Financial Development and Economic Growth:

Evidence from Heterogeneous Panel Data

by

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A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY IN ECONOMICS

at the

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS, ISLAMABAD

2008

Certificate page

Dedicated to my first love, my mother (late)

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Acknowledgements

First of all I would like to praise the Almighty Allah, the most Gracious and the most Merciful, for giving me the strength and motivation to complete this dissertation. I would also like to thank my father who provided support and encouragement from the distance. It is all because of his prayers that I have been able to get this work done.

I would like to thank (late) A. R. Kemal, the former Director of PIDE, for providing me the motivation and the guidance. I would also like to thank my supervisors, Abdul Qayyum and Rehana Siddiqui, for their for their guidance, comments, and suggestions which helped me complete this research. Ejaz Ghani, Head, Department of Economics (PIDE), also deserves thanks for his continuous support. I am also thankful to the participants of various PIDE PhD seminars and to the participants of 14th International Conference on Panel Data (held in Wang Yanan Institute for Studies in Economics (WISE) of Xiamen University during July 16-18, 2007) whose suggestions have been helpful in improving this study.

I am grateful to Clive Granger, Peter Pedroni and Mark N. Harris for their continuous guidance from distance for completing this study. I would also like to thank Asad Zaman, Aurangzeb A. Hashmi, Diana Weinhold, Eatzaz Ahmed, M.S. Khan, Nasri Harb, Pierre Blanchard, Shehzad Latif Mian, Zafar Iqbal and two anonymous referees (of a paper published from a part of this dissertation in Lahore Journal of Economics, 12(1), 2007, pp.1-34) for their helpful comments, and suggestions.

I am also thankful to my colleague-cum-friend who has always been ready to share and swap ideas. Many other colleagues and friends like Abdul Hamid Akhter, Abdul Sattar, Bashir Zia, Farooq Arby, Massod Ashfaque, Afsar Khan, Siddiq Qureshi, Zafar Javed Naqvi, and Zafar Iqbal Shah deserve thanks for their support and encouragement.

For approving the financial assistance and providing constant moral support I would like to thank former Governor, State Bank of Pakistan, Ishrat Hussain.

Special thanks are also due for Aysha for her continuous encouragement whether or not I was under work stress. Last but not least, I am thankful to my sons, Muhammad Abdullah Nadeem and Muhammad Abdurrab Nadeem, who showed so much understanding and patience while I was working on something so strange to them. All errors and omissions are my own.

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Acronyms

ADF	(Augmented) Dickey Fuller
DF	Direct Finance
DMBs	Deposit Money Banks
FEE	Fixed Effect Estimator
FDI	Foreign Direct Investment
GMM	Generalized Method of Moments
HIC	High Income Countries
IF	Indirect Finance
IFS	International Financial Statistics
IMF	International Monetary Fund
IPS	Im – Pesaran – Shin
LB	Lower Bound
LIC	Low Income Countries
LL	Levin-Lin
LMIC	Lower Middle Income Countries
MFR	Mixed Fixed Random
MGE	Mean Group Estimator
MIC	Middle Income Countries
OECD	Organization for Economic Cooperation and Development
OF	Overall Finance
PMG	Pooled Mean Group
PPP	Purchasing Power Parity
PUR	Panel Unit Root
RC	Random Coefficient
RCM	Random Coefficient Model
UB	Upper Bound
UMIC	Upper Middle Income Countries
WDI	World Development Indicators

Abstract

The sharp disagreement in economics literature about the nature of the relationship between financial development and economic growth is widely known. Empirical evidence is also mixed as has been documented by Levine (1997, 2003b). Most empirical studies focused either on indirect finance or on direct finance. Previous panel data studies also failed to permit heterogeneity in slope coefficient. Past empirical studies even ignored the inflation effects on the relationship between finance and growth. This dissertation examines the empirical relationship between financial development and economic growth while incorporating the inflation rate effect on financial development; dividing countries into panels of Low, Lower Middle, Upper Middle, and High Income Countries. It focuses on both the indirect finance and the direct finance, separately as well as collectively. The econometric methodology of Weinhold (1999) and Nair-Reichert and Weinhold (2001) is applied for causality analysis in heterogeneous panel data which is based upon the Mixed Fixed Random Effects model of Hsiao et al. (1989). Two sets of results are reported: First, the relationship between financial development and economic growth from contemporaneous non-dynamic fixed effects panel estimation can be interpreted as mixed. Negative and statistically significant estimates of the coefficient of the inflation and financial development interaction variable, in the case of Low and Lower Middle Income Countries, indicate that financial development may be harmful to economic growth when inflation is rising. Such evidence is not found from the data for Upper Middle and High Income Countries. Second, in contrast to the recent evidence of Beck and Levine (2003), use of a more appropriate econometric methodology of dynamic heterogeneous panel for causality analysis and a refined model reveals that there is no definite indication that finance spurs economic growth or that growth spurs finance. These findings are in line with Lucas's view on finance that the importance of financial matters is over-stressed in popular and even professional discussion. The only exception is the activity in stock markets in High Income Countries, where the result supports the Robinson (1952) view that finance follows where enterprise leads.

1 Introduction and Objectives of the Study

1.1 INTRODUCTION

The financial sector of a country comprises all those entities that are engaged in financial transactions, i.e., incurring liabilities by issuing financial instruments and acquiring financial assets. Financial sector development comprises financial liberalization, deepening, and broadening[1]. The issue of the relationship between financial development and economic growth has a longstanding tradition in economics [Kirkpatrick (2000)]. Economists hold different views regarding the role of financial development for economic growth. Bagehot (1873) and Hicks (1969) argued that financial system played an important role in igniting industrialization in England in the 18th century by facilitating the mobilization of capital [2] for immense works. Goldsmith (1969) stressed the relationship between a country's financial superstructure and its real infrastructure, arguing that the former accelerates economic growth and improves economic performance to the extent that it facilitates the transfer of funds to the best user. Schumpeter (1934) emphasized the importance of the banking system in economic growth and highlighted the circumstances when banks can actively stimulate innovation and future real growth by identifying and financing productive investments. With the contributions of McKinnon (1973) and Shaw (1973) the relationship between financial

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[1] Financial liberalization implies removal of entry barriers, reduction of directed credit allocation, deregulation of interest rates, and removal of controls on inflows and outflows of capital. Financial deepening comprises the growth of financial instruments measured by the ratio of turnover in the financial sector to GDP. Financial broadening refers to an increase in the variety of financial institutions and instruments in a country [Kemal (2000)].

[2] Refer to Schumpeter (1934) definition of capital. To him, it is a fund of purchasing power. It is a means of providing those goods which are to be employed in production.

development and economic growth has become an important debate. During the last thirty years these studies have fostered fresh research interest in the role of financial development in economic growth[3]. While many economists are convinced of a positive role of financial sector for economic growth, Robinson (1952) argues that financial sector follows the real economic activities. King and Levine (1993) asserts that finance not only follows growth, it leads economic growth as well. Lucas (1988), however, dismisses finance as a major determinant of economic growth, believing that the importance of financial matters is rather over-stressed in the literature. Another contrary view is that although financial institutions facilitate risk amelioration and efficient allocation of resources, they do not necessarily boost growth because better finance means greater returns to saving and lower risk, both of which may yield lower growth.

There are, however, many zigzags in the journey from the early work on finance growth nexus to the current state of our knowledge [Kirkpatrick (2000)]. Kirkpatrick asserts that our understanding of the underlying relationships has improved, but remains incomplete. Levine (1997) acknowledges that some recent work has extended our knowledge about the causal links between financial sector development and economic growth but there are still ambiguities about the direction of causality in empirical studies. Resolving the debate and advancing our understanding about the role of financial factors in economic growth, if any, will help distinguish among competing theories of the process of economic growth [Levine (2003b)].

Empirical work on finance and growth has been done in various dimensions. A number of papers studied the finance and growth nexus in a cross-country framework [for

[3] Levine (1997) and Levine (2003b) provide a comprehensive survey in this regards

example Goldsmith (1969), Gelb (1989), World Bank (1989), King and Levine (1993), Levine and Zervos (1998)]. A number of other studies made purely time-series investigations [like Jung (1986), Wachtel and Rousseau (1995), Demetriades and Hussein (1996), Arestis and Demetriades (1997), Xu (2000), Arestis, Demetriades and Luintel (2000), Bekaert, Harvey, Lundblad (2001, 2002)]. Some papers used panel data approach [for example Levine, Loayza and Beck (2000), and Beck, Levine, and Loayza (2000)]. There are two types of problems in the existing empirical studies on financial development and economic growth.

First, most of earlier empirical studies focused either on indirect finance [for example King and Levine (1993)] or on direct finance [for example Levine and Zervos (1996)]. This study focuses not only on the indirect finance but also on direct finance, separately as well as collectively. Past empirical studies even ignored the inflation rate effects on the relationship between finance and growth. There is both theoretical and empirical literature suggesting that increase in the rate of inflation can adversely affect financial market conditions [for example Huybens and Smith (1999), De Gregorio and Sturzenegger (1994a, b), Boyd, Levine, and Smith (2001)]. This dissertation proposes that financial development effect (the coefficient of the financial development variable) is a function of inflation rate. A simple way to allow for such an effect is to write financial development effect as a function of inflation. In this way an interaction (of financial development and inflation) variable is introduced and thus financial development and inflation rate are considered individually as well as in interaction form in the estimated model[4].

[4] Details are in Chapter 3.

Second, in most of the empirical literature either time series techniques are applied to individual country data or cross-sectional methodology has been used. Time series analysis is based on individual country study. The empirical evidence on the causality between financial development and economic growth based on such individual country studies is mixed. In most of the time series studies there are not enough observations necessary for time series analysis. Cross-sectional methodology has been criticized on its failure to control effectively for cross country heterogeneity and possible endogeneity of the regressors. Neither time series studies nor the studies based on cross-sectional methodology have been successful in deciding the issue of causality between financial development and economic growth. Levine, Loayza and Beck (2000) and Beck, Levine, and Loayza (2000) use a panel GMM estimator to assess the finance and growth relationship. This approach improves upon pure cross-country work in various respects as it directly controls for the potential bias induced by the omission of country specific effects and endogeneity of all regressors. However, panel data models based upon instrumental variables estimation often lead to poor finite sample efficiency and bias (Kiviet [1995]). Another potential limitation of the panel data approach is that not much heterogeneity is allowed across countries. Heterogeneity is restricted to the intercept but is not permitted in the slope coefficients. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be homogeneous but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates. Neusser and Kugler (1998) used heterogeneous panel data approach but the study covered only a limited number of developed countries of OECD and that after doing panel cointegration analysis that study used individual country Granger causality methodology for causality analysis rather than using panel causality approach.

Each of the different econometric methodologies that have been used to study the finance-growth debate has some shortcomings [Levine, (2003b)]. Given that the relationship between financial development and economic growth may be complex and heterogeneous across countries, an advanced and appropriate econometric methodology of panel causality analysis for heterogeneous panel data given by Weinhold (1999) and Nair-Reichert and Weinhold (2001) has been used in this dissertation.

1.2 OBJECTIVES OF THE STUDY

The main objective of this study is to investigate the causal relationship between financial development and economic growth. The basic hypothesis to be tested here is that 'financial development does not matter for economic growth' against the alternative hypothesis that 'financial development causes economic growth.' The hypothesis that 'economic growth does not matter for financial development' is also tested against the alternative hypothesis that 'economic growth causes financial development.' If the above (null) hypotheses are rejected, we shall examine if the direction of causality is income-dependent, i.e. the nature of the relationship is different for countries with different levels of income. To test these hypotheses, annual data, from 1973 to 2002, of 41 countries are utilized; these are divided into four panels[5].

This study contributes to the existing literature related to the finance growth nexus in a number of ways. **First**, the issue of causality is tested for a large set of developed and

[5] We have unbalanced panel datasets. This means that we have tried to use as many observations as possible. Any effort to make them 'balanced' would require dropping some observations.

developing countries. These countries are grouped into four panels, i.e. Low, Lower Middle, Upper Middle, and High Income Countries, to test if the direction of causality (if any) is income-dependent. **Secondly**, this study focuses not only on the indirect finance but also on direct finance, separately as well as collectively. **Thirdly**, an advanced and appropriate econometric methodology[6] for causality analysis is applied in heterogeneous panel data model. **Finally**, a refinement has been made in traditional models generally used for empirical research related to finance growth nexus, by taking care of the effect of inflation rate on financial development. Therefore, this study also contributes to an investigation of the inflation effects on the relationship between financial development and economic growth.

1.3 STRUCTURE OF THE STUDY

Chapter 2 reviews some of the theoretical and empirical work related to the relationship between financial development and economic growth. In Chapter 3, details of the model are discussed. In Section 3.1 the refined econometric model of the financial development and economic growth relationship is explained in detail. In Section 3.2 details of the data are discussed. In the last Section of the Chapter, the dynamic heterogeneous panel approach of Weinhold (1999) and Nair-Reichert and Weinhold (2001) used for causality analysis in this study has been discussed. In Chapter 4, with the help of some statistical measures and graphs simple statistical analysis of the data are presented. The results of Im-Pesaran-Shin (1997, 2002) panel unit root test, applied on different variables used in this study, are also discussed. The estimated results are presented for the contemporaneous relationship of economic growth with indirect, direct and overall

[6] Levine (2003b) recognizes that many of the biggest advances in empirical studies on finance and growth have been methodological.

financial development in Chapters 5, 6, and 7 respectively. The results of the dynamic heterogeneous panel causality analysis for financial development and economic growth using Weinhold (1999) and Nair-Reichert and Weinhold (2001) panel causality method are also discussed in these Chapters. Last Chapter, while concluding, gives a summary of the overall picture.

1.4 FINDINGS OF THE STUDY

The evidence of the relationship between financial development and economic growth from contemporaneous non-dynamic fixed effects panel estimation can be interpreted as mixed. Negative and statistically significant estimates of the coefficient of the inflation and financial development interaction variable, in the case of Low and Lower Middle Income Countries, indicate that financial development may be harmful to economic growth when inflation is rising. Such evidence is not found from the data for Upper Middle and High Income Countries.

Furthermore, in contrast with the recent evidence of Beck and Levine (2003), use of more appropriate econometric methodology of dynamic heterogeneous panel for causality analysis and a refined model reveal that there is no indication that financial development spurs economic growth or growth spurs financial development. These findings are in line with the Lucas's view on finance that the importance of financial matters is rather over-stressed in professional discussion. Only exception is the activity in stock markets in high income countries where our results supports the Robinson (1952) view that finance follows where enterprise leads.

2 Review of Literature

2.1 THEORY OF FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

Economists hold different views about the impact of financial sector, including banks and markets, on economic growth. The views over finance-growth nexus can be grouped into four schools of thoughts:

School 1: Finance promotes growth: Banks are the best engines that ever were invented for creating economic growth [Bagehot (1873), Schumpeter, (1934), Hicks (1969), McKinnon (1973), Shaw (1973)]. This is the most commonly held view and it also attracts policy makers.

School 2: Finance hurts growth: This school has the opinion that banks have done more harm to the morality, tranquility, and even wealth of the nations than they have done or ever will do good [Levine, (2003b) quoted US 2nd president, John Adams]. It is argued that although financial institutions facilitate risk amelioration and efficient allocation of resources, they do not necessarily boost growth because better finance means greater returns to saving and lower risk, both of which may yield lower growth[7]. Furthermore, financial development process can increase competition in banking sector which can prove to be a double edge sword that can reduce the intermediation margins and thus erode the profits and make banks more vulnerable by increasing exposure to insolvency [Stiglitz (1993)]. It can hurt economic growth.

[7] Greater returns may lower saving rates (income and substitution effects) and lower risk may also lower savings (risk diversification and precautionary savings).

School 3: Robinson (1952) argued that where enterprise leads finance follows. From this perspective finance does not cause growth rather economic development creates demand for financial arrangements and financial sector responds automatically to these demands.

School 4: Finance doesn't matter: Solow Growth Accounting … 'growth is mainly due to technological progress, leaving little role for finance'. Some third factor may be driving finance and growth – so that finance really doesn't matter for growth [Lucas (1988)].

These schools of thought are discussed below with some detail along with a review of empirical work already done on the subject based on times-series analysis, cross-country methodology, and panel data approach.

2.1.1 Role of Financial Development in Economic Growth[8]

The financial sector of a country comprises all those entities that are engaged in financial transactions, i.e., incurring liabilities by issuing financial instruments and acquiring financial assets. The basic function of financial sector is facilitating the allocation of country's resources which are used in the process of economic growth. Levine (1997) asserts that there are various channels through which financial system affects growth. According to Levine (1997) one may focus on the system as a whole or alternatively can study different markets of the financial sector separately. According to the first approach the basic function of financial sector, i.e. facilitating the allocation of resources, remains same through time and space. The quality of financial services and the way these services are provided may differ across countries/regions and/or over time. This is a wider approach and is not confined to any particular financial instrument or institution rather it

[8] Most of this chapter is taken from Levine (1997) after permission from American Economic Association which publishes the Journal of Economic Literature and has its copyright.

is more comprehensive to understand the relationship between financial development and economic growth in contrast to the approaches that of Gurley and Shaw (1955), Tobin (1965), and McKinnon (1973) in which only money is considered while explaining the role of finance in economic growth [Levine (1997)].

How financial system emerges to play its role in allocation of resources between those who have and those who want to use? It is the cost of acquiring information and making transactions that create incentives for financial markets and institutions to emerge. In perfect market situation when there are no information and transaction costs, there is no need for financial system. Financial markets and institutions may arise to mitigate the problems created by information and transactions frictions. The nature and form of the financial markets and institutions depend upon the type of the information and transaction frictions.

According to Merton and Bodie (1995), the basic function of financial system that is allocation of resources remains same through the time and space while attempting to ameliorate transaction and information costs. Levine (1997) breaks it into five functions of the financial system: a) facilitating risk amelioration, b) allocating resources, c) monitoring managers and exerting corporate control, d) mobilizing savings and e) facilitating the exchange of goods and services. As explained in Levine (1997) there are two channels through which each financial function may affect economic growth: capital accumulation and technological innovation.

"On capital accumulation, one class of growth models uses either capital externalities or capital goods produced using constant returns to scale but without the use of non-reproducible factors to generate steady-state per capita growth (Paul Romer 1986; Lucas 1988; Sergio Rebelo 1991). In these models, the functions performed by the financial system affect steady-state growth by influencing the rate of capital

formation. The financial system affects capital accumulation either by altering the savings rate or by reallocating savings among different capital producing technologies. On technological innovation, a second class of growth models focuses on the invention of new production processes and goods (Romer 1990; Gene Grossman and Elhanan Helpman 1991; and Philippe Aghion and Peter Howitt 1992). In these models, the functions performed by the financial system affect steady-state growth by altering the rate of technological innovation." Levine (1997) pp 691

2.1.2 Role of Economic Growth in Financial Development

The story is not finished yet at the point that financial markets help exchange, exchange allows specialization is production, specialization requires more transactions which involves high transaction costs which are reduced by economies of scales in the financial intermediaries' services, specialization spurs innovations, by mobilizing savings and making them available for production of innovative products using newly introduced techniques, and in this way production and productivity are enhanced and thus economic growth is attained. Let us see how this is an incomplete story.

The area how economic growth affects the financial development is relatively underdeveloped [Levine (2003b)]. However, there are a few strong arguments. Robinson (1952) argued that where enterprise leads finance follows. MacKinnon (1973) also asserts that causation is not necessarily unidirectional. Rapidly growing economies that have received their impetus to develop from other sources may generate an unusual growth in demand for other financial assets. There may also be feedback from the productivity gains to financial market development.

There are fixed costs associated with the formation of markets [Goldsmith (1969)]. When there are fixed costs associated with establishing (financial) markets then higher income per capita implies that these fixed costs are less burdensome as a share of per capita income. Thus, economic development can spur the development of financial markets.

There may be threshold effect of economic development on the development of financial sector. Growth in the size of the potential market will reduce the costs to each participant in the market. As an implication, a particular market may not become active until the economy has developed to the point where the market can sustain enough activity to make it cost effective. And thus threshold effects will be observed in market formation [Greenwood and Smith (1997)]. After income passes such threshold level and economy moves towards large scale production, financial needs of the firms rise substantially inducing demand for financial resources[9] and services[10] and hence accelerates financial sector of the economy.

2.1.3 Role of Financial Development in Economic Growth and that of Economic Growth in Financial Development

There are studies which have discussed the bi-directional causal relationship between financial development and economic growth. For example Greenwood and Jovanovic (1990) show that there is a positive two way causal relationship between financial development and economic growth. On the one hand, economic growth stimulates higher participation in the financial system, thereby facilitating the creation and expansion of financial sector. On the other hand, financial institutions and markets, by collecting and analyzing information improve efficiency of investment projects and hence stimulate economic growth. Past studies have used various examples to discuss the relationship between finance and growth. Schumpeter (1934) uses an example of the banker-industrial

[9] Rising financing needs of firms to undertake larger projects
[10] Like clearing and payments system

development relationship to highlight the role of financial sector in selection and use of innovative technologies and McKinnon (1973) highlighted the importance of the use of better agriculture technology. Levine (1997) criticizes Schumpeter (1934) and McKinnon (1973) for not amalgamating all the functions of financial system into their stories. He uses the example[11] of the truck designed by Fred that can be used to extract rocks from a quarry but in an efficient way than existing trucks to provide a synthesis for the functions of the financial sector and the role of financial development in economic growth. However, Levine (1997) does not discuss how finance follows the growth which is the thesis of Robinson (1952). We, here, will be looking into how economic growth accelerates financial development.

It is assumed that with the production of trucks from the plant of Fred there is growth in real per capita income of the society and with this some of the people are thinking to have their own home[12] and some construction work starts in the area which shows potential rise in the demand for trucks and Fred wants to built another plant of trucks for meeting the potential demand. It will create demand for finance from his side for financial sector. With the increase in per capita income cost of establishing new financial contracts with Fred is expected to be low as a proportion of per capita income and there is incentive for the development of financial sector which can fulfill the needs of growing company of Fred [13].

[11] Which can be read from Levine (1997)

[12] Which can itself create demand for housing finance from the potential house owners and results in the growth of financial sector

[13] Role of financial development in economic growth and that of economic growth in financial development have been modeled rigorously in various studies. These studies include Greenwood and Jovanovic (1990), Bencivegena and Smith (1991), Pagano (1993), Obstfled (1994), and Greenwood and Smith (1997).

2.1.4 Lucas View

Some economists do not believe that finance-growth relationship is important. Most of the development economists frequently express their skepticism about the relationship between financial development and economic growth by ignoring it. For example, a collection of essays by the pioneers of development economics, including three Nobel Laureates, does not mention finance [Meir and Seers (1984)]. Furthermore, Stern's (1989) review of development economics does not discuss the financial system, even in the section that lists omitted topics. According to Nobel Laureate Lucas economists overstress the role of finance in economic growth [Lucas (1988)]. The emergence of financial sector is the result of time and space inconsistency of supply and demand of loanable funds, costs of acquiring information, and making transactions in an uncertain environment. Put differently, in a Arrow (1964) and Debreu (1959) framework, with no information and transaction costs, there is no need for financial system [Gertler and Rose (1994)]. Lucas (1988) treats all exchanges as though it involves goods for goods in a closed competitive economy and thus believes that the importance of financial matters is very badly over stressed in popular and even professional discussion.

2.2 EVIDENCE ON FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

Empirical work on finance and growth has been done in various dimensions. A number of papers studied the issue in a cross-country framework; a lot of studies made purely time-series investigations; and some others used the panel data approach. A review of the empirical literature is given below.

2.2.1 Time Series Studies on Finance and Growth

A substantial time series literature examines the finance-growth relationship using a variety of time-series techniques. These studies use Granger-type causality tests and vector autoregressive (VAR) procedures to examine the nature of the finance- growth relationship (e.g., Arestis and Demetriades [1997]).

In some initial time-series studies Jung (1986) and Demetriades and Hussein (1996) use measures of financial development such as the ratio of money to GDP. They find the direction of causality frequently runs both ways, especially for developing economies. The positive impact of finance on growth is particularly strong when using measures of the value-added provided by the financial system[14] instead of simple measures of the size of the financial system, as documented by Neusser and Kugler (1998).

Rousseau and Wachtel (1998) conduct time-series analysis of relationship between financial development and growth for five countries over the past century using more comprehensive measures of financial development. They use measures of financial development that include the assets of both banks and non-banks. They document that the dominant direction of causality runs from financial development to economic growth.

In a broad study of 41 countries over the 1960-1993, Xu (2000) uses a VAR approach that improves upon early work by Jung (1986). The VAR approach permits the identification of the long-term cumulative effects of finance on growth by allowing for dynamic interactions among the explanatory variables. Xu (2000) rejects the hypothesis that finance simply follows growth. Rather, the analyses indicate that financial development is important for long-run growth.

[14] Like share of financial sector in GDP

Rousseau and Sylla (1999) examined the historical role of finance in U.S. economic growth. They use a set of multivariate time-series models that relate measures of banking and equity market activity to investment, imports, and business incorporations over the 1790-1850 period. Rousseau and Sylla (1999) find strong support for the theory of "finance led growth" in United States.

In a study of the Meiji period (1868-1884) in Japan, Rousseau (1999) uses a variety of VAR procedures and concludes that the financial sector was instrumental in promoting Japan's explosive growth prior to the First World War.

Bekaert, Harvey, Lundblad (2001, 2002) examine the effects of opening equity markets to foreign participation. One statistical innovation in their work is the use of over-lapping data. Many time-series studies use annual observations and even quarterly data to maximize the information included their analyses. Bekaert, Harvey, and Lundblad (2002), however, use data averaged over five-year periods to focus on growth rather than higher frequency relationships, but they use over-lapping data to avoid the loss of information inherent in using non-over-lapping data. Specifically, one observation includes data averaged from 1990-1995 and the next period includes data averaged from 1991-1996. They adjust the standard errors accordingly and conduct an array of sensitivity checks, though the procedure does not formally deal with simultaneity bias. Consistent with Levine and Zervos (1998), Bekaert, Harvey, and Lundblad (2001, 2002) show that financial liberalization boosts economic growth by improving the allocation of resources and the investment rate.

2.2.2 Cross-Country Studies on Finance and Growth

Goldsmith (1969) is a path breaking cross-country study on finance and growth. The study sought to assess whether finance exerts a causal influence on growth and whether the mixture of markets and intermediaries operating in an economy influences economic growth. Toward this end, Goldsmith compiled a dataset on 35 countries over the period 1860 to 1963 on the value of financial intermediary assets as a share of economic output under the assumption that the size of the financial intermediary sector is positively correlated with the provision and quality of financial functions provided by the financial sector to the rest of the economy. After showing that financial intermediary size relative to the size of the economy rises as countries develop, Goldsmith documented positive correlation between financial development and the level of economic activity. Although Goldsmith was unable to provide much cross-country evidence because of the absence of data on securities market development for a broad range of countries, he raised several problems that subsequent work tried to resolve; his study did not systematically control for other factors influencing economic growth, the indicator of financial development, i.e. size of financial intermediation, may not represent true proxy for the financial system, the close association between financial system size and growth does not necessarily identify the direction of causality, his study did not shed light on the whether the mix of financial markets and institutions operating in an economy exerts a first-order impact on economic growth.

In the early 1990s, King and Levine (1993) built on Goldsmith's work. They studied 77 countries over the period 1960-1989, systematically controlled for other factors affecting long-run growth, examined the capital accumulation and productivity growth channels, constructed additional measures of the level of financial development, and analyzed whether the level of financial development predicts long-run economic growth, capital accumulation, and productivity growth.

In terms of measures of financial development, they used different proxies including DEPTH (liquid liabilities of the financial system divided by GDP), BANK (the ratio of bank credit divided by bank credit plus central bank domestic assets), and PRIVY (credit to private enterprises divided by GDP). King and Levine (1993) then assessed the strength of the empirical relationship between each of these indicators of the level of financial development averaged over the 1960-1989 period and three growth indicators also averaged over the 1960-1989 period. The three growth indicators were (i) the average rate of real GDP (per capita) growth, (ii) the average rate of growth in the per person capital stock, and (iii) 'total productivity' growth, which is a Solow residual.

Formally, if $F(i)$ represents the value of the *ith* indicator of financial development averaged over the period 1960-1989, $G(j)$ represents the value of the *jth* growth indicator averaged over the period 1960-1989, and X represents a matrix of conditioning information to control for other factors associated with economic growth (e.g., income per capita, education, political stability, indicators of exchange rate, trade, fiscal, and monetary policy), then the model estimated by King and Levine (1993) on a cross-section of 77 countries was the following:

$$G(j) = \alpha + \beta F(i) + \gamma X + \upsilon$$

Their results show that there is a strong positive relationship between each of the financial development indicators, $F(i)$, and the three growth indicators $G(j)$, long-run real per capita growth rates, capital accumulation and productivity growth.

To examine whether finance simply follows growth, King and Levine (1993) studied whether the value of financial depth in 1960 predicts the rate of economic growth, capital accumulation, and productivity growth over the next 30 years. The results indicate that financial depth in 1960 is a good predictor of subsequent economic growth rates , accumulation of physical capital, and economic improvements in efficiency over the next thirty years even after controlling for education, income, and measures of trade, monetary , and fiscal policies. While King and Levine (1993) showed that financial development predicts economic growth, they do not formally deal with the issue of causality.

La Porta et al (2002) used an alternative indicator of financial development. They examined the degree of public ownership of banks around the world. The authors showed that higher degrees of public ownership were associated with lower levels of bank development and high levels of public ownership of banks were associated with slower economic growth.

While addressing many of the weaknesses in earlier work, cross-country growth regressions do not eliminate them. While researchers improve upon past measures of financial development, they only focus on one segment of the financial system, banks, and their indicators do not directly measure the degree to which comparative financial systems ameliorate information and transaction costs.

Levine and Zervos (1998) constructed various measures of stock market development to analyze the relationship between stock markets development and economic growth, capital accumulation, and productivity growth in a sample of 42 countries over the period 1976-1993. They control for many other potential growth determinants, including banking sector development. They used turnover ratio as liquidity indicators which equals the total value of shares traded on a country's stock exchanges divided by stock market capitalization[15]. Levine and Zervos (1998) found that the initial stock market liquidity and the initial (bank credit) are positively and significantly correlated with the future rates of real economic growth, capital accumulation, and growth in productivity over the next 18 years even after they controlled for initial income, inflation, schooling, government expenditures, the black market (foreign) exchange rate premium, and the political stability. While Levine and Zervos (1998) show that stock market liquidity and bank development predict economic growth, this study also does not formally deal with the issue of causality.

2.2.3 Panel Data Studies on Finance and Growth

Empirical studies on finance and growth nexus have also employed panel data techniques to solve a number of statistical problems with individual country time-series investigations and pure cross-country studies. This section discusses the studies which used panel data approach.

Levine, Loayza and Beck (2000) and Beck, Levine, and Loayza (2000) use a GMM estimator developed for panel data to analyze the finance and growth link. This approach improves upon pure cross-country work in three respects. The first benefit from moving

[15] The value of listed shares on the country's exchanges

to a panel dataset is the ability to exploit the time-series as well as cross-sectional variation in the data. Levine, Loayza and Beck (2000) construct a panel consisting f data for 77 countries for the period 1960-95. Moving from cross-section to a panel incorporates the variability of the time-series dimension. Second, panel estimators avoid systemic biases associated with cross-country regressions. Third, the existing cross country literature suffers from endogeniety bias and panel data approach permits the use of instrumental variables for all regressors and thereby provides more precise estimates of relationship of interest. Levine (1998, 1999) use instrumental variables in pure cross-country regressions. But, the legal origin instruments are only used to extract the exogenous component of financial development. The pure cross-sectional estimator does not control for the endogeneity of all the other explanatory variables. This can lead to inappropriate inferences on the coefficient on financial development. The panel estimator uses instruments based on previous realizations of the explanatory variables to consider the potential joint endogeneity of the other regressors as well. Using the panel dataset and a variety of econometric methodologies, Favara (2003) finds that exogenous component of financial development does not spur economic growth. Favara (2003) reveals that the relationship between financial development and economic growth is not linear and when dynamic specification and slope heterogeneity is taken into account the estimated coefficient of financial development on GDP growth is often negative.

Recently, Christopoulos and Tsionas (2003) use panel unit root test and panel cointegration analysis to examine the relationship between financial sector development and economic growth in ten developing countries. They note that many time-series studies yield unreliable results due to the short time spans of typical datasets. Thus, they use time-series tests to yield causality inferences within a panel context that increases sample size. In contrast to Demetriades and Hussein (1996), Christopoulos and Tsionas (2003) find strong evidence in favor of the hypothesis that long-run causality runs from financial development to growth and that there is no evidence of bi-directional causality. Furthermore, they find a unique cointegrating vector between growth and financial development, and emphasize the long-run nature of the relationship between finance and growth.

Levine (2003b) recognizes that many of the biggest advances in empirical studies of finance and growth have been methodological; however, each of the different econometric methodologies that have been used in such studies has serious shortcomings. Neither time series studies, nor the studies based on cross-sectional analysis, discussed above, have been successful in deciding the issue of causality between financial development and economic growth. Cross-sectional studies are based on analysis in the style of Barro and Sala-i-Martin (1991) which consists of regressing the average growth rates of per capita GDP over a period of time on income at the start of the period and a set of other explanatory variables. This growth regression methodology has been severely criticized. Quah (1993) has pointed out that it is seriously misleading with respect to the issue of convergence since it uses average of growth rates over long periods of time, implying that economies grows continuously and uniformly over time. Casselli et al. (1996) has criticized cross-sectional methodology on its failure to control effectively for cross country heterogeneity and possible endogeneity of the regressors.

Most of the panel data studies discussed above use panel GMM estimator to assess the finance and growth relationship. This approach improves somehow upon pure cross-country work in various respects[16]. However, Kiviet (1995) shows that panel data models that use instrumental variables estimation often lead to poor finite sample efficiency and bias as has been cited in Weinhold (1999). Another problem in the use of the panel data approach is that not much heterogeneity is allowed usually across countries. Heterogeneity in most of the studies is restricted to the intercept and is not permitted in the slope coefficients. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be homogeneous but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates.

Given that the relationship between financial development and economic growth may be complex and heterogeneous across countries, the most advanced and appropriate econometric methodology of panel causality analysis for heterogeneous panel data, given by Weinhold (1999) and Nair-Reichert and Weinhold (2001), is used in this dissertation.

[16] Moving to a panel (from cross-sectional analysis) incorporates the variability of the time-series dimension. The existing cross country literature suffers from endogeniety bias and panel data approach permits the use of instrumental variables for all regressors and thereby provides more precise estimates of the relationship of interest.

3 Model, Data, and Econometric Methodology

We start this chapter with discussion of the econometric model we use to investigate the causal relationship between financial development and economic growth. We reformulate the econometric model of the financial development and economic growth relationship by incorporating the effect of inflation on financial sector highlighted in the literature by Huybens and Smith (1999), De Gregorio and Sturzenegger (1994a, b), Boyd, Levine, and Smith (2001). In Section 3.2 details of the data are discussed. In the last Section of the chapter we explain the econometric methodology we use in this study.

3.1 MODEL

The growing body of empirical work (for example, King and Levine [1993]) models the relationship between financial development and economic growth according to the following linear regression equation:

$$GRGPC = \alpha + \beta F + \gamma X + \varepsilon \tag{3.1}$$

where $GRGPC$ is for growth in real GDP per capita, F is for financial development and X is the set of conditioning information to control for other factors associated with economic growth. ε is the error term.

For heterogeneous panel, model (3.1) above can be written as

$$GRGPC_{it} = \alpha_i + \beta_i' F_{it} + \gamma_i X_{it} + \varepsilon_{it} \tag{3.2}$$

where $i = 1,2,...,N$, and $t = 1,2,...,T_i$.

N refers to the number of countries, and T_i refers to the number of observations over time for i^{th} country in the panel. ε_{it} are assumed to be idiosyncratic errors. The parameter α_i is the country specific intercept or fixed effect parameter [17]. Slope coefficients are also allowed to vary across nations to take into account the possible heterogeneity[18] among the various countries in a panel.

In the model (3.2), *GRGPC* is the (annual percentage) growth rate of GDP per capita based on constant local currency. F is for financial sector development. Following King and Levine [1993]; Levine and Zervos [1998]; and Beck, Demirguc-Kunt, and Levine [2001] we use various indicators of size and activity of the indirect as well as direct finance as a proxy for financial sector development. We also combine the size and activity measures of direct and indirect finance to proxy the overall financial sector development. As a whole, we have six measures of financial sector development which will be used one by one in this study. These measures are given below[19]:

(i) The size of indirect finance

(ii) The size of direct finance

[17] Country specific fixed effects heterogeneity may be because of differences in technology.
[18] Even though we have grouped countries according to their level of income into four panels (LIC, LMIC, UMIC, and HIC), there may still be heterogeneity between the countries in each panel. There are different sources of such heterogeneity like differences in population size, differences in political and economic institutions (Acemoglu, Johnson, and Robinson [2004] believe that economic institutions determine the incentives for and constraints on economic actors and shape economic outcomes, and that the difference in economic institutions across countries is the outcome of differing systems of property rights and political institutions), differences in geography (there are at least two things related to geography: first, climate may be an important determinant of work effort, incentives and even productivity; second, geography may determine the technology available to society, especially in agriculture), and differences in culture (different societies have different culture because of different shared experiences and different religion; and culture is viewed as key determinant of values, preferences, and beliefs of individuals, and societies and these differences play fundamental role in shaping the economic performance). Thus we take slope coefficients to be heterogeneous in the causality analysis we do.
[19] Details are given in Section 3.2

(iii) The size of overall financial sector

(iv) The activity of indirect finance

(v) The activity of direct finance

(vi) The activity of overall financial sector

In the model (3.2) X is a set of conditioning information to account for other factors associated with economic growth. These factors include two types of variables: state as well as control variables.

State variables are the initial stock of physical capital and the initial stock of human capital. The available data on physical capital seem unreliable (Barro and Sala-i-Martin [2004]). Following (Barro and Sala-i-Martin [2004]) we assume that for given stock of human capital, higher level of initial income reflects a greater stock of physical capital or larger quantity of natural resources. For the initial level of income we use real GDP per capita with 1 year lag[20]. Because of diminishing returns to reproducible factors, a richer economy tends to grow at slower rate[21]. Therefore, the influence of the higher initial level of income on the growth rate of real GDP per capita in equation (3.2) would be negative.

[20] Based on past work researcher use following relationship for modeling growth rates $g_{i,t,t+T} = \beta_0 \text{-} \beta \ln y_{it} + \beta y_i^* + \varepsilon_{it}$, where $g_{i,t,t+T}$ is growth rate of per capita GDP for country i between time t and T, y_{it} is per capita GDP for country i at time t, and y_i^* is the steady state value of per capita GDP for country i [Sala-i-Martin (2002]. Other examples can also be found in the convergence literature. Following such literature we have used lagged per capita GDP for country i to proxy the initial level of income since we are using annual data as against T period averages generally used by Barro, R. J. and X. Sala-i-Martin type regressions

[21] From the idea of conditional convergence economic growth depend upon the initial stock of physical capital given the stock of human capital. Conditional (beta) convergence applies if the growth rate of real per capita GDP is negatively related to the starting level of real per capita GDP, after holding fixed some other variables such as initial levels of human capital, measures of government policies, etc.

There are some very interesting and path breaking model which shed light on the role of human capital in economic growth. One of the most prominent and influential contribution is that of Lucas (1988), which in turn is related to the previous work by Uzawa (1965). In the long run, sustained growth is linked with human capital. Human capital is a broader concept. We use educational attainment as a stock of human capital. The variable we use to proxy the educational attainment is the secondary school enrollment ratio. It may be argued that secondary school enrollment ratio may not be a good proxy for education in case of Low Income Countries where a small number of children go beyond primary education. But primary school enrollment ratio may be less relevant for other groups of countries in this study. This dissertation uses secondary school enrollment ratio as a proxy for education for uniformity across the four panels. We use secondary school enrollment ratio with 5 year lag because people in secondary school at time t will generally be entering the labour force in some latter time and will not be productive for 5 years or so. The influence of the higher secondary school enrollment ratio on the growth of real GDP per capita in equation (3.2) would be positive because educational attainment affects productivity positively.

Previous empirical studies (For example Barro [1997], Barro and Sala-i-Martin [2004]) have shown that GRGPC is negatively related to initial level of GDP and is positively related to the initial level of human capital. So we also expect, in our study, the sign of the coefficient of initial level real per capita GDP to be negative and the sign of the coefficient of the initial level of secondary school enrollment ratio to be positive while we regress GRGPC upon these two variables in addition to the control variables.

Following the recent literature on the analysis of financial development and economic growth, the control variables we use are: inflation rate (denoted by INFL) as measure of macroeconomic instability, government consumption to GDP ratio (denoted by GCGR) as fiscal policy variable, and international trade openness (denoted by TRGR) as international trade policy variable.

Temple (2000) asserts that inflation increases uncertainty. It will tend to introduce unwelcome noise into the workings of the markets, for instance raising relative price variability. Planning will become more difficult. Heyman and Leijonhufvus (1995) argue that high inflation rates will increase the complexity of contracts, raise the frequency of negotiations, and perhaps lead to certain contracts being avoided altogether. Planning horizons shorten, and firms avoid long run commitments. In this way, inflation tends to have negative effects on growth.

The issue of the effect of government consumption is complicated somehow. Government consumption is a component of the aggregate demand, and if there is a slack in production and prices and/or wages are sticky downward, it will have a positive effect on GDP according to Keynesian hypothesis. Moreover, public sector may raise the productivity of the private sector by providing defense, legal, judiciary and police services, enforcing property rights, and correcting for failures in markets etc. On the other hand, government interventions can generate disincentive effects caused by revenue raising activities and transfer activities. Taxes to meet the expenditures can results in serious resources misallocation. Additionally, potential inefficiencies caused by the rent-seeking behaviour and principal-agent problems in the provision of government output sometimes result in substantial negative impact on productivity. This can mitigate or even offset the potential positive effects of government consumption on economic growth and we have a negative sign of the impact of government consumption to GDP ratio on growth rate of real GDP per capita.

Overall trade to GDP ratio is a measure of openness of country to international trade. It is argued in the literature that greater the openness greater the competition or exposure to a larger set of ideas or technologies which increases the technological progress and hence permanently rises growth rates [Winters, (2004)].

Now, we can write (3.2) as:

$$\begin{aligned} GRGPC_{it} = \alpha_i + \beta_{1i}' F_{it} + \beta_{2i} INFL_{it} + \beta_{3i} GCGR_{it} + \beta_{4i} TRGR_{it} + \beta_{5i} SSER_{it-5} + \\ \beta_{6i} RGPC_{it-1} + \varepsilon_{it} \end{aligned} \quad (3.3)$$

Chari, Jones and Manuelli (1996) argue that financial regulations and their interaction with inflation have substantial effects on growth. There are some other studies which discuss how inflation is linked with the financial sector. Choi, Smith, and Boyd (1996) argue that inflation reduces real return to savings and makes more severe the adverse selection problems in capital markets inducing a high degree of credit rationing and have negative impact on financial development. In a monetary growth model Huybens and Smith (1999) show that, at the steady state, higher rates of money growth reduces the real return on all assets and, under certain conditions, lead to a reduction in the trading volumes in equity markets. Boyd, Levine and Smith (2001) consider alternative theory regarding the relationship between inflation and financial sector performance and that is a fiscal story. Governments combine high inflation with various restrictions on the financial sector to help fund expenditures. As a result, they have both poorly developed financial systems and high inflation.

This dissertation suggests that financial sector development effect, β'_{1i} in model (3.3), is a function the rate of inflation. We allow such an effect by writing β'_{1i} as $\beta'_{1i} = \beta_{1i} + \beta_{7i} INFL_{it}$. By substituting it back into (3.3) we get.

$$\begin{aligned} GRGPC_{it} = \alpha_i + \beta_{1i} F_{it} + \beta_{2i} INFL_{it} + \beta_{3i} GCGR_{it} + \beta_{4i} TRGR_{it} + \beta_{5i} SSER_{it-5} + \\ \beta_{6i} RGPC_{it-1} + \beta_{7i} (F * INFL)_{it} + \varepsilon_{it} \end{aligned} \quad (3.4)$$

In this way we arrive at our **final model** which includes the proxy for financial development and inflation both individually as well as in product form.

To provide a sense of whether there is a casual relationship between economic growth and the financial development we turn to the dynamic panel form of (3.4) in which GRGPC is modeled as a function only of lags of itself and of all other right hand side variables in (3.4). That is:

$$\begin{aligned} GRGPC_{it} = \alpha_i + \gamma_i GRGPC_{it-1} + \beta_{1i} F_{it-1} + \beta_{2i} INFL_{it-1} + \beta_{3i} GCGR_{it-1} + \\ \beta_{4i} TRGR_{it-1} + \beta_{5i} SSER_{it-6} + \beta_{6i} RGPC_{it-2} + \beta_{7i} (F * INFL)_{it-1} + \varepsilon_{it} \end{aligned} \quad (3.4a)$$

By including the lagged dependent variable we can not only take into account the dynamic process, but it also provides an excellent proxy for many of the omitted variables. We will use a lag length of one due to the large number of explanatory variables and relatively short time series for each country.

To take care of the linear influences of the remaining right-hand side variables in (3.4a) on the candidate causal variable, we orthogonalize the candidate causal variable and thus our **final model in dynamic form** becomes[22]:

[22] The significance of the coefficient of the lagged causal candidate variable represents the short run causal relationship between the financial development and real per capital GDP growth. This is where we are interested in our empirical analysis

$$GRGPC_{it} = \alpha_i + \gamma_i GRGPC_{it-1} + \beta_{1i} F^o_{it-1} + \beta_{2i} INFL_{it-1} + \beta_{3i} GCGR_{it-1} + \beta_{4i} TRGR_{it-1} + \beta_{5i} SSER_{it-6} + \beta_{6i} RGPC_{it-2} + \beta_{7i}(F * INFL)_{it-1} + \varepsilon_{it} \quad (3.4b)$$

On the basis of the evidence documented in Lee, Pesaran and Smith (1997) and in Canning and Pedroni (1999), we expect our dependent variable (GRGPC) to be stationary. Rather than assuming all the variables in the model to be stationary we will test them for stationarity and deal accordingly in our econometric work.

3.2 DATA

Table 3.1 provides complete list of variables with data sources.

Table 3.1: Data Description and Sources

Variable	Data Description and Source
CPIa	Annual Consumer Price Index from IFS (Line 64)
CPIe	End-of-year CPI from IFS (Line 64M, or 64Q where 64M is not available for some country)
GDP	Gross Domestic Product from IFS (Line 99B)
LLB	Liquid Liabilities from IFS (Line 55L or 35L, if 55L is not available for some country)
MCP	Market Capitalization from Global Financial Data Base
PCR	Claims of Private Sector from IFS [Lines 22D.MZF, 22D.TZF, 22D.ZF (or 22D.ZW in case of a country participating in Euro, after its such participation), 42D.FZF, 42D.GZF, 42D.LZF, 42D.NZF, and 42D.SZF are included]
POP	Population (Line 99Z)
VTD	Value Traded from Global Financial Data Base
GCE	Government Consumption Expenditures from IFS (Line 91F)
TRD	Sum of Exports and Import (Line 90C+98C from IFS) of Goods and Services
GRGPC	Annual percentage growth rate of GDP per capita based on constant local currency from WDI-2004. (Dependent Variable)
LLGR	Liquid Liabilities to GDP ratio
PCGR	Private sector credit to GDP ratio
MCGR	Stock market capitalization to GDP ratio
VTGR	Stock market total value traded to GDP ratio
FDGR	(Overall) financial depth to GDP ratio
FAGR	(Overall) financial activity to GDP ratio
INFL	Inflation Rate Calculated from CPIa
GCGR	Government Consumption Expenditures to GDP ratio
TRGR	International Trade (sum of Exports and Import of Goods and Services) to GDP ratio
SSER	Gross Secondary School Enrollment Ratio from UNESCO
RGPC	GDP per capita based on purchasing power parity from WDI-2004

For economic growth we use the (annual[23] percentage) growth rate of GDP per capita based on constant local currency. We denote it by GRGPC. For initial level of income we use lagged (with one year) GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars[24] using purchasing power parity rates. Data for GRGPC and for RGPC is from WDI 2004. SSER is the gross enrollment ratio, secondary level, which is the ratio of total enrollment regardless of age to the population of the age group that officially corresponds to the secondary level of education. For SSER we use data from UNESCO database. This data were made available by World Bank Education Advisory Service. It is useful to note that its annual data are available only after 1990. The same data for the period earlier than 1990 is available with five year intervals. This 5-year interval data evolves very slowly in a very predictable manner. It encourages using interpolated data to get annual data for the time period before 1990.

We measure inflation rate by log difference of (annual) CPI. GCGR is the ratio of government consumption to GDP. TRGR is the ratio of sum of export and imports to GDP. All these data are from International Monetary Fund IFS CD ROM for June 2003. We use six proxies of financial sector development. Three of these relate to the size of

[23] The use of annual observations in panel data analysis may limit the ability both to detect robust relationship between finance and growth and to interpret the results in a way that has strong policy conclusions. However, in the light of financial sector reforms by a large number of countries after the heroic work by McKinnon (1973) and Shaw (1973), and subsequent rapid growth in financial sector size as well as activity, we may expect role of financial sector development in economic growth or the other way round or both even using annual observations in panel data analysis (Arestis and Demetriades, 1997, pp. 785)

[24] An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. Data are in current international dollars. (WDI-2004 definition)

financial sector and the remaining three relate to the activity of the financial sector. We discuss below all the six proxies in detail.

3.2.1 The Size Measures

(i) The size of indirect finance

The first measure is that of size of the sector providing indirect finance. There are three different groups relating to the indirect financial sector. These are monetary authority, deposit money banks (DMBs) and other financial institutions. The first group includes central bank and other institution that performs function of the monetary authority. The deposit money banks consist of all financial institutions that have liabilities in the form of deposits transferable by cheques or otherwise usable in making payments. The other financial institutions, which include other bank-like institutions and nonbank financial institutions, serve as financial intermediaries while not incurring liabilities useable as means of payments. Other bank-like institutions include institutions that accept deposits, but do not provide transferable deposit facilities; intermediaries that finance themselves mainly through issuance of negotiable bonds; and development banks. Nonbank financial institutions include insurance companies, provident and pension funds, trust and custody accounts, real investment schemes, other pooled investment schemes and compulsory saving schemes. To measure size of the financial intermediaries we use currency plus demand and interest bearing liabilities of DMBs and other financial intermediaries divided by GDP which is generally know as liquid liabilities to GDP ratio. We denote it by LLGR. This is the broadest available indicator of financial intermediation, since it includes all three groups: monetary authority, deposit money banks and other financial institutions.

(ii) The size of direct finance

As an indicator of the size of direct finance we use the stock market capitalization to GDP ratio, denoted by MCGR, which equals the market value of listed shares divided by GDP.

(iii) The size of overall financial sector

To have an overall size measure of the financial sector we combine the two size measures and call it as financial depth to GDP ratio, denoted by FDGR, which is sum of the LLGR and MCGR.

3.2.2 The Activity Measures

In addition to the proxies for size of the financial sector we also consider some measures of the activity of the financial sector. These are discussed below.

(i) The activity of indirect finance

To measure the activity of indirect finance we consider private sector credit by DMBs and other financial institutions to GDP ratio. We denote it by PCGR. If for some countries data on private sector credit by 'other financial institutions' is not available, we use only the data on private sector credit by DMBs.

The assumption underlying this measure is that financial systems that allocate more credit to the private firms are engaged in researching firms, exerting corporate control, providing risk management services, mobilizing savings and facilitating transaction than financial systems that simply funnel credit to the government or state owned enterprises.

(ii) The activity of direct finance

As an indicator of the activity of direct finance we use total value of the shares traded in the stock market to GDP ratio, dented by VTGR.

(iii) The activity of overall financial sector

To have an overall activity measure of the financial sector we combine the two activity measures and call it as financial activity to GDP ratio, denoted by FAGR, which is sum of the PCGR and VTGR.

Data on the liquid liabilities and on the private sector credit are from International Monetary Fund IFS CD ROM for June 2003. Data on the stock market capitalization and on value of shares traded in the stock market are from Global Financial Data database.

Among the measures described above there are two types of measures: first, ratios of a stock variable to a flow variable (particularly GDP) such as LLGR, MCGR, and FDGR; and second, ratios of two flow variables, such as PCGR, VTGR, and FAGR. Whereas stock variables are measured at the end of a period, the flow variables are defined relative to a period. This presents a problem in the first type of measures, both in terms of correcting timing and in terms of deflating correctly. To address these problems, we deflate the end-of-year financial aggregates by end-of-year consumer price indices (CPI_e) and deflate the GDP series by annual consumer price index (CPI_a) following Demirguc-Kunt and Levine (2001). Then we compute average of the real financial aggregate in year t, and $t-1$ and divide this average by real GDP measured in year t. The end-of-year CPI is either the value for December, or, where December-CPI is not available, for the last quarter. The formula, say for LLGR, is the following:

$$LLGR = 0.5 * \left(\frac{LLB_t}{CPI_{e,t}} + \frac{LLB_{t-1}}{CPI_{e,t-1}} \right) \Big/ \left[\frac{GDP_t}{CPI_{a,t}} \right] \quad (3.5)$$

In case of ratios of two flow variables measured in same time deflating is not necessary.

We use a dataset of 41 countries divided into four panels of Low, Lower Middle, Upper Middle, and High Income Countries listed in the Tables 3.2 (i) to Table 3.2(iv). The countries have been selected from the overall list of countries for which World Bank publishes income classification in its World Development Indicators. We have unbalance panel data with time span ranging from 1973 to 2002.

Table 3.2 (i): List of Low Income Countries

Group Sr. No.	Country	Time Span and Number of Observations		
1	Bangladesh	1987	2001	15
2	Cote d'Ivoire	1981	2001	21
3	India	1977	2001	25
4	Indonesia	1977	2000	24
5	Kenya	1976	2001	26
6	Korea, South	1974	2002	29
7	Nigeria	1978	2001	24
8	Pakistan	1984	2001	18
9	Zimbabwe	1981	1999	19
Total Observations LIC				**201**

Table 3.2 (ii): List of Lower Middle Income Countries

Group Sr. No.	Country	Time Span and Number of Observations		
1	Jamaica	1981	2001	21
2	Jordan	1979	2000	22
3	Philippines	1976	2001	26
4	Sri Lanka	1986	2001	16
5	Thailand	1977	2001	25
6	Tunisia	1985	2001	17
Total Observations in LMIC				**127**

Table 3.2 (iii): List of Upper Middle Income Countries

Group Sr. No.	Country	Time Span and Number of Observations		
1	Chile	1980	2001	22
2	Malaysia	1978	2001	24
3	Mexico	1978	2001	24
4	Saudi Arabia	1986	2001	16
5	South Africa	1985	2001	17
6	Trinidad & Tobago	1982	1998	17
7	Venezuela	1978	2001	24
Total Observations in UMIC				**144**

Table 3.2 (iv): List of High Income Countries

Group Sr. No.	Country	Time Span and Number of Observations		
1	Australia	1979	2001	23
2	Austria	1974	2001	28
3	Belgium	1974	2001	28
4	Canada	1976	2000	25
5	Denmark	1980	2001	22
6	Finland	1976	2001	26
7	France	1974	2000	27
8	Greece	1974	2001	28
9	Italy	1976	2001	26
10	Japan	1974	2001	28
11	Luxembourg	1978	2001	24
12	Netherlands	1976	2000	25
13	Norway	1976	2001	26
14	Portugal	1978	2001	24
15	Singapore	1981	2001	21
16	Sweden	1974	1999	26
17	Switzerland	1976	2001	26
18	United Kingdom	1974	2001	28
19	United States	1978	2001	24
Total Observations in HIC				**485**

The country classification is based on World Bank estimates of GNI per capita during 2000[25]. Countries for which estimates of GNI per capita are US$ 755 or less are classified as Low Income Countries, those for which estimates of GNI per capita are in the range US$ 756 – 2,995 are classified as Lower Middle Income Countries, those for which estimates of GNI per capita are in the range US$ 2996 – 9,265 are classified as Upper Middle Income Countries, and those for which estimates of GNI per capita are US$ 9,265 or more are classified as High Income Countries.

The countries included are selected on two criteria: there is data both on indirect as well direct finance; and that data are available for at least 15 observations for both type of finance[26]. Keeping these two things we have 41 countries in our dataset. We divided the countries into four panels of 9, 6, 7, and 19 Low, Lower Middle, Upper Middle, and High Income Countries respectively. The time dimension of the dataset is that we use annual data starting from 1973 which is the year in which heroic pieces of work by MacKinnon and Shaw were published. The latest year for which we have data are 2002. The panels under study are unbalanced panels particularly due the fact that data for stock markets are available for different time spans. The time dimension varies between 15 and 29 for different countries.

3.3 ECONOMETRIC METHODOLOGY

Neither time series studies, nor the studies based on cross-sectional analysis have been successful in deciding the issue of causality between financial development and economic growth. Cross-sectional studies are based on analysis in the style of Barro and

[25] The World Development Indicators for year 2002 has been used.
[26] The selection criteria may result in some sample selection bias, however. But this is inevitable as any other criterion will suffer from the same issue.

Sala-i-Martin (1991) which consists of regressing the average growth rates of per capita GDP over a period of time on income at the start of the period and a set of other explanatory variables. This growth regression methodology has been severely criticized. Quah (1993) has pointed out that it is seriously misleading with respect to the issue of convergence since it uses average of growth rates over long periods of time, implying that economies grow continuously and uniformly over time. Moreover, cross-sectional methodology has been criticized on its failure to control effectively for cross country heterogeneity and possible endogeneity of the regressors.

Cross-section studies that use period average whereby time-series characterizing each variables is collapsed into single observation is also criticized because of possibly nonstationary nature of these data. Van den Berg and Schmidt (1994) and van den Berg (1997) argue that nonstationarity of many time series makes the use of such period averages inappropriate. Variables are often nonstationary containing stochastic or deterministic trends. Such variables either have a mean that is changing through time or have expanding variance. Regression estimates from cross section data created from averages of such time series are not well suited for characterizing prospective long run relationship among variables.

Levine, Loayza and Beck (2000) and Beck, Levine, and Loayza (2000) use a panel GMM estimator to assess the finance and growth relationship. This approach improves upon pure cross-country work in various respects as it directly controls for the potential bias induced by the omission of country specific effects and endogeneity of all regressors. However, Kiviet (1995) shows that panel data models that use instrumental variables estimation often lead to poor finite sample efficiency and bias as has been cited in

Weinhold (1999). Another potential limitation of the panel data approach is that not much heterogeneity is allowed across countries. Heterogeneity is restricted to the intercept but is not permitted in the slope coefficients. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be constant but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates.

In recent empirical research there has been increasing interest in the development of methods for nonstationary panels, including tests for panel unit root and panel cointegration. In particular, there exist some interesting contributions on the heterogeneous panels. Baltagi (2001) considers some of the major advantages of using the panel data such as how they allow for heterogeneity of cross sectional units which is absent when using aggregated time series data. One of the benefits of panel datasets is that they also give more variability, which often lead to less collinearity among variables, while cross sections of time series provide more degrees of freedom and more efficiency (more reliable results) when estimating models. In the context of nonstationary data there is another advantage that can be derived from the panel data. That is, by adding the cross sectional dimension to the time series dimension means that the nonstationarity from the time series can be dealt with and combined with the increased data and power that the cross section brings.

The main objective of the study is to investigate the causal relationship between financial development and economic growth. We start with panel unit root analysis. General procedure is to move from panel unit root analysis to panel cointegration analysis. However, on the basis of the evidence documented in Lee, Pesaran and Smith (1997) and in Canning and Pedroni (1999) we expect the dependent variable in our model, growth in real GDP per capita, to be stationary and hence we do not expect to be in need of the application of panel cointegration analysis[27]. We do expect, however, panel unit root in some of our regressors in the regression equation. In case, we find any variable to be nonstationary at levels and stationary after first difference, we will be using it after first difference in our panel causality analysis.

Before going to panel causality analysis we will estimate the contemporaneous non-dynamic model with the help of (heteroscedasticity consistent) fixed effects estimation. We then examine the direction of causality, if there is any, between financial development and economic growth using most advanced and appropriate econometric methodology of panel causality analysis for dynamic heterogeneous panel data models given by Weinhold (1999) and Nair-Reichert and Weinhold (2001)[28]. This methodology is based upon mixed fixed random (MFR) coefficients approach of Hsiao et al (1989).

Now we discuss panel unit roots, estimation of contemporaneous non-dynamic fixed effects model and panel causality analysis in some details.

3.3.1 Panel Unit Root Tests

In the beginning, theoretical work on the non-stationary panels focused on testing for unit roots in univariate panels. Such studies include Quah (1994), which studied the standard unit root null in panels with homogeneous dynamics, and Levin and Lin (1993) which studied unit root tests in panels with heterogeneous dynamics, fixed effects, and

[27] In Lee, Pesaran and Smith (1997) and in Canning and Pedroni (1999) the real GDP per capita is integrated of order one and that its log difference, which is growth in the real GDP per capita, is stationary.
[28] We not only used the methodology of Nair-Reichert and Weinhold (2001), but also followed mostly the steps this paper has used from contemporaneous fixed effects estimation to causality analysis.

individual-specific deterministic trends. These studies assume common autoregressive root under both the unit root null and the stationary alternative hypotheses. More recently, Im, Pesaran and Shin (1997) and Maddala and Wu (1999) suggest several tests for panel unit root which permit heterogeneity of the autoregressive root under the alternative hypothesis. Application of panel unit root tests can be found in Wei and Parsely (1995), Wu (1996), Bernard and Jones (1996), MacDonald (1996), Frankel and Rose (1996), Evans and Karras (1996), Coakley and Fuertes (1997), Papell (1997), Lee, Pesaran and Smith (1997), and O'Connell (1998).

In this section panel unit root tests suggested by Levin and Lin (1992, 1993) – hereafter LL - and Im, Pesaran and Shin (1997, 2002)-hereafter IPS - are considered. For detailed survey of various panel unit root tests one may resort to Baltagi (2001) and to Hariss and Sollis (2003). LL is considered as a seminal work in panel unit root testing being applied these days. The structure of the LL consists of testing for null hypothesis $H_0 : \rho_i = 0$ for all i against the alternative $H_A : \rho_i = \rho < 0$ for all i in the following equation:

$$\Delta y_{it} = \alpha_i + \delta_i t + \rho_i y_{it-1} + \varepsilon_{it}, i = 1,2,....., N \;\&\; t = 1,2,....T_i \tag{3.6}$$

which allows for fixed effects as well as unit specific time trend. The unit specific fixed effects are an important source of heterogeneity here since the coefficient of the lagged dependent variable (ρ_i) is restricted to be homogeneous across all units of the panel. In LL test, the null hypothesis is $H_0 : \rho = 0$ against the alternative $H_1 : \rho < 0$ which is that the series is stationary in all cross sections. IPS (1997, 2002) extends LL (1992, 1993) to allow for heterogeneity in the value of ρ_i under the alternative hypothesis. We use IPS test for panel unit roots in this study.

IPS proposes unit root tests for dynamic heterogeneous panels based on the average (across groups) of the (augmented) Dickey-Fuller statistics. First we consider the calculation of individual country unit root (augmented) Dickey-Fuller test-statistics denoted by $\tilde{t}_{iT_i}$. The process starts by estimating the following (augmented) Dickey-Fuller regression

$$\Delta y_{it} = \alpha_i + \delta_i t + \rho_i y_{it-1} + \sum_{j=1}^{p_i} \Delta y_{it-j} + \varepsilon_{it} \quad (3.7)$$

for each of the cross sectional unit in the panel and estimating the value of the t-statistics for ρ_i and then averaging them. The decision of the number lags of the dependent variables to be included depends on stationarity of the error term and here we will be using step down procedure by starting at maximum lag of four.

The null hypothesis for the IPS panel unit root test is

$$H_0 : \rho_i = 0 \text{ for all } i \quad (3.8)$$

against the alternatives

$$H_1 : \rho_i < 0 \text{, for } i = 1,2,...,N_1 \text{, and } \rho_i = 0 \text{, for } i = N_1 + 1, N_1 + 2,..., N \quad (3.9)$$

This formulation of alternative hypothesis allows for ρ_i differing across groups, and is more general than the homogeneous alternative hypothesis of LL. It allows for some (but not all) of the individual series to have unit roots under the alternative hypothesis.[29] Essentially, the IPS test averages the ADF individual unit root test statistics that are

[29] For the consistency of the panel unit root tests IPS (2002) assumes that $0 < \omega \leq 1$, where $\lim_{N \to \infty} (N_1/N) = \omega$, that is under the alternative hypothesis the fraction of the individual processes that are stationary is not zero.

obtained from estimating (3.7) for each i (allowing each series to have different lag length, p_i if necessary), that is:

$$\tilde{t}-bar_{NT}=\frac{1}{N}\sum_{i=1}^{N}\tilde{t}_{iT_i} \tag{3.10}$$

which is referred to as $\tilde{t}-bar$ statistic.

IPS shows that under the assumption that $\varepsilon_{it}, i=1,2,...,N, t=1,2,...,T_i$ in (3.7) are independently and identically distributed for all i and t with mean zero and finite heterogeneous variances σ_i^2, $\tilde{t}_{iT_i}$ are independently (but not identically) distributed for $T_i > 9$ and that the standardized $\tilde{t}-bar$ statistic

$$Z_{tbar}=\frac{\sqrt{N}\left\{\tilde{t}-bar_{NT}-N^{-1}\sum_{i=1}^{N}E(\tilde{t}_{T_i})\right\}}{\sqrt{N^{-1}\sum_{i=1}^{N}VAR(\tilde{t}_{T_i})}}, \tag{3.11}$$

converges to standard normal variate[30] as N increases indefinitely.

Maddala and Wu (1999) found that IPS test is more powerful than LL test and that is the reason we use IPS test in this dissertation[31]. The power of the LL and IPS tests have also been analyzed and compared in Karlsson and Lothgren (2000). An essential difference between the tests is that under the alternative hypothesis the IPS test needs only some of the series to be stationary, not all, while the LL test require all to be stationary. The extent to which some of the i cross sectional units truly are stationary and some not, impacts on the size and power of these tests when considering null and alternative hypotheses. Their

[30] IPS standardized their test statistics based on simulations of the mean and variance (with different values obtained depending on the lag length used in the ADF tests and the value of N). These simulated values are given in IPS (2002).

[31] For calculating the IPS test statistic we use RATS code developed by Peter L. Pedroni which is available on the site of RATS: www.estima.com

main findings were that the power increase monotonically with: (1) an increased cross sectional dimension in the panel; (2) an increased time series dimension in each individual series; (3) an increased proportion of stationary series in the panel. They also note that for the large time series dimensional panel there is a potential risk that the whole panel may erroneously be modeled as stationary due to the high power of the panel tests for small proportions of stationary series in the panel. For small time dimensional panels, on the other hand, there is a potential risk that the whole panel may erroneously be modeled as nonstationary due to the low power of the panel tests even for large proportions of stationary series in the panel. Fortunately, we have a moderate size sample at our hand from the point of view of this discussion.

While testing for panel unit roots at level we take both unobserved effects and heterogeneous time trend in our equation as in equation (3.7). If in no case we can reject the null hypothesis that every country has a unit root for the series in levels, we then test for a unit root in first differences. There is no need to keep time in the equation while testing for unit root in difference of a series since time trend, if any was there, would have been removed while differencing (Canning and Pedroni [1999]). If we find stationarity in first differences the variable can be regarded as I (1), meaning that it becomes stationary only after differencing.

If we find that the main variables of interest that is the proxy for economic growth and that for financial development are of same order of integration and that none of the control variables is of higher order than that of the dependent variable then we move towards testing for possible cointegration between financial development and economic growth. Otherwise we say the order of integration of series of interest does not support to move to cointegration analysis. In the absence of possibility of cointegration we can first difference of I(1) variables and work with these transformed and other I(0) variables[32]. Since, on the basis of the evidence documented in Lee, Pesaran and Smith (1997) and in Canning and Pedroni (1999), we expect our dependent variable (growth in real GDP per capita) to be stationary and hence we do not expect to be in need of the application of panel cointegration analysis, we do not discuss panel cointegration here in the dissertation.

3.3.2 Contemporaneous Fixed Effects Panel Estimation

Assuming the slope coefficients to be homogeneous we estimate the static model in (3.4) using (heteroscedasticity consistent) fixed effects methodology, which is also know as within transformation estimation. In within transformation the country specific fixed effects are wiped out and each variable is replaced by its deviation form cross-sectional means. To this transformed data OLS method is applied. However, for calculating the estimated t-values robust variance estimator proposed in Arellano (1987) is used to address the issue of possible heteroscedasticity.

3.3.3 Panel Causality

Given that the relationship between financial development and economic growth may be complex and heterogeneous across countries, we cannot ignore the potential for serious errors, highlighted in Nair-Reichert and Weinhold (2001), in the analysis of the relationship if unrealistic homogeneity assumptions are imposed in the dynamic panel econometric modeling. Thus we use Weinhold (1999) and Nair-Reichert and Weinhold

[32] However, in the presence of cointegration the first differences do not capture the long run relationships in the data and the cointegration relationship must be taken into account.

(2001) method of heterogeneous dynamic panel causality analysis[33]. The theoretical framework used by Nair-Reichert and Weinhold (2001), to test causality in panel data, is directly derived from the VAR representation proposed by Holtz-Eakin and al. (1988). Holtz-Eakin and al. (1988) equates the question on whether or not the variable x causes variable y with a test of joint hypothesis of nullity of fixed parameters $\delta_j = 0, \forall j = 1...m$ in the model of type given in 3.12 below.

$$y_{it} = \alpha_0 + \sum_{j=1}^{m} \alpha_j y_{it-j} + \sum_{j=1}^{m} \delta_j x_{it-j} + f_i + u_{it} \qquad (3.12)$$

where $i = 1,..., N$ and f_i is fixed effects.

Such a hypothesis is very restrictive[34] as it implies causality does not exists for any individual. Thus Holtz-Eakin and al. (1988) test for non causality in panel data model assumes homogeneity hypothesis made on the data generating process. Nair-Reichert and Weinhold (2001) treats some parameters in the model 3.12 as random, precisely, in order to account for account for the component of their individual heterogeneity, which is not totally caught by the individual fixed effects f_i.

Earlier studies on finance growth relationship which used traditional panel econometric methodologies on five yearly averages data have several drawbacks which have been pointed out by Nair-Reichert and Weinhold (2001) while studying the causal relation between FDI and economic growth.

"First, models estimated with time-averaged data lose dynamic information and, due to both the lack of dynamics and degrees of freedom, run increased risk of serious omitted variable bias. Second,

[33] This sub-section (3.3.3) is dependent on Weinhold (1999) and Nair-Reichert and Weinhold (2001)
[34] In the sense, 'either causality occurs in all cross sections or it occurs in none of the cross sectionals'

contemporaneous correlation across the cross-section does not imply causation, and thus these models may suffer from endogeneity biases. In addition, as some of the authors have themselves acknowledged, these problems are difficult to address satisfactorily since suitable instruments are often not available. Thus a cross section analysis without good instrumentation will be unable to distinguish between the hypothesis that increased FDI has led to increased growth versus the hypothesis that good growth has attracted additional FDI." pp 155-156.

On the basis of above arguments we can say that in our case a cross sectional analysis without good instrumentation will be unable to distinguish between the hypothesis that financial development has led to increased growth versus the hypothesis that good growth has led to financial development.

While explaining some other alternatives Nair-Reichert and Weinhold (2001) asserts:

"One possible solution to the problems discussed above is the use of time-series, cross-section panel data estimation which allows the researchers to control for country-specific, time-invariant "fixed effects," and include dynamic, lagged dependent variables which can also help to control for omitted variable bias. The ability to lag explanatory variables may also help control for endogeneity bias."

"…potentially much more serious problem with the traditional panel data fixed effects estimators (FEE) is the imposition of homogeneity assumptions on the coefficients of lagged dependent variables when in fact the dynamics are heterogeneous across the panel. Pesaran (1995) argues that this misspecification can lead to serious biases that cannot be remedied with instrumental variable estimation." pp 156.

To overcome this issue some studies use Mean Group Estimators of Pesaran and Smith (1995). One drawback of the MGE, however, is that it produces interpretable estimates even if the relationship is completely idiosyncratic across countries as has been pointed out by Nair-Reichert and Weinhold (2001). The Mixed Fixed Random (MFR) effects approach of Hsiao et al (1989) which has been exploited by Weinhold (1999) and Nair-Reichert and Weinhold (2001) is in between the two extremes of FEE and MGE in terms of allowing for heterogeneity. This method imposes more structure on the coefficient values of the exogenous variables than the MGE (after all, if the relationship is completely idiosyncratic across countries then it is difficult to meaningfully interpret the results from an economic or policy perspective).

In Nair-Reichert and Weinhold (2001) it is explained in detail how the MFR effects estimator differs from alternative panel data estimators in the literature. The main comparable estimators are the standard fixed effects (FE) estimator, a random coefficient (RC) estimator, the mean group (MG) estimator of Pesaran and Smith (1995), the pooled mean group (PMG) estimator of Pesaran, Shin and Smith (1999) and the MFR effects estimator of Nair-Reichert and Weinhold (2001). As compared to FE estimator with small T, MFR coefficients approach produces considerably less biased parameter estimate. While comparing the other estimators Nair-Reichert and Weinhold (2001) asserts:

"The MG estimator gives us an unweighted average of the country specific coefficients and is thus particularly sensitive to outliers. A simple RC estimator, on the other hand, calculates a variance weighted average, but unfortunately it is not possible to estimate dynamic RC models. The PMG estimator would be used specifically when variables are cointegrated and cointegration relationship can theoretically be expected to be equal across all countries. Thus it allows for heterogeneous short run coefficients but constrains the long run coefficients to be homogeneous across countries."

This amounts to assuming dynamic homogeneity and Nair-Reichert and Weinhold (2001) argues that this can seriously bias the coefficient if dynamic homogeneity assumption is violated in the data.

The MFR coefficients approach, on the other hand, allows for complete heterogeneity of the long run coefficients, thus avoiding the Pesaran-type bias (Pesaran and Smith, 1995) induced by imposing unrealistic homogeneity condition on the coefficients of the lagged dependent variable (Nair-Reichert and Weinhold [2001]). Weinhold (1999) shows that the MFR coefficients model performs very well compared to instrumental variables (GMM) approaches as well[35]. The reduction in the bias may make it more reasonable to forgo instrumental variable estimation as we are all familiar with the problem of non-availability of proper instruments in panel data models.

In addition, the MFR coefficients model has other features[36] which make it ideally suited to the task of testing for causality in heterogeneous panel datasets. In particular, Weinhold (1999) allows for a distribution of causality across the panel, rather than imposing an assumption that causality occurs everywhere, or nowhere, in the panel. We may use the distributional information to gain a general idea of the degree of heterogeneity. The combination of a less-biased mean estimate and an idea of the degree of heterogeneity gives a researcher more information about the underlying process than traditional panel causality tests. We will see this below, where we use the estimated variance of the coefficient's estimate, while constructing the confidence interval.

Thus we examine the direction of causality between financial development and economic growth, and vice versa, using methodology introduced by Weinhold (1999) and Nair-Reichert and Weinhold (2001) for causality analysis in heterogeneous panel data which is based upon mixed fixed random (MFR) coefficients approach of Hsiao et al (1989).

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[35] Panel data models that use instrumental variables estimation often lead to poor finite sample efficiency and bias (Kiviet [1995]).

[36] It is useful to point out that the Mixed Fixed Random approach can also be utilized as a diagnostic tool. If the estimated variance is quite large relative to the coefficient estimates, it is a sign of significant heterogeneity in the panel. Rather than continuing with the panel data analysis it would be better at that point to further analyze the heterogeneity to evaluate the the specification and/or the pooling of the data (Nair-Reichert and Weinhold [2001]). However, if the variance is quite small then we can have additional confidence that the conclusions of the estimation are quite general across the panel.

As described above, in the existing empirical literature on panel data, most of the standard causality tests are performed using the model given in 3.12.

The fixed effect in the model 3.12 can be eliminated by taking the first difference of above equation, which gives:

$$y_{it} - y_{it-1} = \sum_{j=1}^{m} \alpha_j (y_{it-j} - y_{it-j-1}) + \sum_{j=1}^{m} \delta_j (x_{it-j} - x_{it-j-1}) + (u_{it} - u_{it-1}) \qquad (3.13)$$

However, this introduces a problem of simultaneity bias as the error term $(u_{it} - u_{it-1})$ is correlated with $(y_{it-j} - y_{it-j-1})$. To take care of this correlation problem while estimating the regression (3.13) a two-stage least squares method with instrumental procedure with a time varying set of instruments is used. The issue of causality from x to y is then tested using the joint hypothesis $\delta_1 = \delta_2 = ... = \delta_m = 0$. The problem with this estimation process is the assumption that the coefficient on the explanatory variables are equal across all the cross sectional units in the panel data. In other words, these models are based on the underlying homogeneity assumption regarding the relationships in question across countries included in the panel. Given the diverse nature of different countries in each panel, we expect a degree of heterogeneity both in the dynamic structure and the relationships between different macroeconomic variables especially in a panel dataset. Estimation of such dynamic heterogeneous models under homogeneous parameter values assumption can potentially lead to misspecification biases in the estimation process (Nair-Reichert and Weinhold [2001]).

Monte Carlo simulations by Pesaran and Smith (1995) and by Weinhold (1999) have shown that these estimates will be biased and inconsistent, and the bias would increase with the sample size. Nair-Reichert and Weinhold (2001) have shown, the restriction of a single coefficient on the causal variable implies that either causality occurs everywhere or it occurs nowhere in the panel. This assumption eliminates the possibility that the dataset can be heterogeneous. Thus in panel dataset, a more flexible criterion would be desirable. Alternative specification would be Mixed Fixed and Random (MFR) coefficients model as suggested by Hsiao *et al.* (1989) in a non-dynamic setting. Weinhold (1999) and Nair-Reichert and Weinhold (2001) have considered a variation of the MFR coefficients model as an alternative specification for panel data causality testing in the presence of heterogeneous dynamics.

Following Nair-Reichert and Weinhold (2001), we consider the model

$$y_{it} = \alpha_i + \gamma_i y_{it-1} + \beta_{1i} x^o_{1it-1} + \beta_{2i} x_{2it-1} + \varepsilon_{it} \tag{3.14}$$

where $\beta_{ji} = \overline{\beta}_j + \eta_i$. η_i is a random disturbance. Here $\beta_{ji} \sim N(\overline{\beta}_j, \sigma^2_{\beta_j})$. The variable x^o_{1it-1} denotes the orthogonalized candidate causal variable after the linear influences of the remaining right-hand side variables have been taken into account. Orthogonalization[37] provides for appropriate interpretation of the estimated variances by making sure that the coefficients are independent. Unobserved effects (α_i) and the coefficient of the lagged dependent variable are fixed and country specific and the coefficients on the exogenous explanatory variables are drawn from a random distribution with mean $\overline{\beta}_j$ and finite variance.

[37] For the purpose of orthogonalization of the lagged casual candidate variable, we regress the lagged causal candidate variable upon constant, lagged dependent variable and all other explanatory variables. We use errors of this regression as orthogonalized (lagged) causal candidate variable. This process does not contradict with the Frisch-Waugh theorem in Statistics as we will use GLS estimate under MFR coefficients assumption.

Weinhold (1999) explains why we have this particular combination of fixed individual specific coefficients on the lagged dependent variable and random coefficients on the lagged independent variables. What if we allow all the coefficients to be fixed and different? Monte Carlo study by Weinhold (1999) has shown that the bias will be considerably higher than the case of MFR coefficients model. Furthermore, introduction of lagged dependent variable into a random coefficient model will create specification problem[38] as the error term will be correlated with the lagged dependent variable. Moreover, it may be difficult, if not impossible, to find instrument which are correlated with the dependent variable but not with the error term. If we instead model the coefficient on the coefficient on the lagged dependent variable as fixed rather than random and constrains it to be equal across all the cross sections there could still be significant bias introduced if in fact coefficients on the lagged dependent variables are not constant across the cross section. The MFR coefficients model avoids both these problems: it allows for heterogeneity in both the coefficients on lagged dependent variable and exogenous variables without introducing the simultaneity problem.

MFR coefficients model is ideally suited for testing the presence of causality in heterogeneous panel datasets as it allows for a distribution of causality across the panel. This method uses the distributional information to get a general idea of the degree of heterogeneity. By allowing for some heterogeneity, the MFR effects estimates are less biased and less susceptible to a few outliers (if any). As pointed out by Nair-Reichert and Weinhold (2001), the combination of a less-biased mean estimate and an idea of the

[38] Consider $y_{it} = \alpha_i + \gamma_i y_{it-1} + \beta_i x_{it-1} + \varepsilon_{it}$ where $\gamma_i = \bar{\gamma} + \eta_{1i}$, $\beta_i = \bar{\beta} + \eta_{2i}$ and η is a random disturbance. This model can thus be written as $y_{it} = \alpha_i + \bar{\gamma} y_{it-1} + \bar{\beta} x_{it-1} + \xi_{it}$, where $\xi_{it} = \eta_{1i} y_{it-1} + \eta_{2i} x_{it-1} + \varepsilon_{it}$. Thus there is a problem of misspecification.

degree of heterogeneity provide a better understanding of the underlying process than the traditional panel causality tests.

Now we discuss how to estimate the MFR coefficients model.

Let Y be dependent variable; Z contains vector of 1s for intercept, and the lagged dependent variables, i.e. those for which we have fixed coefficients; X has orthogonalized causal candidate variable, and other control variables, i.e. all other right hand side variables for which we have random coefficients. We denote the vector of all the right hand side variables (including unobserved effects) by W, i.e. it contains all the variables that are in Z and X. Let θ_2 be vector of fixed coefficients (which are f in number) and θ_1 be vector of random coefficients (which are r in number). Let θ denotes the vector of all fixed as well as random coefficients.

We estimate θ_1 by

$$\widetilde{\theta}_1 = [\sum_{i=1}^{N} X_i' \phi_i^{-1} X_i - \sum_{i=1}^{N} X_i' \phi_i^{-1} Z_i (Z_i' \phi_i^{-1} Z_i)^{-1} Z' \phi_i^{-1} X_i]^{-1} [\sum_{i=1}^{N} X_i' \phi_i^{-1} Y_i - \sum_{i=1}^{N} X_i' \phi_i^{-1} Z_i (Z_i' \phi_i^{-1} Z_i)^{-1} Z' \phi_i^{-1} Y_i] \qquad (3.15)$$

which is the GLS estimate of θ_1 under MFR coefficients assumption. Here

$$\phi_i = (X_i \Delta_r X_i' + \hat{\sigma}_i^2 I_{T-1}) \qquad (3.16)$$

and $\hat{\sigma}_i^2$ is OLS estimate of error variance of individual regression of Y_i upon W_i, i.e. $Y_i = W_i \theta_i + error$, and Δ_r is the covariance matrix which is sub-matrix for random coefficients from

$$\Delta = \frac{1}{N-1} \sum_{i=1}^{N} (\hat{\theta}_i - \bar{\hat{\theta}})(\hat{\theta}_i - \bar{\hat{\theta}})' \qquad (3.17)$$

where $\hat{\theta}_i$ is the OLS estimate from individual regression of Y_i upon W_i , i.e. $Y_i = W_i\theta_i + error$ and $\bar{\hat{\theta}}$ is the average of such $\hat{\theta}_i$s for the individuals countries in the panel.

We estimate individual coefficients under MFR effects approach by

$$\tilde{\theta}_{1i} = [\frac{1}{\hat{\sigma}_i^2}\{X_i'X_i - X_i'Z_i(Z_i'Z_i)^{-1}Z_i'X_i\} + \Delta_r^{-1}]^{-1}[\frac{1}{\hat{\sigma}_i^2}\{X_i'X_i - X_i'Z_i(Z_i'Z_i)^{-1}Z_i'X_i\}\hat{\theta}_{1i} + \Delta_r^{-1}\tilde{\theta}_1] \quad (3.18)$$

and

$$\tilde{\theta}_{2i} = (Z_i'Z_i)\{Z_i'(Y_i - X_i\tilde{\theta}_{1i})\} \quad (3.19)$$

We have

$$\tilde{u}_{it} = Y_{it} - \tilde{\theta}_{2i}Z_{it} - \tilde{\theta}_1 X_{it}$$

and mean square error is $\tilde{\sigma}^2 = (\sum u_{it}^2)/\{\sum T_i - (f * N + r)\}$

and $Var(\tilde{\theta}) = \tilde{\sigma}^2(W'W)^{-1}$ from which we can have standard errors ($\tilde{\sigma}_{\tilde{\theta}}$) of the MFR effects estimates.

For causality testing, we have to build confidence interval around zero[39] (here we will use the first element in the vector $\tilde{\theta}_1$ which is $\tilde{\theta}_{1[1]}$) for which the lower and upper bounds are given below:

[39] Theoretically speaking; for population parameter under the null hypothesis that $\theta_{1[1]}$ is zero.

Lower Bound (Confidence Interval): $\{(-2) * \sqrt{N}\tilde{\sigma}_{\tilde{\theta}_{1[1]}} - \tilde{\theta}_{1[1]}\} \big/ \Delta_{r_{11}}$

Upper Bound (Confidence Interval): $\{2 * \sqrt{N}\tilde{\sigma}_{\tilde{\theta}_{1[1]}} - \tilde{\theta}_{1[1]}\} \big/ \Delta_{r_{11}}$

The area that falls within this interval[40] is interpreted to correspond to observations that are not significantly different from zero[41].

We apply[42] this panel causality technique to our final model (3.4b) above[43].

In this chapter we discussed the econometric model we use in this study to investigate the causal relationship between financial development and economic growth. We reformulated the econometric model of the financial development and economic growth relationship by incorporating the effect of inflation on financial sector development highlighted in the literature by Huybens and Smith (1999), De Gregorio and Sturzenegger (1994a, b), Boyd, Levine, and Smith (2001). After the details of the data, we explained the econometric methodology we use in this study.

[40] The lower bound (LB) and upper bound (UB) are based upon the algorithm Nair-Reichert and Weinhold (2001) has used in her code for dynamic heterogeneous panel causality analysis available on her site.

[41] For panel causality analysis, we use SAS version of the program (which calculates estimate of the coefficient of the causal variable, its standard error, the confidence interval and the estimate of the variance of the estimated random coefficient) developed by Diana Weinhold and available on her site linked with that of London School of Economics, UK. This SAS program does not orthogonalize the candidate casual variable, however, we did it.

[42] While applying panel causality analysis we will take into account the results of the panel unit root tests. We will use all series with order of integration of one after first differencing

[43] Dynamic panel data models with fixed effects are subject to Hurwitz bias of order $1/T$ in cases where time series dimension T is small. In this dissertation none of the panel datasets has average time dimension less than 20 and thus we do not fear such bias in our analysis.

4 Simple Statistical and Univariate Analysis

Before going to the econometric analysis of how the development of financial sector affects economic growth, if any, it is worth analyzing some simple statistical properties of the data with the help of some numbers and graphs[44] which we shall be presenting in this chapter. After such analysis we shall conduct the univariate analysis of the variable we discussed in Chapter 3. For this purpose we use Im-Pesaran-Shin (IPS) panel unit root (PUR) test.

4.1 SIMPLE STATISTICAL ANALYSIS

Table 4.1 shows summary statistics of various variables we have used in this study. These statistics refer to our overall panel of 41 countries containing 957 observations where time dimension varies between 15 and 29 for these countries.

The most important analysis from this table relates to the comparison of within-country standard deviation and between-country standard deviation for all the variables we have. This analysis reveals that for all the variables most of the variability in the data occurs between countries which shows the heterogeneity between the countries for all these variables. None of the variables have larger within-country variation.

[44] The simple statistical analysis does not involve natural logarithm of any variable as against the rest of the analysis in this dissertation where we use the natural logarithm of all the variables except that of inflation and growth in real GDP per capita. An important thing is that all the results, numeric or graphic, in the simple statistical analysis for the overall data of 41 countries are in line with such results available in the existing literature (like those in Favara, (2003)).

Table 4.1: Summary Statistics - Panel Data (yearly observations) of all 41 Countries

Variable		Mean	Std. Dev.	Min.	Max.	Observations
GRGPC	Overall	0.0195	0.0349	-0.1651	0.1454	957
	Between		0.0788			41
	Within		0.0316			15, 29
LLGR	Overall	0.6394	0.4506	0.1286	3.4231	957
	Between		2.0374			41
	Within		0.1751			15, 29
PCGR	Overall	0.6216	0.3842	0.0780	2.2463	957
	Between		1.6206			41
	Within		0.1985			15, 29
MCGR	Overall	0.4272	0.5018	0.0002	2.9530	957
	Between		1.9205			41
	Within		0.3190			15, 29
VTGR	Overall	0.2097	0.4485	0.00001	6.6322	957
	Between		1.2340			41
	Within		0.3788			15, 29
FDGR	Overall	1.0666	0.8093	0.1427	5.2424	957
	Between		3.3899			41
	Within		0.4263			15, 29
FAGR	Overall	0.8313	0.7221	0.0782	7.9635	957
	Between		2.5465			41
	Within		0.5109			15, 29
INFL (%)	Overall	8.4629	9.4543	-3.2642	84.0983	957
	Between		31.0622			41
	Within		7.1521			15, 29
GCGR	Overall	0.1634	0.0573	0.0277	0.3924	957
	Between		0.2619			41
	Within		0.0207			15, 29
TRGR	Overall	0.7230	0.4906	0.1328	3.3712	957
	Between		2.2906			41
	Within		0.1486			15, 29
Initial SSER (%)	Overall	67.94	29.93	6.88	148.25	957
	Between		134.35			41
	Within		12.11			15, 29

The level of LLGR varies from 12.86 percent (for Nigeria in 1994) to 342.31 percent (for Luxembourg in 1993) with an average of 63.94 percent. The level of PCGR oscillates between 7.80 percent (for Indonesia in 1980) to 224.63 percent (for USA in 2000) with an average of 62.16 percent. The size and activity measures do not differ much if we compare the two averages. But both are on higher side when compared with the averages of the size and activity measures of direct finance which are 42.72 percent and 20.97

percent respectively. When we look at the overall financial development, its size measure (FDGR) varies from 14.27 percent (for Indonesia in 1980) to 524.24 percent (for Luxembourg in 1997) with an average of 106.66 percent. The level of FAGR varies between 7.82 percent (for Indonesia in 1980) to 796.35 percent (for UK in 2001) with an average of 83.13 percent. While on the side of real per capita growth, we have Nigeria with minimum growth rate in 1994 and Bangladesh with maximum one in 1990.

The growth rate of GDP per capita varies from -16.51 percent (for Jordan in 1989) to 14.54 percent (for Jordan 1980) with an average of 1.95 percent.

It is interesting to note that our conclusion regarding the heterogeneity between the countries for all the variables is robust in the sense that it remains unchallenged while we divide our countries into four groups/panels of Low, Lower Middle, Upper Middle, and High Income Countries. From tables 4.2 (i) to 4.2 (iv) below we can see easily that for all the variables most of the variability in the data occurs between countries which shows the heterogeneity between the countries for all these variables in each of the four panels. Again none of the variables have larger within-country variation.

An interesting observation from Table 4.1 is that growth in real GDP per capita across the countries is only slightly variable than the growth in real GDP per capita within countries whereas all the financial variables have much greater between variability than within variability. This remains true even after we divided the panel according to level income as we will see in Tables 4.2 (i-iv).

Table 4.2 (i): Summary Statistics - Panel Data (yearly observations) of LIC

Variable		Mean	Std. Dev.	Min.	Max.	Observations
GRGPC	Overall	0.0193	0.0430	-0.1580	0.1011	201
	Between		0.1219			9
	Within		0.0362			15, 29
LLGR	Overall	0.3509	0.1108	0.1286	0.8311	201
	Between		0.3563			9
	Within		0.0866			15, 29
PCGR	Overall	0.3276	0.2783	0.0780	1.5754	201
	Between		1.1291			9
	Within		0.1660			15, 29
MCGR	Overall	0.1373	0.1337	0.0002	0.5402	201
	Between		0.3453			9
	Within		0.1168			15, 29
VTGR	Overall	0.1388	0.3155	0.00001	2.3134	201
	Between		0.7640			9
	Within		0.2817			15, 29
FDGR	Overall	0.4882	0.2205	0.1427	1.2644	201
	Between		0.6732			9
	Within		0.1782			15, 29
FAGR	Overall	0.4664	0.5315	0.0782	3.7543	201
	Between		1.7967			9
	Within		0.3997			15, 29
INFL (%)	Overall	11.05	9.48	-0.81	54.70	201
	Between		26.15			9
	Within		8.07			15, 29
GCGR	Overall	0.1224	0.0475	0.0277	0.2749	201
	Between		0.2074			9
	Within		0.0237			15, 29
TRGR	Overall	0.5126	0.2271	0.1328	1.5271	201
	Between		0.8829			9
	Within		0.1458			15, 29
Initial SSER (%)	Overall	33.72	22.28	6.88	102.01	201
	Between		95.85			9
	Within		11.59			15, 29

Table 4.2 (ii): Summary Statistics - Panel Data (yearly observations) of LMIC

Variable		Mean	Std. Dev.	Min.	Max.	Observations
GRGPC	Overall	0.0199	0.0431	-0.1651	0.1454	127
	Between		0.0820			6
	Within		0.0407			16,26
LLGR	Overall	0.5523	0.2755	0.1796	1.3204	127
	Between		1.1691			6
	Within		0.1517			16,26
PCGR	Overall	0.4930	0.2961	0.0826	1.6594	127
	Between		1.1320			6
	Within		0.1968			16,26
MCGR	Overall	0.2769	0.2403	0.0241	0.9221	127
	Between		0.7206			6
	Within		0.1970			16,26
VTGR	Overall	0.0750	0.1200	0.0006	0.6954	127
	Between		0.3354			6
	Within		0.1019			16,26
FDGR	Overall	0.8292	0.4645	0.2666	1.8382	127
	Between		1.7920			6
	Within		0.3050			16,26
FAGR	Overall	0.5680	0.3770	0.0943	1.8443	127
	Between		1.3891			6
	Within		0.2625			16,26
INFL (%)	Overall	9.03	8.13	-0.33	57.26	127
	Between		21.88			6
	Within		7.01			16,26
GCGR	Overall	0.1457	0.0587	0.0703	0.3193	127
	Between		0.2794			6
	Within		0.0198			16,26
TRGR	Overall	0.8621	0.2627	0.4073	1.5465	127
	Between		0.9992			6
	Within		0.1759			16,26
Initial SSER (%)	Overall	53.53	15.45	20.50	78.38	127
	Between		67.76			6
	Within		7.77			16,26

Table 4.2 (iii): Summary Statistics - Panel Data (yearly observations) of UMIC

Variable		Mean	Std. Dev.	Min.	Max.	Observations
GRGPC	Overall	0.0113	0.0450	-0.1168	0.1041	144
	Between		0.0959			7
	Within		0.0414			16,24
LLGR	Overall	0.4992	0.2719	0.1335	1.3319	144
	Between		1.2110			7
	Within		0.1136			16,24
PCGR	Overall	0.5455	0.3333	0.0813	1.5525	144
	Between		1.3381			7
	Within		0.1937			16,24
MCGR	Overall	0.5451	0.6117	0.0157	2.8265	144
	Between		2.4070			7
	Within		0.3699			16,24
VTGR	Overall	0.1359	0.3190	0.0007	2.2971	144
	Between		0.8344			7
	Within		0.2751			16,24
FDGR	Overall	1.0444	0.7754	0.2207	3.8317	144
	Between		3.2303			7
	Within		0.4130			16,24
FAGR	Overall	0.6814	0.5715	0.1014	3.2969	144
	Between		2.0352			7
	Within		0.3993			16,24
INFL (%)	Overall	14.33	16.10	-3.26	84.10	144
	Between		52.01			7
	Within		12.34			16,24
GCGR	Overall	0.1525	0.0676	0.0501	0.3924	144
	Between		0.3060			7
	Within		0.0258			16,24
TRGR	Overall	0.7151	0.4149	0.2137	2.2958	144
	Between		1.7826			7
	Within		0.2013			16,24
Initial SSER (%)	Overall	53.84	16.66	21.00	96.50	144
	Between		64.75			7
	Within		10.30			16,24

Table 4.2 (iv): Summary Statistics - Panel Data (yearly observations) of HIC

Variable		Mean	Std. Dev.	Min.	Max.	Observations
GRGPC	Overall	0.0219	0.0229	-0.0678	0.0945	485
	Between		0.0396			19
	Within		0.0220			21,28
LLGR	Overall	0.8235	0.5272	0.3049	3.4231	485
	Between		2.4992			19
	Within		0.2177			21,28
PCGR	Overall	0.7998	0.3606	0.1985	2.2463	485
	Between		1.5275			19
	Within		0.2119			21,28
MCGR	Overall	0.5516	0.5513	0.0036	2.9530	485
	Between		2.1076			19
	Within		0.3796			21,28
VTGR	Overall	0.2962	0.5536	0.00001	6.6322	485
	Between		1.5594			19
	Within		0.4737			21,28
FDGR	Overall	1.3751	0.8889	0.4275	5.2424	485
	Between		3.7766			19
	Within		0.5193			21,28
FAGR	Overall	1.0960	0.7931	0.2205	7.9635	485
	Between		2.6485			19
	Within		0.6184			21,28
INFL (%)	Overall	5.50	4.85	-1.40	25.70	485
	Between		14.69			19
	Within		4.01			21,28
GCGR	Overall	0.1883	0.0431	0.0845	0.2944	485
	Between		0.2043			19
	Within		0.0177			21,28
TRGR	Overall	0.7761	0.5990	0.1592	3.3712	485
	Between		3.0445			19
	Within		0.1210			21,28
Initial SSER (%)	Overall	90.08	18.11	37.18	148.25	485
	Between		63.30			19
	Within		13.64			21,28

To further highlight the properties of the data in Figures 1 (a) to 1 (f), we plot the various indicators of financial development for different groups of countries as we have in our study in addition to plotting for overall panel. In Figure 2 we plot the real per capita GDP growth for these panels of countries. In figures 3 (a) to 3 (d), we plot INFL, GCGR, TRGR and SSER respectively.

Figure 1 (a)

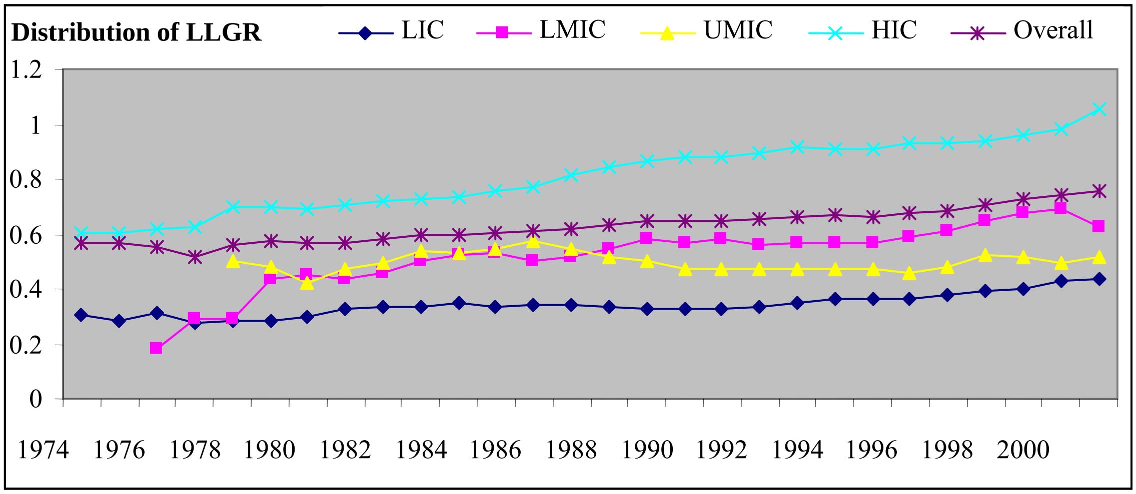


Figure 1 (b)

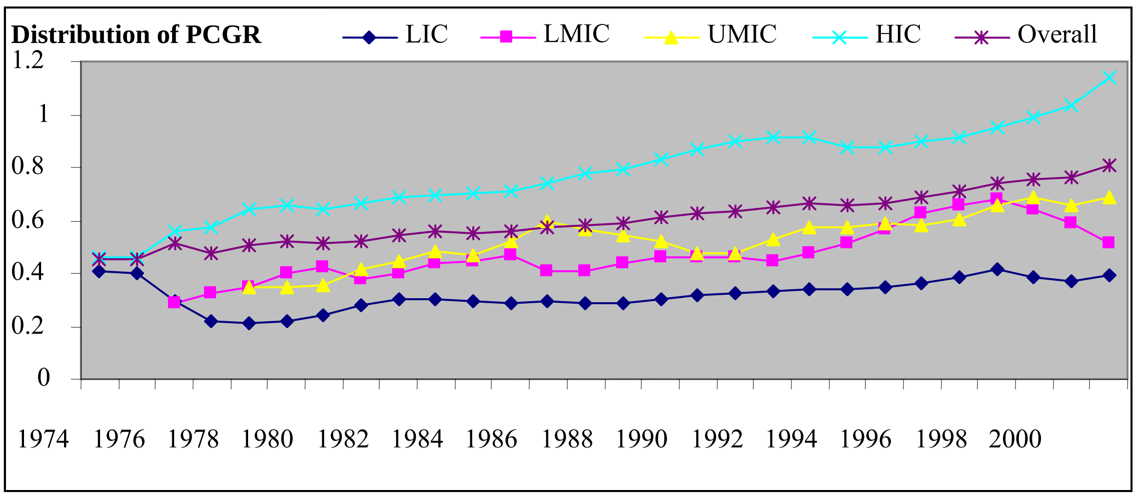


Figure 1 (c)

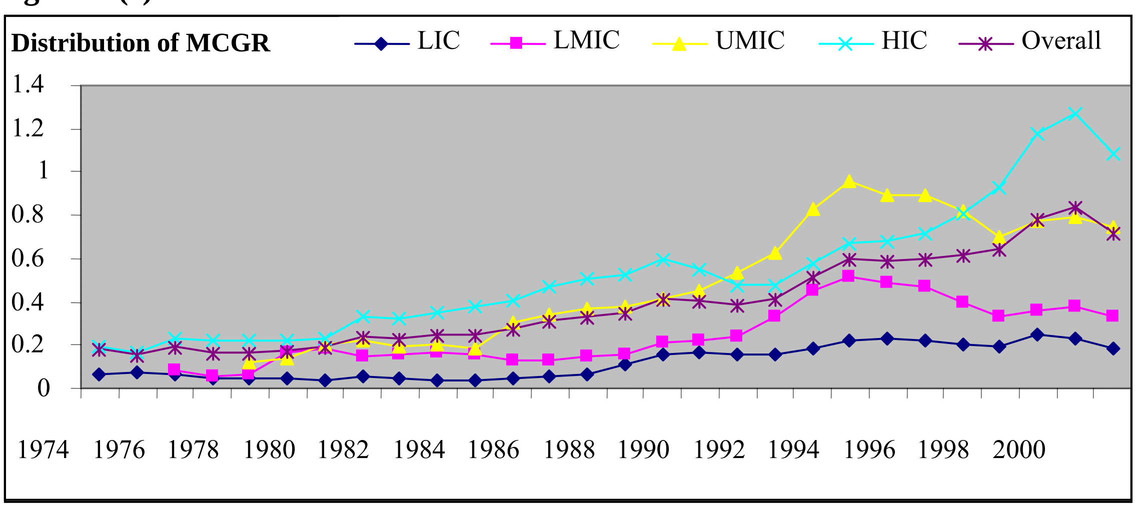


Figure 1 (d)

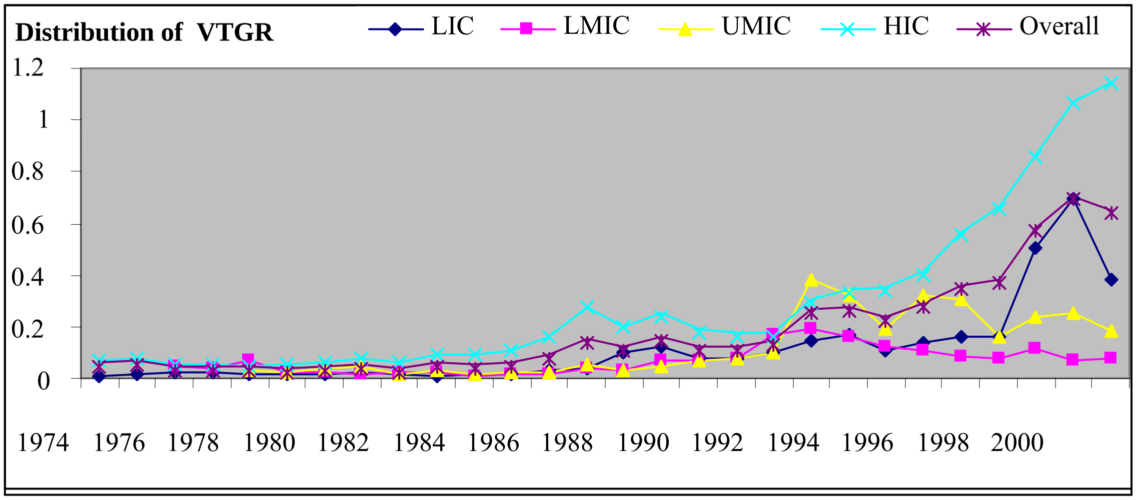


Figure 1 (e)

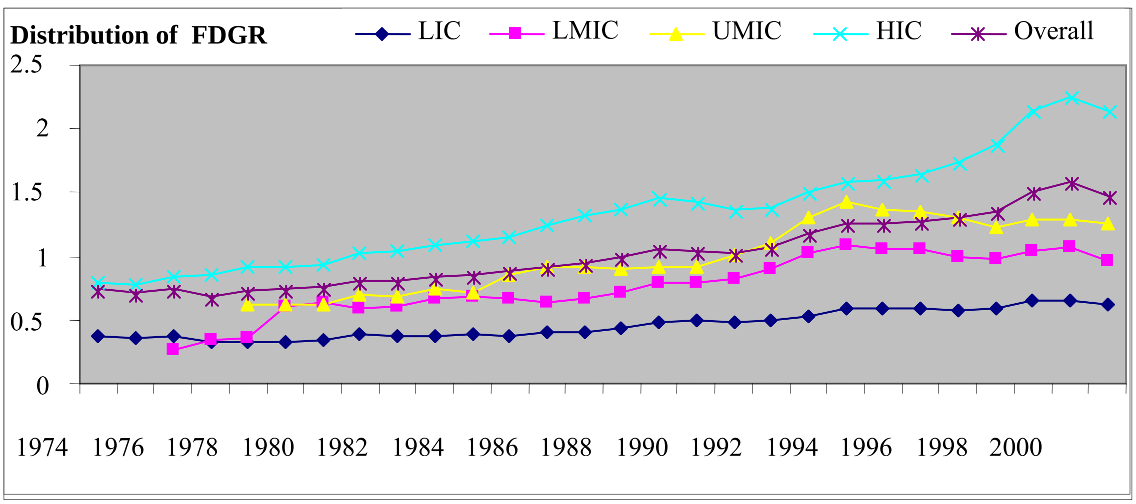


Figure 1 (f)

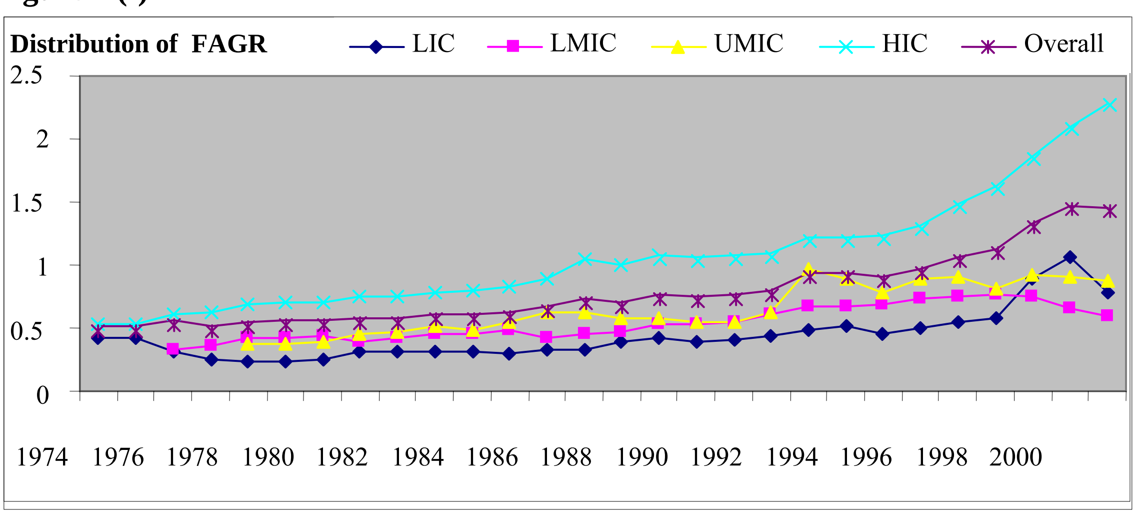


Figure 2

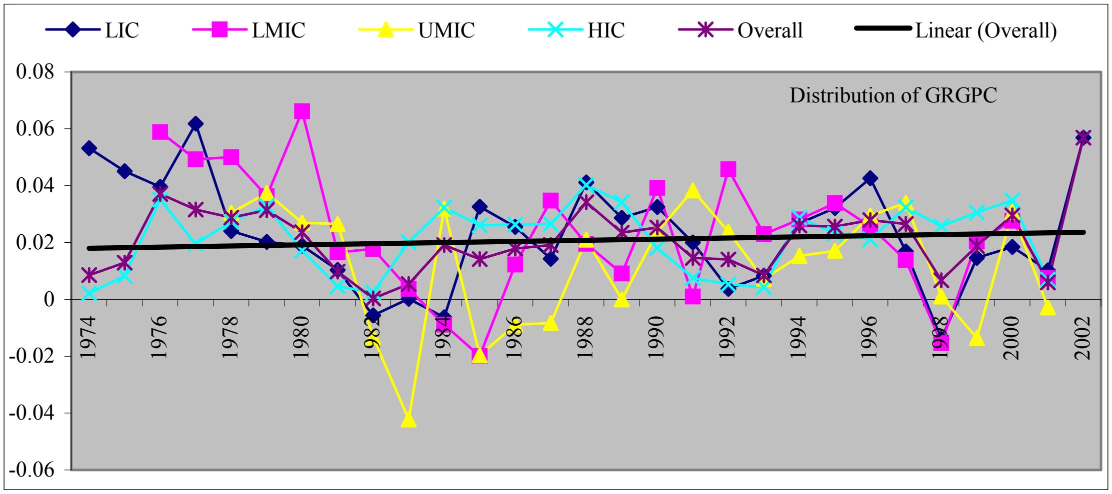


Figure 3 (a)

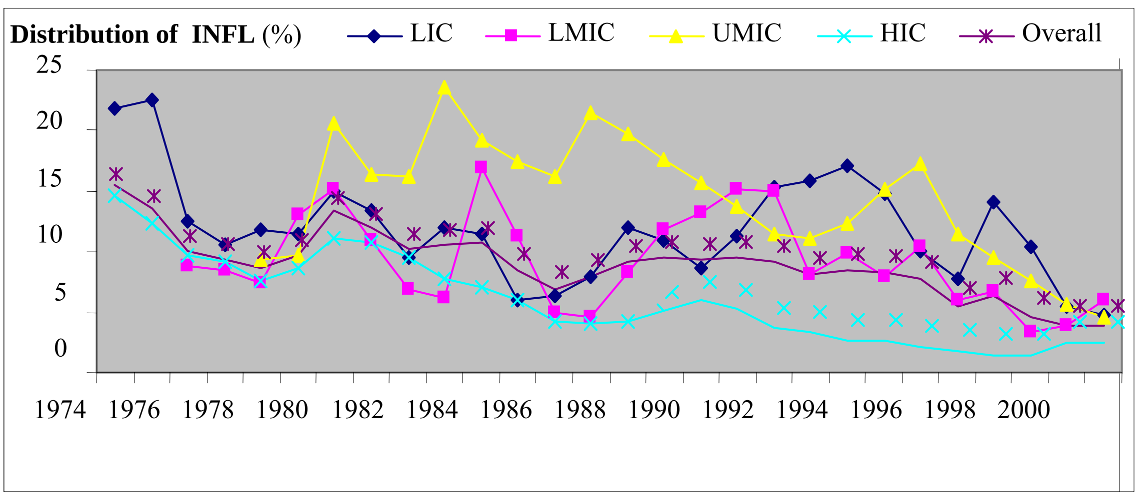


Figure 3 (b)

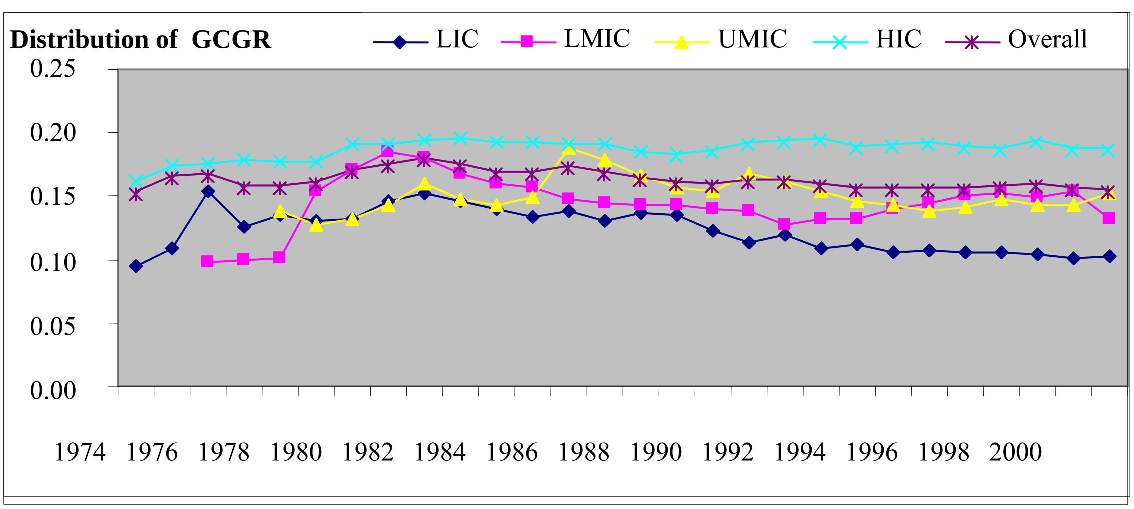


Figure 3 (c)

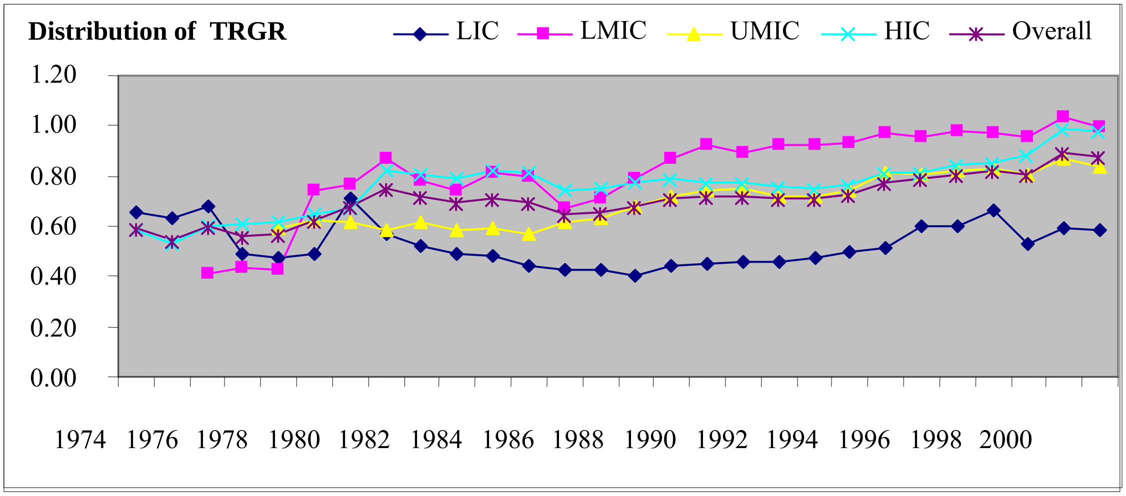
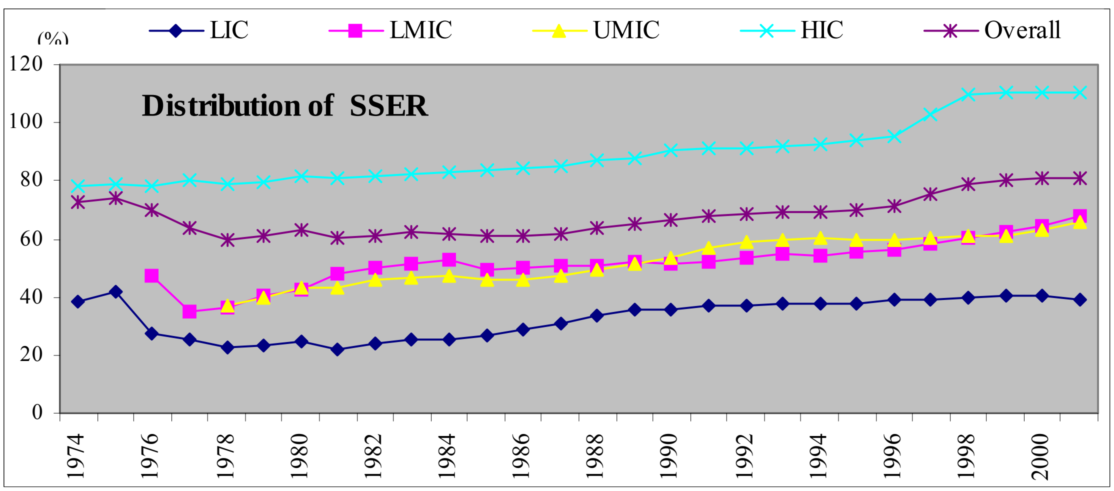


Figure 3 (d)



The curves in these figures are showing panel specific time averages. The important character of all of the graphs relating to the indicators of financial development, irrespective of the nature of the finance and the type of the measure, in figures 1 (a) to 1 (f) is that we have upward sloping curves[45] over time for all the panels. An interesting feature of these plots is that all the financial indicators vary a great deal across panels. Though in all the cases the curves drift upward reflecting an increase in size as well as

[45] In the sense that if we draw a linear trend line to the curve to see the fit.

activity measure of all the three types of indirect, direct, and overall finance; the trend is very less (high) pronounced for the low (high) income countries.

There is no regular pattern[46] over the time in the growth rate of GDP per capita as we plotted in Figure 2. However, there are some interesting features in this case across the panels. On the average panel for LIC has been showing highest growth rates and UMIC is on the other extreme. The times average plotted for the GDP per capita growth have rarely been gone in the negative quadrant[47], in addition to depicting the minimum variability, for the HIC as against the other groups. We can also observe the same by comparing the overall standard deviation of GRGPC for HIC (0.0229) with the same for LIC, LMIC and UMIC (0.0430, 0.0431, and 0.0450 respectively).

We observe very high volatility in case of inflation as depicted in Figure 3 (a), along with a slightly downward trend in it. There is, however, very smooth trend in government consumption to GDP ration which is even smoother in case of high income countries. Trade to GDP ratio has slightly upward trend. We discussed in chapter 3 that secondary school enrollment ratio evolve very slow and in a predictable manner. This can be seen from the Figure 3 (d).

[46] We have shown a simple trend line to the curve of times averages for the real GDP per capita growth only in the case of overall panel of 41 countries. It is clearly almost parallel to horizontal axis with very close to zero slope but positive sign.

[47] Barro (1997) asserts that positive rates of per capita growth can persist even a century or more and that these growth rates have no clear tendency to decline.

Table 4.3 (i): Pair wise Correlations-Cross Section Data (all 41 Observations)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	0.2737	1.0000									
PCGR	0.2909	0.5898	1.0000								
MCGR	0.1661	0.4564	0.6502	1.0000							
VTGR	0.2163	0.2188	0.6049	0.5936	1.0000						
FDGR	0.2579	0.8547	0.7264	0.8520	0.4751	1.0000					
FAGR	0.2887	0.4820	0.9272	0.6971	0.8591	0.6903	1.0000				
INFL	-0.3246	-0.4119	-0.5698	-0.3640	-0.3118	-0.4547	-0.5129	1.0000			
GCGR	-0.2855	0.1175	0.2952	0.1098	0.0886	0.1332	0.2314	-0.3889	1.0000		
TRGR	0.2756	0.4551	0.2805	0.5442	0.1214	0.5853	0.2374	-0.2830	0.0029	1.0000	
SSER	0.1946	0.3070	0.5366	0.3175	0.3494	0.3659	0.5093	-0.3980	0.4669	0.0723	1.0000

Table 4.3 (ii): Pair wise Correlations-Panel Data (all 957 Observations)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	0.0812	1.0000									
PCGR	0.0514	0.5609	1.0000								
MCGR	0.1389	0.4427	0.5820	1.0000							
VTGR	0.1121	0.1907	0.5014	0.6213	1.0000						
FDGR	0.1313	0.8312	0.6731	0.8665	0.4914	1.0000					
FAGR	0.0970	0.4165	0.8429	0.6955	0.8881	0.6631	1.0000				
INFL	-0.2502	-0.3144	-0.4306	-0.2978	-0.2195	-0.3596	-0.3652	1.0000			
GCGR	-0.1686	0.1006	0.2380	0.0600	0.0233	0.0932	0.1409	-0.3188	1.0000		
TRGR	0.1227	0.4258	0.2536	0.4754	0.0911	0.5318	0.1914	-0.1880	-0.0068	1.0000	
SSER	0.1000	0.3036	0.5335	0.3502	0.3174	0.3862	0.4808	-0.3462	0.4145	0.0837	1.0000

Table 4.3 (iii): Pair wise Correlations-Panel Data (201 Observations of LIC)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	0.0451	1.0000									
PCGR	0.2357	0.5278	1.0000								
MCGR	0.1687	0.6224	0.5566	1.0000							
VTGR	0.1477	0.5882	0.6023	0.6762	1.0000						
FDGR	0.1249	0.8802	0.6029	0.9193	0.7057	1.0000					
FAGR	0.2110	0.6252	0.8808	0.6925	0.9085	0.7343	1.0000				
INFL	-0.3123	-0.1467	-0.2279	0.0208	-0.1590	-0.0611	-0.2137	1.0000			
GCGR	-0.2694	0.3034	-0.0238	0.0685	0.0271	0.1941	0.0036	-0.0115	1.0000		
TRGR	-0.1234	-0.0180	0.3289	0.2007	0.1625	0.1127	0.2686	0.1286	0.1585	1.0000	
SSER	0.4130	0.3557	0.8266	0.6035	0.4931	0.5448	0.7252	-0.0872	-0.2432	0.2697	1.0000

Table 4.3 (iv): Pair wise Correlations-Panel Data (127 Observations of LMIC)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	-0.1782	1.0000									
PCGR	-0.1769	0.8902	1.0000								
MCGR	-0.0092	0.8058	0.7269	1.0000							
VTGR	0.0057	0.6657	0.5443	0.6244	1.0000						
FDGR	-0.1151	0.9676	0.8654	0.9292	0.6816	1.0000					
FAGR	-0.1510	0.9149	0.9823	0.7651	0.6917	0.8971	1.0000				
INFL	-0.2523	-0.3426	-0.3999	-0.2232	-0.1761	-0.3089	-0.3836	1.0000			
GCGR	-0.0159	0.8578	0.7546	0.6901	0.3940	0.8296	0.7375	-0.4366	1.0000		
TRGR	-0.0699	0.7728	0.5127	0.7353	0.4864	0.7958	0.5499	0.0088	0.7618	1.0000	
SSER	-0.1768	-0.5340	-0.7077	-0.4973	-0.4216	-0.5452	-0.7033	0.3326	-0.5238	-0.2688	1.0000

Table 4.3 (v): Pair wise Correlations-Panel Data (144 Observations of UMIC)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	0.0915	1.0000									
PCGR	-0.0442	0.7034	1.0000								
MCGR	0.2139	0.4606	0.7751	1.0000							
VTGR	0.2457	0.4690	0.5351	0.7564	1.0000						
FDGR	0.2008	0.7139	0.8580	0.9503	0.7611	1.0000					
FAGR	0.1114	0.6720	0.8819	0.8742	0.8702	0.9252	1.0000				
INFL	-0.1788	-0.5177	-0.5647	-0.3573	-0.2061	-0.4634	-0.4444	1.0000			
GCGR	-0.2007	0.1632	0.3703	0.0500	-0.0916	0.0967	0.1648	-0.5125	1.0000		
TRGR	0.2363	0.8793	0.5994	0.5114	0.5806	0.7117	0.6736	-0.4224	0.0544	1.0000	
SSER	0.1307	0.0598	0.3224	0.3898	0.1955	0.3284	0.2971	-0.2924	0.0576	0.1451	1.0000

Table 4.3 (vi): Pair wise Correlations-Panel Data (485 Observations of HIC)

	GRGPC	LLGR	PCGR	MCGR	VTGR	FDGR	FAGR	INFL	GCGR	TRGR	SSER
GRGPC	1.0000										
LLGR	0.1530	1.0000									
PCGR	-0.0151	0.4936	1.0000								
MCGR	0.2673	0.3677	0.3909	1.0000							
VTGR	0.1918	0.0665	0.3377	0.6585	1.0000						
FDGR	0.2515	0.8403	0.5369	0.8131	0.4255	1.0000					
FAGR	0.1045	0.3496	0.8288	0.6369	0.8066	0.5901	1.0000				
INFL	-0.1847	-0.2145	-0.3785	-0.4506	-0.4060	-0.3969	-0.4791	1.0000			
GCGR	-0.2672	-0.4201	-0.2543	-0.3185	-0.1536	-0.4487	-0.2510	-0.0188	1.0000		
TRGR	0.2857	0.3376	0.2721	0.5976	0.2126	0.5597	0.2972	-0.2503	-0.3445	1.0000	
SSER	-0.1144	-0.1683	0.0839	0.0500	0.3104	-0.0762	0.2372	-0.4509	0.3710	-0.2372	1.0000

The pair-wise correlations matrix for all the variables for overall 41 countries, for which we described the summary statistics in Table 4.1 above, is reported both for cross section and panel data in the Tables 4.3 (i) and Table 4.3 (ii) above. All the signs are expected in these two tables. The growth in real per capita GDP correlates positively with the openness and secondary school enrollment ratio[48] in addition to all the indicators of financial development. In accordance with the Barro (1997)'s finding that big government is bad for growth, government consumption to GDP ratio is negatively correlated to real GDP per capita growth. Similarly, in line with the Barro's results, the rate of inflation has negative correlation with real GDP growth rates. Finally, inflation rate is negatively correlated with each measure of financial development. An interesting feature is that the (absolute) correlation coefficients between inflation and financial development, in almost all the above three cases and for all the proxies of financial development, are higher if we compare them the correlation coefficients between financial development and economic growth[49].

[48] As compared to the correlation coefficients of GRGPC with the variables other than the financial sector development proxies we observe that secondary school enrollment ratio has least correlation magnitude with GRGPC. We will no be surprised in the econometric analysis where we find no statistically significant role for human capital in explaining economic growth while we estimate contemporaneous fixed effects panel regression of GRGPC upon state variable (like initial RGPC and initial SSER) and control variables (like INFL, GCGR, and TRGR). The reason may be that the SSER is very slowly evolving variable.

[49] In the case of yearly panel data which we use in econometric analysis these are 4 -to- 22 times higher.

4.2 IPS PANEL UNIT ROOT ANALYSIS

In the Table 4.4 below we present the results of Im-Pesaran-Shin (1997, 2002) panel unit root (IPS PUR) test on all the state and control variables and growth in real per capita GDP for all the four panels of Low, Lower Middle, Upper Middle, and High Income Countries. It is evident that all the variables are stationary at level except (initial) RGPC of Lower Middle Income and High Income Countries, and GCGR of Upper Middle Income and High Income Countries, and TRGR of High Income Countries which are nonstationary and becomes stationary after first differencing.

Table 4.4: IPS PUR Test for Variables Other Than Financial Variables

Panel	Variable	IPS-PUR test at Level	IPS-PUR test at First Difference	I(0)/I(1)
Low Income Countries	INFL	-3.2362**		I(0)@
	GCGR	-2.3333**		I(0)
	TRGR	-2.6282**		I(0)
	SSER	-1.2944*		I(0)@
	RGPC	-2.6956*		I(0)@
	GRGPC	-8.4528**		I(0)@
Lower Middle Income Countries	INFL	-4.4058**		I(0)@
	GCGR	-2.9568**		I(0)@
	TRGR	-2.2499**		I(0)@
	SSER	-1.4445*		I(0)
	RGPC	-0.4655	-6.5125**	I(1)@
	GRGPC	-3.1481**		I(0)@
Upper Middle Income Countries	INFL	-3.7477**		I(0)@
	GCGR	-0.3594	-9.0568**	I(1)
	TRGR	-1.4364*		I(0)
	SSER	-1.6560**		I(0)
	RGPC	-2.7717**		I(0)@
	GRGPC	-7.4791**		I(0)@
High Income Countries	INFL	-6.2101**		I(0)@
	GCGR	-1.2399	-24.2779**	I(1)@
	TRGR	-1.0099	-33.0263**	I(1)@
	SSER	-2.0165**		I(0)
	RGPC	0.7392	-10.8977**	I(1)@
	GRGPC	-8.3566**		I(0)@

*: Significant at 10% level where critical value is -1.28
**: Significant at 5% level where critical value is -1.64
@: Order of integration is insensitive to maximum lag selection for general to specific methodology between 4 (for which these results are presented) and 1 (results for maximum lag selected 3, 2, and 1 are not presented here).

We use maximum lag of 4 in the IPS panel unit root test, however, in most of the cases the order of integration is insensitive to maximum lag selection between 4 and 1. While testing for panel unit roots at level we take both unobserved effects and heterogeneous time trend in our equation as in equation (3.7) in Chapter 3. One may argue, particularly in the case of growth rate of real GDP per capita and inflation, that there is no reason to include the heterogeneous time trend while testing for unit root but it is observed while doing analysis in this dissertation that the orders of integration of growth and inflation are insensitive to whether or not we include the heterogeneous time trend.

In our dynamic heterogeneous panel causality analysis we take first difference of the nonstationary variables to make them stationary.

Table 4.5 (i): IPS PUR Test for Indirect Finance and Interaction Variables

Panel	Variable	IPS-PUR test at Level	IPS-PUR test at First Difference	I(0)/I(1)
Low Income Countries	LLGR	-0.6761	-7.4896**	I(1)@
	PCGR	-2.1551**		I(0)
	INFL.LLGR	-3.0551**		I(0)@
	INFL.PCGR	-1.9062**		I(0)
Lower Middle Income Countries	LLGR	-2.4273**		I(0)
	PCGR	-3.2582**		I(0)@
	INFL.LLGR	-3.5553**		I(0)@
	INFL.PCGR	-7.4845**		I(0)@
Upper Middle Income Countries	LLGR	-1.3874*		I(0)@
	PCGR	-2.7129**		I(0)@
	INFL.LLGR	-3.4394**		I(0)@
	INFL.PCGR	-2.4753**		I(0)
High Income Countries	LLGR	-2.4721**		I(0)
	PCGR	-2.9472**		I(0)
	INFL.LLGR	-6.0404**		I(0)@
	INFL.PCGR	-1.1889	-12.0460**	I(1)

*: Significant at 10% level where critical value is -1.28
**: Significant at 5% level where critical value is -1.64
@: Order of integration is insensitive to maximum lag selection for general to specific methodology between 4 (for which these results are presented) and 1 (results for maximum lag selected 3, 2, and 1 are not presented here).

Table 4.5 (i) above gives the results of panel unit root test on variables related to indirect financial development, and the interaction between (indirect) financial development and inflation. These results show that except LLGR of Low Income Countries and INFL*PCGR of High Income Countries, all the variables are stationary at level. LLGR of Low Income Countries and INFL*PCGR of High Income Countries are nonstationary and becomes stationary after first differencing, so again we will be using first differences of these nonstationary variables in the panel causality analysis.

Table 4.5 (ii) below gives the results of panel unit root test on variables related to direct financial development, and the interaction between (direct) financial development and inflation. It is clear that that all the variables are stationary at level except VTGR of upper middle income countries. VTGR is stationary at first difference rendering integrated of order one. In our dynamic heterogeneous panel causality analysis we use first difference of VTGR to make it stationary.

Table 4.5 (ii): IPS PUR Test for Direct Finance and Interaction Variables

Panel	Variable	IPS-PUR test at Level	IPS-PUR test at First Difference	I(0)/I(1)
Low Income Countries	MCGR	-1.7027**		I(0)
	VTGR	-3.1012**		I(0)@
	INFL.MCGR	-5.0282**		I(0)@
	INFL.VTGR	-2.4569**		I(0)@
Lower Middle Income Countries	MCGR	-1.9943**		I(0)
	VTGR	-1.5330*		I(0)
	INFL.MCGR	-4.5577**		I(0)@
	INFL.VTGR	-4.2887**		I(0)@
Upper Middle Income Countries	MCGR	-2.2622**		I(0)@
	VTGR	-1.1376	-9.4345**	I(1)@
	INFL.MCGR	-2.5873**		I(0)@
	INFL.VTGR	-2.9742**		I(0)@
High Income Countries	MCGR	-2.9005**		I(0)@
	VTGR	-4.6956**		I(0)@
	INFL.MCGR	-4.3908**		I(0)@
	INFL.VTGR	-3.1746**		I(0)@

*: Significant at 10% level where critical value is -1.28
**: Significant at 5% level where critical value is -1.64
@: Order of integration is insensitive to maximum lag selection for general to specific methodology between 4 (for which these results are presented) and 1 (results for maximum lag selected 3, 2, and 1 are not presented here).

Table 4.5 (iii) below gives the results of panel unit root test on variables related to overall financial development, and the interaction between (overall) financial development and inflation. The results show that all the variables are stationary at level form except FAGR of upper middle income countries and FDGR of high income countries. These two variables are stationary at first difference. In our dynamic heterogeneous panel causality analysis we use first difference of these two variables to make them stationary.

Table 4.5 (iii): IPS PUR Test for Overall Finance and Interaction Variables

Panel	Variable	IPS-PUR test at Level	IPS-PUR test at First Difference	I(0)/I(1)
Low Income Countries	FDGR	-1.6924**		I(0)
	FAGR	-2.5436**		I(0)[@]
	INFL.FDGR	-4.8113**		I(0)[@]
	INFL.FAGR	-2.3257**		I(0)[@]
Lower Middle Income Countries	FDGR	-1.4393*		I(0)
	FAGR	-2.0567**		I(0)[@]
	INFL.FDGR	-3.7655**		I(0)[@]
	INFL.FAGR	-4.3589**		I(0)[@]
Upper Middle Income Countries	FDGR	-3.3602**		I(0)[@]
	FAGR	-1.1083	-17.9434**	I(1)
	INFL.FDGR	-2.3512**		I(0)[@]
	INFL.FAGR	-1.5038*		I(0)
High Income Countries	FDGR	-0.4946	-24.4457**	I(1)
	FAGR	-2.0728**		I(0)
	INFL.FDGR	-5.4697**		I(0)[@]
	INFL.FAGR	-2.3877**		I(0)[@]

*: Significant at 10% level where critical value is -1.28
**: Significant at 5% level where critical value is -1.64
@: Order of integration is insensitive to maximum lag selection for general to specific methodology between 4 (for which these results are presented) and 1 (results for maximum lag selected 3, 2, and 1 are not presented here).

Using IPS panel unit root test we find most of the variables to be I(0) except a few variable which are I(1). The dependent variable for all the four panels is I(0) and thus we do not require testing for panel cointegration. By taking first difference of I(1) variables we will progress with these transformed and other already I(0) variables to the contemporaneous non dynamic fixed effect panel estimation and then to panel causality analysis.

5 Indirect Financial Development and Economic Growth

In this Chapter we explore the relationship between indirect financial development indicators and economic growth. We start with the estimation of contemporaneous non dynamic fixed effects panel estimation of the most general form which relates growth rate of GDP per capita to inflation, government consumption to GDP ratio, overall trade to GDP ratio, (initial) secondary school enrollment ratio and the (initial) level of per capita GDP[50]. We drop the variables with insignificant coefficients and arrive at the basic model. To the basic model we include the proxy for financial development and have intermediate model. Our final model is one where we have inflation and financial development both individually and in product form included in the basic model. In the next Section we do Weinhold panel causality analysis using Mixed Fixed Random coefficients approach of Hsiao et al (1989).

5.1 CONTEMPORANEOUS NON DYNAMIC FIXED EFFECTS PANEL ESTIMATION

Table 5.1 below gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Low Income Countries. As the basic model shows only inflation, government consumption to GDP ratio, (initial) secondary school enrollment ratio and initial per capita income are the significant determinants of growth in per capita GDP. Taking these four variables as explanatory variables we extend the model by including proxies for indirect finance as regressors and re-estimate the simple

[50] All the variables are in log form except growth in real GDP per capita and inflation.

contemporaneous non dynamic fixed effects panel regression and results are shown in the column under intermediate model.

Table 5.1: LIC - Indirect Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.2114 (-2.69**)	-0.2117 (-2.55**)	-0.2117 (-2.55**)	-0.2097 (-2.59**)	-0.6255 (-3.22**)	-0.5867 (-4.19**)
GCGR	-0.0474 (-2.52**)	-0.0456 (-2.68**)	-0.0427 (-2.35**)	-0.0408 (-2.39**)	-0.0381 (-2.17**)	-0.0377 (-2.09**)
TRGR	0.0094 (0.74)					
SSER	0.0249 (3.10**)	0.0246 (3.03**)	0.0225 (3.11**)	0.0238 (2.79**)	0.0260 (2.83**)	0.0284 (3.24**)
RGPC	-0.0299 (-2.97**)	-0.0311 (-2.95**)	-0.0243 (-2.00**)	-0.0223 (-1.64**)	-0.0321 (-2.34**)	-0.0317 (-1.94*)
ΔLLGR			-0.0148 (-1.14)		**0.0293 (1.58)**	
PCGR				-0.0153 (-1.52)		**0.0116 (0.61)**
INFL.LLGR					-0.3414 (-2.82**)	
INFL.PCGR						-0.2400 (-3.61**)
NT	199	199	199	199	199	199
R^2	0.2229	0.2195	0.2246	0.2307	0.2903	0.3152

**Significant at 5% size;*Significant at 10% size.

The results show that all the four significant explanatory variables in the basic model have appropriate sign. These results are consistent with standard growth theory. Inflation depresses growth due to its adverse implications for working markets like rising price variability which makes the log term planning difficult. Government consumption is observed to affect growth negatively. It may be because of well know inefficiencies associated with the larger size of the government. Negative significant coefficient of initial level of per capita GDP is in accordance with the conditional convergence growth theories. Initial secondary school enrollment has positive effect on growth rate of real GDP per capita.

As regard to impact of financial development on growth, the results show that coefficients of the proxies of both the size and the activity of financial sector are negative and statistically insignificant. However, when the interaction of finance with inflation is introduced, then the coefficients of the proxies of both the size and the activity of the financial sector become positive but remain insignificant. The final model for Low Income Countries explains about one third of the variation in growth.

From here we observe that for the LIC finance does not matter for growth and the data we use support the Lucas view and our results are in line with the most recent findings of Barro and Sala-i-Martin (2004). It is interesting to note that both the interaction variables are highly significant and have negative sign. It implies economic growth returns of further financial sector development actually declines with the increased inflation for LIC. In other words a negative significant coefficient on the interaction term means that further financial development accelerates the negative effect of inflation on growth rate of GDP per capita. Another important observation is that the magnitude of the partial effect of inflation on growth rate of GDP per capita is much larger in the final model as compared to that in the basic model which shows that inflation may be a much serious issue in financially developed stage of economy as its impact is larger than that can be at the lesser (financially) developed stage of the economy in case of Low Income Countries.

Table 5.2 below gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of LMIC. Here we find significance of the coefficient of international trade to GDP ratio which has positive sign in all the three models; in addition to the significance of inflation, government consumption to GDP ratio and initial level of GDP per capita. In the intermediate model, only the proxy of size indictor of financial activity is statistically significant and the activity indictor is insignificant. It is important to note that with the inclusion of interaction variable the activity indictor of indirect financial development becomes positively significant show that there is strong positive relationship of indirect financial sector activity with growth rate of GDP per capita. Negative significance of the estimated coefficient of size indictor means finance discourages economic growth in case of LMIC.

Table 5.2: LMIC - Indirect Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.4279 (-3.98**)	-0.4273 (-3.94**)	-0.4522 (-4.16**)	-0.4214 (-3.98**)	-0.7690 (-7.77**)	-0.9837 (-5.37**)
GCGR	-0.1446 (-4.13**)	-0.1458 (-4.49**)	-0.1095 (-2.72**)	-0.1399 (-4.60**)	-0.1064 (-3.27**)	-0.1261 (-5.13**)
TRGR	0.1016 (5.20**)	0.1007 (5.30**)	0.1491 (5.53**)	0.1014 (5.51**)	0.1640 (4.93**)	0.1041 (3.93**)
SSER	-0.0058 (-0.10)					
RGPC	-0.0802 (-3.41**)	-0.0817 (-4.82**)	-0.0568 (-7.15**)	-0.0743 (-4.50**)	-0.0699 (-5.74**)	-0.0910 (-4.13**)
LLGR			-0.0850 (-3.31**)		**-0.0552 (-2.95**)**	
PCGR				-0.0130 (-1.55)		**0.0312 (2.46**)**
INFL.LLGR					-0.4608 (-2.81**)	
INFL.PCGR						-0.4950 (-3.89*)
NT	127	127	127	127	127	127
R^2	0.2905	0.2903	0.3458	0.2966	0.3929	0.3761

**Significant at 5% size;*Significant at 10% size

For the LMIC the evidence suggests that the two indicators of financial development has mixed effects on real GDP per capita growth. Since we are using the panel data with observations kept in annual format, it may be argued that business cycles are the driving force of these findings[51]. Yet, the conflicting results are puzzlingly confined to the indicators of financial development while the standard growth determinants maintain their expected contribution to real GDP per capita growth.

Like that in the case of LIC, here also both the interaction variables are significant (though the coefficient of the interaction of inflation with activity measure of indirect financial development is significant at 10% level) and have negative sign implying that economic growth returns of further financial sector development declines with the increased inflation.

Table 5.3: UMIC - Indirect Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.1920 (-9.00**)	-0.1912 (-9.98**)	-0.1960 (-14.1**)	-0.2094 (-15.3**)	-0.1219 (-1.20)	-0.2223 (-2.47**)
ΔGCGR	-0.1368 (-7.32**)	-0.1366 (-7.61**)	-0.1184 (-3.13**)	-0.1062 (-3.64**)	-0.1183 (-3.19**)	-0.1062 (-3.63**)
TRGR	0.0430 (2.82**)	0.0427 (2.90**)	0.0441 (2.29**)	0.0482 (2.18**)	0.0429 (2.42**)	0.0489 (2.64**)
SSER	-0.0026 (-0.11)					
RGPC	-0.0643 (-9.63**)	-0.0650 (-8.90**)	-0.0595 (-5.24**)	-0.0555 (-5.28**)	-0.0571 (-4.23**)	-0.0664 (-4.21**)
LLGR			-0.0190 (-0.77)		**-0.0226 (-0.89)**	
PCGR				-0.0214 (-1.70*)		**-0.0206 (-1.35)**
INFL.LLGR					0.0520 (0.76)	
INFL.PCGR						-0.0066 (-0.16)
NT	144	144	144	144	144	144
R^2	0.2043	0.2042	0.2114	0.2245	0.2135	0.2246

**Significant at 5% size;*Significant at 10% size

[51] Annual data may contain the business cycle factors that may be irrelevant for long term movements. With dynamics, an annual data analysis may yield coefficient estimates that reflect a mix of both long run and short relationships. To such view use of long run averages may have powerful justification for identifying growth as opposed to cyclical factors.

Table 5.3 above gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Upper Middle Income Countries. This case is different from the earlier two cases in the sense that the proxies of both the size and the activity of indirect financial sector are statistically insignificant irrespective of the fact whether we take finance alone or as an interaction variable with inflation. Thus implications are clear that economic growth is independent of financial development expressed in terms of activities or depth of the financial sector. We do not observe higher magnitude of the partial effect of inflation on growth rate of GDP per capita in the final model as compared to that in the basic model. Rather we find insignificant partial effect of inflation on per capita economic growth both individually as well as in interaction with financial development.

Table 5.4: HIC - Indirect Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.3247 (-8.94**)	-0.3255 (-9.19**)	-0.3275 (-9.96**)	-0.3184 (-8.50**)	-0.3882 (-10.6**)	-0.3286 (-7.77**)
ΔGCGR	-0.0728 (-5.25**)	-0.0729 (-5.35**)	-0.0725 (-5.09**)	-0.0747 (-5.50**)	-0.0767 (-5.72**)	-0.0750 (-5.68**)
ΔTRGR	0.0472 (3.30**)	0.0473 (3.25**)	0.0475 (3.30**)	0.0490 (3.50**)	0.0503 (3.94**)	0.0491 (3.55**)
SSER	0.0011 (0.15)					
RGPC	-0.0212 (-4.64**)	-0.0210 (-5.04**)	-0.0216 (-5.19**)	-0.0156 (-3.59**)	-0.0222 (-5.47**)	-0.0159 (-3.64**)
LLGR			0.0017 (0.25)		**0.0971** **(1.25)**	
PCGR				-0.0121 (-2.80**)		**-0.0108** **(-1.50)**
INFL.LLGR					-0.1481 (-2.25**)	
ΔINFL.PCGR						-0.0195 (-0.28)
NT	471	471	471	471	471	471
R^2	0.2837	0.2837	0.2838	0.3014	0.2933	0.3016

**Significant at 5% size;*Significant at 10% size

Lastly, for the case of panel of High Income Countries the results are presented above in the Table 5.4. As the basic model shows inflation, government consumption to GDP ratio, overall trade to GDP ratio, and initial per capita income are the significant determinants of growth in per capita GDP. Signs of all the coefficients are as expected. Taking these four variables as explanatory variables we extend the model by including proxies for financial development as regressors and re-estimate the simple contemporaneous non dynamic fixed effects panel regression. The coefficient of the proxy of the size of the financial sector is insignificant whereas the coefficient of the proxy of the activity of the financial sector is significant with a negative sign. When the interaction of finance with inflation is introduced, then the coefficients of the proxies of both the size and the activity of the financial sector become insignificant. However, the interaction term is negatively significant in case of interaction with size indictor and is insignificant in case of interaction with activity indicator of financial development. Thus in the High Income Countries, we do not find any relationship between financial development and economic growth when we have interaction variable in the model. However, the economic growth returns of further financial development in the size of indirect finance declines with increased inflation.

The key points emerged from these results of indirect finance and growth (contemporaneous) relationship analyses are the following:

- We do not find any evidence of significant relationship between financial development and economic growth except for the panel of Lower Middle Income Countries while we consider the interaction of indirect finance with inflation as regressor in addition to the proxy for financial development i.e. in the final model.

In case of LMIC we observe that the activity indictor of indirect financial development is positively significant showing that there is positive relationship of indirect financial sector activity with growth rate of GDP per capita whereas the estimated coefficient of size indictor is negatively significant meaning that finance discourages economic growth in case of LMIC. Overall the evidence suggests that the level of financial development has ambiguous effects on real GDP per capita growth for LMIC.

- Both the indictors of size and activity of financial sector have insignificant estimated coefficients for LIC, UMIC and HIC, implying indirect finance and economic growth are independent of each.
- In cases where we find the interaction term to be significant, the magnitude of the partial effect of inflation on growth rate of GDP per capita is larger in the final model as compared to that in the basic model which shows that inflation may be a much serious issue in financially developed stage of economy as its impact is larger than that can be at the lesser (financially) developed stage of the economy.
- Interaction variable is found to be negative and statistically significant for LIC and LMIC. However, it is found to be statistically insignificant for UMIC and HIC except in the case of interaction of the size of direct finance with inflation for HIC where it is negatively significant. It suggests that the negative relation between financial development and inflation is a more serious concern for LIC and LMIC than for UMIC and HIC. It is also important to note that, where significant, sign of the interaction variable is negative for all the cases we study in this chapter.

Entire analysis of contemporaneous non-dynamic fixed effects panel estimation presented above is based on underlying assumption about the homogeneity of the relationships in questions across countries in the respective panels. Heterogeneity is restricted to the intercept but is not permitted in the slope coefficients. Now we will be moving to the causality analysis based on our dynamic model we discussed in Chapter 3. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be constant but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates. For causality analysis we use MFR coefficients approach of Weinhold (1999) and Reichert and Weinhold (2001) for heterogeneous dynamic panel data model.

5.2 PANEL CAUSALITY ANALYSIS

We now estimate MFR coefficients model as outline in chapter 3 which allow for heterogeneous dynamics across countries and for a distribution over the coefficients on the other explanatory variables. We apply Reichert and Weinhold (2001) panel causality method to our final model in dynamic form for various panels of the countries. This includes the lagged dependent variable which not only takes into account the dynamic process of growth but also provides an excellent proxy for many omitted variables. In this model the coefficient on the lagged dependent variable is country specific and the coefficients on the other RHS variables are allowed to have normal distribution. We choose a lag length of one due to the large number of explanatory variables and relatively short time series for each country. The results are presented in Table 5.5 below where we report the mean of the estimated coefficient, standard error of the mean of the estimated coefficient, and the variance estimate of the estimated coefficient on the causal variable.

For causality testing, we build confidence interval around zero (here we will use the first element in the estimated vector $\tilde{\theta}_1$ which is $\tilde{\theta}_{1[1]}$ which is to be tested to be zero) to test for mean of the estimated coefficient on the causal variable to be zero. The lower and upper bounds are given below:

LB (Confidence Interval): $\{(-2) * \sqrt{N}\tilde{\sigma}_{\tilde{\theta}_{1[1]}} - \tilde{\theta}_{1[1]}\} / \Delta_{r_{11}}$

UB (Confidence Interval): $\{2 * \sqrt{N}\tilde{\sigma}_{\tilde{\theta}_{1[1]}} - \tilde{\theta}_{1[1]}\} / \Delta_{r_{11}}$

Table 5.5: Nair-Reichert and Weinhold (2001) Panel Causality Analysis - Indirect Finance

Panel		Direct Causality		Reverse Causality	
		Size	Activity	Size	Activity
Low Income Countries	Estimated Coefficient	**0.0096**	**-0.0487**	**-0.0258**	**0.4119**
	Standard Error	0.0690	0.0762	0.7699	1.0222
	LB (Confidence Interval)	**-2.6839**	**-4.5154**	**-3.5272**	**-1.8752**
	UB (Confidence Interval)	**2.5626**	**5.5914**	**3.5668**	**1.6392**
	Est. Coefficient Variance	0.0249	0.0082	1.6962	12.1826
Lower Middle Income Countries	Estimated Coefficient	**0.3136**	**-0.0620**	**0.0924**	**-0.2658**
	Standard Error	0.0990	0.0541	0.3372	0.8262
	LB (Confidence Interval)	**-2.3242**	**-1.1487**	**-3.3091**	**-7.9499**
	UB (Confidence Interval)	**0.4989**	**1.8501**	**2.9586**	**9.0676**
	Est. Coefficient Variance	0.1180	0.0312	0.2778	0.2263
Upper Middle Income Countries	Estimated Coefficient	**-0.1067**	**-0.1236**	**0.1599**	**-0.3907**
	Standard Error	0.2920	0.2045	0.4629	0.5069
	LB (Confidence Interval)	**-3.3674**	**-5.0152**	**-7.6156**	**-3.6542**
	UB (Confidence Interval)	**3.8670**	**6.3082**	**6.6819**	**4.9001**
	Est. Coefficient Variance	0.1824	0.0365	0.1174	0.3933
High Income Countries	Estimated Coefficient	**-0.0460**	**-0.0246**	**0.1185**	**-0.1911**
	Standard Error	0.0194	0.0201	0.1731	0.3684
	LB (Confidence Interval)	**-1.1651**	**-2.4902**	**-2.4124**	**-1.9209**
	UB (Confidence Interval)	**2.0340**	**3.3034**	**2.0611**	**2.1640**
	Est. Coefficient Variance	0.0112	0.0037	0.4553	2.4722

**Significant at 5% size

The area that falls within this interval is interpreted to correspond to observations that are not significantly different from zero.

In all the four panels we do not find evidence that the mean of the estimated coefficient of the orthogonalized causal candidate variable is significantly different from zero. Thus the results of the tests of causality from finance to growth as well as that of causality from growth to finance show that none is causing the other and hence we find support for Lucas view that the economists overstress the role of finance. However, we need to interpret results of causality analysis with a caution as it relates one variable with the lagged values of the other variable and ignores the contemporaneous relationship between the variables of interest.

6 Direct Financial Development and Economic Growth

In this Chapter we examine the links between economic growth and financial development considering direct sources of finance, i.e. stock market. Like previous chapter, this chapter is also organized in two sections. Section 6.1 presents results of the simple contemporaneous non dynamic fixed effects panel estimation of the most general form which relates growth rate of GDP per capita to inflation, government consumption to GDP ratio, overall trade to GDP ratio, (initial) secondary school enrollment ratio and the (initial) level of per capita GDP[52]. We drop the variables with insignificant coefficients and arrive at the basic model. To the basic model we include the proxy for financial development and have intermediate model. Our final model is one where we have inflation and financial development both individually and in product form included in the basic model. We shall start with the results of panels of Low Income Countries, Lower Middle Income Countries, Upper Middle Income Countries, and High Income Countries. In the second and the last Section of this Chapter we present the results of the Weinhold panel causality analysis in the same panel wise sequence as in the Section 6.1.

6.1 CONTEMPORANEOUS NON DYNAMIC FIXED EFFECTS PANEL ESTIMATION

Table 6.1 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Low Income Countries. As the basic model shows only inflation, government consumption to GDP ratio, (initial) secondary school enrollment

[52] All the variables are in log form except growth in real GDP per capita and inflation.

ratio and initial per capita income are the significant determinants of growth in per capita GDP. Taking these four variables as explanatory variables we extend the model by including proxies for direct finance as regressors and re-estimate the simple contemporaneous non dynamic fixed effects panel regression and results are shown in the column under intermediate model.

Table 6.1: LIC - Direct Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.2114 (-2.69**)	-0.2117 (-2.55**)	-0.2137 (-2.52**)	-0.2101 (-2.56**)	-0.5276 (-3.60**)	-0.4108 (-2.48**)
GCGR	-0.0474 (-2.52**)	-0.0456 (-2.68**)	-0.0446 (-2.57**)	-0.0440 (-2.70**)	-0.0444 (-2.87**)	-0.0430 (-2.74**)
TRGR	0.0094 (0.74)					
SSER	0.0249 (3.10**)	0.0246 (3.03**)	0.0235 (2.54**)	0.0244 (2.94**)	0.0289 (3.11**)	0.0257 (3.27**)
RGPC	-0.0299 (-2.97**)	-0.0311 (-2.95**)	-0.0359 (-3.30**)	-0.0339 (-2.54**)	-0.0417 (-4.66**)	-0.0387 (-2.87**)
MCGR			0.0028 (1.02)		**0.0166 (6.59**)**	
VTGR				0.0010 (0.49)		**0.0052 (1.82*)**
INFL.MCGR					-0.1306 (-3.13**)	
INFL.VTGR						-0.0388 (-1.78*)
NT	199	199	199	199	199	199
R^2	0.2229	0.2195	0.2227	0.2205	0.2893	0.2662

**Significant at 5% size;*Significant at 10% size

The coefficients of the proxies of both the size and the activity of financial sector are statistically insignificant in the intermediate model which becomes significant in the final model when we include interaction variables. This shows that size and activity of direct finance has strong positive relationship with economic growth for LIC. The interaction of inflation with size of direct finance has a negative significant coefficient which has the interpretation that growth return of increase in the size of financial sector decreases with inflation. If we consider the positive significance of the size measure of direct finance we can not ignore the fact that the magnitude of the estimated coefficient of the interaction variable is larger than that of the size of the direct financial development and hence even with the low level of inflation the total impact of financial sector development has negative impact on growth rate of GDP per capita. The interaction of inflation with activity of direct finance has a negative significant coefficient at 10% level. All the other explanatory variables have expected signs in the final model as well as in basic and intermediate models which are consistent with the theory. The final model for Low Income Countries explains about one fourth of the variation in growth.

Here also, like in case of indirect finance in chapter 5, we observe that the magnitude of the partial effect of inflation on growth rate of GDP per capita is much larger in the final model as compared to that in the basic model. It again shows that inflation may be a much serious issue in financially developed stage of economy as its impact is larger than that can be at the lesser (financially) developed stage of the economy in case of Low Income Countries.

Table 6.2 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Lower Middle Income Countries. One difference here than our earlier analysis is that there we have (overall) trade to GDP ratio significant in our basic model as well as in intermediate and final model. In both the intermediate model and final model the estimated coefficients of the proxies of size and activity the direct financial sector are positive and statistically significant. It is interesting to note that interaction of direct finance measures with inflation has no significant impact on growth while we see final model in this case of Lower Middle Income Countries.

Table 6.2: LMIC - Direct Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	**Activity**	**Size**	**Activity**
INFL	-0.4279 (-3.98**)	-0.4273 (-3.94**)	-0.3776 (-3.75**)	-0.3716 (-2.94**)	-0.3619 (-2.03**)	-0.5139 (-1.60)
GCGR	-0.1446 (-4.13**)	-0.1458 (-4.49**)	-0.1215 (-5.21**)	-0.1058 (-2.39**)	-0.1210 (-4.59**)	-0.1016 (-2.78**)
TRGR	0.1016 (5.20**)	0.1007 (5.30**)	0.0499 (2.92**)	0.0617 (2.11**)	0.0498 (2.88**)	0.0577 (2.32**)
SSER	-0.0058 (-0.10)					
RGPC	-0.0802 (-3.41**)	-0.0817 (-4.82**)	-0.0988 (-5.02**)	-0.0804 (-4.23**)	-0.0982 (-4.42**)	-0.0816 (-4.01**)
MCGR			0.0253 (5.12**)		**0.0243 (2.75**)**	
VTGR				0.0094 (2.80**)		**0.0135 (3.67**)**
INFL.MCGR					0.0093 (0.20)	
INFL.VTGR						-0.0393 (-0.67)
NT	127	127	127	127	127	127
R^2	0.2905	0.2903	0.3908	0.3264	0.3910	0.3318

**Significant at 5% size;*Significant at 10% size

Table 6.3 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Upper Middle Income Countries. Like what we observed above for the panel of Lower Middle Income Countries, for the panel of UMIC we find that the proxies of both the size and the activity of direct financial sector are positive and statistically significant irrespective of the fact whether we take finance alone or as an interaction variable with inflation. Thus economic growth is strongly related to the financial development expressed in terms of activities or depth of the financial sector.

In the final model the interaction term is negatively significant in case of interaction with size indictor and is insignificant in case of interaction with activity indicator of financial development.

Table 6.3: UMIC - Direct Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.1920 (-9.00**)	-0.1912 (-9.98**)	-0.1325 (-4.13**)	-0.1637 (-6.04**)	-0.3948 (-7.81**)	-0.1483 (-2.10**)
ΔGCGR	-0.1368 (-7.32**)	-0.1366 (-7.61**)	-0.1199 (-4.95**)	-0.0866 (-3.72**)	-0.1337 (-6.66**)	-0.0867 (-3.72**)
TRGR	0.0430 (2.82**)	0.0427 (2.90**)	0.0166 (1.31)	0.0319 (1.64*)	0.0316 (2.16**)	0.0313 (1.68*)
SSER	-0.0026 (-0.11)					
RGPC	-0.0643 (-9.63**)	-0.0650 (-8.90**)	-0.0836 (-6.15**)	-0.0891 (-9.03**)	-0.1186 (-8.37**)	-0.0883 (-9.18**)
MCGR			0.0253 (1.95*)		**0.0466 (3.42**)**	
ΔVTGR				0.0180 (4.57**)		**0.0175 (4.07**)**
INFL.MCGR					-0.0980 (-3.76**)	
INFL.VTGR						0.0040 (0.20)
NT	144	144	144	144	144	144
R^2	0.2043	0.2042	0.2663	0.3177	0.3026	0.3178

**Significant at 5% size;*Significant at 10% size

Thus in the UMIC, we find positive relationship between financial development and economic growth when we have interaction variable in the model. However, the economic growth returns of further financial development in the size of indirect finance declines with increased inflation.

We also observe that in case where the interaction variable is significant there is large increase in the magnitude of the partial effect of inflation on growth rate of GDP per capita in the final model. However, there is no such increase in the magnitude of the partial effect of inflation on growth rate of GDP per capita in the final model in case where the interaction variable is insignificant.

Table 6.4: HIC - Direct Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.3247 (-8.94**)	-0.3255 (-9.19**)	-0.2500 (-5.75**)	-0.2790 (-6.89**)	-0.3086 (-5.58**)	-0.3151 (-6.83**)
ΔGCGR	-0.0728 (-5.25**)	-0.0729 (-5.35**)	-0.0714 (-4.61**)	-0.0695 (-4.98**)	-0.0693 (-4.15**)	-0.0668 (-4.66**)
ΔTRGR	0.0472 (3.30**)	0.0473 (3.25**)	0.0443 (2.99**)	0.0452 (3.01**)	0.0407 (2.65**)	0.0431 (2.75**)
SSER	0.0011 (0.15)					
RGPC	-0.0212 (-4.64**)	-0.0210 (-5.04**)	-0.0267 (-6.63**)	-0.0245 (-4.80**)	-0.0295 (-8.03**)	-0.0263 (-5.22**)
MCGR			0.0069 (4.34**)		**0.0103 (3.59**)**	
VTGR				0.0021 (1.90*)		**0.0033 (1.99**)**
INFL.MCGR					-0.0302 (-1.36)	
INFL.VTGR						-0.0104 (-1.01)
NT	471	471	471	471	471	471
R^2	0.2837	0.2837	0.3070	0.2920	0.3127	0.2941

**Significant at 5% size;*Significant at 10% size

Lastly, for the case of panel of High Income Countries the results are presented in the Table 6.4. As the basic model shows inflation, government consumption to GDP ratio, overall trade to GDP ratio, and initial per capita income are the significant determinants of growth in per capita GDP. Taking these four variables as explanatory variables we extend the model by including proxies for financial development as regressors and re-estimate the simple contemporaneous non dynamic fixed effects panel regression. Like that of the above case of Lower Middle Income Countries, both the proxies of size and activity of the (direct) financial sector are significant irrespective of the fact interaction variables are included or not. Interaction variables themselves are found to be insignificant.

The key points emerged from these results of direct finance and growth analysis are the following:

- We observe that for all the four panels there is significant and positive relationship between direct financial development and economic growth while we consider the interaction of direct finance with inflation as regressor in addition to the proxy for financial development i.e. in the final model.
- The coefficients of the interaction variables found to be insignificant except in the two cases of LIC and for the one case of UMIC when size of the direct financial development is used in the model. We observe that as the level of income increases from low to higher, the inflation and (direct) financial development interaction variable moves from having negatively significant estimated coefficient to insignificant estimated coefficient.

As discussed in Chapter 5, entire analysis of contemporaneous non-dynamic fixed effects panel estimation presented above is based on underlying assumption about the homogeneity of the relationships in questions across countries in the respective panels. Heterogeneity is restricted to the intercept but is not permitted in the slope coefficients. Now we will be moving to the causality analysis based on our dynamic model we discussed in Chapter 3. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be constant but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates. For causality analysis we use MFR coefficients approach of Weinhold (1999) and Reichert and Weinhold (2001) for heterogeneous dynamic panel data model.

6.2 PANEL CAUSALITY ANALYSIS

We now estimate MFR coefficients model allowing for heterogeneous dynamics across countries and for a distribution over the coefficients on the other explanatory variables. We apply Reichert and Weinhold (2001) panel causality method to our final model in dynamic form for each of the four panels we have. The results obtained are presented in the Table 6.5 where we report the mean of the estimated coefficient, standard error of the mean of the estimated coefficient, and the variance estimate of the estimated coefficient on the causal variable.

Table 6.5: Nair-Reichert and Weinhold (2001) Panel Causality Analysis - Direct Finance

Panel		Direct Causality		Reverse Causality	
		Size	Activity	Size	Activity
Low Income Countries	Estimated Coefficient	**0.0047**	**0.0060**	**-0.3347**	**-2.0784****
	Standard Error	0.0097	0.0048	3.5707	4.5769
	LB (Confidence Interval)	**-2.6297**	**-4.3592**	**-3.4292**	**-1.4603**
	UB (Confidence Interval)	**2.2383**	**2.8596**	**3.5381**	**1.6994**
	Est. Coefficient Variance	0.0006	0.0001	37.8218	302.1487
Lower Middle Income Countries	Estimated Coefficient	**-0.0254**	**0.0150**	**1.3904**	**1.7440****
	Standard Error	0.0245	0.0116	2.9968	4.1906
	LB (Confidence Interval)	**-1.4708**	**-2.0791**	**-3.1627**	**-1.3899**
	UB (Confidence Interval)	**2.2605**	**1.2128**	**2.6155**	**1.1722**
	Est. Coefficient Variance	0.0041	0.0012	25.8229	256.8180
Upper Middle Income Countries	Estimated Coefficient	**-0.0015**	**0.0035**	**-0.2709**	**-1.5766**
	Standard Error	0.1203	0.0118	1.1040	2.9330
	LB (Confidence Interval)	**-14.8158**	**-2.5944**	**-2.5534**	**-2.3666**
	UB (Confidence Interval)	**14.8878**	**2.3185**	**2.8017**	**2.9017**
	Est. Coefficient Variance	0.0018	0.0006	4.7604	34.7132
High Income Countries	Estimated Coefficient	**-0.0003**	**0.0004**	**-1.0713**	**2.4375****
	Standard Error	0.0028	0.0012	0.8431	1.9222
	LB (Confidence Interval)	**-1.3145**	**-0.8474**	**-1.9328**	**-2.4661**
	UB (Confidence Interval)	**1.3493**	**0.7796**	**2.5923**	**1.8397**
	Est. Coefficient Variance	0.0003	0.0002	10.5528	60.5836

**Significant at 5% size

For causality testing, we build confidence interval around zero to test for mean of the estimated coefficient on the causal variable to be zero. The lower and upper bounds are also given in the Table 6.5. The area that falls within this interval is interpreted to correspond to observations that are not significantly different from zero.

For all the cases of causal effect of financial development on economic growth we do not find evidence that the estimated coefficient of the orthogonalized causal candidate variable is significantly different from zero. Thus the results of the tests of causality from finance to growth show that there is no role for finance in economic growth. However, when we conduct the reverse causality analysis we find mixed result. In the case of LIC we observe that economic growth has negative impact upon the financial development. Whereas for the cases of LMIC and HIC countries we find that support for Robinson's view that finance follows growth as the estimated coefficient of the orthogonalized causal candidate variable is positively significantly different from zero. For the case of UMIC, the same is found to be insignificant and hence for UMIC there is no relation between financial development and economic growth while we take care of heterogeneity of the relationship between countries.

7 Overall Financial Development and Economic Growth

In this Chapter we explore the relationship between overall financial development indicators and economic growth. As explained in chapter 3, the overall indicators of financial sector development are obtained by summing the indicators of direct as well indirect finance.

In section 7.1, we shall present the results of simple contemporaneous non dynamic fixed effects panel estimation of the most general form which relates growth rate of GDP per capita to inflation, government consumption to GDP ratio, overall trade to GDP ratio, (initial) secondary school enrollment ratio and the (initial) level of per capita GDP[53]. We drop the variables with insignificant coefficients and arrive at the basic model. To the basic model we include the proxy for financial development and have intermediate model. Our final model is one where we have inflation and financial development both individually and in product form included in the basic model. We shall start with the results of panels of Low Income Countries and then report that of Lower Middle Income Countries, Upper Middle Income Countries, and High Income Countries.

In Section 7.2, the results of the Weinhold causality analysis will be presented in the same panel wise sequence as in the Section 7.1.

[53] All the variables are in log form except growth in real GDP per capita and inflation.

7.1 CONTEMPORANEOUS NON DYNAMIC FIXED EFFECTS PANEL ESTIMATION

Table 7.1 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Low Income Countries. As the basic model shows only inflation, government consumption to GDP ratio, (initial) secondary school enrollment ratio and initial per capita income are the significant determinants of growth in per capita GDP. Taking these four variables as explanatory variables we extend the model by including proxies for overall financial development as regressors and re-estimate the simple contemporaneous non dynamic fixed effects panel regression. The coefficients of the proxies of both the size and the activity of overall financial sector are statistically insignificant in the intermediate model. When the interaction of finance with inflation in introduced, then the coefficient of the proxy of the size turns to be positively significant and that of the activity of overall financial sector remain insignificant. It is interesting to note that both the interaction variables are highly significant and have negative sign. It implies that economic growth returns of further financial sector development actually declines with the increased inflation in the case of Low Income Countries.

Here also, like in case of indirect and direct finance in Chapters 5 and 6 respectively, we observe that the magnitude of the partial effect of inflation on growth rate of GDP per capita is much larger in the final model as compared to the basic model. It again shows that inflation may be a much serious issue in financially developed stage of economy as its impact is larger than that can be at the lesser (financially) developed stage of the economy in case of Low Income Countries.

Table 7.1: LIC - Overall Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.2114 (-2.69**)	-0.2117 (-2.55**)	-0.2125 (-2.52**)	-0.2123 (-2.62**)	-0.4997 (-3.51**)	-0.4313 (-2.96**)
GCGR	-0.0474 (-2.52**)	-0.0456 (-2.68**)	-0.0462 (-2.47**)	-0.0418 (-2.30**)	-0.0435 (-2.44**)	-0.0401 (-2.23**)
TRGR	0.0094 (0.74)					
SSER	0.0249 (3.10**)	0.0246 (3.03**)	0.0247 (3.14**)	0.0244 (2.88**)	0.0297 (3.59**)	0.0269 (2.92**)
RGPC	-0.0299 (-2.97**)	-0.0311 (-2.95**)	-0.0339 (-2.63**)	-0.0206 (-1.44)	-0.0479 (-3.78**)	-0.0277 (-1.56)
FDGR			0.0043 (0.28)		**0.0499 (3.86**)**	
FAGR				-0.0111 (-1.46)		**0.0053 (0.37)**
INFL.FDGR					-0.3198 (-3.04**)	
INFL.FAGR						-0.1588 (-2.32**)
NT	199	199	199	199	199	199
R^2	0.2229	0.2195	0.2200	0.2275	0.3084	0.2896

**Significant at 5% size;*Significant at 10% size

Table 7.2 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Lower Middle Income Countries. Here we find significance of the coefficient of (overall) international trade to GDP ratio which has positive sign in all the three models; in addition to the significance of inflation, government consumption to GDP ratio and initial level of GDP per capita.

The coefficients of the proxies of both the size and the activity of financial sector are statistically insignificant in the intermediate model which becomes significant in the final model when we include interaction variables. This shows that size and activity of overall finance has strong positive relationship with economic growth for LMIC. The interaction of inflation with the size of overall finance has a negative insignificant coefficient.

However, the interaction of inflation with activity of overall finance has a negative significant coefficient which has the interpretation that growth return of increase in the activity of financial sector decreases with inflation.

Table 7.2: LMIC - Overall Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.4279 (-3.98**)	-0.4273 (-3.94**)	-0.4109 (-3.74**)	-0.4277 (-3.92**)	-0.4584 (-2.86**)	-0.9380 (-6.51**)
GCGR	-0.1446 (-4.13**)	-0.1458 (-4.49**)	-0.1539 (-5.66**)	-0.1455 (-4.48**)	-0.1574 (-6.29**)	-0.1293 (-5.59**)
TRGR	0.1016 (5.20**)	0.1007 (5.30**)	0.0682 (2.01**)	0.1024 (5.15**)	0.0716 (1.76*)	0.1027 (3.77**)
SSER	-0.0058 (-0.10)					
RGPC	-0.0802 (-3.41**)	-0.0817 (-4.82**)	-0.0948 (-5.33**)	-0.0802 (-4.93**)	-0.0999 (-4.36**)	-0.0944 (-4.55**)
FDGR			0.0339 (1.57)		**0.0458 (2.28**)**	
FAGR				-0.0035 (-0.35)		**0.0380 (4.22**)**
INFL.FDGR					-0.1069 (-0.75)	
INFL.FAGR						-0.5018 (-4.40**)
NT	127	127	127	127	127	127
R^2	0.2905	0.2903	0.3130	0.2907	0.3204	0.3722

**Significant at 5% size;*Significant at 10% size

We also observe that in case where the interaction variable is significant there is large increase in the magnitude of the partial effect of inflation on growth rate of GDP per capita in the final model. However, there is no such increase in the magnitude of the partial effect of inflation on growth rate of GDP per capita in the final model in case where the interaction variable is insignificant. If we consider the positive significance of the activity measure of overall finance we can not ignore the fact that the magnitude of the estimated coefficient of the interaction variable is larger than that of the activity of the overall financial development and hence even with the low level[54] of inflation the total impact of financial sector development has negative impact on growth rate of GDP per capita.

Table 7.3 gives the results of simple contemporaneous non dynamic fixed effects panel estimation for the panel of Upper Middle Income Countries. Here the proxy of the size of overall financial sector is statistically significant irrespective of the fact whether we take finance alone or in addition to an interaction variable with inflation.

Table 7.3: UMIC - Overall Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	**General Model**	**Basic Model**	**Intermediate Model**		**Final Model**	
			Size	**Activity**	**Size**	**Activity**
INFL	-0.1920 (-9.00**)	-0.1912 (-9.98**)	-0.1565 (-6.03**)	-0.1935 (-11.1**)	-0.2261 (-2.24**)	-0.1927 (-3.18**)
ΔGCGR	-0.1368 (-7.32**)	-0.1366 (-7.61**)	-0.1602 (-8.19**)	-0.1329 (-5.99**)	-0.1632 (-8.31**)	-0.1329 (-5.97**)
TRGR	0.0430 (2.82**)	0.0427 (2.90**)	0.0333 (3.17**)	0.0440 (2.44**)	0.0384 (3.67**)	0.0440 (2.68**)
SSER	-0.0026 (-0.11)					
RGPC	-0.0643 (-9.63**)	-0.0650 (-8.90**)	-0.0883 (-8.44**)	-0.0633 (-2.21**)	-0.0955 (-5.88**)	-0.0633 (-5.29**)
FDGR			0.0364 (3.11**)		**0.0433 (2.70**)**	
ΔFAGR				-0.0028 (-0.33)		**-0.0029 (-0.29)**
INFL.FDGR					0.0598 (0.73)	
INFL.FAGR						0.0005 (0.01)
NT	144	144	144	144	144	144
R^2	0.2043	0.2042	0.2346	0.2047	0.2383	0.2047

**Significant at 5% size;*Significant at 10% size

[54] But not lower than 0.076. Since we have $\hat{\beta}_{Total} = \hat{\beta}_1 + \hat{\beta}_2 INFL = 0.038\text{-}0.516 INFL$, then total effect, $\hat{\beta}_{Total}$, will be negative for $INFL \geq 0.076$ (7.6 percent).

However, the proxy of the activity of overall financial sector is statistically insignificant irrespective of the fact whether we take finance alone or as an interaction variable with inflation. Thus implications are clear that economic growth has relationship with only the size of the overall financial sector whereas it is independent of financial development expressed in terms of activities of the (overall) financial sector. The coefficient of interaction variable is insignificant for both the cases of size and activity of the overall financial sector.

Lastly, for the case of panel of High Income Countries the results are presented in the Table 7.4. As the basic model shows only inflation, government consumption to GDP ratio, overall trade to GDP ratio, and initial per capita income are the significant determinants of growth in per capita GDP.

Table 7.4: HIC - Overall Finance

Contemporaneous "Fixed Effects" Panel Regressions: Dependent Variable= GRGPC: Heteroscedasticity Consistent t-statistics in parentheses

Variable	General Model	Basic Model	Intermediate Model		Final Model	
			Size	Activity	Size	Activity
INFL	-0.3247 (-8.94**)	-0.3255 (-9.19**)	-0.3137 (-8.00**)	-0.3304 (-8.47**)	-0.3291 (-8.93**)	-0.3696 (-9.82**)
ΔGCGR	-0.0728 (-5.25**)	-0.0729 (-5.35**)	-0.0675 (-4.27**)	-0.0753 (-4.93**)	-0.0702 (-4.75**)	-0.0756 (-5.11**)
ΔTRGR	0.0472 (3.30**)	0.0473 (3.25**)	0.0425 (2.89**)	0.0499 (3.20**)	0.0420 (3.17**)	0.0496 (3.34**)
SSER	0.0011 (0.15)					
RGPC	-0.0212 (-4.64**)	-0.0210 (-5.04**)	-0.0272 (-8.59**)	-0.0184 (-4.80**)	-0.0273 (-8.18**)	-0.0193 (-5.04**)
ΔFDGR			0.0127 (2.34**)		**0.0172 (2.62**)**	
FAGR				-0.0042 (-1.02)		**0.0004 (0.07)**
INFL.FDGR					-0.1260 (-1.88*)	
INFL.FAGR						-0.1029 (-1.67*)
NT	471	471	471	471	471	471
R^2	0.2837	0.2837	0.2973	0.2867	0.3045	0.2929

**Significant at 5% size;*Significant at 10% size

Taking these four variables as explanatory variables we extend the model by including proxies for overall financial development as regressors and re-estimate the simple contemporaneous non dynamic fixed effects panel regression.

Here for HIC, the proxy of the size of overall financial sector is statistically significant irrespective of the fact whether we take finance alone or as an interaction variable with inflation. However, the proxy of the activity of overall financial sector is statistically insignificant irrespective of the fact whether we take finance alone or in addition to an interaction variable with inflation. Thus implications are clear that economic growth has relationship with only the size of the overall financial sector whereas it is independent of financial development expressed in terms of activities of the (overall) financial sector. The coefficient of interaction variable is insignificant (at 5% level of significance) for both the cases of size and activity of the overall financial sector.

The key points emerged from these results are the following:

- We observe that for all the four panels there is significant and positive relationship between size of the overall financial development and economic growth while we consider the interaction of overall finance with inflation as regressor in addition to the proxy for financial development i.e. in the final model.
- We do not observe any such relationship between the activity of the overall financial development and economic growth, except in the case of LMIC, while we consider the interaction of overall finance with inflation as regressor in addition to the proxy for financial development i.e. in the final model.

- The coefficients of the interaction variables found to be insignificant except in the two cases of LIC and for the one case of LMIC when activity of the overall financial development is used in the model. We observe that as the level of income increases from low to higher, the inflation and (overall) financial development interaction variable moves from having negatively significant estimated coefficient to insignificant estimated coefficient. This observation is like that we have in Chapter 6 for the case of direct financial development.

The analysis of contemporaneous non-dynamic fixed effects panel estimation presented above is based on underlying assumption about the homogeneity of the relationships in questions across countries in the respective panels. Heterogeneity is restricted to the intercept but is not permitted in the slope coefficients. Now we will be moving to the causality analysis based on our dynamic model we discussed in Chapter 3. Pesaran and Smith (1995) show that if in a dynamic panel data model slope coefficients are assumed to be constant but in fact they vary across countries, the traditional panel estimators (fixed effects or GMM estimators) yield inconsistent estimates. For causality analysis we use MFR coefficients approach of Weinhold (1999) and Reichert and Weinhold (2001) for heterogeneous dynamic panel data model.

7.2 PANEL CAUSALITY ANALYSIS

We now estimate MFR coefficients model allowing for heterogeneous dynamics across countries and for a distribution over the coefficients on the other explanatory variables. We apply Reichert and Weinhold (2001) panel causality method to our final model in dynamic form for each of the four panels we have. The results obtained are presented in the Table 7.5 where we report the mean of the estimated coefficient, standard error of the mean of the estimated coefficient, and the variance estimate of the estimated coefficient on the causal variable. For causality testing, we build confidence interval around zero to test for mean of the estimated coefficient on the causal variable to be zero. The lower and upper bounds are also given in the Table 7.5. The area that falls within this interval is interpreted to correspond to observations that are not significantly different from zero.

Table 7.5: Nair-Reichert and Weinhold (2001) Panel Causality Analysis - Overall Finance

Panel		Direct Causality		Reverse Causality	
		Size	**Activity**	**Size**	**Activity**
Low Income Countries	Estimated Coefficient	**0.0073**	**-0.0322**	**-0.1077**	**-1.4776****
	Standard Error	0.0727	0.0664	1.2469	1.1890
	LB (Confidence Interval)	**-3.0122**	**-4.5973**	**-4.4458**	**-1.1648**
	UB (Confidence Interval)	**2.9127**	**5.4047**	**4.5757**	**1.7733**
	Est. Coefficient Variance	0.0217	0.0063	2.7510	23.5830
Lower Middle Income Countries	Estimated Coefficient	**-0.0115**	**-0.0482**	**-0.0646**	**0.2100**
	Standard Error	0.0433	0.0617	0.8231	0.8511
	LB (Confidence Interval)	**-3.6064**	**-2.5749**	**-3.3073**	**-4.2765**
	UB (Confidence Interval)	**4.0193**	**3.5504**	**3.4149**	**3.8665**
	Est. Coefficient Variance	0.0031	0.0098	1.4393	1.0488
Upper Middle Income Countries	Estimated Coefficient	**-0.0021**	**-0.0783**	**-0.0834**	**-0.3021**
	Standard Error	0.1972	0.1651	0.4176	1.3957
	LB (Confidence Interval)	**-14.2916**	**-4.1747**	**-2.4631**	**-5.3153**
	UB (Confidence Interval)	**14.3491**	**4.9960**	**2.6563**	**5.7687**
	Est. Coefficient Variance	0.0053	0.0363	0.7452	1.7758
High Income Countries	Estimated Coefficient	**0.0496**	**-0.0178**	**0.1270**	**-0.2003**
	Standard Error	0.0196	0.0092	0.3432	0.4977
	LB (Confidence Interval)	**-2.1991**	**-1.0345**	**-3.2416**	**-1.5984**
	UB (Confidence Interval)	**1.2086**	**1.6218**	**2.9776**	**1.7532**
	Est. Coefficient Variance	0.0100	0.0037	0.9259	6.7026

**Significant at 5% size

In all the four panels we do not find evidence that the mean of the estimated coefficient of the orthogonalized causal candidate variable is significantly different from zero except the case of case of reverse causality for LIC when we use the activity measure of the overall financial development. In the case of LIC we observe that economic growth has negative impact upon the financial development. The results of the tests of causality (for all other cases) from finance to growth as well as that of causality from growth to finance show that both are independent of each other and hence we find support for Lucas view that economists overstress the role of finance.

8 Summary

The sharp disagreement in economics literature about the nature of the relationship between financial development and economic growth is widely known. Empirical evidence is also mixed as has been documented by Levine (1997, 2003b). Most of the empirical studies focused either on indirect finance [for example King and Levine (1993)] or on direct finance [for example Levine and Zervos (1996)]. Past panel data studies on financial development and economic growth [for example Levine, Loayza and Beck (2000); and Beck, Levine, and Loayza (2000)] also failed to permit heterogeneity in slope coefficient which if assumed to be homogenous, but in fact vary across the cross sectional units, the traditional panel estimators, like fixed effects or GMM estimators, yield inconsistent estimates as shown by Pesaran and Smith (1995). Furthermore, despite the fact that increase in inflation adversely affects the financial market conditions [Khan, Senhadji and Smith (2003)]; past empirical studies ignored the role of inflation in the relationship between finance and growth.

This dissertation examines the empirical relationship between financial development and economic growth while incorporating the inflation rate effect on financial development as highlighted in the literature by Huybens and Smith (1999), De Gregorio and Sturzenegger (1994a, b), Boyd et al (2001), and Khan et al (2003). The evidence is presented using panel data of a large number of countries divided into four groups of Low, Lower Middle, Upper Middle, and High Income Countries. Advanced and appropriate econometric methodology of panel causality analysis for heterogeneous panel data, given by Weinhold (1999) and Nair-Reichert and Weinhold (2001), is applied. The study focuses both on indirect finance and direct finance, separately as well as collectively. While performing simple statistical analysis in Chapter 4 the comparison of ‘within-country standard deviation’ with ‘between-country standard deviation’ reveals that most of the variability in the data occurs between countries and that shows the heterogeneity between the countries for all these variables. None of the variables have larger within-country variation than the between-country variation. This justifies the use of the heterogeneous panel methodology for causality analysis rather than inappropriately applying the homogeneity assumption as practiced in past panel data studies on financial development and economic growth.

The evidence of the relationship between financial development and economic growth from contemporaneous non-dynamic fixed effects panel estimation can be interpreted as mixed. Any positive significant relationship between indirect finance and economic growth is not found except for the Lower Middle Income Countries. Whereas the direct finance is found to be significantly positively related to economic growth for all the four panels examined in this study. It is interesting, however, to note that size of the overall financial development is found to be in a significant and positive relationship with economic growth for all the four panels as against the evidence of no such relationship between activity of the overall financial development and economic growth except for panel of Lower Middle Income Countries where the activity of the overall financial development and economic growth are significantly positively related.

Significant but negative estimates of the coefficient of the inflation and financial development interaction variable, in the cases of Lower Income Countries and in some cases of Lower Middle Income Countries indicate that financial sector development is can actually be harmful to economic growth at some higher level of inflation in such countries. In other words, the higher inflation is more harmful to economic growth for these countries at more developed stage of the financial system as compared to the less developed financial system. In cases where the interaction term is found to be significant, the magnitude of the partial effect of inflation on growth rate of GDP per capita is found to be larger in the final model as compared to that in the basic model which shows that inflation may be relatively a serious issue in financially developed economy as its impact is larger than that can be at the lesser (financially) developed stage of the economy. There is no such evidence for Upper Middle Income Countries and High Income Countries as it has been observed that as the level of income increases from low to higher, the inflation and financial development interaction variable turns from having negative and significant estimated coefficient to insignificant one.

The contemporaneous analysis is based on underlying assumption about the homogeneity of the relationships in questions across countries in the respective panels. However, it is reasonable to expect quite a bit of heterogeneity in such relationships as discussed in Chapter 4. Weinhold (1999) and Nair-Reichert and Weinhold (2001) exploited mixed fixed and random coefficients approach of Hsiao et al (1989) to develop a panel causality method allowing for heterogeneous dynamics across countries and for a distribution over the coefficients on the other explanatory variables. Weinhold (1999) and Nair-Reichert and Weinhold (2001) panel causality method is applied to the dynamic heterogeneous model for various panels of the countries.

In contrast to the recent evidence of Beck and Levine (2003), use of more appropriate econometric methodology of dynamic heterogeneous panel for causality analysis and a refined model reveal that there is no indication that financial development spurs economic growth or growth spurs financial development. Findings of this study are in line with the Lucas's view on finance that the importance of financial matters is over-stressed in popular and even much professional discussion. Only exception is the activity in stock markets in High Income Countries where results support the Robinson (1952) view that finance follows where enterprise leads. Overall results are consistent with the findings of Favara (2003).

The empirical proxies of the financial development, which most of the past empirical studies used, and following those, used in this study as well, may not measure accurately the concepts emerging from underlying theoretical models related to finance and growth. Thus the results of this dissertation may be interpreted with caution before drawing any policy conclusion. Theories focus on particular functions provided by the financial sector, like producing information, exerting corporate governance, facilitating risk management, pooling savings, and easing exchange – and how these functions influence recourse allocation decisions and economic growth. Future research that concretely links the concepts from theory with the data may substantially improve understanding of the finance-growth link. To further improve understanding of the finance growth relation, future research work may focus to model this relationship by incorporating the inflation effect on financial development, using the industry-level and firm-level data, and applying dynamic heterogeneous panel methodology for causality analysis.

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