statistic.

A different procedure is used in the **KPSS test** (Kwiatkowski, Phillips, Schmidt and Shin, 1992) where the null hypothesis is that y is stationary and the alternative is that y has a unit root. This test uses the spectrum of the OLS residuals from a regression of y on a constant (and trend, if needed) and the article includes the critical values of the test statistic.

6.3.2. Panel Unit Root Tests

For panel data observations on different countries in different time periods, the series y_{it}, where i = 1,…, N denotes the country, and t = 1,…, T denotes the time period, the corresponding basic equation for testing for unit roots is a generalisation of (6.21):

$$\Delta y_{it} = \alpha_i + \delta_i t + \beta_i y_{it-1} + \Sigma\varphi_{ij}\,\Delta y_{it-j} + \xi_{it.} \qquad (6.22)$$

Here the intercept, trend and coefficient on y all vary with the country. Interest centres on whether the series y_{it} is non-stationary, so that $\beta_i = 0$. Six different tests are now considered.

(a). In the **Levin Lin & Chu (2002) test** or LLC test it is assumed that in (6.22) $\beta_i = \beta$, so there is a common value of β, and the hypotheses are:

$$H_0\text{: } \beta = 0 \text{ with } H_1\text{: } \beta < 0. \qquad (6.23)$$

That is, the null is y is I(1) so all the cross-sections are non-stationary, and the alternative is all individual cross-sections are stationary (and have the same value of β). Here H_1 is rather restrictive since it is also possible for the cross-sections to be stationary with different values of β. Like the ADF test, the LLC test is a t-type one based on estimating a single value of β in (6.22) for the pooled data, but this follows standardising each cross-section to remove autocorrelation and any deterministic components.

(b). The second test is the one proposed by **Breitung** (2000) and the null and alternative hypotheses are as in (6.23) for the LLC test, but the details of the calculations in the test are different. The standardisation only removes autocorrelation and a different method of de-trending is used. A single value of β is estimated from the pooled data and a t-type test is used.

(c). The **Im, Pesaran and Shin (2003) test** or IPS test is also based on (6.22) but instead of (6.23) the hypotheses are

$$H_0: \beta_i = 0 \text{ with } H_1: \beta_i < 0 \text{ for at least one i.} \qquad (6.24)$$

Here there is no requirement for a common value of β_i. The IPS test is based on estimating a separate ADF statistic (possibly using different lag lengths) for each individual country and forming the mean of the t-type values, which is then tested for significance.

(d). The **ADF-Fisher test** has the same null and alternative hypotheses, (6.24), as IPS but uses a different approach, based on R.A. Fisher (1932). The ADF test is carried out separately for each country and Maddala and Wu (1999) and Choi (2001) use the probability values from the test in each cross-section to give an overall test for unit roots. This is a chi-squared test.

(e). The **PP-Fisher test** is similar to the ADF-Fisher test but starts with the Phillips-Perron (1988) approach to estimation. The test is a chi-squared one.

(f). The **Hadri (2000) test** has the null hypothesis that the level of every cross-section series is stationary, and the alternative that, for every cross-section, the difference is stationary. A separate regression, with a constant and perhaps a trend, is estimated for each cross-section and the estimated residuals are tested for stationarity using a Lagrange multiplier test. The test statistic has a standard normal distribution.

Comparing these panel unit root tests, the most obvious difference is that for the Hadri test the null hypothesis is a stationary series while for all the others, the null is an I(1) series.

6.3.3. Conclusions on the Unit-Root Tests

The various unit-root tests for single series and for panel data are likely to give different results for any particular data set. There is limited knowledge about which tests perform well in different circumstances. Some of the limited empirical evidence is discussed in the next section. However, it is generally agreed that the tests perform better with large samples. The approach adopted here is to carry out each of the tests on the interest rates and inflation from individual countries, where the sample size is small, and then with the data as a panel, with the intention of checking whether the conclusions agree. Also, the results with quarterly data will be compared with those from annual data, to see if there are any effects from temporal aggregation.

6.4. Literature on Unit Roots in Interest Rates

In the literature there is widespread evidence that, in **developed** economies, nominal interest rates are not stationary with annual, quarterly, monthly or daily data. For example, in the early work of Nelson and Plosser (1982) the unit root hypothesis could not be rejected, using the ADF test, for **annual** data on US interest rates. More recently, Gil-Alana (2004) finds evidence of a unit root in annual US treasury bond yields for 1940 - 2000 but for the longer period, 1798 - 2000, the order of integration is less than one.

Hassapis, Pittis & Prodromidis (1999) find that short-term **quarterly** interest rates for six European countries and the USA are non-stationary, using the ADF test. Rapach & Weber (2004) examined quarterly data on the long-term bond rate in 16 OECD countries and found that the nominal interest rate is I(1). Koustas & Serletis (1999), find quarterly interest rates of 11 industrialised countries are I(1) using the ADF and KPSS tests.

Balz (1998) examined **monthly** German bond rates and while the standard ADF tests supported the unit root hypothesis, when the seemingly-unrelated regression approach was used, the interest rates were found to be stationary. He concluded that the contrast between the results is due to the lack of power of the univariate tests. Brooks & Rew (2002) find that the short and long Euro-Sterling daily interest rates are I(1), with evidence of a structural break in short-rates at the time of the ERM crisis in September 1992.

To summarise, a number of different unit-root tests have been used to examine the properties of nominal interest rates for the US and other high-income economies, using data of different frequencies. The consensus is that nominal interest rates are non-stationary, except in a few cases where there is evidence of structural breaks. However, there has been little consideration of the behaviour of interest rates in developing economies and that is the gap this chapter aims to fill.

6.5. Methodology and the Data

The intention is to compare the different results for developing and industrialised countries, using different unit root tests, and for quarterly and annual data. The variables are the deposit rate, the lending rate and the rate of inflation. Inflation is included because of its importance as a policy variable and its role in determining the real interest rate. The definitions of the variables are:

Deposit interest rate (%): The rate of interest paid by commercial or similar banks for demand, time, or savings deposits (IMF code: 60L.ZF).

Lending interest rate (%): The rate of interest charged by banks on loans to prime customers (IMF code 60P.ZF).

Inflation (annual %): The annual percentage change in the consumer price index (IMF code 64.XZF). This reflects the change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.

The data are taken from the IMF CD-Rom (September 2002) updated from more recent issues of **International Financial Statistics**. The countries were selected if there was annual data for 1980 - 2003 (24 observations) and quarterly data for 1986

Q1 - 2003 Q4 (72 observations). While there would be some advantages from both the annual and quarterly data being for the same years, say 1986 - 2003, this would reduce the number of annual observations to 18 and instead the longer sample, 1980 - 2003 is preferred. The 19 developing countries are Bangladesh, Chile, Colombia, Egypt, Indonesia, Israel, Jamaica, Kenya, Korea, Malaysia, Mauritius, Nigeria, Philippines, South Africa, Sri Lanka, Thailand, Trinidad and Tobago, Venezuela and Zimbabwe. The 10 industrialised countries are Australia, Canada, Denmark, Germany, Japan, New Zealand, Sweden, Switzerland, the U.K. and the USA. The details of the series are:

(a) **Annual Data for Developing Countries:** 1980 – 2003. 24 observations

Deposit Rates: 16 countries, excluding Colombia, Israel and Venezuela.

Lending Rates: 16 countries, excluding Colombia, Indonesia and Venezuela.

Inflation: 18 countries, excluding Bangladesh.

(b) **Quarterly Data for Developing Countries:** 1986 Q1 – 2003 Q4. 72 observations.

Deposit Rates: 16 countries, excluding Kenya and Trinidad and Tobago.

Lending Rates: 19 countries.

Inflation: 18 countries, excluding Bangladesh.

(c) **Annual Data for Industrialised Countries:** 1980 – 2003. 24 observations

Full data for all 10 countries for deposit rates, lending rates and prices.

(d) **Quarterly Data for Industrialised Countries:** 1986 Q1 – 2003 Q4. 72 observations

Full data for all 10 countries for deposit rates, lending rates and prices.

6.6. Empirical Results

In examining the empirical evidence, the results for the individual countries are considered, and then the panel data results. In each case differences in the alternative tests results, differences between annual and quarterly data, differences between developing and industrialised countries and differences between the two interest rates and inflation are considered.

6.6.1. Individual Countries Results

The first-order autocorrelations for the individual countries are given in table 6.2. If the quarterly pure random walk model is valid, the first-order autocorrelation coefficient with quarterly data is expected to be close to one and that with annual data near 0.23 (as shown in section 6.2.1 above). For the industrialised countries the quarterly first-order autocorrelation coefficients are generally high, suggesting there might be unit roots, with the annual coefficients always being lower, but still higher than 0.577. For the developing countries the quarterly values are high but some of the ones for annual inflation (Indonesia, Sri Lanka, Philippines and Mauritius) are below 0.25. This suggests that in general the simple quarterly random walk model does not apply, except possibly for the four cases of annual inflation just mentioned. All the annual values of the first-order autocorrelation are lower than the corresponding quarterly ones except for just two cases: lending rates for Bangladesh and inflation for Israel. This suggests that unit roots are more likely to be found in the quarterly series than the annual ones.

(a) Differences between the Unit Root Tests

The results of the unit root tests for the individual countries are given in tables 6.3 to 6.5 for deposit rates, lending rates and inflation. While it can be argued that there is no long-term trend in interest rates or inflation, for most countries there was a downward trend in all three series for the sample periods 1980 - 2003 (annual data) and 1986 Q1 - 2003 Q4 (quarterly data) while for some other countries there was an upward trend. It was therefore decided to include a trend term in each equation. For the ADF and PP tests the null hypothesis is that there is a unit root, while for the KPSS test the null hypothesis is that the series is stationary. If all the test results are to be compatible, the results for ADF and PP should agree and should differ from those for KPSS.

Taking the ADF and Phillips-Perron unit root tests first, there are surprising differences between the outcomes for the same series. Out of a total of 164 cases (in tables 6.3 - 6.5) where both statistics are calculated, the results are different in 24 cases (i.e. in 85% of the cases the results agree). When taking in consideration the KPSS test results, these three tests agree in only 56 cases out of the total of 164 or for 34% of the results (see table 6.6). For anyone engaged in empirical testing this is rather worrying. The message is that the choice of unit root test influences the results. The tests tend to agree more with the quarterly data (in 36 cases out of the 84 cases or 43%) than with the annual data (20 out of 80 or 25%). One explanation of this is the larger sample size for the quarterly data (72 compared with 24 annual observations). Also, the tests are more likely to agree for the developing countries with 42 cases out of 104 (or 40%) than with the industrialised countries (14 out of 60 or 23%). The conclusion is that the results of the tests are more likely to be in agreement for the developing countries with quarterly data.

In terms of the different tests used for the individual countries, the KPSS test rejects a unit root (by accepting the null of a stationary series), in 117 cases out of 164 cases, or 70% of the cases. For the ADF there are 35 rejections of a unit root or 21% of the cases, while for the Phillips-Perron there are 19 rejections of a unit root or 12% of the cases. This suggests that these three tests are not equally effective in distinguishing between I(0) and I(1) series. Without knowing which series are I(1) or I(0) it is not possible to say which is the most reliable test. However, this result confirms the earlier remark that the choice of unit root test affects the conclusion.

(b) Differences between the Annual and Quarterly Data

From comparing the final two columns of table 6.6 it can be seen that the outcome is a unit root in 34 cases for the quarterly data and 10 cases for the annual data, while the outcome is a stationary series for only 2 cases for quarterly data and 10 cases for annual data. These results imply that aggregating data from quarterly to annual reduces the number of unit roots and increases the number of stationary series. Also, there are more disagreements between the three tests at the annual level of aggregation, possibly because of the smaller sample size. These effects are more marked in the developing countries than in the industrialised countries.

(c) Differences between the Developing and the Industrialised Countries

For the developing countries, a unit root is accepted in 33 out of 104 cases (or 32%) and a unit root is rejected in only 9 cases (or 9%) with disagreement in the remaining 62 cases (60%) For the industrialised countries, out of the 60 series considered, the three tests accept a unit root in 11 cases (18%) and reject it in only 3 cases (5%), with the tests disagreeing in 46 (77%) cases. While more unit roots are found in the developing countries, the differences between the results for developing and industrialised countries are small, and given the high number of disagreements between the tests it is difficult to reach any clear conclusions.

(d) Differences between the Deposit Rate, Lending Rate and Inflation

From table 6.6 it can be seen that there are few important differences between the results for these three series. The main one is that the annual data for inflation have more stationary series than the other variables but this is not reflected in the quarterly data.

6.6.2. Panel Data Results

The results of the panel data tests are given in table 6.7. The main advantage of using panel data is the increased sample size, which now varies from 240 observations for the annual data for the industrialised countries to 1413 observations for the quarterly data for the developing countries.

(a) Differences between the Panel Unit Root Tests

As stated earlier, the null hypothesis for the panel data unit root tests is that the series is I(1), except in the case of Hadri's test. This suggests that for compatible results the first five tests should agree in accepting or rejecting the null, while Hadri's test should give the opposite conclusion. In table 6.7 this agreement only occurs for the quarterly deposit rate for the industrialised countries, where the result is the series is I(1) in every test. For all the other series the results are mixed: some tests indicate I(1) series and others indicate I(0) series. From table 6.7, comparisons between developing and industrialised countries show little difference for the LLC and IPS tests. Breitung's test shows that all interest rates in the developing countries are I(0) while they are I(1) in the industrialised countries. The Fisher tests show some differences in conclusions. The Hadri test, however, rejects the null hypothesis of stationarity in favour of a unit root in every case for both the developing and the industrialised countries. The conclusion is that, as with the individual countries unit root tests, the different tests give different results, so care is needed in the choice of panel unit root test.

(b) Differences between Annual and Quarterly Data

Comparing the annual and quarterly series, the panel individual test results differ for the deposit rate (1 disagreement in developing against 3 in industrialised countries), lending rate (2 disagreements in developing and 2 in industrialised countries) and for inflation (2 disagreements in developing and 2 in industrialised countries). As with the individual annual series, the annual panel data tend to reject a unit root more than the quarterly data. While overall the panel test results are more in agreement for the quarterly data compared with the annual data, the major problem of contradictions in the panel test results remains.

(c) Differences between the Developing and Industrialised Countries

Comparing the developing and industrialised countries, the panel data unit root tests show different results with the unit root more likely to be rejected in the developing countries in 25 cases, out of the total of 36, than in the industrialised countries with only 11 cases out of 36. The Hadri test, with the null hypothesis that differs from the other tests, always agrees with the Breitung test results in industrialised countries in favour of a common unit root process. Unlike the results from individual countries, this suggests differences in interest rate behaviour between developing and industrialised countries. A unit root more likely to be rejected in the former and accepted in the latter.

(d) Differences between the Deposit Rate, Lending Rate and Inflation

As mentioned above, with quarterly data for the deposit rate in the industrialised countries, all the tests agree that the series are I(1), while for the other series the tests disagree. Beyond this, it is difficult to identify any differences in the results for the different interest rates and inflation.

6.7. Conclusions

Although some patterns do emerge when testing for unit roots in interest rates and inflation there is little agreement overall in the test results. The single series unit root tests - the ADF, PP and KPSS tests - disagree more than they agree and so any conclusions about the presence of unit roots are unreliable. With the panel unit root tests care is needed in the interpretation since the null hypothesis may imply a common or an individual cross-sectional unit root process. Again the results of the panel unit root tests do not agree and any conclusions based on them are unreliable. However, there is enough evidence here to suggest that the empirical results for the annual and quarterly series are different, and so the choice of time unit in this empirical work is important. Also, the results of the panel unit root tests suggest that developing and industrialised countries have different properties and so when testing for unit roots the data should not be pooled. Finally, given the number of the cases where the tests disagree about the presence of a unit root, it would be rash to assume that all the series are non-stationary and to progress to testing for evidence of cointegration to test the long-run Fisher hypothesis.

Appendix 6.1

A6.1.1 Temporal Aggregation for a Random Walk

Initially it is assumed that the quarterly variable, x, follows a random walk so that

$$x_t = x_{t-1} + u_t \qquad \text{(A6.1)}$$

where u_t is assumed to be white noise

i.e. $E(u_t)=0$, $E(u_t^2)=\sigma^2$, $E(u_t u_{t-j}) = 0$ for all t and $j \neq 0$ (A6.2).

The aggregate variable X is given by

$$X_n = (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4 \qquad \text{(A6.3)}$$

and $X_{n-1} = (x_{4n-7} + x_{4n-6} + x_{4n-5} + x_{4n-4})/4$

But from (A6.1), repeated substitution gives

$$x_{4n} = x_{4n-1} + u_{4n} = x_{4n-2}+u_{4n-1}+u_{4n} = x_{4n-3} + u_{4n-2}+u_{4n-1}+u_{4n} = x_{4n-4}+u_{4n-3}+u_{4n-2} + u_{4n-1} + u_{4n}$$

$$x_{4n-1}=x_{4n-2}+u_{4n-1}=x_{4n-3}+u_{4n-2}+u_{4n-1}=x_{4n-4}+u_{4n-3}+u_{4n-2}+u_{4n-1}=x_{4n-5}+u_{4n-4}+u_{4n-3}+u_{4n-2}+u_{4n-1}$$

$$x_{4n-2}=x_{4n-3}+u_{4n-2}=x_{4n-4}+u_{4n-3}+u_{4n-2}=x_{4n-5}+u_{4n-4}+u_{4n-3}+u_{4n-2}=x_{4n-6}+u_{4n-5}+u_{4n-4}+u_{4n-3}+u_{4n-2}$$

$$x_{4n-3}=x_{4n-4}+u_{4n-3}=x_{4n-5}+u_{4n-4}+u_{4n-3}=x_{4n-6}+u_{4n-5}+u_{4n-4}+u_{4n-3}=x_{4n-7}+u_{4n-6}+u_{4n-5}+u_{4n-4}+u_{4n-3}$$

Summing the four quarters gives

$$x_{4n}+x_{4n-1}+x_{4n-2} +x_{4n-3}=(x_{4n-4}+u_{4n-3}+u_{4n-2}+u_{4n-1}+u_{4n})+(x_{4n-5}+u_{4n-4}+u_{4n-3}+u_{4n-2} +u_{4n-1})$$

$$+(x_{4n-6}+u_{4n-5}+u_{4n-4} +u_{4n-3}+u_{4n-2}) +(x_{4n-7}+u_{4n-6}+u_{4n-5} +u_{4n-4}+u_{4n-3})$$

$$= [x_{4n-7}+x_{4n-6}+x_{4n-5} +x_{4n-4}] + u_{4n-6}+2u_{4n-5} +3u_{4n-4}+4u_{4n-3} +3u_{4n-2}+2u_{4n-1}+u_{4n}$$

Hence, using this in (A6.3)

$$X_n =(x_{4n-3}+ x_{4n-2} + x_{4n-1} + x_{4n})/4$$

$$= ([x_{4n-7}+x_{4n-6}+x_{4n-5} +x_{4n-4}] + u_{4n-6}+2u_{4n-5} +3u_{4n-4}+4u_{4n-3} +3u_{4n-2}+2u_{4n-1}+u_{4n})/4$$

$$= X_{n-1} + [u_{4n-6}+2u_{4n-5} +3u_{4n-4}+4u_{4n-3} +3u_{4n-2}+2u_{4n-1}+u_{4n}]/4$$

$$= X_{n-1} + U_n \qquad \text{(A6.4)}$$

where $U_n = [u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]/4$ (A6.5)

This looks like a random walk but the properties of U_n need to be checked. If the u_t satisfy the assumptions (A6.2) then

$$E(U_n) = 0$$

since $E(u_{4n-6}) = E(u_{4n-5}) = E(u_{4n-4}) = E(u_{4n-3}) = E(u_{4n-2}) = E(u_{4n-1}) = E(u_{4n}) = 0$.

Also, $E(U_n^2) = E([u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]^2/16)$

$= E([u_{4n-6}^2+4u_{4n-5}^2+9u_{4n-4}^2+16u_{4n-3}^2+9u_{4n-2}^2+4u_{4n-1}^2+u_{4n}^2+\text{cross products}]/16$

$= 44E(u_t^2/16) = 2.75\sigma^2$, (A6.6)

which is a constant, since the cross-product terms $E(u_t u_{t+s})=0$ for $s \neq 0$ and $E(u_t^2)= \sigma^2$ for all t.

$E(U_n U_{n-1}) = E[u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]\,[u_{4n-10}+2u_{4n-9}$
$+3u_{4n-8}+4u_{4n-7}+3u_{4n-6}+2u_{4n-5}+u_{4n-4}]/16$

$= (E[3u_{4n-6}^2] + E[4u_{4n-5}^2] + E[3u_{4n-4}^2])/16$, ignoring the cross-product terms which are zero,

$= 10\sigma^2/16 = 0.625\sigma^2$ (A6.7)

which is not zero. Thus while U has a mean of zero and a constant variance, it has a first-order autocorrelation coefficient of

$\rho_1 = E(U_n U_{n-1}/U_n^2) = 0.625\sigma^2/2.75\sigma^2 = 0.23$. (A6.8)

The conclusion is that if the quarterly series follows a simple random walk, the annual series, consisting of averages of the quarterly values, has a first-order autocorrelation coefficient of 0.23. However, if there is positive autocorrelation in the u terms, it is clear from the positive signs in (A6.6) and (A6.7) that the cross-product terms will be positive, increasing the size of the first-order autocorrelation coefficient above 0.23.

In Working (1960) the general case of the average of a simple random walk with m observations is considered and, as m tends to infinity, the first-order autocorrelation tends to the value 0.25. Notice that if interest rates follow a day-by-day random walk, the annual average will include about 260 observations and the first-order autocorrelation coefficient will be close to 0.25.

When the higher-order autocorrelations are considered they are all found to be zero for the simple random walk. For example, from (A6.5)

$$E(U_nU_{n-2}) = E([u_{4n-6}+2u_{4n-5}+3u_{4n-4}+4u_{4n-3}+3u_{4n-2}+2u_{4n-1}+u_{4n}]\,[u_{4n-14}+2u_{4n-13}+3u_{4n-12}+4u_{4n-11}+3u_{4n-10}+2u_{4n-9}+u_{4n-8}]/16)$$

gives only cross-products which are zero so that $E(U_nU_{n-2}) = 0$.

Now a characteristic of a first-order moving-average or MA(1) process is that the first-order autocorrelation coefficient is non-zero and the other autocorrelations are zero. (see, e.g. Johnston and Di Nardo, 1997, p.176). The implication is that a pure random walk for quarterly data aggregates up to an MA(1) model for annual averages.

A6.1.2 Temporal Aggregation for an AR(1) Process

The assumed AR(1) model for the quarterly variable, x, is

$$x_t = \beta x_{t-1} + u_t \qquad \text{(A6.9)}$$

where $0 < \beta < 1$, so that the process is stationary, and u_t is assumed to be white noise, as in (A6.2).

The aggregate variable X is given by

$$X_n = (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4 \qquad \text{(A6.3)}$$

and $X_{n-1} = (x_{4n-7} + x_{4n-6} + x_{4n-5} + x_{4n-4})/4$

But from (A6.9), repeated substitution gives

$x_{4n} = \beta x_{4n-1} + u_{4n} = \beta^2 x_{4n-2} + \beta u_{4n-1} + u_{4n} = \beta^3 x_{4n-3} + \beta^2 u_{4n-2} + \beta u_{4n-1} + u_{4n}$

$= \beta^4 x_{4n-4} + \beta^3 u_{4n-3} + \beta^2 u_{4n-2} + \beta u_{4n-1} + u_{4n}$

$x_{4n-1} = \beta x_{4n-2} + u_{4n-1} = \beta^2 x_{4n-3} + \beta u_{4n-2} + u_{4n-1} = \beta^3 x_{4n-4} + \beta^2 u_{4n-3} + \beta u_{4n-2} + u_{4n-1}$

$= \beta^4 x_{4n-5} + \beta^3 u_{4n-4} + \beta^2 u_{4n-3} + \beta u_{4n-2} + u_{4n-1}$

$x_{4n-2} = \beta x_{4n-3} + u_{4n-2} = \beta^2 x_{4n-4} + \beta u_{4n-3} + u_{4n-2} = \beta^3 x_{4n-5} + \beta^2 u_{4n-4} + \beta u_{4n-3} + u_{4n-2}$

$= \beta^4 x_{4n-6} + \beta^3 u_{4n-5} + \beta^2 u_{4n-4} + \beta u_{4n-3} + u_{4n-2}$

$x_{4n-3} = \beta x_{4n-4} + u_{4n-3} = \beta^2 x_{4n-5} + \beta u_{4n-4} + u_{4n-3} = \beta^3 x_{4n-6} + \beta^2 u_{4n-5} + \beta u_{4n-4} + u_{4n-3}$

$= \beta^4 x_{4n-7} + \beta^3 u_{4n-6} + \beta^2 u_{4n-5} + \beta u_{4n-4} + u_{4n-3}$

Summing these gives

$x_{4n} + x_{4n-1} + x_{4n-2} + x_{4n-3} = (\beta^4 x_{4n-4} + \beta^3 u_{4n-3} + \beta^2 u_{4n-2} + \beta u_{4n-1} + u_{4n}) + (\beta^4 x_{4n-5} + \beta^3 u_{4n-4} + \beta^2 u_{4n-3} + \beta u_{4n-2} + u_{4n-1}) + (\beta^4 x_{4n-6} + \beta^3 u_{4n-5} + \beta^2 u_{4n-4} + \beta u_{4n-3} + u_{4n-2}) + (\beta^4 x_{4n-7} + \beta^3 u_{4n-6} + \beta^2 u_{4n-5} + \beta u_{4n-4} + u_{4n-3})$

$= \beta^4 [x_{4n-7} + x_{4n-6} + x_{4n-5} + x_{4n-4}] + \beta^3 u_{4n-6} + (\beta^3 + \beta^2) u_{4n-5} + (\beta^3 + \beta^2 + \beta) u_{4n-4} + (\beta^3 + \beta^2 + \beta + 1) u_{4n-3} + (\beta^2 + \beta + 1) u_{4n-2} + (\beta + 1) u_{4n-1} + u_{4n}$

Hence, using this in (A6.3)

$X_n = (x_{4n-3} + x_{4n-2} + x_{4n-1} + x_{4n})/4$

$= (\beta^4 [x_{4n-7} + x_{4n-6} + x_{4n-5} + x_{4n-4}] + \beta^3 u_{4n-6} + (\beta^3 + \beta^2) u_{4n-5} + (\beta^3 + \beta^2 + \beta) u_{4n-4}$

$+ (\beta^3 + \beta^2 + \beta + 1) u_{4n-3} + (\beta^2 + \beta + 1) u_{4n-2} + (\beta + 1) u_{4n-1} + u_{4n})/4$

$= \beta^4 X_{n-1} + U_n$ (A6.10)

where $U_n = [\beta^3 u_{4n-6} + (\beta^3 + \beta^2) u_{4n-5} + (\beta^3 + \beta^2 + \beta) u_{4n-4} + (\beta^3 + \beta^2 + \beta + 1) u_{4n-3} + (\beta^2 + \beta + 1) u_{4n-2}$

$+ (\beta + 1) u_{4n-1} + u_{4n}]/4$ (A6.11)

Here, if U was white noise then (A6.10) would be an AR(1) process and so the properties of U are examined next.

Assuming that the u_t satisfy the assumptions (A6.2) then it is easily shown that $E(U_n) = 0$ since $E(u_t) = 0$ for all t. Similarly, the variance of U is given by the following (ignoring the cross-product terms which are zero)

$$E(U_n^2) = [\beta^6+(\beta^3+\beta^2)^2+(\beta^3+\beta^2+\beta)^2+(\beta^3+\beta^2+\beta+1)^2+(\beta^2+\beta+1)^2+(\beta+1)^2+1]\sigma^2/16$$

which is a constant and depends on the value of β.

Similarly, $E(U_nU_{n-1}) = E[\beta^3u_{4n-6}+(\beta^3+\beta^2)u_{4n-5} +(\beta^3+\beta^2+\beta)u_{4n-4} +(\beta^3+\beta^2+\beta+1)u_{4n-3}+(\beta^2+\beta+1)u_{4n-2} + (\beta+1)u_{4n-1}+u_{4n}] \; [\beta^3u_{4n-10}+(\beta^3+\beta^2)u_{4n-9} +(\beta^3+\beta^2+\beta)u_{4n-8} +(\beta^3+\beta^2+\beta+1)u_{4n-7}+(\beta^2+\beta+1)u_{4n-6}+ (\beta+1)u_{4n-5}+u_{4n-4}]/16$

$$= [\beta^3(\beta^2+\beta+1)+(\beta^3+\beta^2)(\beta+1)+(\beta^3+\beta^2+\beta)]\sigma^2/16$$

$$= [\beta^5 + 2\beta^4 + 4\beta^3 +2\beta^2 + \beta]\sigma^2/16 \qquad \text{(A6.12)}$$

which is not zero. Thus while U has a mean of zero and a constant variance, it has a first-order autocorrelation coefficient

$$\rho_1 = E(U_nU_{n-1}/U_n^2) \qquad \text{(A6.13)}$$

which depends on the value of β. In the special case of the random walk, β = 1 and the value, from (A6.12) is 0.23, as above in (A6.8).

Next, the higher-order autocorrelations are considered. For example,

$E(U_nU_{n-2}) = E[\beta^3u_{4n-6}+(\beta^3+\beta^2)u_{4n-5}+(\beta^3+\beta^2+\beta)u_{4n-4}+(\beta^3+\beta^2+\beta+1)u_{4n-3}+(\beta^2+\beta+1)u_{4n-2} + (\beta+1)u_{4n-1}+u_{4n}] \; [\beta^3u_{4n-14}+(\beta^3+\beta^2)u_{4n-13} +(\beta^3+\beta^2+\beta)u_{4n-12} +(\beta^3+\beta^2+\beta+1)u_{4n-11}+(\beta^2+\beta+1)u_{4n-10}+ (\beta+1)u_{4n-9}+u_{4n-8}]/16.$

Since there are no common u terms in both sets of square brackets, all the cross-product terms are zero and so $E(U_nU_{n-2}) = 0$.

More generally, $E(U_nU_{n-s}) = 0$ for $|s|>1$ and Chambers (2005) proves that (A6.10) is a first-order autoregressive-moving average or ARMA(1,1) process. That is, if the quarterly series is an AR(1) process and aggregation to annual data takes place using averages of the quarterly values, then the annual series will follow an ARMA(1,1) process.

Table 6.2 First-order Autocorrelations for individual countries

Country	Deposit rates		Lending rates		Inflation	
Developing Countries						
	A	Q	A	Q	A	Q
Bangladesh	0.838	0.976	0.806	0.796	NA	NA
Chile	0.693	0.706	0.739	0.742	0.603	0.920
Colombia	NA	0.935	NA	0.942	0.775	0.948
Egypt	0.715	0.951	0.867	0.975	0.689	0.910
Indonesia	0.536	0.875	NA	0.913	0.137	0.878
Israel	NA	0.781	0.556	0.868	0.698	0.594
Jamaica	0.724	0.924	0.858	0.961	0.503	0.938
Kenya	0.616	NA	0.832	0.944	0.554	0.926
Korea	0.454	0.875	0.544	0.902	0.504	0.866
Malaysia	0.666	0.927	0.652	0.895	0.606	0.877
Mauritius	0.355	0.803	0.849	0.920	0.241	0.834
Nigeria	0.633	0.870	0.778	0.855	0.497	0.919
Philippines	0.643	0.900	0.665	0.905	0.201	0.900
S. Africa	0.554	0.908	0.423	0.901	0.805	0.879
Sri Lanka	0.705	0.890	0.597	0.903	0.186	0.780
Thailand	0.752	0.937	0.738	0.908	0.469	0.894
Trinidad	0.482	NA	0.765	0.920	0.615	0.878
Venezuela	NA	0.870	NA	0.887	0.587	0.903
Zimbabwe	0.548	0.778	0.463	0.576	0.692	0.862
Industrialised Countries						
Australia	0.853	0.973	0.836	0.966	0.743	0.927
Canada	0.768	0.940	0.768	0.942	0.774	0.894
Denmark	0.869	0.969	0.834	0.956	0.794	0.888
Germany	0.759	0.977	0.732	0.955	0.648	0.871
Japan	0.809	0.964	0.858	0.972	0.614	0.897
N. Zealand	0.843	0.881	0.813	0.923	0.727	0.911
Sweden	0.865	0.958	0.864	0.957	0.734	0.937
Switzerland	0.724	0.959	0.805	0.970	0.711	0.935
UK	0.758	0.954	0.737	0.951	0.583	0.939
USA	0.747	0.932	0.718	0.925	0.578	0.897

NA – Data not available for the full period.
A - Annual data for 1980 - 2003 (24 observations)
Q - Quarterly data for 1986(1) - 2003(4) (72 observations)

Table 6.3 Unit Root test results for individual countries: Deposit Rates

Country	Annual				Quarterly			
Developing Countries								
	ADF	PP	KPSS	Result	ADF	PP	PSS	Result
Bangladesh	-3.85*	-2.97	0.091	?	-1.90	1.39	0.175*	I(1)
Chile	-4.33*	-4.30*	0.056	I(0)	-3.27	-5.24**	0.095	?
Colombia	NA	NA	NA	NA	-3.05	-2.22	0.193*	I(1)
Egypt	-2.47	-3.08	0.184*	I(1)	-1.30	-1.39	0.211*	I(1)
Indonesia	-2.37	-2.19	0.125	?	-3.63*	-2.46	0.084	?
Israel	NA	NA	NA	NA	-4.38**	-9.04**	0.125	I(0)
Jamaica	-1.99	-1.36	0.162*	I(1)	-1.50	-1.56	0.233**	I(1)
Kenya	1.12	-1.10	0.147*	I(1)	NA	NA	NA	NA
Korea	-2.66	-2.51	0.085	?	-1.79	-2.24	0.145	?
Malaysia	-3.39	-2.51	0.072	?	-2.36	-2.02	0.168*	I(1)
Mauritius	-5.78**	-3.14	0.139	?	-2.82	-2.82	0.071	?
Nigeria	-2.91	-2.37	0.130	?	-3.25	-2.30	0.126	?
Philippines	-3.90*	-2.88	0.124	?	-2.16	-2.32	0.103	?
S. Africa	-3.81*	-2.15	0.135	?	-2.20	-1.97	0.106	?
Sri Lanka	-5.00*	-4.73**	0.07	I(0)	-2.35	-2.35	0.154*	I(1)
Thailand	-2.57	-2.56	0.136	?	-2.31	-1.98	0.198*	I(1)
Trinidad	NA	-0.34	0.106	NA	NA	NA	NA	NA
Venezuela	NA	NA	NA	-	-3.06	-2.36	0.194*	I(1)
Zimbabwe	-4.53**	-3.36	0.076	?	-2.07	-2.50	0.074	?
Industrialised Countries								
Australia	-2.73	-2.60	0.132	?	-2.48	-2.33	0.128	?
Canada	-4.29*	-3.04	0.078	?	-3.42	-2.56	0.063	?
Denmark	-3.74*	-2.30	0.072	?	-2.53	-2.06	0.128	?
Germany	-3.55	-2.03	0.071	?	-1.93	-1.71	0.145	?
Japan	-3.37	-2.36	0.060	?	-2.27	-1.88	0.123	?
N. Zealand	-4.86**	-2.17	0.094	?	-1.98	-2.62	0.198*	I(1)
Sweden	-3.17	-3.16	0.116	?	-2.31	-2.60	0.124	?
Switzerland	-2.99	-2.22	0.080	?	-1.56	-1.89	0.118	?
UK	-2.55	-2.86	0.069	?	-1.88	-1.86	0.114	?
USA	-4.22*	-2.25	0.119	?	-2.30	-1.91	0.078	?

NA – Data not available for the full period.
A - Annual data 1980 - 2003 (24 observations)
Q -Quarterly data 1986(1) - 2003(4) (72 observations)
* - significant at the 5% level. ** - significant at the 1% level.
ADF - Augmented Dickey-Fuller statistic. Lag length selected using the Schwarz information criterion. 5% critical values: annual data -3.61; quarterly data -3.47.
PP - Phillips - Perron test. 5% critical values: annual data -3.61; quarterly data -3.47.
KPSS – Kwiatkowski, Phillips, Schmidt and Shin test statistic. Asymptotic 5% critical value 0.1460, 1% critical value 0.2160.

Result: I(1) or I(0) - all three tests agree.
? - tests disagree

Table 6.4 Unit Root test results for individual countries: Lending Rates

Country	Annual				Quarterly			
Developing Countries								
	ADF	PP	KPSS	Result	ADF	PP	KPSS	Result
Bangladesh	-2.25	-1.69	0.117	?	-3.15	-3.16	0.179*	I(1)
Chile	-4.23*	-4.21*	0.057	I(0)	-3.22	-4.96**	0.08	?
Colombia	NA	NA	NA	NA	-2.85	-2.18	0.211*	I(1)
Egypt	-1.83	-1.79	0.156*	I(1)	-2.15	-2.04	0.176*	I(1)
Indonesia	NA	NA	NA	NA	-3.09	-2.32	0.069	?
Israel	-18.0**	-2.92	0.113	?	-17.5**	-11.13**	0.217**	?
Jamaica	-2.14	-0.78	0.159*	I(1)	-1.08	-1.05	0.256**	I(1)
Kenya	-0.76	-0.87	0.126	?	-1.44	-0.53	0.257**	I(1)
Korea	-2.97	-2.95	0.098	?	-2.78	-1.56	0.114	?
Malaysia	-3.30	-2.40	0.057	?	-2.77	-2.29	0.112	?
Mauritius	-4.01*	-2.77	0.090	?	-2.87	-3.00	0.124	?
Nigeria	-2.00	-1.90	0.130	?	-2.37	-2.37	0.154*	I(1)
Philippines	-3.50	-2.23	0.106	?	-2.10	-2.33	0.113	?
S. Africa	-3.60	-2.40	0.136	?	-2.22	-1.79	0.137	?
Sri Lanka	-1.72	-1.72	0.102	?	-1.78	-1.19	0.210*	I(1)
Thailand	-3.39	-2.68	0.086	?	-1.75	-1.97	0.172*	I(1)
Trinidad	0.11	-0.05	0.137	?	0.57	0.29	0.213*	I(1)
Venezuela	NA	NA	NA	NA	-1.81	-1.81	0.226**	I(1)
Zimbabwe	-0.55	-1.79	0.205*	I(1)	0.05	-2.03	0.058	?
Industrialised Countries								
Australia	-2.59	-2.59	0.131	?	-3.24	-2.12	0.130	?
Canada	-4.69**	-2.96	0.085	?	-3.46	-2.52	0.073	?
Denmark	-3.58	-3.46	0.093	?	-3.31	-2.81	0.119	?
Germany	-3.53	-1.72	0.073	?	-1.74	-1.18	0.186*	I(1)
Japan	-3.51	-1.83	0.076	?	-2.69	-1.79	0.118	?
N. Zealand	-2.42	-2.17	0.105	?	-2.32	-1.75	0.224**	I(1)
Sweden	-2.36	-2.36	0.126	?	-1.89	-2.14	0.152*	I(1)
Switzerland	-2.16	-1.47	0.13	?	-2.34	-1.70	0.162*	I(1)
UK	-3.22	-2.48	0.064	?	-2.29	-2.13	0.077	?
USA	-4.55*	-2.08	0.131	?	-2.59	-1.85	0.084	?

NA – Data not available for the full period.
A - Annual data 1980 - 2003 (24 observations)
Q -Quarterly data 1986(1) - 2003(4) (72 observations)
* - significant at the 5% level. ** - significant at the 1% level.
ADF - Augmented Dickey-Fuller statistic. Lag length selected using the Schwarz information criterion. 5% critical values: annual data -3.61; quarterly data -3.47.
PP - Phillips - Perron test. 5% critical values: annual data -3.61; quarterly data -3.47.
KPSS – Kwiatkowski, Phillips, Schmidt and Shin test statistic. Asymptotic 5% critical value 0.1460, 1% critical value 0.2160.

Result: I(1) or I(0) - all three tests agree.
? - tests disagree.

Table 6.5 Unit Root test results for individual countries: Inflation

	Annual				Quarterly			
	Developing Countries							
	ADF	PP	KPSS	Result	ADF	PP	KPSS	Result
Bangladesh	NA	NA	NA	NA	NA	NA	NA	NA
Chile	-3.95*	-3.91*	0.080	I(0)	-2.03	-3.18	0.090	?
Colombia	-1.61	-1.60	0.154*	I(1)	-2.73	-2.15	0.234**	I(1)
Egypt	-2.52	-3.75*	0.143	?	-1.11	-4.22**	0.088	?
Indonesia	-4.00*	-3.95*	0.079	I(0)	-6.02**	-3.02	0.065	?
Israel	-3.54	-2.60	0.101	?	-12.6**	-15.0**	0.121	I(0)
Jamaica	-2.63	-2.64	0.124	?	-2.65	-2.25	0.164*	I(1)
Kenya	-2.57	-2.57	0.118	?	-3.33	-2.42	0.149*	I(1)
Korea	-2.97	-1.97	0.100	?	-3.76*	-2.94	0.140	?
Malaysia	-2.45	-2.55	0.104	?	-2.62	-2.06	0.238**	I(1)
Mauritius	-3.65*	-3.65*	0.118	I(0)	-2.82	-2.96	0.099	?
Nigeria	-2.59	-2.48	0.132	?	-3.42	-2.59	0.129	?
Philippines	-5.40**	-8.52**	0.500**	?	-3.12	-2.34	0.146*	I(1)
S. Africa	-2.59	-2.42	0.132	?	-2.52	-3.45	0.124	?
Sri Lanka	-5.44**	-4.57**	0.08	I(0)	-4.13**	-3.40	0.074	?
Thailand	-2.51	-2.52	0.100	?	-2.27	-2.53	0.180*	I(1)
Trinidad	-5.58**	-4.49**	0.207*	?	-4.49**	-3.32	0.051	?
Venezuela	-2.43	-2.50	0.128	?	-2.42	-2.41	0.160*	I(1)
Zimbabwe	0.21	0.419	0.171*	I(1)	-1.08	-0.86	0.134	?
	Industrialised Countries							
Australia	-2.91	-2.39	0.133	?	-1.72	-2.03	0.196*	I(1)
Canada	-1.90	-1.86	0.149*	I(1)	-3.22	-2.61	0.177*	I(1)
Denmark	-2.08	-2.85	0.176*	I(1)	-2.28	-2.80	0.192*	I(1)
Germany	-6.42**	-2.21	0.087	?	-2.18	-2.33	0.166*	I(1)
Japan	-3.79*	-3.89*	0.082	I(0)	-2.25	-2.35	0.119	?
N. Zealand	-2.46	-2.76	0.132	?	-4.13**	-2.33	0.203*	?
Sweden	-2.71	-2.70	0.075	?	-2.45	-2.27	0.118	?
Switzerland	-2.41	-2.41	0.061	?	-3.32	-1.98	0.127	?
UK	-5.67**	-4.10*	0.092	I(0)	-3.14	-2.24	0.078	?
USA	-4.12*	-7.82**	0.115	I(0)	-2.59	-2.62	0.091	?

NA – Data not available for the full period.
A - Annual data 1980 - 2003 (24 observations)
Q -Quarterly data 1986(1) - 2003(4) (72 observations)
* - significant at the 5% level. ** - significant at the 1% level.
ADF - Augmented Dickey-Fuller statistic. Lag length selected using the Schwarz information criterion. 5% critical values: annual data -3.61; quarterly data -3.47.
PP - Phillips - Perron test. 5% critical values: annual data -3.61; quarterly data -3.47.
KPSS – Kwiatkowski, Phillips, Schmidt and Shin test statistic. Asymptotic 5% critical value 0.1460, 1% critical value 0.2160.
Result: I(1) or I(0) - all three tests agree.
? - tests disagree.

Table 6.6 Summary of the Unit Root Test Results for Individual Countries

Series is	Countries	Deposit Rates		Lending Rates		Inflation		Total of Results	
		A	Q	A	Q	A	Q	A	Q
I(1)	Developing	3	8	3	10	2	7	8	25
	Industrialised	0	1	0	4	2	4	2	9
I(0)	Developing	2	1	1	0	4	1	7	2
	Industrialised	0	0	0	0	3	0	3	0
Tests disagree	Developing	11	8	12	9	12	10	35	27
	Industrialised	10	9	10	6	5	6	25	21
Total of Series		26	27	26	29	28	28	80	84

Table 6.7 Panel Data Tests Results

	Deposit Rate		Lending Rate		Inflation	
	A	Q	A	Q	A	Q
Developing Countries						
Levin, Lin Chu	-5.47**	0.52	-1.74*	-4.20**	-4.42**	0.27
Breitung	-3.79**	-4.36**	-2.74**	-2.36**	-1.86*	-1.53
Im, Pesaran, Shin	-5.88**	-2.44*	-1.17	-5.21**	-4.73**	-7.71**
ADF-Fisher	85.2**	54.8*	49.2*	63.4**	91.5**	103**
PP-Fisher	52.0**	71.4**	31.0	60.2*	96.1**	74.6**
Hadri	5.35**	6.89**	4.54**	9.62**	4.82**	7.14**
Result	?	?	?	?	?	?
Industrialised Countries						
Levin, Lin Chu	-4.17**	-0.41	-3.56**	-1.32	-1.56	-0.75
Breitung	-1.21	-0.72	-1.46	-1.10	0.31	-1.42
Im, Pesaran, Shin	-4.42**	-0.41	-3.83**	-1.67*	-2.04*	-2.28*
ADF-Fisher	52.6**	18.5	48.9**	28.2	31.4	33.9*
PP-Fisher	23.5	14.6	20.3	12.5	54.5**	19.1
Hadri	2.23*	4.20**	3.26**	5.38**	3.91**	7.02**
Result	?	I(1)	?	?	?	?

All the test equations include individual intercepts and individual trends. For the annual data there are 240 observations for industrialised countries and a maximum of 432 for developing countries. For the quarterly data there are 720 observations for industrialised countries and a maximum of 1413 for developing countries. For developing countries, see tables 6.2, 6.4 and 6.6 for which series are not available.

* - reject the null hypothesis at the 5% level
** - reject the null hypothesis at the 1% level
For the first 5 tests the null is the series is I(1). For Hadri's test the null is the series is I(0).
Result: ? - the tests disagree. I(1) - all six tests agree the series is I(1).

Chapter 7

Conclusions and Recommendations

7.1. Review

This thesis has examined the relationship between stock markets and banks development and economic growth in developing countries. Chapter 2 presents the theoretical base of the link, focusing on the macroeconomic aspects. It shows that finance does not always promote growth in the real sector, as the endogenous and neoclassical growth theories assume. The Keynesians and post-Keynesians claim that there are no guarantees that financial development enhances real investment and that speculative bubbles may grow at the cost of the real sector. Having presented the conflicting theoretical views regarding the link between finance and growth, chapter 2 looked at the definition of financial development and concluded that it is a very complex concept that the current literature fails to measure adequately.

In chapter 3 the review of the empirical literature shows that the majority of studies conclude that a strong positive association exists between the state of development of the financial system and economic growth. However, the reviewed studies focused mainly on developed countries with less attention to developing countries. Moreover, the empirical measures of financial development are generally narrow, referring to either banks or stock markets development, and rarely to both. A further point is that the vast majority of cross- sectional studies use averaged data in investigating the relationship. This has the effect of reducing variation in the sample by smoothing out shocks, reducing the number of observations used and distorting any lag structure that may be present. Also, time-series studies report mixed results regarding the significance as well as the direction of the relationship.

Taking into account the shortcomings noted in the literature review, this study concentrates on developing countries. It mainly uses annual data rather than averaged data and employs recently developed estimation methods. Some newly collected annual measures of financial development are presented in chapter 4. Their importance for growth is tested in chapter 5. These measures are also used in the framework of principal components analysis to account for the complex concept of financial development. Recently developed estimation methods, used to test the importance of finance for growth, are set out in chapter 4 and used in chapter 5. These are the advanced techniques of dynamic GMM panel models which control for the endogeneity of the explanatory variables, the use of the individual fixed effects and the presence of the lagged dependent variable.

Chirwa & Mlachila (2004), among others, claim that government control and intervention in the financial sector negatively affect economic growth. The attempts made by developing countries to reform their financial systems involve mainly liberalising interest rates and decontrolling credit limits so that credit is allocated more efficiently. This suggests the existence of a different behaviour of interest rates in developed and developing countries. In chapter 6, the time-series behaviour of interest rates is studied. The importance of time aggregation is acknowledged and the stationarity properties of both quarterly and annual data on interest rates are examined using both individual country and panel unit root tests. Comparisons are made between developing and industrialised countries, annual and quarterly data and the alternative unit root tests.

7.2. Conclusions

In chapter 5, the cross-sectional regressions performed using four-year averaged data, for the purpose of comparison only, for thirty developing countries reveal that there is a positive but not significant association between the different measures of financial development and growth when controlling for initial income, schooling, inflation, government size, trade openness and legal origin. German legal origin, which effectively enforces compliance with laws, is significantly and positively associated with economic growth in all the regressions. However, the weaknesses of using averaged data and ordinary least squares estimation mean that other approaches are needed.

When using system GMM panel estimation with annual data over 1988-2001 in chapter 5, in general, banks development is found to be negatively related to economic growth. Stock markets development, however, has a positive impact on economic growth. When putting together the ten different traditional measures of financial development mostly used in the literature and extracting 80 per cent of their variation through principal components analysis, the new measures of financial development are found to positively affect economic growth. The conditioning variables were then incorporated with the traditional measures in the framework of principal components analysis to test for the robustness of the results. The results were confirmed, with the fifth principal component that gives highest weights to inflation and government consumption being negatively related to growth. The study concluded that overall financial development matters for growth.

As for interest rate behaviour in chapter 6, the main result is that both the panel and the singles series unit root tests do not agree and any conclusions based on them are unreliable. However, the results stress the importance of the choice of time unit when testing for unit roots. This is interpreted as evidence to suggest that empirical results are needed for both annual and quarterly series.

7.3. Recommendations for Future Research

Despite the results achieved throughout this study, it should be pointed out that there are still issues, which remain unexamined.

Arising from the results in chapter 5, additional work in this area should look more at the links between law, finance and economic growth by examining theoretically and empirically the costs and the benefits of alternative legal rules regarding financial contacts and analyzing how well these rules are enforced in different countries. Different countries actually do have substantially different rules that might explain their financing patterns and hence their growth rates. Also relevant are differences in the laws concerning the protection to investors in limited liability companies, which affect the support for entrepreneurs.

The validity of the results of any empirical study is limited by the data. Further effort would try to lengthen the span of the time-series data and the number of individual countries in chapters 5 and 6. It may focus on developing countries or industrialised countries as both results from chapter 5 and 6 argue in favour of distinguishing between their financial sectors specific features. Future work could also investigate the effects of time aggregation to see how important this is for the conclusions. Also, fractional integration seems a promising way forward in testing for stationarity.

Further investigation is needed into measuring financial development and linking these measures to the functions of the financial sector. Such studies will move us closer to an overall definitive conclusion and a comprehensive understanding of the relationship between financial development and economic growth.

Finally, in all the work on growth and financial development in the economics literature it is assumed that growth of real income per capita is beneficial to society. However, recent work by Layard (2005) questions the assumption that higher real incomes result in happier people. The evidence he discusses, partly based on surveys of consumer satisfaction, suggests that the situation is complex with little association between the level of real income and happiness. While this thesis has been concerned with whether financial development promotes growth, perhaps future research should focus on identifying what makes people happy.

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