Essays on Financial Development and Economic Performance

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by

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Declaration of Authorship

I hereby declare that this thesis is my own work and has not been submitted for the award of a higher degree elsewhere. This thesis contains no material previously published or written by any other person except where references have been made in the thesis.

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Abstract

This thesis attempts to provide empirical evidence for the hotly debated relationship between financial development and economic performance using a variety of time series and panel data methods. Also, it extends the previous finance-growth literature by examining the role of democracy in the process. Three inter-related studies form the work undertaken.

Chapter 2: In the first of these the impact of financial development on growth is investigated for the case of China using a range of time-series techniques. The results from this work - which spans almost five decades from 1952 - uncover a bi-directional causality between the country's output performance and its financial development. Meanwhile, domestic financial development failed to promote China's long-term economic performance over the period under investigation. These findings are inconsistent with the previous studies of Hao (2006) and Liang and Teng (2006). Here, the failure of financial development to stimulating the long-term growth is attributed to the issues of majority government ownership and the high volume of non-performing loans in the domestic financial system.

Chapter 3: The relationship between domestic financial development and economic growth has been on the agenda of growth economics for a long time. Notwithstanding its hypothesized benefits certain studies have uncovered evidence of the detrimental effect of domestic financial development for the long-term growth prospects. Such findings highlighted the importance of institutional conditions of financial development. With a panel of 171 countries worldwide over the period 1960 to 2014, this study presents an examination of the question of whether the

existence of sound democratic institutions is necessary for financial development to stimulate economic growth in these countries. The baseline results show that financial sector development per se has the capacity of exerting a significantly positive impact on domestic economic growth. However, little evidence of any significant effect of democracy on growth is observed. Meanwhile, the results suggest that the positive effect of financial development on economic growth does not require the condition of the existence of democratic institutions. The study conjectures that, for policymakers, improving the domestic financial system can contribute growth, even in the absence of sound democratic institutions.

Chapter 4: This research provides a re-examination of the long-term effect of financial development on economic growth using annual data for 67 countries from 1971 to 2007. Autoregressive distributed lag (ARDL) and cross-sectionally augmented autoregressive distributed lag (CS-ARDL) models have been applied to confront cross-country heterogeneity and error cross-country dependence. A positive and significant effect of financial development on the long-run per capita output is observed. Typically, such a beneficial impact is largely driven by non-democratic countries. Also, some evidence of a nonlinear effect of financial development is revealed in this study.

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Chapter 1

Introduction

One of the most controversial and hotly heated topics in growth economics is the relationship between financial development and economic performance. From the early 20th century, a burgeoning volume of theoretical literature emphasizes the importance of the functions of financial institutions and financial markets in the process of economic progress. (Schumpeter, 1912; McKinnon, 1973; Shaw, 1973; Greenwood and Jovanovic, 1990; Bencivenga and Smith 1991) In particular, it is commonly regarded that a well-developed financial sector contributes to the long-term economic growth via facilitating transactions, mobilizing savings and diversifying risk. However, such a theoretical expectation is never free from scepticism. As witnessed in various financial sectors worldwide, the pitfalls of the financial system, such as, excessive speculative activities and financial resource misallocation, inevitably shed a doubt on the expected growth-enhancing role of financial development. At the same time, it is worth noting that growth economists have attempted to prove the existence of a beneficial impact of the development of financial sector on economic progress since the 1990s. (King and Levine, 1993a, b; Levine et al., 2000; Beck et al, 2014) Despite these efforts, however, existing empirics have failed to reach a complete consensus.

Given the continuing interest in academia and among policymakers, this thesis investigates the well-known association between economic performance and financial development. Specifically, it focuses on the effect of financial development

on growth in a single country setting (China) and in cross-country scenarios. By and large, the originality of this thesis derives from the employment of sophisticated wide range of time series methods and recently developed panel data models. Clearly, such applications have important bearings on how to empirically estimate the effect which financial development exerts on the long-term economic performance.

Chapter 2 explores the financial-growth association in the current second largest economy worldwide; China. Despite its rapid economic growth in last few decades, mixed evidence is revealed on the relationship between local financial development and economic performance. Within the constraint of data availability, annual statistics of the level of real output and the level of credit of financial intermediaries are collected over a relatively long time of period from 1952 to 2010. The estimation strategy is based on the multi-variate vector autoregressive (VAR) and vector error correction (VECM) frameworks. For the purposes of comparison, two popular cointegration approaches, namely the Johansen maximum likelihood and Pesaran autoregressive distributed lag (ARDL) models, have been utilised. According to the estimates, some evidence of a negative effect of China's domestic financial development on the country's long-run output level is revealed. Also, a bi-directional causality between economic performance and local financial development is uncovered. Briefly, it is suggested that China's financial sector failed to promote the nation's economic performance over the period from 1952 to 2010. This result is believed to be caused by government major ownership of banks and the high volume of non-performing loans in the domestic financial system.

The findings of Chapter 2 clearly indicate the uniqueness of China's socio-economic conditions. One important aspect of these, which is often regarded as absent in Chinese economy, is democracy. Noticeably, the impact of democracy on economic performance has been on the recent agenda of growth economics. However, the role of democracy has been largely ignored in the previous literature on the finance-growth nexus.

In order to fulfill this gap, Chapter 3 of this thesis investigates whether democracy has an impact on the expected growth-enhancing role of financial development worldwide. An unbalanced panel dataset of 171 countries over the period 1960 to 2014 is constructed to investigate this further. Credit of financial institutions to private sector over GDP is selected as the measure of financial development in this chapter. Different indicators, including the Polity 2 score from the Polity IV dataset and the newly-proposed index from Acemoglu et al. (2014), have been employed as the measures of democracy. Furthermore, for the estimation strategy, diverse estimators, such as, first-difference and system Generalised Method of Moments (GMM) estimators, are employed in the dynamic panel data model. In particular, we highlight the issue of "too many instruments" when using the GMM estimators in the finite sample after which the instrument count is restricted in our estimation. Our baseline results suggest a significant and positive effect of financial development on economic growth. By and large, a one percent increase of financial development indicator generally leads to a two percent increase of average output growth according to the system GMM estimation results. At the same time, limited evidence of a significant effect of democracy and the interaction term between financial development and democracy is observed. Overall, the results suggest that the beneficial effect of financial development generally does not require the condition of democracy and that financial development per se has the capacity of stimulating domestic economic growth.

Chapter 4 provides a re-examination on the relationship between financial development and long-term output performance by exploiting both the time series and cross-section dimensions of the data. Given data availability, a balanced dataset containing 67 countries from 1971 to 2007 is constructed. The usage of annual data uncovers the potential dynamic relationship in the context of finance-growth nexus. In the meantime, cross-country heterogeneity and error cross-section dependence in macro panel data have received a lot of attention in recent growth empirics. (Eberhardt and Teal, 2011; Pesaran, 2015) In order to

confront these issues, our estimation strategy takes advantage of autoregressive distributed lag (ARDL) and cross-sectionally augmented autoregressive distributed lag (CS-ARDL) models. Based on the Pooled Mean Group (PMG) estimation results, the effect of the financial development, measured by the ratio of private credit of financial institutions to GDP, on the long-term output performance is found to be positive and significant. According to the subsample (democratic and non-democratic subsamples) estimates, the beneficial effect of financial development is believed to be largely driven by the 29 non-democratic countries in the sample. In addition, some evidence of a bell-shaped relationship between financial development and economic performance is uncovered in this chapter, which supports a nonlinear finance-growth association.

Chapter 2

Financial Development and Economic Performance in China: Cointegration and Causality Analyses

2.1 Introduction

Throughout economic history there is a continuing controversy on the relationship between financial development and output performance. By and large, a growing body of literature has emphasized a positive role that finance plays in the modern economy. Typically, a well-functional financial system has the capacity to promote economic growth through producing essential information, exerting sound corporate governance etc. (Beck et al., 2010) However, given the lasting influence of financial instability and the financial crisis, scepticism arises on the expected benefits of finance. At the same time, a strand of studies paid attention to the causality pattern between financial development and economic performance; an issue of key importance for policy. Nevertheless, a consensus on this causality has not been forthcoming given the contradictory predictions of the "demand-following" and the "supply-leading" hypotheses.

As the largest developing country nowadays, the rapid growth of China's economy provides a good opportunity to contribute to previous research on the relationship between finance and growth. With data covering the period 1952 to 2010, this empirical study aims to investigate the long-term relationship and causality pattern between China's financial development and the country's real output. In particular, we contribute to the existing literature by (1) examining a long period in the history of the People's Republic of China; (2) partially resolving the potential omitted variable bias by the introduction of two extra control variables in the regression and (3) by taking advantage of both the autoregressive distributed lag regression (ARDL) and the Johansen maximum likelihood approaches for the detection of cointegrating relationships.

In general, the empirical evidence revealed in this study proves the existence of a long-term relationship among China's real output, financial development, capital stock and trade openness. Meanwhile, a detrimental effect of domestic financial development on China's long-term output level is observed. A bi-directional causality

between economic performance and financial development has also been identified in China's case. Collectively, this chapter conjectures that China's financial system failed to promote the country's real output from 1952 to 2010. Typically, the finding of the failure of the Chinese financial sector in the nation's long-term economic progress is not consistent with previous studies of Hao (2006) and Liang and Teng (2006). In order to fulfill the expected beneficial effect of financial development in China, this study calls for the recognition of the necessity of further reforms in the domestic financial sector. Also, for policy makers, efforts should be made on the identification of the binding constraints and on the determination of the priorities of future reforms.

The rest of this chapter is organized as follows. Section 2.2 provides a literature review on the finance-growth relationship. Section 2.3 introduces the data used and methodology applied. Section 2.4 shows the regression results with associated analyses. Section 2.5 summarises and concludes the work.

2.2 Literature Review

2.2.1 Financial Development and Economic Performance

The investigation of the role of financial development on economic growth is not new. At the theoretical level, Smith (1776) suggested the effect of money in reducing transaction costs. Hamilton (1781) wrote that "banks were the happiest engines that ever were invented" in economic progress. Schumpeter (1912) stressed that the services of financial intermediaries are crucial in the technological innovation and economic growth. Meanwhile, McKinnon (1973) and Shaw (1973) pointed that government interventions for financial repression were likely to restrict the financial intermediaries from channeling financial resources to productive enterprises thus lowering economic performance. The endogenous growth literature also focused on the various functions of financial institutions and financial markets in capital accumulation and technological innovation. As summarized

by Levine (2005), financial development could be defined as the improvements of five basic functions provided by the financial system:

(1) Information Production

Both financial institutions and financial markets have an advantage in producing and collecting essential information on investment and economic activities at a low cost. Such information could be used to identify the most promising investments, thus allocating resources in an efficient way. (Levine, 1997; Beck et al. 2010)

(2) Corporate Governance

The difficulty of shareholders in monitoring the activities of managers could be resolved by the financial sector. With instruments like financial arrangements and publicly traded stocks, the overall cost of corporate governance could be reduced while managers would have extra motivation to exert sound governance, thus promoting resource allocating efficiency, overall productivity and economic growth. (Diamond, 1984; Beck and Levine, 2004)

(3) Risk Diversification

The financial system has the ability to match a huge volume of loans with diverse maturity periods which decreases the overall risk that individuals need to face and investors are exposed to. In particular, a well-established financial sector is capable of diversifying the cross-sectional and inter-temporal risks in investment projects. Consequently, as the financial system develops, more investments can be conducted under a relatively low risk level, which facilitate the research and development activities and economic performance. (Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991; Allen and Gale, 1997)

(4) Savings Mobilization

With the advantages of lowering transaction costs, the financial system has the capacity of pooling the savings and diversifying them into different portfolios via financial arrangements, bilateral contracts for instance. New enterprises could have access to credit with the support of financial "mobilizers" which would encourage

activities of innovation and technological reform. As a result, the financial system is able to boost economic growth through the mobilization of savings. (Levine, 1997; Beck et al. 2010)

(5) Transaction Facilitating

Cost reduction provided by financial sector contributes to the process of specialization, which is stressed by Adam Smith (1776) as a key element in the growth of the economy. Also, individuals and enterprises could take advantages of financial arrangements to avoid difficulties during evaluating investments and searching for funds. Together, with a well-developed financial system, innovation and technological reform can be motivated which promotes economic performance in the long run. (Levine, 1997; Beck et al. 2010)

In general, according to Levine (2007), each of these functions is capable of exerting impacts on the investment decisions and the efficiency of financial resources allocation, thus promoting long-term output. As a result, if existing, the causal relationship should be running from financial development to economic performance. Such a view is also referred to as the "supply-leading" hypothesis. However, some argued that financial sector passively responds to the new demand for financial service in the economy. In short, as stated by Robinson (1952), "where enterprise leads finance follows". According to this "demand-following view, the causality is from economic performance to financial development.

2.2.2 Empirical Evidence

The empirical examination on the effect of financial development on growth started from the 1960s. Findings of some key research on this finance-growth nexus are displayed in Table 2.1. Following Goldsmith (1969), King and Levine (1993a, b) first provided the evidence of positive conditional cross-country relationships between financial development and output growth. In particular, with a sample of around 80 nations, both papers conducted by King and Levine extended the standard cross-country growth regressions proposed by Barro (1991) and included diverse

Table 2.1: Empirical Findings on Finance-Growth Relationship

Authors	Method	Country	Time Period	Findings
King & Levine (1993a)	CC	80	1960-1989	FD is positively correlated with EG.
Demetriades & Hussein(1996)	TS	16	1960-1993	FD does not cause EG.
Arestis & Demetriades (1997)	TS	12	1979-1991	Causality pattern differs across countries.
Levine & Zervos (1998a)	CC	47	1976-1993	FD is positively correlated with EG.
Luintel & Khan (1999)	TS	10	1951-1995	Bi-directional causality between FD and EG.
Beck et al. (2000)	PD	61	1971-1995	FD is positively correlated with EG.
Levine et al.(2000)	PD	74	1960-1995	FD is positively correlated with EG.
Xu (2000)	TS	41	1960-1993	FD leads to EG.
Arestis et al.(2001)	TS	5	1968-1998	FD is positively correlated with EG.
Beck & Levine(2004)	PD	40	1976-1998	FD is positively correlated with EG.
Christopoulos & Tsionas(2004)	PD	10	1970-2000	FD leads to EG.
Thangavelu & Jiunn (2004)	TS	Australia	1970-1989	EG leads to FD.
Caporale et al.(2004)	TS	4	1979-1998	FD leads to EG.
Loayza & Ranciere (2006)	PD	75	1960-2000	FD is positively correlated with EG.
Ang & McKibbin (2007)	TS	Malaysia	1960-2001	Positive correlation. EG leads to FD.
Abu-Bader & Abu-Qarn (2008)	TS	Egypt	1960-2001	Bi-directional causality between FD and EG.
Kyophilavong et al. (2014)	TS	Laos	1984-2012	Bi-directional causality between FD and EG.
Abosedra et al. (2015)	TS	Lebanon	2000-2010	FD leads to EG.
Alexiou et al. (2018)	PD	34	1998-2014	Insignificant effect of FD on EG for developing economies.

Notes: Notes: “CC”, “PD”, and “TS” stand for cross-country, panel data, and time series, respectively. “FD” stands for financial development and “EG” is economic growth.

measures of financial development as additional regressors. Inspired by King and Levine (1993a, b), a burgeoning volume of empirical studies have emerged on the importance of financial development on economic performance from the 1990s to the early 2000s. In particular, diverse econometric techniques have been applied to analyze the effect on economic growth of financial system development. For instance, under the multi-variate vector autoregression (VAR) framework, Luintel and Khan (1999) revealed a positive correlation and a bi-directional causality between financial development and economic performance with the time-series data of 10 nations from 1951 to 1995. Abu-Bader and Abu-Qarn (2008) and Abosedra et al. (2015) also found bi-directional causality between economic performance and financial development in Egypt and Lebanon respectively. Meanwhile, Beck et al. (2000), Levine et al. (2000), and Beck and Levine (2004) used the panel datasets of both developed and developing countries for the post-1960 period. The existence of a significantly positive relationship between output growth and financial development was found in these studies. With panel unit roots and cointegration analyses, Christopoulos and Tsionas (2004) argued that there is a uni-directional causality which runs from financial development to economic growth in 10 developed economies from 1970 to 2000. By and large, the majority of empirical finance-growth literature before the recent global financial crisis commonly suggested that a well-developed financial system has a positive, significant and robust effect on economic performance.

2.2.3 Scepticism on the Finance-Growth Relationship

Despite the theoretical and empirical evidence for a growth-enhancing role of financial development, various scholars shared the sceptical view of Lucas (1988), who stated that the influence of the financial sector in the process of economic growth is overemphasized. To start with, many pointed out the potential detrimental effects of a financial sector of an excessive size. Specifically, recent evidence suggested that a series of factors, including imperfect competition, rent extraction,

and negative externalities from auxiliary financial services, contribute to an oversized financial system (Cahuc and Challe, 2012; Beck et al., 2014; Arcand et al., 2015). Such a financial system could lead to excessive speculative activities, financial resource misallocation and economic instability without benefiting long-term economic performance. (Keynes, 1936; Kindleberger, 1978; Beck et al., 2014; Cournede and Denk, 2015)

At the same time, a strand of literature highlighted instances of financial crises, which shed doubt on the previous findings of a growth-enhancing role of finance. Early studies, for example, Minsky (1982, 1991), contended that bank lending is essentially central for economic activities and that the financial sector is likely to engage in excessive over-leveraged investment during the economic expansion stage. However, such an engagement could lead to financial instability and provide incentives for enterprises to default on the loan repayments. The instability in the financial sector could then trigger a financial crisis as the bankruptcies start, and thus lead to the phase of economic recession. In the meantime, as witnessed in the recent 2007- 2008 financial crisis, the malfunctioning financial sector is believed to be capable of encouraging speculation, discouraging saving, and to misallocate resources both directly and indirectly. As a consequence, many countries experienced sharp employment declines and drastic output losses (Law and Singh, 2014; Cournede and Denk, 2015) As stated by Rajan (2006), the further development of financial sector in the second half of the last century altered managerial incentives leading to a preference for risky investments. A large and complicated financial sector is likely to end up in a "catastrophic meltdown" due to the changes in the nature of risks undertaken in the financial system. Also, financial development is itself also regarded as a precursor of crisis in some literature. (Kaminsky and Reinhart 1999; Wachtel, 2011; Schularick and Taylor 2012) Typically, after revisiting fifteen cases of severe financial crises in the late last century, Reinhart and Reinhart (2010) found that countries suffering these crises had commonly witnessed a surge in the domestic bank credit to GDP ratio in the pre-crisis periods.

2.2.4 Measures of Financial Development

Diverse indicators have been proposed to capture the level of development of financial sector. However, most of these indicators are essentially measures of the size of the financial institutions, such as:

M1. Deposits of financial intermediaries/ GDP

M2. Loans of financial intermediaries/ GDP

M3. Credit of financial intermediaries/ GDP

Such a phenomenon is partially based on the assumption that the quantity of financial sector is synonymous with the quality. However, the idea that larger is better is no longer well embraced and the measure of the size of financial sector only captures one aspect of the overall development of the financial system. (Wachtel, 2011; Arcand et al., 2015) In other words, these three indicators generally fail to account for either efficiency or access to financial system.

Meanwhile, as argued by Abosedra et al. (2015), money stock is a reliable measure of financial intermediaries and money supply could be applied as a proxy for financial development, that is,

M4. Broad Money (M2)/ GDP

However, as monetisation can be increased without improvements in the financial system, this ratio could be inappropriate especially for underdeveloped economies. (Luintel and Khan, 1999)

Also, according to Ang and McKibbin (2007), commercial banks are more efficient than central banks in providing basic financial services. Another financial development measure is employed in the previous literature, that is:

M5. Bank credit/ (Bank credit + Central bank domestic assets)

Nevertheless, La Porta et al. (2002) highlighted the political influence of governments on commercial banks in the allocation of financial resources in socialist countries. Sahay et al. (2015) argued that the well-functioning of a large financial system could be limited if it is wasteful or not accessible to the large body of en-

terprises. Considering commercial banks may only lend to the private enterprises favoured by government or to the public sector under political influence, questions remain on this measure.

At the same time, recent finance-growth literature shared the tendency to use the private credit ratio as a standard financial development indicator, that is,

M6. Credit by financial intermediaries to the private sectors/ GDP

The frequent usage of this financial development ratio is largely due to the belief that a financial sector lending to private firms is more capable of promoting output growth than one only offering credit to the government or state-owned enterprises (SOEs). (Levine, 2005; Beck et al., 2010; Wachtel, 2011) Nonetheless, to some extent, this private credit to GDP indicator is poor considering it may reflect economy wide leverage instead of capturing how much finance can accomplish its basic functions in the economy. (Arcand et al., 2015; Sahay et al., 2015)

In addition, several other indicators have been adopted to proxy the level of development of financial markets, such as:

M7. Market capitalisation ratio (Market capitalisation/ GDP)

M8. Turnover ratio (Total value of shares traded/ Stock market capitalisation)

M9. Market volatility ratio[1]

However, listing shares does not necessarily foster resource allocation and the market capitalisation ratio may fail to reflect the development of financial markets. Also, it is doubtful if all funds raised from stock markets are actually used to finance productive projects, considering merger and acquisition activities nowadays. (Beck and Levin, 2004; Beck et al., 2010)

Clearly, every financial development measure described earlier has its own pitfalls. As Wachtel (2011) and Sahay et al. (2015) emphasized, given these indicators remain available but imperfect, one should take the deficiencies of a measure into account when interpreting empirical results.

[1]For example, Arestis and Demetriades (1997) measured market volatility by a sixteen quarter moving standard deviation of the end of quarter change of stock market prices.

2.2.5 China's Financial System

Since the establishment of the People's Republic of China (PRC) in 1949, China's financial system has experienced a dramatic evolution and has become a crucial component of the domestic economy. In general, before the "opening-up and reform" policy adopted in 1978, People's Bank of China (PBC) was both the central bank and the only commercial bank in China. With a series of reforms in the domestic financial sector, a financial regulatory system has been constructed since 2003: the central bank, i.e. PBC, is primarily in charge of monetary policies. Meanwhile, two institutions - the China Banking Regulatory Commission (CBRC)[2]and the China Securities Regulatory Commission (CSRC) - manage daily activities of domestic financial institutions and financial markets, respectively.

Except for the regulatory authorities, financial institutions in China consist of 4399 legal entities of banking and non-banking financial institutions with 409 million employees by the end of 2016 [3]. From Figure 2.1, both total deposits and total loans in domestic financial institutions have been enjoying stable growth since the early 1990. Typically, according to the annual report of CBRC in 2016, the outstanding balance of deposits and loans reached 155 trillion yuans (23.4 trillion US dollars [4]) and 112 trillion yuans (16.9 trillion US dollars), respectively.

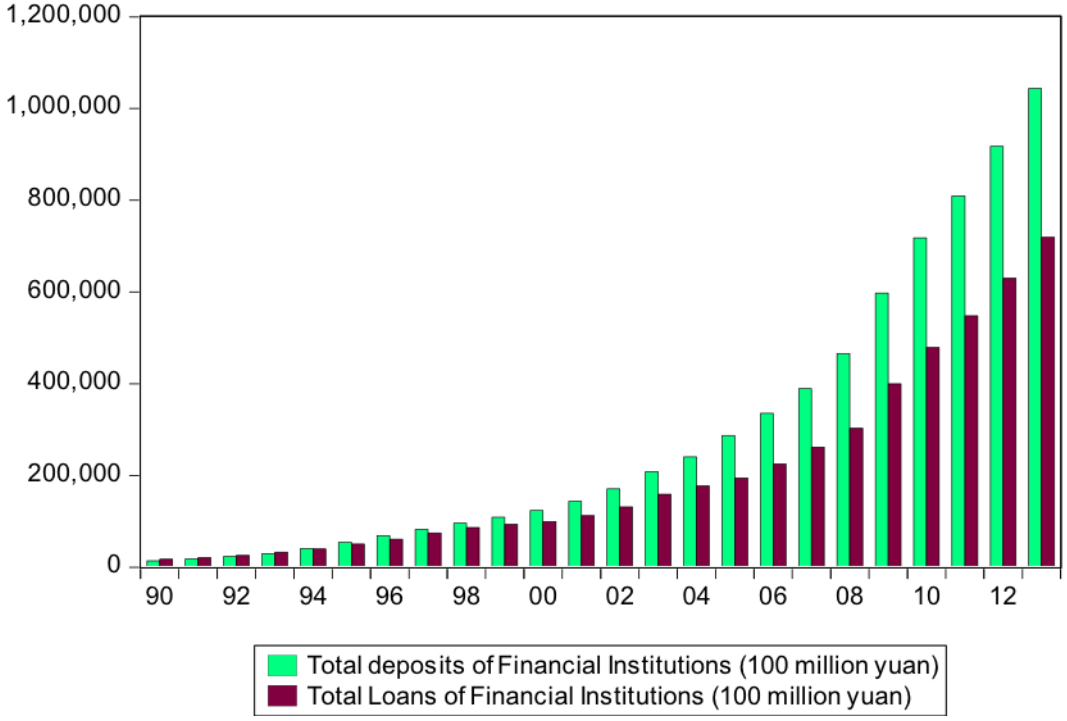
One typical characteristic of China's financial system is that the whole banking sector is mainly composed of the five large commercial banks [5], which were formerly state-owned in the early 1980s. Since the early 21st century, a series of plans of financial reforms were adopted for the purpose of efficiency improvement for the domestic banking industry, including the process of partial privatization of the "Big Five". However, as argued by Allen et al. (2012) and Elliott and Yan (2013),

[2]CBRC and the China Insurance Regulatory Commission (CIRC) have been further organized as a single regulatory institution since April, 2018.

[3]Banking financial institutions include policy banks, commercial banks, rural cooperative banks, rural credit cooperatives, locally incorporated foreign banking institutions etc.; non-banking financial institutions include trust companies, finance companies of corporate groups, financial leasing companies, rural credit cooperatives etc.

[4]Average central parity rate of the RMB yuan against the US dollar was 6.64 approximately in 2016.

Figure 2.1: Changes of Nominal Deposits and Loans of Financial Institutions



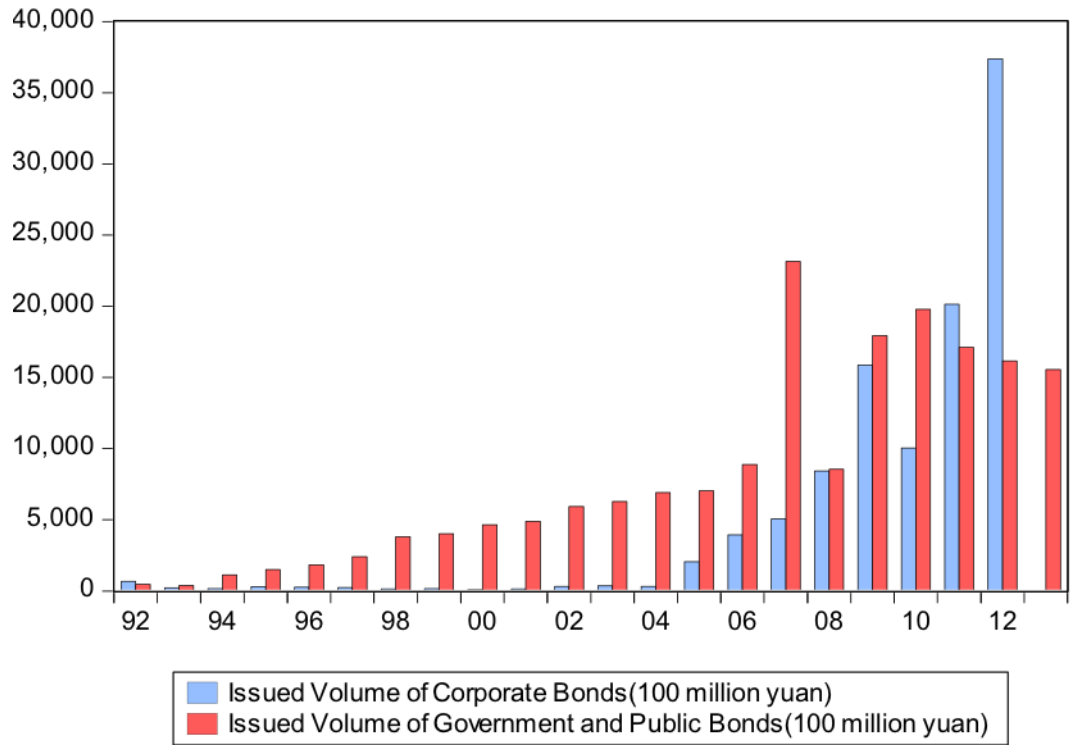
the "Big Five" still have the capacity of providing nearly half of the loans of all financial institutions in China.

Another characteristic of the Chinese financial sector is the lasting influence of the Chinese Communist Party (CCP) and of local authorities on the decision-making of financial institutions. Firstly, a large proportion of domestic financial institutions are majority-owned by the state, or by the state-owned financial enterprises. As a result, the appointment system of the executives of these financial institutions is comparable to the one for the government and the CCP officials. Allen et al. (2012) pointed out that the executives of these financial institutions could favour political benefit when making crucial operational decisions. Secondly, government intervention can be traced by the allocation of financial resources. As argued by Elliott and Yan (2013), China's financial institutions are in favour of channeling funds to the large SOEs instead of small private enterprises especially in the second half of the 20st century. Such a phenomenon could be due to the fact that large SOEs normally have held monopolistic power in various local industries,

[5]China Construction Bank (CCB), Agricultural Bank of China (ABC), Industrial and Commercial Bank of China (ICBC), Bank of China (BOC), and Bank of Communications (BCM).

which ensures stable economic returns for financial institutions. Also, banks may even make loans to the non-profitable and non-solvent SOEs under certain political pressures. However, such a decision is not entirely against their institutional interest. (Cull and Xu, 2003; Elliott and Yan, 2013)

Figure 2.2: Changes of Nominal Issued Volume of Government and Corporate Bonds



In the meantime, financial markets in China mainly consist of bond markets and stock markets. According to the International Monetary Fund (IMF), the largest bond holders of China's bond market are financial institutions. After releasing a series of strict regulatory requirements for bond issuance in 2010, corporate bonds enjoyed a rapid growth in issuance compared to the decreasing issuance of government bonds which occurred at the same time (see Figure 2.2). However, China's bond markets remain generally underdeveloped. By the end of 2016, the aggregate value of bonds issued had reached 3.6 trillion yuans (0.55 trillion US dollars). Meanwhile, both established in 1990s, the Shanghai Stock Exchange (SHSE) and the Shenzen Stock Exchange (SZSE) together have been ranked as the second largest stock market worldwide in 2016 with 3052 listed companies and

an aggregate market value of 50.8 trillion yuans (7,65 trillion US dollars).

Several features of China's financial markets could be highlighted here. Firstly, according to the International Monetary Fund (IMF), the largest bond holders of China's bond markets are financial institutions. To compare, the majority of investors in the stock markets are individual investors instead of institutions because of the legal prohibition of market entrance. Secondly, investors in the stock market focus on the short-term return of price differentials instead of the long-term value of stock growth. Such speculative investments have been criticized for decades, given the potential damaging effect for domestic financial markets. (Elliott and Yan, 2013) Thirdly, the basic rights of shareholders are poorly protected in China's stock markets, which limits voting power of shareholders on the major operational issues of large listed companies. (Allen et al., 2012; Elliott and Yan, 2013)

2.2.6 Empirical Studies for China

A growing number of empirical studies have attempted to examine the finance-growth nexus in China. In particular, a majority of scholars, such as, Liang and Teng (2006) and Jalil and Ma (2008), have used measures of financial institution development - *M1*, *M2* or *M3* - to indicate overall financial development in China. On the one hand, the role of local financial institutions is vital and irreplaceable in providing financial services in the history of the PRC (Liang and Teng, 2006); on the other hand, such a strategy is essentially due to the availability of these measures over a relatively long time period in China. In particular, China experienced a long period of political instability before the "opening-up and reform" policy in 1978, during which the state departments failed to collect comprehensive statistics concerning the development of the domestic financial system.

Mixed empirical results have been observed on China's finance-growth relationship with diverse analytical techniques (See Table 2.2). To be specific, time series studies by Liang and Teng (2006), Chen and Zhang (2008) and Jalil and Ma (2008) generally suggested a positive association between financial develop-

Table 2.2: Empirical Findings on China's Finance-Growth Relationship

Authors	Method	Time Period	Data Level	Findings
Boyreau-Debray(2003)	PD	1990-1999	Province	FD is negatively correlated with EG.
Hao (2006)	PD	1985-1999	Province	FD is positively correlated with EG.
Liang & Teng (2006)	TS	1952-2001	Nation	FD is positively correlated with EG. EG leads to FD.
Chen & Zhang (2008)	TS	1952-2007	Nation	FD is positively correlated with EG. No causal relationships.
Guariglia & Poncet (2008)	PD	1989-2003	Province	FD is negatively correlated with EG.
Jalil & Ma (2008)	TS	1960-2005	Nation	FD is positively correlated with EG.
Hasan et al. (2009)	PD	1986-2002	Province	FD is negatively correlated with EG.
Cheng & Degryse (2010)	PD	1995-2003	Province	FD is positively correlated with EG.
Jalil et al. (2010)	TS	1977-2006	Nation	FD is positively correlated with EG.
Zhang et al. (2012)	PD	2001-2006	City	FD is negatively correlated with EG.

Notes: Notes: "CC", "PD", and "TS" stand for cross-country, panel data, and time series, respectively. "FD" stands for financial development and "EG" is economic growth.

ment and economic growth. In particular, Liang and Teng (2006) also found a uni-directional causality from China's economic progress to financial development over the period 1952 to 2001. However, Chen and Zhang (2008) did not observe a clear causal relationship from 1952 to 2007. Under the panel data framework, Hao (2006) and Cheng and Degryse (2010) suggested that the relationship between China's financial development and economic growth is a positive one at the regional level. However, others, including Boyreau-Debray (2003), Hasan et al. (2009) and Zhang et al. (2012), found a negative effect of financial development on output performance in China.

2.3 Methodology and Data

2.3.1 Model Identification

Early empirical studies, for instance, Arestis and Demetriades (1997), employed a bi-variate framework in the investigation of the effect of financial development on output performance. However, as stressed by Caporale and Pittis (1995), findings based on the bi-variate method could be misleading considering the potential omitted variable bias. For the purpose of avoiding erroneous inferences, a multi-variate framework is employed in this study.

Following Demetriades and Hussein (1996) and Christopoulos and Tsionas (2004), this study uses the level of output, that is, real per capita gross domestic product (GDP), as the measure of economic performance.[6] Apart from the financial development indicator, two control variables, namely, a measure of physical capital stock and a measure of trade openness are included on the right-hand side of the regression.

Under the condition of a constant technology, a log-linear Cobb-Douglas production function is applied in this chapter:

$$GDP_t = \alpha_0 + \alpha_1 FinDev_t + \alpha_2 Invest_t + \alpha_3 Trade_t + u_t \tag{2.1}$$

where GDP_t is the natural logarithm of real per capita GDP. $FinDev_t$ is the natural logarithm of aggregate credit of financial intermediaries to GDP. While $Invest_t$ and $Trade_t$ are natural logarithm of real per capita physical capital stock to GDP and natural logarithm of sum of exports and imports to GDP. Summary statistics are displayed in Table 2.3.

[6] Sianesi and Van Reenen (2003) argued that regressions using level of output as the left-hand side variable should not strictly be treated as "growth" regressions. Here, the simplified interpretation of real per capita GDP as "economic growth" is not accurate.

Table 2.3: Data Description

Variable	Max	Min	Mean	St.Dev.
GDP_t	8.401	4.772	6.156	1.034
$FinDev_t$	2.051	-1.743	0.359	1.266
$Invest_t$	7.568	4.086	6.020	0.770
$Trade_t$	-0.428	-3.003	-1.783	0.798

Note: Statistics are for the variables after the log transformations.

2.3.2 Data Sources

As stressed by Campbell and Perron (1991) and Hakkio and Rush (1991), the use of a sufficiently long sampling time is crucial for a time-series study. However, expanding the time series by converting low-frequency data to high-frequency data will not help enhance the power of unit root test, cointegration test or causality test. Meanwhile, in China's case, the time span of the study is subject to data constraints: firstly, the official records of macroeconomic statistics can only be traced back to 1952; secondly, China's statistics department, the National Bureau of Statistics (NBS), made major changes on the data collecting and reporting from 2010. Typically, the data published in the post-2010 period is not completely comparable to that in the pre-2010 period. As a result, the time span for this empirical study is from 1952 to 2010. In comparison, our sample size exceeds that used in most of the former studies on the China's finance-growth nexus.

Diverse indicators of financial development have been put into practice in the previous empirical finance-growth literature. However, issue of data availability has restricted our choices of financial development measure. In detail, given the official statistical collection of broad money started in 1990, indicator *M4* is not selected for this chapter. Likewise, *M5* is not considered given that the information on central bank assets can only be traced back to the 1990s. Besides, financial resources to the private sector is not well-documented in the history of the PRC and thus *M6* is abandoned. In addition, as China's stock markets only started in 1990, measures of financial market development are also not employed due to a

limited time period available.[7] As it is available for our sample period, indicator *M3 (Credit of of financial intermediaries/ GDP)* is selected as the measure of China's domestic financial development in this chapter.

Data constraints have also affected the selection of control variables for this study. In general, China's official records of human capital, government spending and other institutional variables are incomplete for the period 1952 to 2010, especially for the period before the implement of the "opening-up and reform" policy. As we managed to collect series of physical capital stock and trade openness over the sample period, these variables are employed as control variables. In particular, physical capital stock is normally assumed to greatly influence in the economy as demonstrated by both neoclassical and endogenous growth models (Barro and Sala-i-Martin, 2004). Besides, as suggested by Liang and Teng (2006) and Jalil and Ma (2008), both exports and imports have played a crucial part in stimulating China's economy.

The data source for this empirical study mainly consists of two parts (see Table 2.4). One is the online NBS database which provides various macro level data, e.g. population, nominal GDP, consumer price index (CPI), exports and imports. The other one is the publications of NBS, including "Comprehensive Statistical Data and Materials on 50 Years of New China (1949-1998)", "Statistical Yearbook of China's Fixed Asset Investment (1952-1995)" and fourteen versions of "China Statistical Yearbook" from year 1997 to year 2010. These official publications jointly provide credible statistics of China's domestic financial system.

Typically, all the series collected are in nominal terms initially except the series of consumer price index (CPI) and population. Following Beck et al. (2000) and Beck and Levine (2004), the GDP series is deflated by the annual CPI. Also, end-of-year financial balance sheet items are deflated by end-of-year CPI. Data of

[7] Other potential China's financial development measures are also not used in this study. These indicators are: *sum of loans to township enterprises, enterprises with foreign funds, private enterprises and self-employed individuals/ GDP*, *household savings deposited in financial intermediaries/ GDP*) and *share of fixed asset investment financed by domestic loans to that financed by state budgetary appropriation.* Typically, the availability of these three measures only starts from 1981.

aggregate capital stock of China is collected from Shan (2008) for period 1952 to 2006, and Lin and Du (2015) for period 2007 to 2010. As both papers applied the perpetual inventory method in computing capital stock, further merging the data is an appropriate process.

Table 2.4: Data Source

Category	Time Period	Source
Gross Domestic Product (GDP)	1952 - 2010	NBS Database etc.
Consumer Price Index (CPI)	1952 - 2010	NBS Database etc.
Population	1952 - 2010	NBS Database etc.
Credit of Financial Intermediaries	1952 - 2010	NBS Database etc.
Aggregate Capital Formation	1952 - 2010	Shan (2008), Lin & Du (2015)
Exports and Imports	1952 - 2010	NBS Database etc.

Notes: NBS Database website is: http://data.stats.gov.cn/. Other official publications used include "Comprehensive Statistical Data and Materials on 50 Years of New China (1949-1998)", "Statistical Yearbook of China's Fixed Asset Investment (1952-1995)" and "China Statistical Yearbook".

2.3.3 Methodological Framework

2.3.3.1 Unit Root Test

As is common for most macroeconomic time series, measures of real output, financial development and other variables described above are likely to be unit roots. To examine whether a time series is stationary, two unit root tests, namely, augmented Dickey-Fuller (ADF) test and Pillips-Perron test, are implemented in this study. Nevertheless, it is highlighted by various scholars, e.g. Perron (1989, 1990) among others, that results of stationarity generated by universal unit root tests may be biased in the presence of unknown structural breaks. To identify whether the series of interest is a unit root or a stationary process contaminated with a structural break, the Zivot-Andrews (1992) unit root test is also applied. In particular, the Zivot-Andrews (1992) test does not include dummy variables to allow for an exogenous structural break. Instead, it selects the break point where the t-statistic testing the null hypothesis of a unit root is the most negative. Such a procedure of Zivot-Andrews (1992) test is endogenous in essence as it allows for

an unknown break point, which is determined endogenously from the data. (Lee and Strazicich, 2003)

2.3.3.2 Pesaran ARDL Approach for Cointegration

Cointegration arises if a linear combination of several unit root processes results in a stationary series. Allowing each variable in the system to have different number of lag terms, the autoregressive distributed lag (ARDL) approach of Pesaran et al. (1996, 2001) is considered to outperform other cointegration methods in several aspects. Firstly, ARDL bound testing techniques can be established regardless of whether the regressors in the system are $I(0)$ or $I(1)$. However, if a regressor is an $I(2)$ series, the ARDL bound testing technique is no longer suitable. Secondly, simulation evidence of Pesaran and Shin (1998) suggested that the ARDL bound testing approach has the capacity of generating consistent result for small size samples. In order to detect the presence of cointegration, the first-difference form of the ARDL equations is constructed:

$$\begin{aligned}\Delta GDP_t =&\alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\Delta GDP_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\Delta FinDev_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\Delta Invest_{t-i} \\ &+ \sum_{i=0}^{n} \alpha_{4i}\Delta Trade_{t-i} + \alpha_5 GDP_{t-1} + \alpha_6 FinDev_{t-1} + \alpha_7 Invest_{t-1} + \alpha_8 Trade_{t-1} \\ &+\alpha_9 D_1 + \epsilon_{1t}\end{aligned} \tag{2.2}$$

$$\begin{aligned}\Delta FinDev_t =&\beta_0 + \sum_{i=0}^{n} \beta_{1i}\Delta GDP_{t-i} + \sum_{i=1}^{n} \beta_{2i}\Delta FinDev_{t-i} + \sum_{i=0}^{n} \beta_{3i}\Delta Invest_{t-i} \\ &+ \sum_{i=0}^{n} \beta_{4i}\Delta Trade_{t-i} + \beta_5 GDP_{t-1} + \beta_6 FinDev_{t-1} + \beta_7 Invest_{t-1} + \beta_8 Trade_{t-1} \\ &+\beta_9 D_2 + \epsilon_{2t}\end{aligned} \tag{2.3}$$

$$\Delta Invest_t = \gamma_0 + \sum_{i=0}^{n} \gamma_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta FinDev_{t-i} + \sum_{i=1}^{n} \gamma_{3i} \Delta Invest_{t-i}$$
$$+ \sum_{i=0}^{n} \gamma_{4i} \Delta Trade_{t-i} + \gamma_5 GDP_{t-1} + \gamma_6 FinDev_{t-1} + \gamma_7 Invest_{t-1} + \gamma_8 Trade_{t-1}$$
$$+ \gamma_9 D_3 + \epsilon_{3t} \tag{2.4}$$

$$\Delta Trade_t = \delta_0 + \sum_{i=0}^{n} \delta_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta FinDev_{t-i} + \sum_{i=0}^{n} \delta_{3i} \Delta Invest_{t-i}$$
$$+ \sum_{i=1}^{n} \delta_{4i} \Delta Trade_{t-i} + \delta_5 GDP_{t-1} + \delta_6 FinDev_{t-1} + \delta_7 Invest_{t-1} + \delta_8 Trade_{t-1}$$
$$+ \delta_9 D_4 + \epsilon_{4t} \tag{2.5}$$

where Δ is the difference operator. D_1, D_2, D_3 and D_4 are four dummies in equations (2.2) to (2.5), respectively, accounting for structural breaks indicated by the Zivot and Andrew (1992) test. ϵ_{1t}, ϵ_{2t}, ϵ_{3t} and ϵ_{4t} are normally distributed independent error terms.

The ARDL bound testing procedure is based on the joint F-statistic through the restrictions on the estimated coefficients of one period lagged regressors to zero. To be specific, in Eq. (2.2), the null hypothesis of no cointegration is ($H_0 : \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8 = 0$) against the alternative hypothesis ($H_1 : \alpha_5 \neq 0, \alpha_6 \neq 0, \alpha_7 \neq 0, \alpha_8 \neq 0$). In Eq. (2.3), the null becomes ($H_0 : \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$) against the alternative ($H_1 : \beta_5 \neq 0, \beta_6 \neq 0, \beta_7 \neq 0, \beta_8 \neq 0$). Meanwhile, the null hypothesis is ($H_0 : \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = 0$) in Eq. (2.4) against the alternative ($H_1 : \gamma_5 \neq 0, \gamma_6 \neq 0, \gamma_7 \neq 0, \gamma_8 \neq 0$). Then, in Eq. (2.5), the null hypothesis of no cointegration is ($H_0 : \delta_5 = \delta_6 = \delta_7 = \delta_8 = 0$) against the alternative hypothesis ($H_1 : \delta_5 \neq 0, \delta_6 \neq 0, \delta_7 \neq 0, \delta_8 \neq 0$).

Pesaran et al. (2001) argued that the F-statistic is asymptotically non-standard distributed under the null hypothesis and proposed two sets of critical bound val-

ues. As stated by Pesaran et al. (2001), once the joint F-statistic exceeds upper critical bounds (UCB) value, the null hypothesis of the no cointegration relationship is rejected. On the contrary, if the computed test statistic is lower than lower critical bounds (LCB) value, the null hypothesis cannot be rejected. Meanwhile, if the computed F-statistic falls in between UCB and LCB, the cointegration test is inconclusive. Considering the sample investigated in this study is small (i.e. 59 years), critical bounds reported in Pesaran et al. (2001), which are based on the large sample size, are not employed. Instead, critical bound values for the relatively small sample size are collected from Narayan (2005) in the present study.

2.3.3.3 Johansen Maximum Likelihood Approach for Cointegration

Following the procedure of the maximum likelihood approach of Johansen (1988), the VAR model with optimal lag length of p is:

$$X_t = \mu + A_1 X_{t-1} + \cdots + A_{p-1} X_{t-p} + \epsilon_t \tag{2.6}$$

where μ is a 4×1 vector of constant drifts. X_t represents a 4×1 vector. ϵ_t is also a 4×1 vector and every element should be a normally distributed independent error term. If every element in $X_t = (GDP_t, FinDev_t, Invest_t, Trade_t)'$ is a unit root process in level and there is a cointegration relationship among them, the VAR model above should be rewritten as:

$$\Delta X_t = \mu + \Gamma(L)\Delta X_{t-p+1} + \Pi X_{t-1} + \epsilon_t \tag{2.7}$$

where Δ is the difference operator and $\Gamma(L)$ is the 4×4 matrix of coefficients. Here, the method to select appropriate lag length in a VAR model is through information criteria, that is, to choose the optimal number of lags which minimizes the value of the given information criterion like the Akaike information criterion (AIC).

According to Johansen (1988), the existence of a cointegration relationship

relies on the number of distinct cointegrating vectors among variables. Then, the maximal eigenvalue test and the trace test, which are initially proposed by Johansen (1988) and Johansen and Juselius (1994), could be employed to examine the existence, as well as the number, of the distinct cointegrating vectors in the VAR system.

In general, the rank of the Π matrix is equivalent to the number of its characteristic roots that differs from zero. By identifying the exact rank of Π, it is feasible to judge whether there exists a cointegration relationship among the four time series. To be specific, if the rank of Π equals zero, then the four variables are not cointegrated. If the rank of Π is full, the vector process is stationary. Meanwhile, if the rank of Π, represented by r, is in the range between zero and four, i.e. rank deficient, then we have r long-run cointegrating relationships. Let $\Pi = \alpha\beta'$, we have the VECM given by

$$\Delta X_t = \mu + \Gamma(L)\Delta X_{t-p+1} + \alpha(\beta' X_{t-1}) + \epsilon_t \tag{2.8}$$

where both α and β are matrices. The term $\beta' X_{t-1}$ can be interpreted as the linear stationary relationship and rows of β' stand for the distinct cointegrating vectors. The matrix α is the vector of the error correction coefficients, which measures the adjustment speed towards long-run equilibrium. In particular, the significant elements in α suggest that the variables in the system revert to the long-run relationship over some time periods.

2.3.3.4 Granger Causality Test

According to Granger (1963), if the information in the series x_{1t} contributes in the forecast of the series x_{2t}, x_{1t} is said to "cause" or Granger-cause x_{2t}. Here, the word "cause" is a misnomer in a sense, given the fact that it only stands for a correlation between the current value of one variable and the past value of another. It does not imply that the movements of x_{1t} cause movements of x_{2t}.

Following the case above, if four regressors GDP_t, $FinDev_t$, $Invest_t$, $Trade_t$

are all $I(1)$ processes, the Granger causality test should be implemented in a first-differenced VAR model in the case of an absence of a cointegration relationship:

$$\Delta X_t = \mu + \Gamma(L)\Delta X_{t-p+1} + \epsilon_t \tag{2.9}$$

However, if there exists a stationary long-run equilibrium relationship among four unit roots, one can derive the VECM form:

$$\Delta X_t = \mu + \Gamma(L)\Delta X_{t-1} + \alpha(\beta' X_{t-1}) + \epsilon_t \tag{2.10}$$

$$\begin{aligned}\begin{bmatrix} \Delta GDP_t \\ \Delta FinDev_t \\ \Delta Invest_t \\ \Delta Trade_t \end{bmatrix} &= \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \varphi_{11i} & \cdots & \varphi_{14i} \\ \vdots & \ddots & \vdots \\ \varphi_{41i} & \cdots & \varphi_{44i} \end{bmatrix} \times \begin{bmatrix} \Delta GDP_{t-i} \\ \Delta FinDev_{t-i} \\ \Delta Invest_{t-i} \\ \Delta Trade_{t-i} \end{bmatrix} \\ &+ \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix}\end{aligned} \tag{2.11}$$

For example, the causality from $FinDev_t$ to GDP_t is not only from the lagged dynamic terms $\Delta FinDev_t$ given φ_{12i} is different from zero, but also comes from the lagged cointegrating vector ECT_{t-1} if α_1 differs from zero. In practice, three causality tests can be performed: the first one is the significance test of the lagged dynamic terms. The second one is the significance test of the lagged cointegrating vectors, which is equivalent to a weak exogeneity test. And the last one is the joint significance test of both the lagged dynamic terms and the lagged cointegrating terms, which also refers to a strong exogeneity test. (Demetriades and Hussein, 1996; Narayan and Smyth, 2005)

2.4 Regression Results

2.4.1 Unit Root Test Results

Two standard unit root tests, i.e. ADF and Phillips-Perron tests, are used to examine the integration properties of the four analysed variables. Results are shown in Table 2.5. In general, both conventional tests indicate that GDP_t, $FinDev_t$, $Invest_t$ and $Trade_t$ are unit root processes and become stationary in their first differences over the sample period.

Table 2.5: Augmented Dickey-Fuller and Phillips-Perron Tests (1952-2010)

Augmented Dickey-Fuller (ADF) Test				
Variables	Level		Difference	
	Intercept	With Trend	Intercept	With Trend
GDP_t	3.800	0.070	-5.455***	-6.246***
	[1.000]	[0.996]	[0.000]	[0.000]
$FinDev_t$	-0.685	-2.005	-4.473***	-4.421***
	[0.842]	[0.586]	[0.001]	[0.004]
$Invest_t$	-0.698	-2.375	-3.604***	-3.544**
	[0.839]	[0.388]	[0.009]	[0.044]
$Trade_t$	-0.321	-2.375	-5.489***	-5.522***
	[0.915]	[0.388]	[0.000]	[0.000]
Phillips-Perron Test				
Variables	Level		Difference	
	Intercept	With Trend	Intercept	With Trend
GDP_t	8.013	0.712	-4.768***	-8.232***
	[1.000]	[1.000]	[0.000]	[0.000]
$FinDev_t$	-0.277	-1.501	-4.348***	-4.296***
	[0.922]	[0.818]	[0.001]	[0.006]
$Invest_t$	-1.640	-2.645	-3.492**	-3.445*
	[0.456]	[0.263]	[0.012]	[0.056]
$Trade_t$	-0.164	-2.051	-5.321***	-5.315***
	[0.937]	[0.562]	[0.000]	[0.000]

Notes: P-values are in the brackets. *** significant at 1%; ** significant at 5%; * significant at 10%. Null hypothesis under ADF or Phillips-Perron test is that the series is a unit root.

As mentioned earlier, conventional unit root tests do not account for the presence of a structural break in the time series. The non-rejections of two tests may occur for a stationary process affected by breaks. Therefore, the Zivot-Andrews (1992) unit root test with one structural break is adopted to confirm the findings of ADF and Phillips-Perron tests. From Table 2.6, all four variables are $I(1)$s in levels and $I(0)$s in first differences. Clearly, three unit root tests used have reached the same conclusion. In particular, the endogenous break points can be identified in this table.[8] GDP_t has an endogenous time break in 1980, which is after the implementation of "opening up and reform" policy in 1978. Meanwhile, $FinDev_t$ has its break in 1986. Tracing history in China, a series of reforms were conducted in the early 1980s and four major state-owned banks had finished their separations from PBC successively by 1984.[9]

Table 2.6: Zivot-Andrews Structural Break Unit Root Test (1952-2010)

Variables	Level		Difference	
	T-Statistic	Time Break	T-Statistic	Time Break
GDP_t	-3.072	1980	-7.724***	1964
$FinDev_t$	-4.132	1986	-5.388**	1963
$Invest_t$	-4.144	1988	-4.915*	1996
$Trade_t$	-3.619	1973	-6.419***	1972
Critical Values				
1%	-5.570			
5%	-5.080			
10%	-4.820			

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. Null hypothesis under Zivot-Andrews (1992) test is that the series is a unit root with a structural break in intercept and trend.

[8] We do not impose any exogenous break points, such as, 1978 (the start of "opening-up and reform" policy), 2008 (recent financial crisis) etc., for each of the four series. Instead, the endogenous breaks detected by Zivot-Andrews (1992) test are used in the following ARDL cointegration analyses.

[9] These four banks are: Agricultural Bank of China (ABC), Bank of China (BOC), China Construction Bank (CCB) and Industrial and Commercial Bank of China (ICBC).

2.4.2 ARDL Approach for Cointegration and Causality

Considering none of four analysed series is $I(2)$, the ARDL bound testing can be applied for the identification of potential cointegration relationship. In general, each variable in the model acts as dependent variable in the calculation of F-statistics, which then need to be compared against the critical values provided by Narayan (2005). As the computed F-statistic is sensitive to the lag length selection, AIC is used in the determination of the optimal lag length following Abosedra et al. (2015).[10]The results of ARDL cointegration test are displayed in Table 2.7.

Table 2.7: ARDL Cointegration Test

Bounds Testing to Cointegration		
Dependent Variable	Estimated Models	F-Statistics
GDP_t	F($GDP/\ FinDev$, $Invest$, $Trade$)	5.008**
$FinDev_t$	F($FinDev/\ GDP$, $Invest$, $Trade$)	3.533
$Invest_t$	F($Invest/\ GDP$, $FinDev$, $Trade$)	9.333***
$Trade_t$	F($Trade/\ GDP$, $FinDev$, $Invest$)	4.159*
Significance Level	LCB	UCB
1%	4.828	6.195
5%	3.408	4.623
10%	2.843	3.920

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. Critical values are collected from Narayan (2005). Null hypothesis under bound testing is that no cointegration among the variables.

From Table 2.7, when GDP_t is selected as the dependent variable, the computed F-statistic, 5.008, is greater than the UCB value of 4.623 at the 5% level for the 1952 2010 period. Accordingly, the null hypothesis of no cointegration is rejected here. Similarly, if choosing $Invest_t$ as the left-hand side variable, the F-statistic, 9.333, also exceeds the UCB value. Also, when $Trade_t$ acts as the dependent variable, the F-statistic, 9.333, also exceeds the UCB value at the 10% level. However, the bound test suggests that when $FinDev_t$ is the dependent variable, the calculated F-statistic is lower than the UCB. Therefore, three cointegration vectors are found once measures of output, capital stock and trade openness are treated as the

[10]The maximum lag length is set to 3 due to the finite sample size.

left-hand side variables. Such findings validate that there is a long-run relationship between GDP_t, $FinDev_t$, $Invest_t$ and $Trade_t$ in China's case.

Given the existence of the cointegration relationship among four variables in the model, the long-term and short-term effects of $FinDev_t$, $Invest_t$ and $Trade_t$ on GDP_t could be estimated via the error correction form of the ARDL model. The estimates are shown in Table 2.8.

Table 2.8: ARDL Cointegration Analysis

Long Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
$FinDev$	-0.343	-0.870	0.391
$Invest$	0.741***	3.310	0.002
$Trade$	1.415**	2.450	0.018
Constant	4.792***	3.740	0.001
Short Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
ECT	-0.080*	-1.796	0.079
$\Delta GDP(-1)$	0.519***	6.770	0.000
$\Delta FinDev$	-0.286***	-6.270	0.000
$\Delta Invest$	0.998***	12.060	0.000
$\Delta Invest(-1)$	-0.804***	-8.600	0.000
$\Delta Trade$	0.014	0.330	0.746
$\Delta Trade(-1)$	-0.114***	-2.570	0.014
$\Delta Trade(-2)$	-0.102**	-2.190	0.034
Diagnostic Test Statistics			
	F-Statistic	P-Value	
Normal	1.509	0.470	
Serial	1.505	0.228	
ARCH	0.001	0.983	
RAMSEY	0.062	0.805	
CUSUM	Stable		
CUSUMSQ	Stable		

Notes: Estimates based on the error correction model with ΔGDP_t as the dependent variable. ***, ** and * are significance levels at 1%, 5% and 10%.

From Table 2.8, the long-run coefficient of financial development on China's long-run output level is negative. However, such an effect is statistically insignificant at the conventional significance level. In comparison, capital stock and international trade are positively, and significantly (at the 1% level), associated with

long-term real per capita output. All other things being equal, a 1% increase of capital stock enhances domestic output by over 0.74 percent. Also, a 1% international trade increase promotes real GDP by 1.42%. Meanwhile, the short-run results are reported in the middle segment of Table 2.8. In particular, the estimate of the error correction term, ECT, is statistically significant with a negative sign. The short-term deviation from the long-term equilibrium relationship is corrected at the rate of eight percent each year. Such findings essentially validate the established long-term relationship between GDP_t, $FinDev_t$, $Invest_t$ and $Trade_t$ over the sample period. Also from the middle segment, the short term effect of financial development on domestic output level is negative and significant at the 1% level.

The results of diagnostic tests are detailed at the bottom of Table 2.8. In particular, the error term is normally distributed and free from the issues of serial correlation and heteroskedasticity. A well-specified functional form is ensured by passing the Ramsey RESET test. In addition, to examine the constancy in the parameters, the cumulative sum of recursive residuals (CUSUM) test and the cumulative sum of recursive residuals of square (CUSUMSQ) test are adopted. From Figure 2.3 and Figure 2.4, the stability of the ARDL parameters can be ensured as graphs of two tests are located within critical bounds at the 5% significance level.

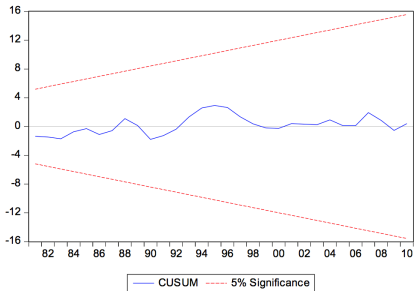


Figure 2.3: CUSUM Plot

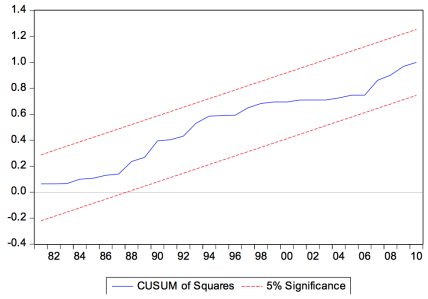


Figure 2.4: CUSUMSQ Plot

With the establishment of the long-term relationship in the model, three Granger causality tests can be conducted under the error correction mechanism (ECM). First is the short-term causality test. The significance of the short-run causal effects can be implied via the F-statistics on the lagged explanatory variables. Second is the long-term causality test. The significance of the long-run causal

effects can be indicated by the T- statistics on the coefficients of the lagged error-correction term. Third is the joint causality tests. The significance of both the short-run and long-run causal effect is indicated by the F-statistics on both lagged explanatory variables and the lagged error-correction term. (Narayan and Smyth, 2005) Table 2.9 displays the results.

Table 2.9: Granger Causality Analysis I

LHS Variable	Short Run		Long Run	Joint	
	ΔGDP	$\Delta FinDev$	ECT	ΔGDP, ECT	$\Delta FinDev$, ECT
ΔGDP	—	39.270***	-1.796*	—	22.540***
		[0.000]	[0.079]		[0.000]
$\Delta FinDev$	11.610***	—	—	—	—
	[0.000]				

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. T-statistics are reported for long-run Granger causality tests. F-statistics are shown for the short-run and the joint causality tests. P-values are in the brackets.

From the first row of Table 2.9, the F-statistic, 39.27, on the $\Delta FinDev$ indicates a significant short-term causal effect when ΔGDP acts as the left-hand side variable under the ECM. Therefore, the null hypothesis of no short-run causality from China's financial development to economic performance is rejected. Meanwhile, the T-statistic, -1.796, on the ECT suggests a significant, albeit relatively weak, long-term causal effect. Accordingly, the null of no long-term causality from financial development to output performance is also rejected. In addition, the F-statistic, 22.54, also implies a joint causality running from domestic financial development to economic performance in Chinas case. From the second row of Table 2.9, if $\Delta FinDev$ is the left-hand side variable, the F-statistic, 11.61, on the ΔGDP indicates a significant short-term causal effect. The null of no short-run causality from China's economic performance to financial development is rejected. At the same time, the ECT is not included in the long-term causality test because the variables are not cointegrated when $\Delta FinDev$ is regarded as the left-hand side variable. Collectively, we observe a bi-directional causality between China's economic performance and the country's financial system development over the period 1952 to 2010.

2.4.3 Johansen Maximum Likelihood Approach for Cointegration and Causality

Considering that all the regressors in the system are unit root processes in levels, it is feasible to conduct the Johansen cointegrating test to detect the long-run relationship among the level of real output, financial development, capital stock and international trade. Here, the optimal lag length for the VAR is selected by the AIC with maximum lag of 3 allowed for each variable. According to AIC, lag 2 is appropriate in the VAR system. Meanwhile, for the purpose of identifying the number of distinct cointegration equations (CEs), the trace test is applied. Table 2.10 shows the trace test results. From Table 2.11, the null hypothesis of no cointegration relationships among variables is rejected at the 5% significance level. However, the null of at most one cointegration equation is accepted and therefore a unique cointegration relationship among the four analysed variables is identified.

Table 2.10: Johansen Cointegration Test

Variable List	Hypothesized No. of CE(s)				CE(s)
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	
GDP_t, $FinDev_t$,	50.669**	23.352	9.698	1.297	1
$Invest_t$, $Trade_t$	[0.027]	[0.229]	[0.305]	[0.255]	

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. Optimal lag length is determined by AIC with allowance of maximum lags of 3. Trace statistics are reported. P-values are in the brackets. Null hypothesis is that there is at most r cointegration equations in the system.

After confirming the number of CEs, the cointegrating relationship can be established in the VECM form. The results are displayed in Table 2.11. From the upper segment of Table 2.11, the long-term effect of financial development on real output is negative and statistically significant, albeit at the relatively weak 10% level. By and large, a 1% increase of financial development measure is associated with a 0.26% decrease of the level of average output. To compare, the long-term effects of both capital stock and international trade on economic performance

are significant and positive. Typically, the estimated coefficients are generally similar with the ones generated by the ARDL cointegration method: a 0.71% increase in real per capita GDP is boosted by a 1% increase in the capital stock and a 1.34% increase in real average output is stimulated by a 1% increase in trade openness. Meanwhile, from the middle segment of Table 2.11, the negative and significant estimated coefficient on the ECT corroborates the existence of the long-term relationship between four variables in the model. The short-run deviation away from the long-run equilibrium can be corrected at a rate of 7.8% each year. Also, it is evident here that the short-term impacts of China's financial development on economic performance are negative over the sample period.

Table 2.11: Johansen Cointegration Analysis

Long Run Results			
Variable	Coefficient	T-Statistic	P-Value
$FinDev$	-0.263*	-1.780	0.075
$Invest$	0.712***	4.960	0.000
$Trade$	1.337***	6.660	0.000
Constant	5.183		
Short Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
ECT	-0.078**	-2.012	0.044
$\Delta GDP(-1)$	0.428	1.600	0.110
$\Delta GDP(-2)$	-0.256	-1.210	0.226
$\Delta FinDev(-1)$	-0.027	-0.210	0.835
$\Delta FinDev(-2)$	-0.208**	-2.000	0.045
$\Delta Invest(-1)$	0.105	0.310	0.754
$\Delta Invest(-2)$	-0.143	-0.460	0.644
$\Delta Trade(-1)$	0.040	0.500	0.619
$\Delta Trade(-2)$	-0.211**	-2.170	0.030
Constant	0.012	0.410	0.685
Diagnostic Test Statistics			
	F-Statistic	P-Value	
Serial	14.356	0.572	

Notes: Estimates based on the error correction model with ΔGDP_t as the dependent variable. ***, ** and * are significance levels at 1%, 5% and 10%.

Granger causality tests can then be performed under the VECM. From the first row of Table 2.12, the T-statistic, -2.012, on the ECT suggests a significant

long-term causal effect. Accordingly, the null of no long-term causality from financial development to the average output level is rejected. Also from this row, we observe some weak evidence of short-run and joint causal effects from China's financial development to economic performance over the sample period. Meanwhile, from the second row, the F-statistic, 9.97, on ΔGDP indicates significant short-term causality from output performance to financial development. Such a causality pattern is also indicated by the joint causality test when $\Delta FinDev$ is the left-hand side variable. Therefore, a bi-directional causality between China's economic performance and the country's financial development from 1952 to 2010 is confirmed.

Table 2.12: Granger Causality Analysis II

LHS Variable	Short Run		Long Run	Joint	
	ΔGDP	$\Delta FinDev$	ECT	ΔGDP, ECT	$\Delta FinDev$, ECT
ΔGDP	—	5.070*	-2.012**	—	6.490*
		[0.079]	[0.044]		[0.092]
$\Delta FinDev$	9.970***	—	0.300	14.510***	—
	[0.007]		[0.585]	[0.002]	

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. T-statistics are reported for long-run Granger causality tests. F-statistics are shown for the short-run and the joint causality tests. P-values are in the brackets.

2.4.4 Robustness Check

To verify the findings observed earlier, an alternative financial development measure ($FinDev2$); that is, indicator *M2 (Loans of financial intermediaries/GDP)*, is employed in the robust check. Detailed results of cointegration and Granger causality tests can be found from the Table A2.1 to Table A2.6 in the appendix. In essence, the existence of cointegration is, again, observed among real output, financial development, capital stock and trade openness under both ARDL and Johansen maximum likelihood approaches. Similar to what has been suggested in previous sections, a bi-directional causality is indicated between China's economic performance and financial system development over the period 1952 to 2010.

2.4.5 An Analysis of the Results

In the preceding section, we conducted an empirical examination on the relationship between financial development and the level of real output in China over the period 1952 to 2010. By and large, two major points emerged from the regression results earlier. Firstly, the existence of the long-run equilibrium among average output, capital stock, international trade and financial development is revealed by using both the ARDL and Johansen maximum likelihood cointegration approaches. In particular, we found some evidence suggesting that the effect of domestic financial development on long-term real output is statistically significant and negative. However, in other cases, such an effect is insignificant. Secondly, a bi-directional causality between China's real output and the country's financial development is observed in the sample period. Collectively, China's financial system development failed to promote the long-term economic performance from 1952 to 2010. This finding is generally in favour of the "demand-following" hypothesis and is in line with previous China's studies, such as, Boyreau-Debray (2003), Hasan et al. (2009) and Zhang et al. (2012)

Two reasons can be listed here to explain the failure of local financial institutions on promoting real output in China. One is the political influence on the credit distribution of financial institutions. In particular, domestic banks, which are predominantly state-owned banks, generally follow the "political pecking order" in the allocation of financial resources. To be specific, China's private enterprises do not rank as high as the SOEs in terms of political status. Despite being efficient and productive, private firms are often disadvantaged in acquiring loans from the domestic financial sector. To compare, under political pressure, local SOEs, even the loss-making and inefficient ones, could be favoured and supported by large banks with cheap loans. (Liang and Teng, 2006; Poncet et al, 2010; Zhang et al., 2012) The historical records of the allocation of financial resources to SOEs and to private firms remain unavailable. However, Brandt and Zhu (2000) estimated that nearly 85% of newly issued credit from domestic banks was distributed to

SOEs over the period 1979 to 1993. Also, as suggested by Poncet et al. (2010), the phenomenon of "political pecking order" in the allocation of bank credit was only alleviated from the late 1990s.

The other reason is the high volume of non-performing loans (NPLs) in the financial system. In particular, historical data on the NPLs is still not available from individual banks, which is referred to a strategic disclosure decision of the Chinese authorities by Allen et al. (2012). Nevertheless, in a study by Qiu et al. (2000), over a half of aggregate loans in the entire banking sector are estimated to be NPLs in the 1990s. Typically, incentives of financial institutions in the identification of the high-quality borrowers are not enhanced by the government ownership. Any old NPLs, which were largely generated due to the inefficiency of SOEs, can always be covered up by domestic authorities. (Hao, 2006; Liang and Teng, 2006; Liang et al., 2013)

2.5 Conclusion

This chapter has attempted to examine the controversial finance-growth nexus in China. Using a variety of time series techniques, empirical evidence suggests the existence of a long-term relationship among China's real output, financial development, capital stock and international trade. At the same time, some evidence of a detrimental effect of domestic financial development on China's long-term output level is revealed. Also, a bi-directional causality between China's economic performance and financial development has been identified. Collectively, this study conjectures that China's financial system failed to promote the country's real output from 1952 to 2010. The finding of the failure of Chinese financial sector in the nation's long-term economic progress is consistent with some existing studies, such as, Boyreau-Debray (2003), Hasan et al. (2009) and Zhang et al. (2012), but against the arguments from Hao (2006) or Liang and Teng (2006).

In general, the work here highlights the necessity of the reforms on the domestic financial sector in the fulfillment of its expected growth-enhancing role in China. Firstly, as suggested by Allen et al. (2012) and Lin and Zhang (2009), state ownership is negatively related to bank performance in terms of efficiency and profitability. Therefore, the ongoing reforms on the domestic bank ownership, such as, privatization of financial institution, foreign acquisition and public listing of large state-owned banks, should continue to be pushed forward. (Berger et al, 2010; Allen et al., 2012; Elliott and Yan, 2013) Secondly, in a study of Liang et al. (2013), the stock of NPLs in the Chinese banking system is positively correlated with the degree of political connections of the bank directors. Clearly, a market-oriented banking sector under the sound corporate governance is needed to limit the expansion of NPLs. Thirdly, policy efforts are needed in the removal of the credit constraints for private Chinese enterprises. As the private firms have benefited from the foreign financial resources, further liberalization of foreign capital into Chinese financial system should be encouraged. (Poncet et al, 2010)

Also, this chapter emphasizes the identification of the binding constraints on China's financial sector. Typically, a series of reforms on domestic financial system have been implemented since the early 1990s. However, in a study of bank performance over the period 1997 to 2004, Lin and Zhang (2009) found that domestic banks which undergo a foreign acquisition or public listing failed to enjoy improved efficiency and profitability after the ownership reform. This finding highlights the "growth diagnostics" approach of Hausmann, Rodrik, and Velasco (2008), which argues that not well-focused reforms may not contribute to economic growth. Specifically, according to Hausmann et al. (2008), governments are incapable of implementing a long list of reforms with the intention of removing all constraints at the same time due to limited resources. Therefore, this "growth diagnostics" method argues that efforts should be made in the identification of a small number of binding constraints, in the sense that their removal would have a large impact on growth. (Hausmann et al., 2008; Rodrik, 2008) In the spirit of this approach, our finding of a negative growth effect of China's financial sector may not only reflect the lack of policy reforms but also may indicate the ineffectiveness of ongoing all-round reforms. As a result, this chapter calls for the focus on the identification of the binding constraints and on the determination of the priorities of future reforms in order to fulfill the growth-enhancing role of the Chinese financial sector.

Appendix: Additional Tables

Table A2.1: ARDL Cointegration Test: Robustness Check

Bounds Testing to Cointegration		
Dependent Variable	Estimated Models	F-Statistics
GDP_t	F(GDP / $FinDev2$, $Invest$, $Trade$)	5.319**
$FinDev2_t$	F($FinDev2$ / GDP, $Invest$, $Trade$)	2.607
$Invest_t$	F($Invest$ / GDP, $FinDev2$, $Trade$)	8.964***
$Trade_t$	F($Trade$ / GDP, $FinDev2$, $Invest$)	3.473
Significance Level	LCB	UCB
1%	4.828	6.195
5%	3.408	4.623
10%	2.843	3.920

Notes: $FinDev2$ is proved to be a $I(1)$ series in level using ADF, Phillips-Perron and Zivot-Andrews tests. *** significant at 1%; ** significant at 5%; * significant at 10%. Critical values are collected from Narayan (2005). Null hypothesis under bound testing is that no cointegration among the variables.

Table A2.2: Johansen Cointegration Test: Robustness Check

Variable List	Hypothesized No. of CE(s)				CE(s)
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	
GDP_t, $FinDev2_t$,	51.143**	24.838	9.806	0.813	1
$Invest_t$, $Trade_t$	[0.024]	[0.167]	[0.296]	[0.367]	

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. Optimal lag length is determined by AIC with allowance of maximum lags of 3. Trace statistics are reported. P-values are in the brackets. Null hypothesis is that there is at most r cointegration equations in the system.

Table A2.3: ARDL Cointegration Analysis: Robustness Check

Long Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
$FinDev2$	-0.282	-1.01	0.319
$Invest$	0.714***	4.330	0.000
$Trade$	1.224***	3.450	0.001
Constant	4.433***	4.360	0.000
Short Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
ECT	-0.091**	-2.660	0.011
$\Delta GDP(-1)$	0.533***	7.240	0.000
$\Delta FinDev2$	-0.275***	-6.610	0.000
$\Delta Invest$	1.002***	12.390	0.000
$\Delta Invest(-1)$	-0.792***	-8.750	0.000
$\Delta Trade$	0.008	0.200	0.845
$\Delta Trade(-1)$	-0.118***	-2.730	0.009
$\Delta Trade(-2)$	-0.109**	-0.470	0.644
Diagnostic Test Statistics			
	F-Statistic	P-Value	
Normal	1.986	0.370	
Serial	1.059	0.377	
ARCH	0.012	0.913	
RAMSEY	0.390	0.536	
CUSUM	Stable		
CUSUMSQ	Stable		

Notes: Estimates based on the error correction model with ΔGDP_t as the dependent variable. ***, ** and * are significance levels at 1%, 5% and 10%.

Table A2.4: Granger Causality Analysis I: Robustness Check

LHS Variable	Short Run		Long Run	Joint	
	ΔGDP	$\Delta FinDev2$	ECT	ΔGDP, ECT	$\Delta FinDev2$, ECT
ΔGDP	—	43.630***	-2.660**	—	24.890***
		[0.000]	[0.011]		[0.000]
$\Delta FinDev2$	12.410***	—	—	—	—
	[0.000]				

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. T-statistics are reported for long-run Granger causality tests. F-statistics are shown for the short-run and the joint causality tests. P-values are in the brackets.

Table A2.5: Johansen Cointegration Analysis: Robustness Check

Long Run Results			
Variable	Coefficient	T-Statistic	P-Value
$FinDev2$	-0.254*	-1.780	0.075
$Invest$	0.705***	5.320	0.000
$Trade$	1.223***	7.240	0.000
Constant	4.768		
Short Run Coefficients			
Variable	Coefficient	T-Statistic	P-Value
ECT	-0.083**	-2.000	0.045
$\Delta GDP(-1)$	0.410	1.520	0.129
$\Delta GDP(-2)$	-0.255	-1.180	0.239
$\Delta FinDev2(-1)$	-0.025	-0.200	0.844
$\Delta FinDev2(-2)$	-0.224**	-2.180	0.029
$\Delta Invest(-1)$	0.109	0.320	0.748
$\Delta Invest(-2)$	-0.132	-0.420	0.675
$\Delta Trade(-1)$	0.047	0.590	0.552
$\Delta Trade(-2)$	-0.210**	-2.170	0.030
Constant	0.024	0.990	0.323
Diagnostic Test Statistics			
	F-Statistic	P-Value	
Serial	15.739	0.471	

Notes: Estimates based on the error correction model with ΔGDP_t as the dependent variable. ***, ** and * are significance levels at 1%, 5% and 10%.

Table A2.6: Granger Causality Analysis II: Robustness Check

LHS Variable	Short Run		Long Run	Joint	
	ΔGDP	$\Delta FinDev2$	ECT	ΔGDP, ECT	$\Delta FinDev2$, ECT
ΔGDP	—	6.360**	-2.000**	—	7.580*
		[0.042]	[0.045]		[0.056]
$\Delta FinDev2$	9.050**	—	0.190	12.370***	—
	[0.011]		[0.665]	[0.006]	

Notes: ***, ** and * are significance levels at 1%, 5% and 10%. T-statistics are reported for long-run Granger causality tests. F-statistics are shown for the short-run and the joint causality tests. P-values are in the brackets.

Chapter 3

Economic Growth, Financial Development and Democracy: Panel Evidence

3.1 Introduction

As a long-standing question in growth economics, the relationship between economic performance and financial development remains controversial. As argued by a large body of literature, such as, Levine et al. (2000), Levine (2005), Beck et al. (2010), and Greenwood et al. (2013), financial development has played a crucial role in the process of stimulating sustainable growth. However, notwithstanding its hypothesized benefits, certain empirics have uncovered evidence of the detrimental effect of domestic financial development for long-term growth prospects. Menyah et al. (2014) observed that financial system development failed to promote domestic output growth in Cameroon, Central Africa Republic, Chad, Congo and Sudan. Furthermore, Omri et al. (2015) found evidence of a negative effect of financial sector development on output growth in Egypt, Iran, Oman and Syria. Similarly, in the preceding chapter of this thesis, the evidence presented suggested that China's financial development did not exert a positive impact on the nation's economic performance. Noticeably, the countries mentioned above commonly lack democracy in the domestic economy. Recent growth literature, such as Acemoglu et al. (2014), and Madsen et al. (2015), has highlighted democracy to be a major driver of economic growth. However, prior studies have largely ignored the role of democracy in the finance-growth nexus.

In this chapter, we extend previous research by examining the impact of democratic institutions on the relationship between financial development and economic growth. Three contributions have been made to the existing literature. First, this study specifically examines the interaction between financial development and democracy to test the hypothesis that democracy is potentially a key condition which compounds the growth-effect of financial development. Second, this chapter assembles a large panel for 171 economies spanning 55 years over the period 1960 to 2014. Different indicators of financial development are constructed alongside both standard and newly introduced measures of democracy. Using historical data,

we are able to identify the impact on output growth through the interaction term between democracy and financial development. The third contribution is on the variety of the estimation methods in the identification of the effects of financial development, democracy and the interaction between the two. Typically, Ordinary Least Squares (OLS), Within Group (WG), differenced GMM and system-GMM estimators have been employed for the linear dynamic panel data model. Also, GMM estimators are prone to the problems associated with instrument proliferation and this issue is addressed in the chapter.

The baseline results show that financial development per se is capable of exerting a significant and positive impact on domestic economic growth. Such a finding is in line with classic finance-growth empirical studies such as those of Beck et al. (2000) and Beck and Levine (2004). According to the system GMM estimation, a one percent increase of the ratio of private sector credit to GDP leads to a two percent increase of the rate of growth of per capita GDP. Meanwhile, limited evidence of a significant impact on output growth of democracy, or the interaction term between financial development and democracy, is observed in the analysis. In general, the finding of an insignificant effect of democracy on output growth is also consistent with previous literature; for instance, Murtin and Wacziarg (2014). As a result, the paper conjectures that the beneficial effect of financial development on economic performance generally does not require the condition of the existence of democracy. For policymakers, improving the domestic financial system can contribute growth, even in the absence of sound democratic institutions.

The rest of this chapter is organized as follows. The next section reviews the theoretical and empirical literature on the relationship between democracy and growth. Section 3.3 outlines the modelling strategies, data and the empirical model used for this study. Section 3.4 is the methodology section, with the empirical results in Section 3.5. Section 3.6 concludes the chapter.

3.2 Literature Review

3.2.1 The Ambiguous Effect of Democracy on Growth

Theoretical research on the impact of a political system on economic growth has been ongoing for decades. However, the issue concerning whether democracy directly exhibits a positive, or a negative, effect on economic growth remains controversial among political science and economics scholars. Generally speaking, three diverse opinions on the influence of the democratic system on growth have been put forward.[1]

a. Conflict School

The conflict school states that democracy hinders economic performance in essence. (Lindblom, 1977; Schumpeter, 1942) Initially, a democratic state is often characterized by universal suffrage. However, it is very likely that median voters are an economically disadvantaged group, given the spread of voting rights in society. In particular, these low income voters are believed to have a strong demand for immediate consumption and a tendency to use political rights to fulfill such a demand by influencing the process of policy-making. To fulfill requests of immediate consumption, democratic states may be forced to lower income tax rates, raise wages and adopt redistribution policies at the expense of profitability of potential investment. Inevitably, democratic states would face an inefficient resource allocation, a low investment level and, hence, a retarded rate of output growth in the long run. (Alesina and Rodrik, 1994; Helliwell, 1994; Persson and Tabellini, 1994)

On the contrary, it is believed that autocratic states are capable of resisting immediate consumption demands and prohibiting potential dysfunctional consequences in the decision-making procedure through the implementation of policies suppressing individual incomes or labor unions (Huntington, 1987; Przeworski and Limongi, 1993; Olson, 1993, 2000). At the cost of economic and political free-

[1] A literature review of the relationship between economic performance and financial development can be found in Chapter 2.

dom, such strong policies in a dictatorship are believed to be necessary for rapid growth, especially for developing nations. Also, with a low discount factor given secure tenure, it is likely that autocratic rulers outperform democratic ones in smoothing resource allocation, stimulating investment and, eventually, promoting long-term economic growth (Moore, 1966; Huntington, 1987; Sirowy and Inkles, 1990; Przeworski and Limongi, 1993).

b. Compatibility School

The second perspective, the compatibility school, emphasizes the positive role that the democratic system plays in economic performance (Przeworski and Limongi, 1993; Saint-Paul and Verdier, 1993; Benabou, 1996). Initially, the process of policy-making is commonly discretionary in autocracy regimes. In the absence of any sound supervision, kleptocratic dictators have the capacity of establishing arbitrary policies aligned to the interests of a small proportion of elites in society.

In contrast, decision-making processes in democratic states are normally subject to strong public checks which essentially prevent attempts at monopolizing lucrative economic opportunities (Acemoglu et al., 2008; Acemoglu and Robinson, 2013). Besides, with advantages in protecting the private sphere, ensuring socioeconomic rights, encouraging market competition, limiting state intervention etc., a democratic political system is best suited for underdeveloped countries pursuing sustainable growth (Lipset, 1959; Przeworski and Limongi, 1993; Acemoglu et al., 2014). In addition, although democratic redistribution under popular demand is potentially distortionary, it is hard to ignore the fact that such redistribution could be beneficial for long-run economic performance if conducted in the form of public goods or education. (Przeworski and Limongi, 1993; Acemoglu et al., 2014)

c. Sceptical Perspective

The sceptical perspective believes that there is not a systematic connection between democracy and growth. In particular, as argued by Barro (1997), democracy is not the key to economic growth. At the same time, proponents of this perspective argued that because countries with diverse political systems can adopt

the same economic policies, it seems pointless to merely focus on the influence of a specific political system on economic performance. As a result, more attention should be directed to the typical institutional structures, as well as to development strategies chosen by the government. (Sirowy and Inkeles, 1990; Feng, 1997)

3.2.2 Democracy and Growth: Channels

Various political and social scientists have proposed that, other than its ambiguous direct effect on growth, democracy is potentially capable of exerting a significant effect of long-term economic performance indirectly through diverse channels. In particular, it is worth noting that the ignorance of the potential indirect mechanisms could result in erroneous arguments on the democracy-growth relationship. (Tavares and Wacziarg, 2001; Baum and Lake, 2003; Acemoglu et al., 2014)

Physical Capital Investment

A connection between democracy and physical capital investment is widely suggested given democracies have advantages in protecting property rights, ensuring economic rights, and improving contract enforcement. (Przeworski and Limongi, 1993; Helliwell, 1994; Tavares and Wacziarg; 2001) Such advantages are believed to exert a positive influence on the increasing rate of return to physical capital and to contribute to a higher rate of growth of output in the long run. However, due to the pressure of immediate consumption, democracies have tendencies to narrow income inequality through a series of redistributive policies, which could generate a low level of return to capital and discourage future investment activities. As a result, the overall effect of democracy on physical capital investment is theoretically controversial. (Przeworski and Limongi, 1993; Helliwell, 1994; Tavares and Wacziarg; 2001)

Human Capital

A large number of authors have pointed out the connection between democracy and human capital is bi-directional. Human capital is considered as a crucial precondition in the process of democratization. At the same time, it is expected that

public demand for education and health would be largely satisfied once a democratic political system is achieved. With more resources and stronger incentives for pursuing a higher level of human capital, democratic states are believed to perform better than autocratic ones in providing public health services, extending life expectancy, and improving schooling attainments etc. Given the positive effect of human capital on economic growth, as suggested by Mankiw et al. (1992), a democratic political system is capable of stimulating long-term output growth through human capital. (Helliwell, 1994; Baum and Lake, 2003; Gerring et al.; 2005)

Government Size

It is theoretically controversial whether a democracy or an autocracy is accompanied with greater government size. In fact, both political systems have incentives to expand their public expenditures. With more voices for the poor, democracies could be required to increase size and sphere. Meanwhile, autocracies have natural motivations to expand their activities for the maximization of economic resources under control. (Tavares and Wacziarg, 2001)

Trade Openness

Tavares and Wacziarg (2001) argued that the extent of trade openness is generally affected by the degree of political freedom in society. Typically, democratic states share the tendencies to pursue the interests of domestic consumers and, as a result, to abandon popular protectionist policies in the autocracies. Nonetheless, the policy-making process of democratic governments on international trade could be manifested by a few benefiting from protectionism through lobbying and voting. Consequentially, it is unclear if a democracy performs better than an autocracy in promoting trade openness on the theoretical level.

Other Channels

Apart from the three mechanisms mentioned above, various studies proposed other potential channels through which democracy could potentially exert an impact on economic performance. Such channels include: income inequality (Prze-

worski and Limongi, 1993; Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Gerring et al.; 2005), political instability (Feng, 1997; Tavares and Wacziarg, 2001), quality of governance (Tavares and Wacziarg, 2001; Acemoglu et al., 2008; Acemoglu and Robinson, 2013), union membership and welfare expenditure (Pougerami, 1988), fiscal balance, trade balance, money supply, wages, employment, foreign investment, inflation (Gasiorowski, 2000), social unrest (Gasiorowski, 2000; Acemoglu et al., 2014), population (Przeworkski et al., 2001; Grundler and Krieger, 2015b), total factor productivity, economic reforms and taxation (Acemoglu et al., 2014).

3.2.3 Empirical Evidence

At the empirical level, it is difficult nowadays to reach a consensus of the direct effect of democracy on economic performance. A summary of selected empirical literature can be found in Table A3.1.

Taking advantage of the Freedom House dataset, Barro (1996) investigated the impact of democracy on economic performance for a sample of 100 countries over the period 1960 to 1990. The direct effect of democracy on economic growth was shown to be negative, but statistically insignificant. Barro (1996) also examined potential indirect channels of democracy on economic growth and suggested that the overall effect of democracy is negative.

Tavares and Wacziarg (2001) also examined potential effects of democracy on output growth in a cross-country framework. Using a three stage least squares technique in the identification of statistically feasible indirect channels of democracy, it was revealed that democracy slows economic growth via low physical capital accumulation and high government consumption. At the same time, democracy stimulates growth via high human capital accumulation and high income equality. However, the finding of overall effect of democracy on growth is negative.

Persson and Tabellini (2008) employed alternative democracy measures from Polity IV and applied propensity scores methods in their cross-country study. With

a large sample of 138 nations covering the period 1960 to 2000, they suggested a positive impact on economic performance if a country moves from dictatorship to democracy, a result which differed from the conclusions from earlier cross-country studies.

In general, various cross-country analyses have failed to reach agreement of what exactly the effect of democracy on economic performance is. However, it is worth noting that the drawbacks of such cross-country studies are obvious. In particular, as suggested by Acemoglu et al. (2014), biased results on the influence of democracy on output growth could be generated from cross-sectional regressions if one failed to take into account the fact of a great diversity of socioeconomic conditions in different countries worldwide.

Meanwhile, empirical evidence based on panel data regressions is, again, inconclusive. The emergence of panel data studies on the connection between democracy and economic performance was initially accompanied by the interest of capturing the possible influence of democratization. In particular, panel studies, including Rodrik and Wacziarg (2005), Giavazzi and Tabellini (2005), Persson and Tabellini (2006), and Papaioannou and Siourounis (2008b), collectively employed Polity IV database and constructed an index of democratization based on specific mathematical criteria.

Under the fixed-effects panel data regression, Rodrik and Wacziarg (2005) found some evidence that the influence of democratic transition is beneficial for short-term economic performance. However, such a positive influence vanishes in the long run. In comparison, with a similar data set, Papaioannou and Siourounis (2008b) failed to find supportive evidence, but instead suggested that democratic transition hinders growth in the short term while it exhibits a beneficial effect for the economy only in a longer period. In another two panel studies, Giavazzi and Tabellini (2005) and Persson and Tabellini (2006) also found a positive effect of democratic transformation on output growth. In particular, both papers also suggested the beneficial impact of democratization could be enhanced if the domestic

economy is liberalized in advance.

Rock (2009) and Kutsen (2013) tried to measure whether democracy or autocracy performs better in promoting economic performance in the context of Sub-Saharan African countries and Asian countries respectively. In particular, both studies proposed some consistent empirical evidence on the positive direct effect of democracy on economic performance. Meanwhile, democracy's indirect effects, through investment and state capacity, are highlighted in the two papers. With a small sample of African countries, Bates et al. (2012) proposed the application of pooled mean group estimation in their study. Consistent with previous regional studies of Rock (2009) and Kutsen (2013), Bates et al. (2012) also found some evidence against the prediction of "conflict school" in the case of Africa.

Recent evidence based on the panel data analyses again suggested mixed results. With a large panel of 175 nations over the period 1960 to 2010, Acemoglu et al. (2014) revealed evidence of a significantly positive impact of democracy on growth. Using a new dichotomous measure of democracy, Acemoglu et al. (2014) argued the impact of democracy on economic performance is positive after controlling for output dynamics. Such a finding was generally confirmed by Grundler and Krieger (2015a, b) and Madsen et al. (2015). In comparison, other studies, such as, Murtin and Wacziarg (2014) and Jacob and Osang (2015), did not observe any significant influence of democracy on economic performance.

Here, it is worth noting that the results from the panel data regressions are not entirely free from technical concerns. Typically, issues of omitted variable bias and collinearity between measures of democracy and other growth determinants could lead to the misspecification of regression which threatens the reliability of empirical findings.

3.3 Modelling Strategy, Data Description and the Empirical Model

3.3.1 Introduction of Modelling Strategy

One of the fundamental difficulties for the empirical study of growth is the identification of salient growth determinants. A simple approach for early empirical scholars, for example, Barro (1996), facing this difficulty was to include a set of regressors thought to represent everything important for growth of the economy and to employ one, or a few, regressions as if these indeed reflect the real-world mechanisms that had generated the data. (Durlauf et al., 2005; Sianesi and Van Reenen, 2003)

However, this all-encompassing approach is obviously quite problematic. On the one hand, as summarised by Durlauf et al. (2005), a sum of 145 different explanatory variables has been investigated for the standard growth regression in the early empirical growth studies. It is computationally impossible to employ one single all-inclusive regression considering the number of potential growth determinants could be as large as number of countries worldwide. On the other hand, credibility of such a routine is doubtful considering that the choices of variables and models are arbitrary in essence. Ignoring the uncertainty of model validity, any inference based entirely on the absolute truth of these models would be imprecise and misleading.

Several attempts have been made to formally confront the issue of model uncertainty. Firstly, following Leamer (1983, 1985), Levine and Renelt (1992) extreme-bounds analysis was proposed in the identification of key growth determinants. Through repeating extreme-bound tests for the variables in the dataset, a regressor is identified as a robust determinant of growth if both the statistical significance and predicted sign of this regressor do not vary across different model specifications. On the contrary, if a regressor loses its significance, or has a contrasting

sign across specifications, it is then labeled as fragile. Two robust growth determinants, i.e. the initial level of income together with investments share in GDP, are suggested by Levine and Renelt (1992).

Secondly, in their study in 2004, Sala-i-Martin, Doppelhofer, and Miller applied the Bayesian Averaging of Classical Estimates (BACE) approach in tackling model uncertainty. In particular, this approach requires a construction of estimates as a weighted average of OLS estimates for every potential growth regression. Meanwhile, with sample-dominated Bayesian priors and least-squares estimates, minimal prior information is applied in this BACE method. Using a balanced dataset of 67 regressors for 88 countries, Sala-i-Martin et al. (2004) identified eighteen robust determinants of long-term economic growth, which includes an East Asian dummy, initial primary schooling enrollment rate, the average price of investment goods, the initial level of per capita GDP, the proportion of a country's area in the tropics, the density of the population in coastal areas, an index of malaria prevalence, the initial life expectancy, the fraction of population Confucian, an African dummy, a Latin American dummy, the fraction of GDP in mining, a dummy for former Spanish colonies, the number of years an economy has been open, the fraction of the population Muslim, the fraction of the population Buddhist, an index of ethnolinguistic fractionalization, and the share of government consumption in GDP.

Thirdly, since late last century, a variety of scholars have established their specified models on the basis of solid theoretical grounding. Specifically, based on the studies of Solow (1956) and Swan (1956), the textbook Solow model suggests the growth rate of the per capita output depends on the initial per capita output, the savings rate, the corrected population growth rate, the initial level of technology, the technological progress rate, and the rate of convergence to the steady state. Meanwhile, Mankiw, Romer and Weil (1992) proposed their augmented version of the Solow model by introducing the role of human capital accumulation. In their cross-country regressions, per capita output growth rate is specified as a function

of both regressors implied in the textbook Solow model, such as, the initial level of per capita output, rate of population growth, accumulation of physical capital etc., and the accumulation of human capital. Inspired by Mankiw, Romer and Weil (1992), many following cross-country studies, Caselli, Equivel and Lefort (1996) for example, also based their analyses on a similar theoretical set-up. The method has also been adapted for panel data studies, including those of Bassanini et al. (2001), Bond, Leblebicioglu and Schiantarelli (2010), and Arnold, Bassanini and Scarpetta (2011).

Although the controversy remains over the method to resolve the identification of salient growth determinants, together with the underlying model, in our perspective, the choice of right-hand-side regressors will adhere closely to standard theoretical models and accepted robust growth determinants. As a result, we follow the third route described above in the specification of our empirical regressions.

3.3.2 Model Specification

3.3.2.1 The Dependent Variable

Empirically, division remains on whether the log level or log first difference of per capita output should be used as the dependent variable. On the one hand, the majority of growth regressions, under both cross-country and panel data frameworks, uses the rate of growth of real output per capita as the dependent variable. However, potential long-term correlation between per capita output and regressors of interest may not be captured under the log first difference specification given a limited time span. (Madsen et al., 2015) On the other hand, many empirical regressions applied a log level specification and explained cross-country differences in per capita output levels. Nevertheless, it is doubtful if such regressions could be regarded as standard growth regressions. (Sianesi and Van Reenen, 2003) In addition, it is also likely for log level specifications to face spurious correlations if both the dependent variable and explanatory variables have common trends. (Madsen

et al., 2015) Here the log first difference of per capita real GDP is selected as dependent variable.

3.3.2.2 Institutional Variables

(1) Financial Development

At the theoretical level, both neoclassical and endogenous growth theories accepted the roles of development of both financial institutions and financial markets in the process of long-term output growth for an economy. As summarised by Cihak et al. (2013), five basic functions of financial system could be highlighted in the economy: (1) to enhance the quality of information, (2) to exert sound corporate governance, (3) to provide effective mechanisms for managing, pooling, and diversifying risk, (4) to mobilize savings, and (5) to facilitate trade.

Empirically, a large number of indicators have been proposed to measure the diverse aspects such as, size, access, efficiency and stability of both financial institutions and financial markets. However, most of these indicators are available only for a small number of countries or for a few points in time. (Beck et al., 2010; Cihak et al., 2013) In the meantime, the banking system still constitutes the major financial systems of instrument in the most nations worldwide. As a result, given limited choice, indicators of financial development for this study are restricted to measures of the size of financial institution development. Typically, two indicators will be introduced as detailed below.

a. Credit by financial intermediaries to the private sector/GDP

This ratio can be regarded as a standard measure of financial development under the assumption that a higher ratio represents a higher quality of financial service and better financial system development. Specifically, it includes credit to private enterprises from both deposit money banks and other financial institutions, and excludes credit to the private sector from the central bank, government agencies, and public enterprises. Also, this indicator isolates any cross claims of one group of financial intermediaries on another and credit to the public sector.

As a measure of the asset side of financial intermediaries balance sheet, this ratio captures one of the credit allocation mechanism of the financial system and is frequently used in empirical literature, such as Beck et al. (2000) and Levine et al. (2000).

b. Deposit money banks assets/GDP

The early finance-growth literature, such as King and Levine (1993a, b), Beck et al. (2000), and Beck and Levine (2004), emphasized the efficiency and effectiveness of commercial banks in identifying profitable projects and facilitating risk management. As an alternative to private credit to output, this work uses total deposit money banks assets to GDP as another measure of domestic financial development. In detail, deposit money banks include commercial banks and other financial institutions that accept transferable deposits. Meanwhile, deposit money banks assets include claims not just on the private sector, but also on local public enterprises and governments. This ratio is frequently regarded as a comprehensive indicator of size of the banking sector. As suggested by Beck et al. (2010), an economy where deposit banks have a great role in financial intermediation generally has a higher level of financial development.

(2) Democracy

Controversies always exist over the constituent components and numerical form in the construction of a most appropriate index of democracy. To be specific, it is never clear what exactly should be evaluated given the conception of democracy, or whether democracy should be measured as a continuous or a binary variable. (Cheibub et al., 2010; Boix et al., 2013; Acemoglu et al., 2014) In the meantime, it is widely recognized that all measures of democracy are commonly subject to substantial measurement errors, given the fact that existing measures are essentially constructed based on diverse theoretical groundings and operational procedures. It is therefore difficult to identify the most accurate measure of democracy among all available. (Cheibub et al., 2010; Boix et al., 2013; Grundler and Krieger, 2015b; Jacob and Osang, 2015)

Recent empirical studies of the effect of democracy on economic performance have exploited the plethora of measures of democracy available from various data sources. In particular, democracy indexes from the Polity project dataset are frequently employed given their wide coverage. Meanwhile, newly-established democracy measures also provide alternatives for empirical analyses. As a result, two measures of democracy will be introduced below.

a. Polity 2 Score

Based on multiple historical sources, Polity IV, the latest version of the Polity dataset, has constructed a series of annual measures of authority of the executive and the nature of political participation for 167 countries worldwide over the period 1800 to 2014. Among various measures, three indicators; i.e. institutionalized democracy, institutionalized autocracy, and Polity score indicators have been widely accepted in the democracy-growth literature.

Construction of these three indicators starts with the analysis of distinct qualities of authority patterns. As argued by the Polity project, many authorities exhibit a mixture of both democratic and autocratic qualities. In order to distinguish diverse authority patterns, five attributes, namely, competitiveness of executive recruitment, openness of executive recruitment, constraints on chief executive, regulation of participation, and competitiveness of political participation, are assessed by awarding scores each year. On the basis of scores of each attribute, two composite indicators, that is, institutionalized democracy and institutionalized autocracy indicators, could be then allocated to each country. In particular, both indicators are essentially presented in an eleven-point scale, which ranges from 0 (smallest level of democratic or autocratic quality) to 10 (greatest level of democratic or autocratic quality). Further, the third indicator proposed, i.e. the Polity score, is constructed by subtracting the institutionalized autocracy point from the institutionalized democracy point. This Polity score indicator, which ranges from minus 10 (strongly autocratic) to plus 10 (strongly democratic), is frequently regarded as a convenient tool for examining general regime effects. In

particular, the revised 21-point Polity score indicator, namely, the Polity2 score indicator, has been frequently employed in the recent empirical literature.

b. Democracy Index of Acemoglu et al. (2014)

In their recent research, Acemoglu et al. (2014) proposed a new dichotomous index for democracy status, which covers the post-independence period for 183 countries from 1960 to 2010 worldwide on the annual basis. In essence, this index consolidates existing democracy measures of both continuous and dichotomous forms.

The method of construction for this binary measure of democracy, is generally as followed: firstly, country in year is labelled as "democratic" if the Freedom House status is "Free" or "Partially Free" and the Polity score indicator is positive at the same time. Secondly, for those countries covered in Freedom House sample but not in Polity IV, if Freedom House status is "Free" or "Partially Free", and a "democratic" status is observed from either Cheibub et al. (2010) or Boix et al. (2013). Thirdly, for countries covered in the Polity IV dataset but not in the Freedom House sample, especially between 1960 to 1971, if the Polity score is positive, and either Cheibub et al. (2010) or Boix et al. (2013) confirms its "democratic" status. Meanwhile, for some cases that both Freedom House status of democracy and Polity score index are missing but covered by Cheibub et al. (2010) and Boix et al. (2013), a democratic status is manually coded according to the authors' secondary sources.

3.3.2.3 Traditional Economic Variables

(3) Initial level of per capita output

One of key arguments from neoclassical growth theory is the existence of the convergence effect. Specifically, given diminishing returns to reproducible factors, rich countries tend to grow slower than poor countries. As a result, poor countries will eventually catch up with rich ones. (Jones, 2002a; Barro and Sala-i-Martin, 2004) Meanwhile, as highlighted by Barro and Sala-i-Martin (1992), Mankiw et al.

(1992), and Islam (1995), neoclassical growth models essentially did not suggest different countries would reach the same level of average output but that countries would reach their respective steady states. A negative partial relationship between the rate of growth of average output and the initial level of output per capita is predicted only after controlling for other explanatory variables which determine the steady state level of output of a country. As a result, such a convergence effect is conditional in essence. In this study, we follow previous growth literature and include the logarithm of lagged level of per capita output on the right hand side of the regression for the purpose of measuring the rate of conditional convergence effect.

(4) Physical capital investment

As one of the fundamental growth determinants in the neoclassical growth model, the savings rate is normally measured by the ratio of the gross domestic investment to GDP. According to the Solow model, a higher volume of physical capital investment is predicted to have a positive effect on the steady-state level of output per capita. Meanwhile, if the transition to the new steady-state position needs a long time, the effect of physical capital investment on the steady-state growth rate of average output could also last for a long time during the transitional period. Following Mankiw et al. (1992), Islam (1995), Caselli et al. (1996), Hoeffler (2002), and Barro and Sala-i-Martin (2004), we employ the ratio of gross capital formation to annual output as the measure of physical capital investment in this study.

(5) Human capital investment

The role of investment of human capital was emphasized strongly by Mankiw et al. (1992) in their augmented Solow model. As another key growth determinant, the effect of human capital investment is generally analogous to that of physical capital investment in the neoclassical growth models. Thus, a higher volume of human capital investment would have a positive effect on the steady-state level of average output, and it also promotes rate of growth of average output during

the transition interval to the new steady-state position. Meanwhile, a large body of empirical literature restricted the focus on human capital investment in the form of education attainment. Empirically, either by gender or by level, literacy rates, school enrolment rates, and average years of schooling are frequently used as indicators of education attainment in various growth studies, including Mankiw et al. (1992), Islam (1995), Caselli et al. (1996), Beck et al. (2000), Tavares and Wacziarg (2001), Hoeffler (2002), Sianesi and Van Reenen (2003), Madsen et al. (2015) etc. For this study, we make full use of the recent published human capital index of Penn World Tables 9.0 to measure education attainment. Typically, this human capital index combines datasets of average years of schooling from Barro and Lee (2013) and Cohen et al. (2014) with the assumed rate of return to education for 150 economies worldwide.

(6) Population growth

In the neoclassical growth model, population growth has a negative effect on the steady-state level of per capital output. And a decline in the rate of growth of population could also promote the rate of growth of average output in the transition interval to the new steady-state position. Early empirical studies, including Mankiw et al. (1992), Islam (1995), Caselli et al. (1996), and Hoeffler (2002), commonly made the assumption that the correction factor of population growth, that is, the sum of depreciation rate and technology progress rate, to be 0.05 for all countries and this practice is followed here.

3.3.2.4 Macroeconomic Policy Variables

(7) Government consumption

As defined by World Bank, general government final consumption includes all government current expenditures for purchases of goods and services and national defense and security, but excludes some military expenditures that are part of government capital formation. In practice, the ratio of government final consumption expenditure to annual output is normally used to indicate the public outlays

that do not directly result in any improvements of productivity in the economy. Bassanini et al. (2001), Jones (2002a) and Barro and Sala-i-Martin (2004) argue that, if government finances its unproductive consumption mainly through taxes on income, profit, payroll and manpower, it is likely for these taxes to have a distortionary effect on private investment decisions and the efficiency of resource allocation. As a result, ceteris paribus, a higher proportion of government final consumption in output would lead to a lower steady-state level of average output in the economy. (Bassanini et al., 2001; Barro and Sala-i-Martin, 2004)

(8) Openness to trade

A higher level of openness to trade is believed to have a positive effect on the steady-state level of output per capita under the framework of neoclassical growth models. Specifically, through engaging in international trade, an economy would generally benefit from diffusion of knowledge, exposure of global competitiveness, exploitation of comparative advantages, and an improvement in economic efficiency. (Bassanini et al., 2001; Barro and Sala-i-Martin, 2004) Empirically, openness to trade is frequently measured as the ratio of the sum of exports and imports of goods and services to annual output.

(9) Inflation

The rate of inflation is typically measured as the consumer price index or the GDP deflator. Typically, a high rate of inflation generally reflects a high degree of macroeconomic instability which could be potentially harmful to the economy. Following Levine et al. (2000), the inflation variable used here is defined as logarithm of one plus inflation rate in order to eliminate heteroskedasticity problems associated with the high variability of inflation rates.

3.3.3 Data and Data Source

A panel dataset of 171 countries over the period 1960 to 2014 was constructed for this study. Typically, these 171 countries (see Table A3.2) consist of 36 developed and 135 developing economies according to International Monetary Fund.

Variables used for this study and their sources are displayed in Table A3.3. Apart from the indicators of democracy, other measures are from the Penn World Tables Version 9.0 and Global Financial Development dataset of World DataBank.

Data in the sample are averaged over non-overlapping five-year intervals. Such a data averaging process is regarded as a necessity to limit the potential measurement errors and to smooth business cycle fluctuations. In particular, both five-year and ten-year averaging processes are widely applied in the empirical growth studies. However, it is not clear which one outperforms the other with respect to capturing the long-term perspective of growth theory and disentangling short-term disturbances. As a result, following a large body of previous growth studies, such as, Mankiw et al. (1992), Caselli et al. (1996) and Hoeffler (2002), the five-year averaging process is applied. Specifically, the 11 five-year periods are defined as 1960-1964,. . . , 2005-2009, 2010-2014. At the same time, given the data is not available for all 171 countries for all 11 periods, the panel is essentially unbalanced.

3.3.4 Empirical Model

The empirical specification for five-year average model is shown as:

$$g_{it} = \alpha + \beta y_{it-1} + \gamma x_{it} + \eta_i + p_t + v_{it} \tag{3.1}$$

where i and t stand for 171 countries and 11 five-year periods. v_{it} is the idiosyncratic error term, η_i is the time-invariant country-specific effect. p_t are the eleven time dummies, which are included under the assumption of no correlation across individuals in v_{it}.

Meanwhile, the dependent variable, g_{it}, is the rate of growth of real average

output, i.e. the logarithm difference in real output per capita (GROWTH). y_{it-1} is the lagged logarithm of the level of real average output (GDP(-1)). x_{it} is a vector of other explanatory variables. To be specific, it includes:

(1) a measure of democracy, for example, rescaled Polity2 score (POLITY2);

(2) an indicator of financial development, that is, logarithm of the ratio of private sector credit issued by financial intermediaries to GDP (FINDEV1), or, logarithm of the ratio of deposit money banks assets over GDP (FINDEV2);

(3) logarithm of the ratio of the gross domestic investment to GDP (INVEST);

(4) averaged human capital index from the Penn World Tables (HC), constructed on the basis of average years of schooling from Barro and Lee (2013) and Cohen et al. (2014);

(5) logarithm of the population growth rate plus 0.05 (POP);

(6) logarithm of the ratio of general government final consumption to GDP (GOV);

(7) logarithm of the ratio of the sum of exports and imports of goods and services to GDP (TRADE);

(8) logarithm of one plus inflation rate (INF).

In addition, the lagged logarithm of real per capita GDP is assumed to be predetermined while all the other variables on the right hand side are assumed to be endogenous.

Table 3.1 shows the summary statistics for the five-year averaged variables used for this study. Here, the values for growth rates of average output and population are the total of the growth over the five-year averages. From Table 3.1, the mean of the growth rate of per capita GDP is 9.7%. The highest average GDP growth rate, 113.4%, is from Equatorial Guinea for the period 2000-2004 while the lowest is from Liberia for the period 1990-1994. Meanwhile, the highest per capita GDP is from United Arab Emirates for the period 1970-1974, followed by Qatar in the same period, while, the lowest average GDP level value is from Myanmar for 1965 to 1969. The largest values of our two financial development indicators collectively

come from Cyprus in the period 2010 to 2014. The smallest values of two indicators are from Democratic Republic of the Congo for 1980-1984.

Correlation analyses among these variables are shown in Table 3.2. As we do not observe high correlations among the explanatory variables from this table, the issue of multicollinearity is not considered in the following regressions. Meanwhile, two measures of financial development are highly correlated with a correlation of over 0.9, and so are the two measures of democracy. However, the correlation between a single measure of financial development and a single measure of democracy is moderate, which is generally around 0.4. In addition, a positive and strong correlation of 0.759 is found between per capita GDP and the human capital index in our sample.

Table 3.1: Summary Statistics for Five-Year Average Variables

Variable	Format	Definition	No. of Obs	Mean	SD	Min	Max
GROWTH	log	GDP growth rate	1,501	0.097	0.168	-1.098	1.134
GDP	log	GDP level	1,672	12951.690	19951.980	223.429	226687.200
INVEST	log	Domestic investment (%)	1,672	0.207	0.107	0.011	1.360
HC	level	Human Capital Index in PWT 9.0	1,438	2.058	0.718	1.007	3.719
POP	log	Population growth (%) + 0.05	1,557	0.151	0.082	0	1.225
GOV	log	Government size (%)	1,672	0.201	0.106	0.019	0.912
TRADE	log	Trade openness (%)	1,672	0.501	0.496	0.002	7.100
INF	log	Inflation (%) + 1	1,576	1.226	0.360	0.272	4.699
FINDEV1	log	Private credit (%)	1,491	0.367	0.350	0	2.474
FINDEV2	log	Deposit money banks assets (%)	1,493	0.423	0.374	0	2.474
POLITY2	level	Polity2 Score	1,493	0.553	0.366	0	1
ACE	level	Acemoglu et al. (2014) Democracy Index	1,764	0.463	0.484	0	1

Note: The last five columns show the summary statistics for original five-year average variables before log transformations.

Table 3.2: Correlations of Five-Year Average Variables

	GROWTH	GDP	INVEST	HC	POP	GOV	TRADE	INF	FINDEV1	FINDEV2	POLITY2	ACE
GROWTH	1											
GDP	0.083	1										
INVEST	0.247	0.583	1									
HC	0.116	0.759	0.449	1								
POP	-0.186	-0.351	-0.173	-0.605	1							
GOV	-0.065	-0.114	-0.140	0.001	-0.151	1						
TRADE	0.154	0.603	0.438	0.517	-0.264	0.044	1					
INF	0.049	0.108	0.197	0.002	-0.011	0.048	0.110	1				
FINDEV1	0.155	0.609	0.411	0.548	-0.282	-0.096	0.479	0.030	1			
FINDEV2	0.154	0.583	0.379	0.541	-0.302	-0.057	0.458	0.011	0.953	1		
POLITY2	0.129	0.421	0.293	0.639	-0.486	-0.065	0.324	-0.007	0.401	0.395	1	
ACE	0.108	0.392	0.268	0.578	-0.449	-0.069	0.263	0.000	0.356	0.347	0.926	1

Note: The correlation analysis is based on 1,121 observations.

3.4 Methodology

3.4.1 Introduction

Given the growth rate of per capita output is the logarithm difference in output per capita, the dynamic panel data model has the form as below:

$$y_{it} - y_{it-1} = \alpha + \beta y_{it-1} + \gamma x_{it} + \eta_i + v_{it} \tag{3.2}$$

or, equivalently,

$$y_{it} = \alpha + \beta^* y_{it-1} + \gamma x_{it} + \eta_i + v_{it} \tag{3.3}$$

where $\beta^* = \beta + 1$. Typically, the process shown by equation (3.3) is dynamic given the current realization of the dependent variable is influenced by its previous value, y_{it-1}. Here, we also assume the standard error components structure:

$$E[\eta_i] = E[v_{it}] = E[\eta_i v_{it}] = 0; i = 1, \cdots, N; t = 2, \cdots, T \tag{3.4}$$

idiosyncratic errors are assumed to be serially uncorrelated:

$$E[v_{it} v_{is}] = 0; i = 1, \cdots, N; t \neq s \tag{3.5}$$

Further, the initial conditions are predetermined:

$$E[y_{i1} v_{it}] = 0; i = 1, \cdots, N; t = 2, \cdots, T \tag{3.6}$$

3.4.2 OLS and Within Group Estimation

The ordinary Least Squares (OLS) estimator suffers from dynamic panel bias in the presence of a lagged dependent variable. Given the fact that it is positively correlated to the fixed effect, the OLS estimate of the coefficient of the lagged dependent variable is generally inconsistent and biased upwards.

To confront the endogeneity one solution is to employ the Within Group (WG) estimator. To be specific, one needs to transform equation (3.3) as the expression of deviations of each variable from its time series mean. Although the individual country effects are eliminated, a negative correlation exists between the transformed idiosyncratic error and the transformed lagged dependent variable as argued by Nickell (1981). As a result, the WG estimator is inconsistent and biased downwards.

In the meantime, according to Bond et al. (2001), Hoeffler (2002), and Roodman (2009a, b), the OLS levels estimate and the WG estimate of the coefficient of the lagged dependent variable can be treated as approximate upper and lower bounds. Normally, a candidate consistent estimator should be lie between two estimates in a well specified model. If not, issues such as inconsistency and severe finite sample bias for the estimator should be suspected.

3.4.3 Arellano and Bond (1991) Generalised Method of Moments Estimation

Another attempt to confront the issue of endogeneity is to apply first-differencing transformation; that is, subtracting the one period lagged equation (3.3) from the original:

$$y_{it} - y_{it-1} = \beta^* \left(y_{it-1} - y_{it-2}\right) + \gamma \left(x_{it} - x_{it-1}\right) + v_{it} - v_{it-1} \tag{3.7}$$

or,

$$\Delta y_{it} = \beta^* \Delta y_{it-1} + \gamma \Delta x_{it} + \Delta v_{it} \tag{3.8}$$

Again, the time-invariant individual-specific effects are eliminated. However, given the correlation between the transformed lagged dependent variable and the transformed error term, the OLS estimator is inconsistent. Nevertheless, Arellano and Bond (1991) suggested that values of y_{it} lagged two periods and more are cor-

related with Δy_{it-1} while orthogonal with Δv_{it}. As a result, y_{it-2} and earlier values are valid instruments in the first-differenced equation. Arellano and Bond (1991) further proposed the first-differenced Generalized Method of Moments (GMM) estimator, which has the capacity of delivering consistent and asymptotically efficient estimates in a standard large N, small T panel model. In general, a sum of $(T-1)(T-2)/2$ moment conditions can be exploited:

$$E\left(y_{it-l}\Delta v_{it}\right) = 0; t = 3, \cdots, T, l \geq 2 \tag{3.9}$$

3.4.4 Blundell and Bond (1998) System Generalised Method of Moments Estimation

Initially, Arellano and Bover (1995) and Blundell and Bond (1998) argued that the first-difference GMM estimator suffers from a potential large downward small sample bias. Such a bias could occur if the time series of instrumented variable is persistent, or the relative variance of the individual fixed effect is high. To be specific, little correlation exists between past levels and subsequent changes if the series is like a random walk. As a result, level instruments are likely to be weak for first-differenced variables, leading to large finite sample biases and poor precision under the dynamic panel framework.

To increase the efficiency of estimation, Arellano and Bover (1995) and Blundell and Bond (1998) further proposed the system GMM estimator, which largely improved both consistency and efficiency in Monte Carlo simulations. In particular, a system of two sets of equations is estimated. One is the first-differenced equation (3.8), where first-differenced variables are instrumented by their level values. The other is a level equation (3.3), where level variables are instrumented by first-differenced values. An additional $(T-2)$ moment restrictions can be derived:

$$E\left[\Delta y_{it-1}\left(\eta_i + v_{it}\right)\right] = 0; t = 3, \cdots, T, i \geq 1 \tag{3.10}$$

Meanwhile, it is worth noticing here that the extra $(T-2)$ moment conditions are only valid when the stationarity assumption is satisfied:

$$E\left(\Delta y_{i2}\eta_i\right) = 0; i \geq 1 \tag{3.11}$$

As suggested by Blundell and Bond (1998), this assumption essentially requires a mean stationarity restriction on the initial conditions. If not, individual fixed effects and the autoregressive process of y_{it} cannot offset in expectation of the other, which further results in the failure of the additional moment conditions (3.10).

3.4.5 Instrument Proliferation and Strategies

Both difference and system GMM estimators are widely regarded as popular means for the dynamic panel data model estimation. However, it is worth noting here that both methods are far from perfect. A typical issue when applying GMM estimators is the problem of "too many instruments". (Roodman, 2009a, b) Essentially, the number of instruments is quadratic in T in both GMM estimations. If T is large, it is likely that the instrument count may exceed sample size for a finite sample.

The first concern associated with instrument proliferation is the possibility of instruments overfitting endogenous variables. Second, instrument proliferation could potentially hinder the asymptotically efficient property of GMM estimation. Besides, instrument proliferation can also lead to a weak Hansen test of instrument validity. In addition, given the orthogonality assumption (3.10), the left-hand-side variable ought to either reach the long-term steady state in first sample period $(t = 1)$ or stay the same distance away from steady state points for all N in the system GMM estimation. However, in the context of empirical growth models, it is difficult to identify whether either of these two stands for per capita GDP series for various countries in the sample. (Roodman, 2009a, b)

For empirical studies, it is not yet clear what is a reasonable instrument count. As a liberal rule, Roodman (2009a, b) suggested that the instrument count should

not exceed N. In practice, various methods have been adopted in order to reduce the number of instruments. The first is to select certain lags in the instrument set instead of all the available ones. The second is to collapse the instrument set. When applying either of these two methods, the instrument count is restricted to be linear in T. The third is to collapse and to limit lag depth of the instrument set at the same time. Under such a combination, the instrument count is essentially invariant to T. In the meantime, Mehrhoff (2009), Kapetanios and Marcellino (2010), Bai and Ng (2010), and Bontempi and Mammi (2012), highlighted the application of principal component analysis in confronting the issue of "too many instruments". To be specific, a principal component analysis is conducted on the correlation matrix of the GMM instruments. The principal components with the largest eigenvalues are then selected as instruments instead of GMM instruments. Such a method is regarded as a generally data-driven and essentially an arbitrary way in reducing the instrument count in recent literature.

As suggested by Mehrhoff (2009) and Bontempi and Mammi (2012), the first three methods mentioned earlier involve a certain extent of arbitrariness. For example, variation in the number of lags included and collapsing the instrument set may lead to diverse results and difficulties in the interpretation of any robustness check. It is also likely to distort the reliance in the restrictions implicitly imposed on the instrument matrix. As a result, we rely on principal component analysis in order to limit the instrument count for this study.

3.5 Regression Results

3.5.1 Baseline Regression Results: The Augmented Solow model

This section provides an empirical examination of the augmented Solow model under the dynamic panel data framework [2] Table 3.3 shows the results.[3]

In the first column, OLS level estimates are displayed. Clearly, all variables are significant at the one percent level with the expected signs: the effect of initial level of per capita GDP is negative on the sequential per capital GDP growth, which could be interpreted as the evidence of existence of conditional convergence. In particular, the implied speed of convergence is around one percent per annum.[4]The effects of both physical capital investment and human capital on the growth rate of average output are positive while that of population growth is negative.

In the second column, the WG estimator is applied. Here, only the lagged level per capita GDP and physical capital investment are significant with expected signs in this column. In comparison to the OLS estimates, the human capital index and population growth are insignificant. Also, the estimated coefficient of lagged average output is larger in absolute terms than the one suggested by the OLS level estimation. In particular, the implied speed of conditional convergence becomes 3.5% per annum, which is much higher than the one obtained from OLS level estimation.

The two-step first-differenced GMM estimator is used in the third column of Table 3.3. As mentioned earlier, lagged average output is assumed to be predetermined and the other three regressors are assumed to be endogenous in the analyses. Meanwhile, the work does not apply restrictions on the count of instruments in

[2]The empirical examination of the Solow model can be found in Table 3.4 in the appendix.

[3]Time dummies are included which are jointly significant in the regressions.

[4]The convergence rate (λ) measures the speed at which a country's output converges to its steady-state level. Following Hoeffler (2002) and Arnold et al. (2011), the estimate for λ can be recovered from the coefficient on lagged output, β, as: $\beta = -(1 - e^{-\lambda t})$ and $\lambda = \frac{ln(1+\beta)}{-t}$, where t is the length of the time interval, that is 5 in this study.

Table 3.3: Baseline regression results: Augmented Solow Model

VARIABLES	(1) OLS	(2) WG	(3) DIF-GMM	(4) SYS-GMM	(5) DIF-GMM	(6) SYS-GMM	(7) SYS-GMM
GDP(-1)	-0.052***	-0.160***	-0.163***	-0.072***	-0.353	-0.095***	-0.105***
	(0.008)	(0.017)	(0.033)	(0.013)	(0.348)	(0.026)	(0.030)
INVEST	0.090***	0.106***	0.071***	0.131***	0.243***	0.219***	0.249***
	(0.013)	(0.016)	(0.020)	(0.019)	(0.080)	(0.038)	(0.034)
HC	0.056***	0.056	-0.111*	0.080***	1.499	0.112**	0.103*
	(0.014)	(0.041)	(0.067)	(0.024)	(0.907)	(0.044)	(0.052)
POP	-0.029***	-0.012	-0.030	-0.045***	-0.050	-0.026	-0.052*
	(0.010)	(0.020)	(0.030)	(0.016)	(0.077)	(0.017)	(0.031)
Constant	0.583***	1.533***		0.000		0.000	0.000
	(0.071)	(0.132)		(0.000)		(0.000)	(0.000)
Implied λ	0.011	0.035	0.036	0.015	0.087	0.020	0.022
	(0.002)	(0.004)	(0.008)	(0.003)	(0.152)	(0.006)	(0.006)
Obs	1,283	1,283	1,137	1,283	1,137	1,283	1,283
Countries	142	142	142	142	142	142	142
No. of IVs			189	226	25	42	40
AR(1)			0.001	0.001	0.792	0.003	0.005
AR(2)			0.043	0.023	0.823	0.020	0.018
Hansen test			0.984	1.000	0.176	0.006	0.093
No. of PCs					16	32	30
PCA R2					0.931	0.885	0.875
KMO					0.940	0.935	0.929

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

this column. To be specific, instruments for difference GMM are two period lagged and all further lagged values of per capita GDP, physical capital investment, human capital and population growth rate. Clearly, the coefficients of lagged average output and physical capital investment are statistically significant at the 1% level. The estimated coefficient of the human capital index is negative and significant at the 10% level. Although the sign of this coefficient is unexpected, such a finding is not new. Notably, Bond et al. (2001) and Hoeffler (2002) also observed a negative effect of human capital on output growth when the first-differenced GMM estimator is applied. The effect of population growth on output growth is insignificant in this column. In particular, the coefficient of lagged per capita GDP is very close to the WG estimate in Column 2. Such a finding is again consistent with Bond et al. (2001) and Hoeffler (2002). Blundell and Bond (1998) argued that the difference GMM is likely to be seriously biased downwards in a finite sample. As a result, the implied speed of conditional convergence is similar to the one found by the WG estimator.

Column 4 displays the results of two-step system GMM estimator. Again, no restrictions are applied for the instrument count. Specifically, for the first-differenced equations, the same set of instruments are used as in difference GMM estimation of Column 3. For the level equations, additional instruments are essentially first-differenced values of one period lagged average output, one period lagged physical capital investment, and one period lagged population growth rate. It is apparent that all the estimated coefficients are statistically significant at the 1% level under the system GMM estimation. In particular, the coefficient of lagged output lies between the upper and lower bounds obtained from first two columns in Table 3.3. The estimated speed of conditional convergence is 1.5 percent per annum.

It is worth noting here that two GMM estimation results in Columns 3 and 4 demonstrate the threats of instrument proliferation issue. Typically, the p-values of Hansen tests in both columns are generally 1. To confront such an issue, principal

component analysis is then used to reduce the instrument count.

In Column 5, the two-step first-difference estimates are presented. To be specific, the principal component analysis is applied on the original instrument matrix used in Column 3. The GMM instruments are essentially replaced by their 16 principal components, which explains the majority of variation in the instruments. Meanwhile, the value of Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is above 0.9, which implies the well-performance of 16 principal components. Correspondingly, the instrument count is restricted to 25. In addition, no evidence of an AR(2) structure is found in the first-differenced idiosyncratic error term. The Hansen test upholds the validity of instruments used. Noticeably, the estimated coefficient on physical capital investment retains its significance. However, the coefficient of lagged per capita GDP, the human capital index, and the population growth rate are statistically insignificant. Again, it is likely that, due to weak instruments, the difference GMM estimate suffers from downwards bias in the small sample.

A two-step system GMM estimator is employed in the Column 6 of Table 3.3. Again, the principal component analysis is used on the original instrument matrix constructed in Column 4. A sum of 32 principal components replaces the instrument set and the number of instruments drops 42. However, an AR(2) structure is observed in the first-differenced idiosyncratic error term. As suggested by Bond et al. (2001), the original instrument matrix structure should be modified in this case. In particular, for the first-differenced equation, the two lagged period values of real average output, physical capital investment, the index of human capital, and the rate of population growth are omitted.[5]

The last column of Table 3.3 displays the two-step system GMM estimation

[5]Bond et al. (2001) argued the assumption (3.5) that there is no serial correlation in the v_{it} is checked via testing for no second-order serial correlation in the first-differenced residuals. Given the AR(2) structure in Δv_{it}, we have $E\left[\Delta v_{it}\Delta v_{it-2}\right] \neq 0$, i.e. $E\left[(v_{it}-v_{it-1})(v_{it-2}-v_{it-3})\right] \neq 0$. It implies $E\left[v_{it}v_{it-1}\right] \neq 0$ due to the correlation between the v_{it-1} in Δv_{it} and the v_{it-2} in Δv_{it-2}. As a result, when $l = 2$, the moment condition (3.9) does not stand as $E\left[y_{it-2}(v_{it}-v_{it-1})\right] \neq 0$. y_{it-2} would not be a valid IV and needs to be omitted in the first-differenced equations. However, y_{it-3} and deeper lags remain available as instruments, for instance, $E\left[y_{it-3}(v_{it}-v_{it-1})\right] = 0$.

results after modifying the instrument matrix used in Column 4 earlier. Similarly, the principal component analysis is used on the new instrument set for the purpose of reducing the instrument count. To be specific, the modified GMM instruments are substituted by 30 principal components. These components collectively are capable of explaining over 90% of the variation in the instruments, and generally perform well according to a Kaiser-Meyer-Olkin (KMO) value of 0.929. At the same time, an AR(2) structure is again observed. However, as we do not observe any evidence of a higher order autocorrelation in the first-differenced idiosyncratic error, the application of the modified instrument matrix is appropriate.

From the last column, all four estimated coefficients are significant at the 10% level at least with the expected signs. The impact of initial per capita GDP level has a negative effect on sequential per capita GDP growth, which suggests the existence of conditional convergence. The coefficient of initial average output again falls between the upper and lower bounds obtained by OLS and WG estimates. Here, the implied speed of convergence is 2.2 percent per annum.

Earlier growth studies, including Mankiw et al. (1992) and Caselli et al. (1996), Bond et al. (2001) and Hoeffler (2002), provided examinations of the augmented Solow model. However, due to the diversity of the measures, assumptions, and estimation methods, the estimated conditional convergence rate differs at the empirical level. For instance, the conditional convergence rate is approximately ten percent a year in Caselli et al. (1996). On the contrary, both Bond et al. (2001) and Hoeffler (2002) observed an estimated speed of convergence around two percent per annum under the system GMM estimator. Using the same estimator, the implied conditional convergence rate in the analysis presented here is generally close to the ones found in Bond et al. (2001) and Hoeffler (2002).

Meanwhile, from Column 7 of Table 3.3, the effects of physical capital investment on output growth is positive and significant at the 1% level. The magnitude of such an effect is similar to that found under the first-differenced GMM estimator. The impact of the rate of population on economic growth is negative at the

10% level. In addition, the effect of the human capital index on output growth is positive, although it is only significant at the weak 10% level.

It is obvious from Table 3.3 that the sign and magnitude of the estimated effect of human capital on economic growth differ given different estimation methods. And such an effect is not always significant at the conventional 5% level. As suggested by Pritchett (2001) and Hoeffler (2002), it is common to observe a non-robust partial relationship between the human capital indicator and growth in growth studies. In particular, deficiencies may exist in the human capital index used, which is essentially based on average years of schooling. For instance, Sianesi and Van Reenen (2003) argued that human capital indicators based on formal schooling generally fail to account for any other aspect of education attainment, for example, on-the-job training. Similarly, quality of schooling is also hardly captured with aggregate measures of education attainment. (Sianesi and Van Reenen, 2003; Barro and Sala-i-Martin, 2004) Although Barro and Sala-i-Martin (2004) suggested that one may use scores of globally comparable tests as proxies of education quality, such tests, for example, programs for international student assessment, are currently only available for a relatively small number of countries and for a limited time period.

3.5.2 Baseline Regression Results: Additional Regressors

Table 3.4 reports the results of our baseline regressions with additional regressors. Four different estimators, i.e. OLS, WG, first-differencing GMM and system GMM estimators have been applied for the purpose of result comparisons. Here, lagged average output is assumed to be predetermined. While other explanatory variables, namely, physical capital investment, the human capital index, the corrected rate of the growth of population, general government consumption, trade openness, inflation, financial development and democracy, are assumed to be endogenous in the analyses. In particular, private sector credit to GDP and rescaled POLITY2 score are selected as measures of financial system development and democracy.

Table 3.4: Baseline regression results: Additional Regressors

VARIABLES	(1) OLS	(2) WG	(3) DIF-GMM	(4) SYS-GMM
GDP(-1)	-0.070***	-0.212***	-0.533***	-0.117***
	(0.010)	(0.024)	(0.134)	(0.022)
INVEST	0.081***	0.089***	0.128***	0.126***
	(0.013)	(0.013)	(0.046)	(0.027)
HC	0.046***	0.055	0.424	0.076*
	(0.016)	(0.047)	(0.309)	(0.042)
POP	-0.035***	-0.029	-0.077	-0.062**
	(0.010)	(0.018)	(0.088)	(0.030)
GOV	-0.025	-0.047**	0.022	-0.087*
	(0.017)	(0.018)	(0.096)	(0.046)
TRADE	0.031***	0.057***	0.172***	0.077**
	(0.010)	(0.017)	(0.059)	(0.037)
INF	-0.046	-0.020	-0.007	0.100
	(0.032)	(0.025)	(0.094)	(0.061)
FINDEV1	0.020***	-0.002	-0.007	0.018**
	(0.005)	(0.006)	(0.030)	(0.008)
POLITY2	-0.009	0.089**	0.210	-0.054
	(0.025)	(0.038)	(0.258)	(0.083)
FINDEV1*POLITY2	0.003	0.067***	0.170*	0.015
	(0.013)	(0.019)	(0.091)	(0.026)
Constant	0.766***	1.911***		0.000
	(0.096)	(0.189)		(0.000)
Obs	1,121	1,121	978	1,121
Countries	134	134	133	134
No. of IVs			52	88
AR(1)			0.704	0.000
AR(2)			0.373	0.083
Hansen test			0.110	0.106
No. of PCs			43	78
PCA R2			0.886	0.856
KMO			0.930	0.925

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

Meanwhile, an interaction term between the financial development and democracy measures, that is, FINDEV1*POLITY2, is added into the preferred specification (3.1) in order to test the hypothesis of whether financial development requires democracy as an institutional condition in the process of promoting economic growth for various countries worldwide. If the hypothesis is valid, it would be expected that this interaction term would be statistically significant. In addition, time dummies are also included which are jointly significant in the regressions.

To start with, the OLS level estimation results are displayed in the first column in Table 3.4. Firstly, the significant and negative coefficient of lagged average GDP can be regarded as proof of the conditional convergence. In addition, the estimated coefficients of physical capital formation, human capital index, and population growth are all statistically significant at the 1% level with expected signs. Meanwhile, among the macroeconomic policy and institutional variables, the estimated effect of trade openness is also significant on output growth at the 1% level. In particular, a one percent increase of international trade leads to a three percent increase in average GDP growth according to OLS level estimation. In comparison, the coefficients of both government consumption and inflation rate are insignificant in the first column of Table 3.4. Also, the coefficient on financial system development is also significantly positive: a one percent increase of private sector credit is associated with a two percent increase in growth. In addition, using the OLS level estimator, the estimated coefficient of POLITY2 on growth is not statistically significant and neither is the joint effect of FINDEV1*POLITY2.

In Column 2, the WG estimator is applied. The estimated coefficient of lagged level of average output is again negative and significant at the 1% level. However, the magnitude of such an effect is much larger in absolute terms than that from OLS estimate. Another explanatory variable that remains significant is physical capital formation. Typically, a one percent increase of the investment of physical capital promotes average output growth by over eight percent. Such a finding is basically similar to that of OLS estimation earlier. In the meantime, the effects of

human capital and population growth are not statistically significant according to the WG estimation. Moreover, the estimated coefficient of government consumption on growth is negative, which is significant at the 5% level. A one percent increase of government consumption generally leads to an approximate five percent decline on the average output growth. To compare, the estimated effect of trade openness on growth is positive and significant at the 1% level. A one percent increase of openness to trade leads to a five percent increase on per capita output growth. However, inflation, again, still does not exert a significant impact on growth in Column 2. At the same time, using the WG estimator, the estimated coefficient of private credit on growth is also insignificant. In comparison, a positive and significant impact of democracy indicator, Polity 2 score, on average GDP growth is observed in the second column of Table 3.4. In addition, the interaction term, FINDEV1*POLITY2, is also found to exert a significantly positive effect on the growth rate of per capita GDP at the 1% level. Such a finding reveals some evidence that democracy, a typical institutional condition, contributes to financial development in the process of stimulating domestic economic growth worldwide.

In the third column, the regression results using the two-step difference GMM estimator are presented. In order to avoid the potential issue of instrument proliferation, the principal component analysis is applied. As a result, the instrument count is restricted to 52 in this column, which is smaller than the number of countries in the regression. Validity of such a set of instruments is supported by the Hansen test with a p-value of 0.11. Also, no evidence of an AR(2) structure is found in the first-differenced idiosyncratic errors.

Similar to the estimates in the first two columns, a significant and negative coefficient of lagged per capita GDP is, again, observed in Column 3. Nonetheless, the estimated coefficient is much greater in absolute terms than the one obtained by the WG estimator. Such a finding is generally in line with the argument of Blundell and Bond (1998) which suggested that the first-differenced GMM is likely to be seriously biased downwards in a finite sample. Also, the coefficient of physical

capital formation is significant and a one percent increase of physical capital investment is associated with a more than a twelve percent increase in real per capita GDP growth. Meanwhile, the effects of either human capital or population growth are generally insignificant under the first-differenced GMM estimator. A positive effect of trade openness, which is significant at the 1% level, is also revealed in this column. Noticeably, the estimated coefficient of the measure of financial development, private sector credit to GDP, is insignificant and so is that of the democracy indicator when using the difference GMM estimator. The estimated coefficient of the interaction term, FINDEV1*POLITY2, is positive and significant at the 10% level.

Column 4 of Table 3.4 displays the two-step system GMM estimation results. Again, principal component analysis is applied and a set of 88 instruments is used. Validity of such an instrument set is proved via Hansen test and no evidence of an AR(2) structure is found in the first-differenced idiosyncratic errors.

From Column 4, the estimated coefficient of lagged per capita GDP is again statistically significant at the 1% level. In particular, this coefficient falls between the upper bound of OLS estimate and lower bound of WG estimate. The implied speed of conditional convergence is approximately 2.5% per annum. The effect of physical capital investment is significantly positive as before. Generally, a one percent increase of physical capital investment leads to a thirteen percent increase in real per capita output growth. Meanwhile, the coefficient for the human capital index on average GDP growth is positive, but is only significant at the 10% level. The impact of population growth is significantly negative at the 5% level. A one percent increase of the corrected rate of population growth is associated with a six percent decline of the average output growth. The estimated coefficient of government consumption is also negative and significant at the 10% level. The finding of a negative effect on output growth of government spending is consistent with some existing empirics on growth and government expenditure, such as, Barro (1997) and Acemoglu et al. (2002). As suggested by Bassanini et al. (2001) and

Barro and Sala-i-Martin (2004), this detrimental impact on economic performance could be largely due to distortionary taxation. In general, if the financing of government expenditure is mainly through taxation on income and profit or on payroll and manpower, this taxation could distort the incentives of investment on physical capital and human capital, and decrease the efficiency of resource allocation. Typically, these negative impacts of government expenditure could be severe when government activities are extended into the areas which can be more efficiently carried out in the private sector. (Bassanini et al., 2001; Barro and Sala-i-Martin, 2004) Moreover, the impact of trade openness on GDP growth is positive and significant. A one percent increase of openness to trade generally leads to a 7.7 percentage increase on per capita output growth in Column 4. In addition, the coefficient of financial system development indicator, FINDEV1, is also significantly positive in the system GMM estimation. It is suggested that a one percent increase of private sector credit to GDP is associated with a nearly two percent increase in growth. Such a finding is similar to that of OLS level estimation. However, the effect of democracy measure, POLITY2, is statistically insignificant. Likewise, the impact of the interaction term, FINDEV1*POLITY2, on average output growth is also not significant. As a result, based on the system GMM estimation, financial development per se has the capacity of exerting a significantly positive impact on economic growth.

3.5.3 Robustness Check

In the robustness check, the democracy measure of Acemoglu et al. (2014) is used as the alternative democracy indicator. An interaction term between financial development and democracy measures, that is, FINDEV1*ACE, is included in the regressions to examine the hypothesis of whether the development of financial sector requires democracy in the process of promoting economic growth. Table 3.5 shows the results. Typically, for both GMM estimations, the construction of GMM instrument sets follows the same procedure as in the last two columns of Table 3.4.

From Table 3.5, there is strong evidence of the existence of conditional convergence effect considering the estimated coefficients of lagged per capita GDP are negative and statistically significant at 1% level in all four columns. Typically, the coefficient of lagged per capita GDP of system GMM estimation is located between those of OLS and WG estimations. According to system GMM estimator, the implied speed of convergence is approximately 2.5 percent per annum. Meanwhile, physical capital investment always has a positive effect on output growth, which is significant at the 5% level at least throughout different regressions. Specifically, a one percentage increase in the share of physical capital investment to GDP would lead to around a ten percentage increase in average GDP growth. Besides, based on both GMM estimators, the estimated coefficients of human capital index, corrected population growth, government consumption, and inflation are generally insignificant at the conventional 5% level. Also, the impact of openness to trade on GDP growth is positive and significant in all four columns, although the magnitude varies according to different estimators. In addition, some evidence of a significant and positive effect of financial sector development is revealed according to OLS and system GMM estimators. A one percent increase of private credit to GDP is associate with a two percent increase in per capita GDP growth approximately. The estimated coefficient of either democracy measure, i.e. ACE, or the interaction term, i.e. FINDEV1*ACE, is positive and statistically significant at

Table 3.5: Robustness check: alternative measure of democracy

VARIABLES	(1) OLS	(2) WG	(3) DIF-GMM	(4) SYS-GMM
GDP(-1)	-0.068***	-0.181***	-0.602***	-0.120***
	(0.010)	(0.024)	(0.170)	(0.025)
INVEST	0.082***	0.093***	0.128**	0.118***
	(0.012)	(0.015)	(0.065)	(0.021)
HC	0.040***	0.035	0.484*	0.075
	(0.015)	(0.045)	(0.291)	(0.055)
POP	-0.035***	-0.030*	0.013	-0.048
	(0.009)	(0.018)	(0.099)	(0.035)
GOV	-0.022	-0.042**	0.152	-0.069
	(0.017)	(0.019)	(0.103)	(0.044)
TRADE	0.032***	0.055***	0.216***	0.086**
	(0.009)	(0.017)	(0.071)	(0.037)
INF	-0.047	-0.026	-0.043	0.064
	(0.031)	(0.026)	(0.086)	(0.056)
FINDEV1	0.021***	0.007	0.021	0.029***
	(0.004)	(0.010)	(0.041)	(0.011)
ACE	-0.008	0.067**	0.308	-0.065
	(0.018)	(0.029)	(0.247)	(0.058)
FINDEV1*ACE	-0.002	0.038**	0.162*	0.003
	(0.010)	(0.015)	(0.085)	(0.022)
Constant	0.764***	1.708***		0.000
	(0.091)	(0.176)		(0.000)
Obs	1,174	1,174	1,025	1,174
Countries	140	140	140	140
No. of IVs			57	90
AR(1)			0.674	0.000
AR(2)			0.820	0.051
Hansen test			0.580	0.121
No. of PCs			48	80
PCA R2			0.881	0.846
KMO			0.93	0.925

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

the 5% level only when using WG estimator.

In the second part of robustness check, an alternative financial development indicator, that is, deposit money banks assets to GDP, is used in the analyses. Meanwhile, the indicator of democracy is the rescaled Polity 2 score. Again, four estimation methods are employed, results of which can be found in Table 3.6. In line with regressions earlier, for the two GMM estimations, the construction of GMM instrument sets and approach of reducing instrument counts are same as before. A series of diagnostic tests on the bottom of the table generally suggest the validity of the instrument sets used for the GMM estimations.

As before, the effect of lagged per capita GDP level has a significantly negative effect on the per capita GDP growth throughout different regressions here. Similarly, the impact of international trade on growth is statistically significant with a positive sign in all four columns. Typically, there is some evidence of positive effect of financial development based on OLS, and system GMM estimations. A one percent increase of the ratio of deposit money banks' assets to GDP generally leads to a two percent increase of the growth of per capita GDP. At the same time, the estimated coefficient of democracy on output growth is generally insignificant at the 5% level. However, under the WG estimation, the joint effect of FINDEV2*POLITY2 is significant at the 1% level with a positive sign. Such finding when adopting WG estimator is generally consistent with what we observe in Tables 3.4 and 3.5.

Given the majority of the countries in our sample are developing economies, we further examine whether the effects of financial development and democracy found in the full sample differ for these developing countries. Table A3.5 in the appendix shows the regression results using the system GMM estimator. Specifically, different measures of financial development and democracy have been adopted in each of the four columns. From Table A3.5, we observe significant effects of lagged average output and physical capital investment on output growth for the 135 developing countries over the sample period. Meanwhile, the estimated coefficient of

Table 3.6: Robustness check: alternative measure of financial development

VARIABLES	(1) OLS	(2) WG	(3) DIF-GMM	(4) SYS-GMM
GDP(-1)	-0.070***	-0.204***	-0.464***	-0.114***
	(0.010)	(0.025)	(0.107)	(0.022)
INVEST	0.082***	0.091***	0.128***	0.109***
	(0.013)	(0.014)	(0.047)	(0.027)
HC	0.047***	0.047	0.452	0.085*
	(0.016)	(0.047)	(0.296)	(0.043)
POP	-0.035***	-0.030*	-0.131**	-0.047
	(0.010)	(0.018)	(0.059)	(0.032)
GOV	-0.027	-0.045**	0.035	-0.096**
	(0.017)	(0.019)	(0.107)	(0.045)
TRADE	0.032***	0.055***	0.173***	0.082**
	(0.009)	(0.018)	(0.053)	(0.034)
INF	-0.045	-0.022	-0.037	0.080
	(0.032)	(0.026)	(0.096)	(0.063)
FINDEV2	0.024***	-0.007	0.005	0.017**
	(0.006)	(0.004)	(0.035)	(0.008)
POLITY2	-0.015	0.066*	0.157	-0.035
	(0.027)	(0.035)	(0.243)	(0.086)
FINDEV2*POLITY2	-0.000	0.061***	0.154	0.015
	(0.015)	(0.018)	(0.098)	(0.031)
Constant	0.769***	1.861***		1.044***
	(0.093)	(0.193)		(0.249)
Obs	1,123	1,123	980	1,123
Countries	134	134	133	134
No. of IVs			52	88
AR(1)			0.638	0
AR(2)			0.256	0.079
Hansen test			0.154	0.102
No. of PCs			43	78
PCA R2			0.884	0.855
KMO			0.931	0.926

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

either democracy or its interaction with financial development is not statistically significant. Also, we; again; find some evidence of a significant and positive effect of financial development on output performance from this table. Generally, for developing economies, a one percent increase of the ratio of deposit money banks' assets to GDP leads to a two percent increase of the per capita GDP growth.

In the last part of robustness check, we test the potential nonlinearity in the finance-growth relationship.[6]From Table A3.6 in the appendix, the system GMM estimation reveals, again, a significantly positive linear effect of financial development. However, the nonlinear effect of finance on growth is not statistically significant. Also from this table, we fail to find any evidence supporting the significance of either a linear or a nonlinear effect of democracy on economic performance over the sample period.

[6]A literature review of the nonlinear relationship between financial development and economic performance can be found in Chapter 4.

3.6 Conclusion

The effect of financial development on economic growth has been controversial for decades. Despite its hypothesized benefits, certain studies have revealed a detrimental impact of finance on long-run output performance. In particular, we notice that democracy, which is frequently emphasized as an important institutional condition for economic progress, has been largely ignored in the existing finance-growth research.

This chapter contributes to the previous literature by testing the impact of democratic institutions on the relationship between financial development and economic growth. With a large panel of 171 economies over the period 1960 to 2014, we specifically examine the interaction between financial development and democracy to investigate the hypothesis that democracy is a key condition which compounds the growth-effect of financial development.

Different indicators of financial development are constructed alongside both standard and newly introduced measures of democracy. Diverse panel estimators, namely, OLS, WG, first-differenced GMM, and system GMM estimators, are utilized in our panel estimation. To confront the issue of instrument proliferation, a data-driven method is applied in the reduction of instrument count in the GMM estimation.

The baseline results show that the estimated coefficient of lagged average output on the out growth is statistically significant. Meanwhile, the impacts of both physical capital investment and openness to trade on growth are always significant with positive signs. Also, evidence of a positive effect of the financial development indicator, which is significant at the conventional 5% level, is observed under the system GMM estimation. In general, a one percent increase of the ratio of private sector credit to GDP is found to be associated with a two percent increase of the growth rate of per capita GDP. In comparison, limited evidence of a significant impact on output growth of democracy, or its interaction term with financial

development, is observed in this chapter.

Based on such findings, this study conjectures that, financial development per se is capable of exerting a significant and positive impact on domestic economic growth. The growth-enhancing effect of the development of financial sector does not require the condition of democracy. For policymakers, improving the domestic financial system can contribute growth, even in the absence of sound democratic institutions.

Appendix: Additional Tables

Table A3.1: Democracy-growth literature review summary

Study	Type	Period	Countries	Source	Main Finding
Tavares & Wacziarg (2001)	CC	1970 - 1989	65	FH	The overall impact of democracy on growth is negative.
Barro (2003)	CC	1965 - 1995	83	FH	A non-linear relationship between democracy and growth.
Rodrik & Wacziarg (2005)	PD	1950 - 2000	154	Polity IV	Positive effect of democratic transitions on short-run growth.
Papaioannou & Siourounis (2008b)	PD	1960 - 2005	174	FH, Polity IV	Democratization leads to increase in GDP growth.
Knutsen (2013)	PD	1972 - 2004	44	FH	Positive effects of democracy on growth in Africa.
Acemoglu et al. (2014)	PD	1960 - 2010	175	FH, Polity IV, etc.	Positive effect of democracy on economic performance.
Murtin & Wacziarg (2014)	PD	1870 - 2000	69	FH, Polity IV	No robust evidence of an impact of democracy on GDP.
Grundler & Krieger (2015b)	PD	1981 - 2011	188	FH, Polity IV, UDS	Positive relation between democracy and growth.
Jacob & Osang (2015)	PD	1961 - 2010	120	FH, Polity IV, UDS	Democracy does not have a significant impact on growth.
Madsen et al. (2015)	PD	1820 - 2000	141	Polity IV	Democracy: a significant determinant of income and growth.

Notes: "CC"and "PD" mean cross-country and panel data analyses in Column 2."c" and "d" in Column 5 stand for continuous and dichotomous. Grundler & Krieger (2015a, b) created their own index of democracy and also used measures from Freedom House (FH), Polity IV, UDS, Vanhanen (2000) for comparison purpose in their research. Madsen et al. (2015) also included cross-country analyses for the period 1500 to 2000.

Table A3.2: List of Countries

Albania	D.R. of the Congo	Latvia*	Saint Lucia
Algeria	Denmark*	Lebanon	Sao Tome and Principe
Angola	Djibouti	Lesotho	Saudi Arabia
Antigua and Barbuda	Dominica	Liberia	Senegal
Argentina	Dominican Republic	Lithuania*	Serbia
Armenia	Ecuador	Luxembourg*	Seychelles
Australia*	Egypt	Madagascar	Sierra Leone
Austria*	El Salvador	Malawi	Singapore*
Azerbaijan	Equatorial Guinea	Malaysia	Slovakia*
Bahamas	Estonia*	Maldives	Slovenia*
Bahrain	Ethiopia	Mali	South Africa
Bangladesh	Fiji	Malta*	Spain*
Barbados	Finland*	Mauritania	Sri Lanka
Belarus	France*	Mauritius	St. Vincent and the Grenadines
Belgium*	Gabon	Mexico	Sudan
Belize	Gambia	Mongolia	Suriname
Benin	Georgia	Montenegro	Swaziland
Bhutan	Germany*	Morocco	Sweden*
Bolivia	Ghana	Mozambique	Switzerland*
Bosnia and Herzegovina	Greece*	Myanmar	Syrian Arab Republic
Botswana	Grenada	Namibia	Taiwan Province*
Brazil	Guatemala	Nepal	Tajikistan
Brunei Darussalam	Guinea	Netherlands*	TFYR of Macedonia
Bulgaria	Guinea-Bissau	New Zealand*	Thailand
Burkina Faso	Haiti	Nicaragua	Togo
Burundi	Honduras	Niger	Trinidad and Tobago
Cabo Verde	Hungary	Nigeria	Tunisia
Cambodia	Iceland*	Norway*	Turkey
Cameroon	India	Oman	Turkmenistan
Canada*	Indonesia	Pakistan	U.R. of Tanzania: Mainland
Central African Republic	Iran (Islamic Republic of)	Panama	Uganda
Chad	Iraq	Paraguay	Ukraine
Chile	Ireland*	Peru	United Arab Emirates
China	Israel*	Philippines	United Kingdom*
China, Hong Kong SAR*	Italy*	Poland	United States*
Colombia	Jamaica	Portugal*	Uruguay
Comoros	Japan*	Qatar	Uzbekistan
Congo	Jordan	Republic of Korea*	Venezuela
Costa Rica	Kazakhstan	Republic of Moldova	Viet Nam
Cte d'Ivoire	Kenya	Romania	Yemen
Croatia	Kuwait	Russian Federation	Zambia
Cyprus*	Kyrgyzstan	Rwanda	Zimbabwe
Czech Republic*	Lao People's DR	Saint Kitts and Nevis	

Notes: Countries with * signs are developed countries. Countries without * signs are developing countries.

Table A3.3: Variables, definitions and data sources

Variables	Definition	Source
GDP growth rate	Per capita GDP growth rate	Penn World Table Version 9.0
GDP level	Per capita real GDP at constant 2011 national prices	Penn World Table Version 9.0
Domestic investment (%)	Gross capital formation to GDP	Penn World Table Version 9.0
Human capital index	Human capital index of PWT 9.0	Penn World Table Version 9.0
Population growth (%)	Population growth rate plus 0.05	Penn World Table Version 9.0
Government size (%)	Government consumption expenditure to GDP	Penn World Table Version 9.0
Trade openness (%)	Share of exports and imports to GDP	Penn World Table Version 9.0
Inflation (%)	Inflation based on price level of household consumption	Penn World Table Version 9.0
Private credit (%)	Private credit by financial institutions to GDP	Global Financial Development
Deposit money bank assets (%)	Deposit money bank assets to GDP	Global Financial Development
Polity2 Score	democracy minus autocracy, rescale to (0 & 1)	Polity IV
Acemoglu et al. (2014) Democracy Measure	Binary democracy index of Acemoglu et al. (2014)	Self-construction

Table A3.4: Regression results: Solow Model

	(1) OLS	(2) WG	(3) DIF-GMM	(4) SYS-GMM	(5) DIF-GMM	(6) SYS-GMM
GDP(-1)	-0.033***	-0.155***	-0.195***	-0.039***	-0.285***	-0.034***
	(0.006)	(0.018)	(0.051)	(0.010)	(0.060)	(0.012)
INVEST	0.094***	0.109***	0.091***	0.140***	0.073**	0.127***
	(0.012)	(0.019)	(0.029)	(0.021)	(0.033)	(0.024)
POP	-0.054***	-0.023	-0.014	-0.094***	-0.003	-0.069***
	(0.010)	(0.016)	(0.026)	(0.021)	(0.031)	(0.023)
Constant	0.475***	1.564***		0.000		0.000
	(0.066)	(0.138)		(0.000)		(0.000)
Obs.	1482	1482	1307	1482	1307	1482
Countries	169	169	169	169	169	169
No. of IVs			144	172	114	142
AR(1)			0.004	0.001	0.025	0.001
AR(2)			0.022	0.005	0.064	0.005
Hansen test			0.126	0.334	0.083	0.061

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. The lag selection method is applied in restricting the number of GMM instruments.

Table A3.5: Regression Results: Developing Countries

VARIABLES	(1) SYS-GMM	(2) SYS-GMM	(3) SYS-GMM	(4) SYS-GMM
GDP(-1)	-0.119***	-0.117***	-0.121***	-0.119***
	(0.030)	(0.025)	(0.029)	(0.028)
INVEST	0.105***	0.104***	0.104**	0.109***
	(0.039)	(0.037)	(0.043)	(0.031)
HC	0.097	0.116*	0.128**	0.130**
	(0.065)	(0.061)	(0.058)	(0.064)
POP	-0.044	-0.033	-0.020	-0.017
	(0.039)	(0.043)	(0.037)	(0.043)
GOV	-0.089*	-0.071*	-0.071	-0.075*
	(0.047)	(0.039)	(0.045)	(0.040)
TRADE	0.058*	0.071	0.070**	0.062
	(0.034)	(0.045)	(0.033)	(0.038)
INF	0.107	0.003	0.054	0.001
	(0.069)	(0.064)	(0.069)	(0.054)
FINDEV1	0.010	0.024***		
	(0.009)	(0.009)		
FINDEV2			0.016*	0.026**
			(0.009)	(0.011)
POLITY2	0.080		0.043	
	(0.114)		(0.131)	
ACE		0.008		-0.012
		(0.097)		(0.083)
FINDEV1*POLITY2	0.076			
	(0.046)			
FINDEV1*ACE		0.037		
		(0.041)		
FINDEV2*POLITY2			0.063	
			(0.048)	
FINDEV2*ACE				0.038
				(0.041)
Constant	0.000	0.000	0.972***	0.000
	(0.000)	(0.000)	(0.309)	(0.000)
Obs	852	880	853	881
Countries	103	107	103	107
No. of IVs	93	102	91	100
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.095	0.059	0.090	0.058
Hansen test	0.139	0.150	0.160	0.192
No. of PCs	83	92	81	90
PCA R2	0.855	0.856	0.850	0.854
KMO	0.896	0.890	0.886	0.884

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines over-identifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

Table A3.6: Testing Nonlinearity

VARIABLES	(1) SYS-GMM	(2) SYS-GMM	(3) SYS-GMM	(4) SYS-GMM
GDP(-1)	-0.117***	-0.121***	-0.115***	-0.132***
	(0.022)	(0.022)	(0.023)	(0.030)
INVEST	0.126***	0.144***	0.129***	0.155***
	(0.027)	(0.038)	(0.029)	(0.037)
HC	0.076*	0.074*	0.063	0.088**
	(0.042)	(0.044)	(0.039)	(0.044)
POP	-0.062**	-0.063**	-0.069**	-0.048
	(0.030)	(0.032)	(0.027)	(0.029)
GOV	-0.087*	-0.072	-0.103**	-0.109**
	(0.046)	(0.045)	(0.049)	(0.049)
TRADE	0.077**	0.055*	0.071*	0.055*
	(0.037)	(0.030)	(0.036)	(0.033)
INF	0.100	0.069	0.088	0.077
	(0.061)	(0.070)	(0.072)	(0.087)
FINDEV1	0.018**	0.046	0.022**	0.033
	(0.008)	(0.039)	(0.010)	(0.049)
POLITY2	-0.054	-0.05	-0.48	-0.404
	(0.083)	(0.079)	(0.378)	(0.532)
FINDEV1*POLITY2	0.015	0.001	-0.012	-0.01
	(0.026)	(0.032)	(0.032)	(0.048)
(FINDEV1)^2		0.002		0.001
		(0.002)		(0.003)
(POLITY2)^2			0.376	0.319
			(0.330)	(0.468)
Constant	0.000	1.204***	0.000	0.000
	(0.000)	(0.255)	(0.000)	(0.000)
Obs	1121	1121	1121	1121
Countries	134	134	134	134
No. of IVs	88	96	91	100
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.083	0.037	0.088	0.050
Hansen test	0.106	0.045	0.130	0.117
No. of PCs	78	86	81	90
PCA R2	0.856	0.864	0.863	0.873
KMO	0.925	0.908	0.919	0.898

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%. The dependent variable is the growth rate of per capita GDP. Time dummies are included in all columns. Two-step GMM estimator is used with Windmeijer (2005) corrected standard errors. AR(1) and AR(2) tests examine serial correlation in the first-differenced errors of order 1 and 2. p-values of AR(1) and AR(2) are reported in the table. Hansen test examines overidentifying restrictions. p-values of Hansen test are reported in the table. PCA R2 is the part of the variance explained by the principal components. Kaiser-Meyer-Olkin (KMO) measures the sampling adequacy of principal components.

Chapter 4

Financial Development and Economic Performance: A heterogeneous panel analysis

4.1 Introduction

A long standing question in growth economics concerns whether there is any economic gains from financial development. Inspired by Loayza (1994) and Islam (1995), one strand of studies on the finance-growth nexus take advantage of the recent sophisticated dynamic panel modelling frameworks in their empirical investigation. For its benefits in avoiding the endogeneity problem and mitigating the omitted variable bias, panel data estimation is also employed in the preceding chapter of this thesis in which we observed a significant and positive growth effect of financial development.

However, concerns over the standard panel estimation framework have arisen in the recent literature. First, as suggested by Temple (1999), Durlauf et al. (2005), Eberhardt and Teal (2011) and Pesaran (2015), pooling a set of countries with different economic or institutional conditions is quite typical in the previous growth research. Nevertheless, neglecting the heterogeneity across countries could lead to misleading inferences as the panel estimation may suffer from influential outliers. Besides, as highlighted by Pesaran and Smith (1995), if the slope coefficients differ across nations, the homogeneous panel estimators are likely to produce inconsistent estimates. In the context of the finance-growth relationship, the method of pooling of heterogeneous economies, which is adopted in Chapter 3, might also result in an incorrect conclusion on the growth effect of finance. Second, recent growth studies, Eberhardt and Teal (2011) for example, have paid attention to the distorting effect of the cross-section dependence issue. Typically, Phillips and Sul (2003) and Andrews (2005) emphasised that, ignoring the impact of cross-section correlation, as in the previous chapter of this thesis, could yield seriously biased estimates. Therefore, given the macroeconomic linkages and common shocks, recent financial crisis for instance, it is important to account for the potential effect of cross-section dependence on identifying the finance-growth nexus.

Given the technical concerns over the standard panel data estimation which we

essentially applied in the previous chapter, this chapter re-visits the relationship between financial development and growth based on a balanced panel dataset of countries. The originality of this study arises from several aspects. First, we identify the long-run effect of financial development on economic performance by employing recently developed methods which have significant bearings on how we could model empirically the finance-growth nexus. Specifically, the heterogeneous panel estimation methods, including autoregressive distributed lag (ARDL) and cross-sectionally augmented autoregressive distributed lag (CS-ARDL) models, are adopted to account for the issues of slope heterogeneity and error cross-country dependence. A potential nonlinear effect of financial development is also controlled for under both estimation approaches.

Second, we obtain a large panel dataset for 67 countries spanning 37 years over the period 1971 to 2007 and annual observations are directly utilized in the heterogeneous panel estimation. Such a procedure is distinct from the data averaging process we had in Chapter 3. Noticeably, the procedure of data averaging over five-year intervals is primarily conducted for the purpose of smoothing business cycle fluctuations. However, albeit standard, data averaging over five-year intervals is arbitrary in essence and is likely to induce a loss of information. Also, the effectiveness of elimination of the business cycle fluctuations is often questioned. (Loayza and Ranciere, 2006; Cavalcanti et al., 2015) To fully exploit the dynamics in the finance-growth relationship that may be hidden in the data averaging process, direct usage of the annual observations is therefore applied in this chapter.

The third originality is to examine whether the effect of financial development on economic performance differs for the countries with distinct democratic institutions. Specifically, we split the sample into two sub-samples, namely, democracy and non-democracy sub-samples, to investigate if countries being democracies benefit or lose more from financial development than those being non-democracies.

The estimation result in the full sample (67 countries) suggests that the effect on the long-term economic performance of financial development is significant and

positive after accounting for cross-country heterogeneity and error cross-country dependence. Some evidence of a nonlinear relationship between financial development and output performance is also observed in the full sample estimation, which implies a potential detrimental effect of financial sector once a level of financial development has been achieved. Meanwhile, based on the sub-sample estimation results, the long-run effect of financial development is found to be beneficial and statistically significant in the 29 non-democratic nations. For the 38 democratic nations, however, such an effect is insignificant.

The remainder of this chapter is organized as follows: Section 4.2 examines the issues of cross-country heterogeneity, cross-country dependence and nonlinearity. As stressed in the previous literature, these three issues have become new challenges in the estimation of the relationship between financial development and output performance. Section 4.3 introduces heterogeneous panel estimation methodology. Empirical models used will also be discussed in this section. Section 4.4 provides a data description. Regression results for the full sample and two sub-samples can be found in the following Section 4.5. Section 4.6 concludes the paper.

4.2 Literature Review

4.2.1 Cross-Country Heterogeneity

As Durlauf et al. (2005) argued, strong homogeneity in the cross-country growth process is normally assumed in the existing empirical growth literature. For instance, all slope coefficients are frequently constrained to be identical while intercepts are allowed to differ across countries in studies using a fixed effect specification. In other words, cross-country heterogeneity is limited as the possibility of some slope coefficients being different over the cross-sectional units is commonly ignored.

Such practice, which restricts the degree of cross-country heterogeneity, has

obviously raised concerns in the current growth empirics. Pesaran and Smith (1995) highlighted the potentially inconsistent and misleading estimates of average values of parameter values considering a substantial degree of cross-sectional heterogeneity in the growth model. Lee et al. (1997) contended that conventional methods which impose strong homogeneity could lead to biases based on the evidence of universal heterogeneity in growth rates and speed of convergence for 102 economies worldwide. Brock and Durlauf (2001) and Durlauf et al. (2005) stressed that countries are essentially complex heterogeneous systems and questioned the appropriateness of a strong assumption of parameter homogeneity in previous growth studies. Luintel and Khan (1999) also suggested that the homogeneity of slope coefficients is unlikely to hold given the different stages of industrial development in various nations.

At the same time, it is worth noting that a large part of finance-growth literature commonly conducts estimations under the strong assumption of a cross-country homogeneity on the role of financial development on output performance. However, empirical evidence from several finance-growth studies have shed doubts on such a method. For instance, De Gregorio and Guidotti (1995), Huang and Lin (2009), and Rioja and Valev (2004b) collectively found that the growth-enhancing effect of financial system development is more significant in poor countries than in rich ones. Aghion et al. (2005) argued a declining influence of financial development on economic performance as nations become wealthier. In research on European economies, Masten et al. (2008) showed that the positive impact of development of domestic financial sector on output performance is smaller in developed countries than in developing ones. All of the above therefore suggests that the potential cross-country heterogeneity on the role of financial development on economic performance should be addressed.

4.2.2 Cross-Country Dependence

As stated by Eberhardt and Teal (2011), various seminal growth studies using standard econometric approaches, including Mankiw et al. (1992), Islam (1995), and Caselli et al. (1996), generally assume errors to be cross-sectionally independent. In particular, such a phenomenon, as argued by Phillips and Moon (1999), is largely due to difficulties in characterizing and modelling cross-section dependence.

However, various recent growth studies doubt whether the assumption of cross-country independence is likely to hold. Typically, it is widely accepted nowadays that a shock which affects one country may also affect others with Westerlund and Edgerton (2008) arguing that "cross-sectional dependencies are likely to be rule rather than the exception" in the context of macroeconomic analysis. Eberhardt and Teal (2011), Pesaran (2015), and Cavalcanti et al. (2015) collectively admitted that the potential cross-sectional dependence could be salient considering the high degree of macroeconomic linkages from history, geography, globalization, and common shocks. Building on this, Monte Carlo experiments conducted by Pesaran (2006) highlighted substantial bias and size distortions if ignoring the potential cross-sectional dependence. Furthermore, Bhattacharya et al. (2016) pointed out that only a small improvement in efficiency can be expected from panel estimators, relative to a single time-series, if the cross-sectional dependence is not properly addressed.

Such doubts on the appropriateness of the conventional assumption of cross-section independence naturally lead to questions regarding the standard panel econometric approaches, which have been largely applied in the previous finance-growth studies. In particular, Cavalcanti et al. (2015) suggested that taking into account the country-specific observed characteristics alone does not ensure error cross-sectional independence. In the context of the finance-growth nexus, ignoring the issue of cross-country dependence could result in biased estimates and incorrect inference for the effect of financial development on economic performance. As implied by Eberhardt and Teal (2011) and Dogan and Aslan (2017), given the

international socioeconomic linkages, error cross-sectional dependence should be considered via using recent developments in estimation techniques to obtain more accurate policy implications for sample countries.

4.2.3 Nonlinearity

A growing number of studies suggest the existence of a nonlinear effect of financial development on economic growth. Recent evidence of this nonlinearity is summarised in Table A4.1 in the appendix. For instance, with a sample of 48 nations from 1976 to 2001, Shen and Lee (2006) found that the relationship between financial development and output growth to be inverse U-shaped. Based on their analyses, a high level of financial development could be a drag on economic growth past a certain point. Such a nonlinear effect is also observed in Masten et al. (2008). With a sample of 31 European countries for the period 1996 to 2004, these authors argued that the beneficial effect of finance on growth starts vanishing once a certain level of financial development is achieved. More recent evidence, certain authors, including Cecchetti and Kharroubi (2012), Law and Singh (2014), Beck et al. (2014), Arcand et al. (2015), Cournede and Denk (2015), and Alexiou et al. (2018), upheld a nonlinear effect. Despite the differences in samples and econometric approaches, these studies collectively showed that financial development promotes output growth only at low levels of financial development. Once a certain threshold is reached, the impact on economic growth becomes negative. Some also attempted to quantify the threshold for the so-called "too much finance" effect. Based on the estimates of Cecchetti and Kharroubi (2012), Law and Singh (2014), and Arcand et al. (2015), such a threhold is reached when private sector credit around 90% to 100% of GDP.

Various reasons have been proposed to support this finding. The first is the suboptimal allocation of talents. In general, it is widely believed that the financial sector tends to extract excessively high informational rents and attract too much talent from other sectors as it grows. Without sufficient skilled workers in

productive industries, the economy suffers due to the allocative inefficiency and financial sector expansion as a whole. (Tobin, 1984; Cecchetti and Kharroubi, 2012) The second is the productivity frontier with Aghion et al. (2005) stating that the growth-enhancing role of financial development might help countries to catch up to the productivity frontier. However, only a limited effect of financial development would be evident if countries have reached the frontier. The third focuses on the types of loans issued by the financial sector. Beck et al. (2014) highlighted that the important beneficial effect of financial development essentially comes from enterprise rather than household credit. As any financial sector expansion could potentially be driven by increases in the volume of household lending, a higher level of financial development could result in speculative bubbles instead of productive asset investment, thus lowering economic growth. (Beck et al., 2014)

4.3 Methodology

4.3.1 ARDL Model

Following Pesaran et al. (1999) and Pesaran (2015), a heterogeneous panel data approach, i.e. panel autoregressive distributed lag (ARDL) model, is initially applied to account for potential cross-country heterogeneity in this study.

The standard ARDL model ($Y_t = f(Y_{t-1}, X_t, X_{t-1})$ facilitates different dynamics across countries. Typically, distinct from the partial adjustment model (PAM) ($Y_t = f(Y_{t-1}, X_t)$) used in a strand of growth studies, such as, Islam (1995) and Caselli et al. (1996), this ARDL specification does not impose a zero coefficient on X_{t-1} and hence is recommended as a more general specification of dynamics by Eberhardt and Teal (2011). At the same time, the panel ARDL approach is valid irrespective of whether the underlying variables are $I(0)$ or $I(1)$ or a mixture of the two in the context of the existence of cointegration. (Pesaran and Smith, 1995; Pesaran, 1997; Pesaran et al., 1999) Moreover, the validity of the ARDL model is ensured regardless of the exogeneity or otherwise of the regressors.

The ECM representation of the panel ARDL model is frequently applied in the growth literature given its estimation advantages. Specifically, a distinction between short-term and long-term behaviour can be identified in the ECM representation. Besides, the error correction term and speed of adjustment for the economy to the long-run equilibrium can be deduced. Also, one can easily investigate cointegration via the statistical significance of the error correction term. (Eberhardt and Presbitero, 2015)

4.3.2 CS-ARDL Model

It is worth noting that the panel ARDL model generally assumes the errors to be cross-sectionally independent. However, as discussed earlier, the potential error cross-sectional dependence should be taken into consideration. Recent developments in the estimation techniques provide such an option. For this study, this chapter follows Pesaran (2006), Chudik and Pesaran (2015), and Cavalcanti et al. (2015), and addresses cross-country heterogeneity and cross-country dependence by employing the cross-sectionally augmented autoregressive distributed lag (CS-ARDL) model.

In essence, the CS-ARDL model augments the ARDL model with a linear combination of the cross-sectional averages of the dependent variables and of all regressors, which aims to capture the cross-sectional correlation in the error term. Typically, as shown by Chudik and Pesaran (2015), both mean group (MG) and pooled mean group (PMG) estimators can be used in the estimation of the CS-ARDL model. Of course, the time-dimension (T) needs to be large enough so that the model can be estimated for each cross-country unit. Also, a sufficient number of lagged cross-section averages should be included to ensure the validity of these estimators.

The mean group (MG) estimator initially requires estimating time series equations for each country separately. The coefficients across countries can then be computed as the unweighted means of the estimated coefficients. Pesaran and

Smith (1995) suggested that the MG estimator provides consistent estimates of the average of the parameters given a sufficiently large time-series dimension. At the same time, it is worth noting that the MG estimator does not impose any restrictions on the cross-sectional parameters and ignores the possibility that some parameters can be the same across countries. Given the fact that all intercepts and coefficients can differ freely, a maximum degree of heterogeneity could be reached via this technique. However, the shortcomings of such an approach are quite apparent. Although consistent, the MG estimator is likely to be inefficient for a small cross-country dimension (N). Also, as suggested by Arnold et al. (2011) and Samargandi et al. (2015), this estimator is sensitive to any country outliers which may affect the averages of the country coefficients severely.

An alternative method is the pooled mean group (PMG) estimator proposed by Pesaran, Shin and Smith (1999). In particular, this PMG approach is widely applied in recent empirical growth studies, such as, Loayza and Ranciere (2006), Arnold et al. (2011), Samargandi et al. (2015), and Cavalcanti et al. (2015), largely due to it being an intermediate routine between the averaging and pooling methods of estimation. Specifically, a two-step procedure is applied. First, the long-term slope coefficients are estimated jointly across countries via a concentrated maximum likelihood procedure. Second, given the estimates of the long-term slope coefficients, intercepts, short-term coefficients, the speed of adjustment, and error variances are estimated through maximum likelihood on a county-by-country basis. Such an approach essentially restricts the long-term slope coefficients to be homogeneous over the cross-sections, but otherwise allows for heterogeneity. Given a large cross-country dimension, this PMG approach also provides consistent estimates of the mean of the short-term coefficients across countries by averaging individual country coefficients. (Loayza and Ranciere, 2006; Samargandi et al., 2015)

It is worth noting here that several conditions should be required to ensure the validity of the PMG estimator. (Samargandi et al.,2015; Cavalvanti et al., 2015)

First, there must exist a long-term relationship among the variables of interest. Such a condition can be examined via a negative and significant coefficient on the error correction term. Second, the dynamic specification of the model should be sufficiently augmented so that the regressors can be treated as weakly exogenous. Third, the resulting residuals from the error correction model must be serially uncorrelated.

4.3.3 Method Selection

Obviously, the selection between MG and PMG approaches for the growth regression analysis rests on whether homogeneous slopes can be imposed for the estimated long-term parameters. Hence, it essentially involves a trade-off between consistency and efficiency. Specifically, given the invalid homogeneous restrictions, the restricted estimators are inconsistent. For instance, if the long-term coefficients are, in fact, not equal across countries, the MG estimates of the mean of long-term coefficients are consistent while the PMG estimates are inconsistent. However, if the homogeneous restrictions are valid, estimators which impose cross-country constraints dominate the heterogeneous ones in terms of efficiency. For example, when the long-run coefficients are the same for individual countries, both MG and PMG estimates are consistent, but only the latter are efficient. (Arnold et al., 2011; Loayza and Ranciere, 2006; Samargandi et al., 2015) However, as emphasized in Arnold et al. (2011), the hypothesis of homogeneity of long-run parameters cannot be treated as a given. Instead, such a hypothesis should be tested via a standard Hausman test. If the null of this test is not rejected, the PMG estimator is recommended on efficiency grounds.

Often the PMG approach is regarded as best available compromise for consistency and efficiency. (Loayza and Ranciere, 2006; Arnold et al., 2011; Samargandi et al.,2015; Cavalcanti et al., 2015). Such an approach could also be appropriate in the context of the finance-growth nexus. On the one hand, various previous studies, including Loayza and Ranciere (2006), Arnold et al. (2011), and Samargandi

et al. (2015), have implied that there is a homogeneous long-term relationship between financial development and economic performance across countries. Short-term adjustment, on the other hand, could be affected by country-specific monetary policies, laws and regulations, as well as macroeconomic fundamentals and hence is expected to be subject to a substantial degree of heterogeneity. (Loayza and Ranciere, 2006; Arnold et al., 2011; Samargandi et al., 2015; Cavalcanti et al., 2015).

4.3.4 Empirical Model

The empirical models used for this study are essentially based on the ARDL and CS-ARDL model specifications. We initially employ the error correction form of the ARDL model:

$$\Delta y_{it} = \omega_i + \alpha_i(y_{i,t-1} - \theta_i^{'} x_{i,t-1}) + \sum_{j=1}^{p-1} \phi_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{'} \Delta x_{i,t-j} + \varepsilon_{it} \qquad (4.1)$$

where y_{it} is the natural logarithm of real per capita GDP for country i at year t. x_{it} is a 4×1 vector of explanatory variables, which are the logarithm of domestic investment over GDP (INVEST), logarithm of secondary school enrollment rate (SSE) from Cross-National Time-Series Data Archive[1], logarithm of corrected population growth rate (POP), logarithm of private credit by financial institutions to GDP (FINDEV) and the squared term of the financial development measure ((FINDEV)ˆ2) In particular, the long-run and short-run behaviors are distinguished in equation (4.1). Specifically, θ_i represents the long-term equilibrium relationship between x_{it} and y_{it} while ϕ_{ij} and δ_{ij} capture the short-term dynamics between variables. α_i implies the speed of convergence of the economy to the long-term equilibrium. Meanwhile, terms in parentheses represent the candidate cointegrating relationship that we aim to identify for the panel estimation.

[1]We thank Norman Lin of Edinburgh University for sharing his series.

As suggested by, the traditional panel ARDL approach accounts for slope heterogeneity and different order of integration in variables, and can be applied regardless of whether the regressors are exogenous or not. However, Phillips and Sul (2003) highlighted the potential misleading estimates if ignoring the error cross-section correlation. Following Pesaran (2006), Chudik et al. (2013) and Eberhardt and Presbitero (2015), we then move to the panel CS-ARDL approach where cross-sectional averages of independent variables, the dependent variables, and a series of their lag values are added to account for the cross-sectional correlation in the error term. The error correction form of this CS-ARDL model can be shown as:[2]

$$\begin{aligned}\Delta y_{it} =& \mu_i + \alpha_i(y_{i,t-1} - \theta_i^{'} x_{i,t-1} + \alpha_i^{-1}\eta_i \overline{y}_t + \alpha_i^{-1}\zeta_i^{'}\overline{x}_t) + \sum_{j=1}^{p-1}\phi_{ij}\Delta y_{i,t-j} + \sum_{j=0}^{q-1}\delta_{ij}^{'}\Delta x_{i,t-j} \\ &+ \sum_{j=0}^{p-1}\nu_{ik}\Delta\overline{y}_{t-j} + \sum_{j=0}^{q-1}\varsigma_{ik}^{'}\Delta\overline{x}_{t-j} + \varepsilon_{it}\end{aligned} \tag{4.2}$$

where $\overline{y}_t$ and $\overline{x}_t$ are the simple cross-section averages of y_{it} and x_{it}. Noticeably, we distinguish the short-term and long-term behaviors of the cross-sectional correlation in equation (4.2). Following Eberhardt and Presbitero (2015), only the level parts of cross-sectional averages are included in the long-term equilibrium relationship in the parentheses. Meanwhile, the long-run coefficients between y_{it} and x_{it}, that is, θ_i, and the speed of adjustment towards the long-run equilibrium, that is, α_i, are the key coefficients of economic interest in the following regression analysis.[3]

4.4 Data Description

As discussed earlier, the ARDL and CS-ARDL models are selected for this study. As shown in Loayza and Ranciere (2006) and Cavalcanti et al. (2015), these ap-

[2]Full derivation of the error correction forms of both models can be found in the appendix.

[3]We also report the short-run coefficients (ϕ_{ij} and δ_{ij}.) in our regressions. However, as it is a common practice as in Loayza and Ranciere (2006), Chudik et al. (2013) and Eberhardt and Presbitero (2015), our focus is on θ_i and α_i.

proaches also enable the utilization of annual data instead of averaging. To be specific, the same data source as in the previous chapter is used for measures of economic performance and financial development. Definitions and sources of all variables can be found in Table A4.2 in the appendix. These variables in the estimation, including measures of economic performance and financial development, fluctuate instead of being stable over years. Hence, it is possible to employ annual data under the ARDL and CS-ARDL model frameworks.

Of course, sufficiently large time series and cross-sectional dimensions are normally required to allow for cross-sectional slope heterogeneity and residual cross-sectional dependence. (Loayza and Ranciere, 2006; Arnold et al., 2011; Samargandi et al., 2015; Cavalcanti et al., 2015) Given such conditions, only countries for which there are 37 consecutive observations on financial development and real per capita GDP series available are used in the analysis. As a result, the dataset is balanced, covering 67 countries over the period 1971 to 2007. The list of countries included can be found in Table A4.3.

Here, the dichotomous democracy indices of Cheibub et al. (2010) and Acemoglu et al. (2014) are matched for these nations in the sample. A country is defined as a democracy if both two measures have a value of 1 for at least 19 out of 37 years over the sample period. Otherwise, a non-democracy is identified from 1971 to 2007. Accordingly, 38 nations were identified as democracies with the other 29 being non-democracies.

Table 4.1 below displays the summary statistics of variables for the whole sample and the sub-samples. From Table 4.1, the average annual growth rate of real per capita output is 1.6% for all 67 nations in the sample period. By comparison, 38 democratic nations have enjoyed a relatively high average output growth rate. The average economic growth rate is merely 0.9% for the non-democratic economies. In terms of the level of per capita output, the democratic sub-sample largely outperformed the non-democratic sub-sample. In the meantime, the variation of the per capita output level, on average during the period 1971 to 2010, is

relatively close for the whole sample and for the two individual sub-samples.

Also, it is worth noting that democratic sub-sample has experienced high domestic investment and secondary school enrollment rates. The average population growth rate of the 29 non-democratic economies is relatively higher than that of the 38 democracies. In addition, despite the fact that the levels of financial development vary dramatically within the 38 democratic nations, the average private credit indicator is twice as large as that of non-democracy sub-sample.

Table 4.1: Summary Statistics

Panel A: Whole Sample					
Variable	Obs	Mean	Std. Dev.	Min	Max
GROWTH	2,412	0.016	0.046	-0.298	0.314
GDP	2,479	11679.220	12742.030	518.180	94431.080
INVEST	2,479	0.198	0.093	0.006	0.546
SSE	2,479	0.056	0.031	0.001	0.166
POP	2,479	0.069	0.011	0.041	0.115
FINDEV	2,479	0.373	0.353	0.011	1.981
Panel B: Democracy Sub-sample					
Variable	Obs	Mean	Std. Dev.	Min	Max
GROWTH	1,368	0.022	0.036	-0.161	0.198
GDP	1,406	16152.180	12180.800	1148.387	58643.040
INVEST	1,406	0.229	0.080	0.049	0.516
SSE	1,406	0.068	0.027	0.007	0.166
POP	1,406	0.064	0.009	0.047	0.087
FINDEV	1,406	0.501	0.391	0.033	1.981
Panel C: Non-democracy Sub-sample					
Variable	Obs	Mean	Std. Dev.	Min	Max
GROWTH	1,044	0.009	0.056	-0.298	0.314
GDP	1,073	5818.103	10964.380	518.180	94431.080
INVEST	1,073	0.157	0.094	0.006	0.546
SSE	1,073	0.040	0.028	0.001	0.126
POP	1,073	0.076	0.009	0.041	0.115
FINDEV	1,073	0.205	0.194	0.011	1.552

Notes: Summary statistics are for original annual variables before log transformations.

Table 4.2 shows the correlation analysis for the whole sample and two sub-samples. Noticeably, real per capita GDP is highly positively related to the domestic investment, human capital and financial development measures. While the correlation between the growth rate of population and average output is highly negative. For the non-democractic countries, a higher level of per capita output is associated with a higher rate of growth of per capita output. Also, the financial development indicator is positively associated with the growth rate of average output for both sub-samples.

Table 4.2: Correlation Analysis

Panel A: Whole Sample						
	GROWTH	GDP	INVEST	SSE	POP	FINDEV
GROWTH	1.000					
GDP	0.129	1.000				
INVEST	0.211	0.569	1.000			
SSE	0.154	0.644	0.376	1.000		
POP	-0.143	-0.593	-0.342	-0.534	1.000	
FINDEV	0.121	0.696	0.479	0.539	-0.533	1.000
Panel B: Democracy Sub-sample						
	GROWTH	GDP	INVEST	SSE	POP	FINDEV
GROWTH	1.000					
GDP	-0.001	1.000				
INVEST	0.238	0.513	1.000			
SSE	0.120	0.358	0.256	1.000		
POP	-0.084	-0.614	-0.267	-0.530	1.000	
FINDEV	0.048	0.637	0.454	0.352	-0.513	1.000
Panel C: Non-democracy Sub-sample						
	GROWTH	GDP	INVEST	SSE	POP	FINDEV
GROWTH	1.000					
GDP	0.091	1.000				
INVEST	0.134	0.411	1.000			
SSE	0.089	0.624	0.213	1.000		
POP	-0.062	-0.078	-0.035	-0.275	1.000	
FINDEV	0.057	0.494	0.282	0.435	-0.100	1.000

Notes: Correlation analyses are based on 2412, 1368 and 1044 observations, respectively.

4.5 Regression Results

4.5.1 Panel Unit Root Testing

As described earlier, the panel ARDL approach is valid irrespective of whether the underlying variables are $I(0)$ or $I(1)$, or a mixture of the two. Hence, it is important to examine the time series properties of these. Two panel unit root tests, i.e. Im, Pesaran and Shin (2003) (IPS) and the Pesaran (2007) cross-sectionally augmented IPS (CIPS) tests, are conducted here.

The IPS test generally allows for heterogeneous autoregressive parameters for each panel. All panels have a unit root under the null hypothesis of the IPS test. Once rejecting the null, it is indicated that a nonzero fraction of panels is stationary. However, as stated by Cavalcanti et al. (2015) and Eberhardt and Presbitero (2015), the presence of cross sectional dependence threatens the validity of standard panel unit root tests. Hence, we also apply the CIPS test proposed by Pesaran (2007). In particular, this panel unit root test allows for heterogeneous unit root processes via an augmented ADF regressions for each country with cross section averages.

Tables 4.3 and 4.4 report the results of IPS and CIPS tests for GDP, INVEST, HC, POP, FINDEV, and a square term of FINDEV for the whole sample. As shown in Tables 4.3 and 4.4, for each lag equal to 1, 2, and 3, two scenarios; namely, including both an intercept and a linear trend, and including only an intercept are considered in the testing. From both tables, the GDP series can be identified as a $I(1)$ series while SSE is generally a $I(0)$ series. Some mixed results are observed on the time series properties for the variables in their level values. However, the hypothesis of a panel unit root process is rejected after first-differencing using both IPS and CIPS tests. As a result, the validity of panel ARDL approach is guaranteed as the estimated model does not contain a $I(2)$ series. In particular, same validities are also confirmed in both democratic and non-democratic sub-samples after applying two panel unit root tests.

Table 4.3: Im-Pesaran-Shin (2003) IPS Test: Whole Sample

With an intercept and a linear trend				
Variables	Lag 1	Lag 2	Lag 3	Integration Order
GDP	−1.362*	0.067	−1.379	1
INVESTMENT	−3.548***	−1.247	−1.107	1
SSE	−3.482***	−5.182***	−6.182***	0
POP	−35.700***	4.182	−5.111***	1
FINDEV	−3.022**	−0.688	−2.515***	1
(FINDEV)^2	−4.293***	−2.911***	−4.320***	0
With an intercept				
Variables	Lag 1	Lag 2	Lag 3	Integration Order
GDP	6.341	7.963	6.848	1
INVESTMENT	−4.940***	−2.752***	−2.459***	0
SSE	−4.206***	−4.091***	−4.831***	0
POP	−19.769***	7.369	−0.744	1
FINDEV	−0.979	0.200	−0.574	1
(FINDEV)^2	−4.755***	−4.276***	−4.791***	0
D(GDP)	−21.765***	−13.442***	−12.520***	0
D(INVESTMENT)	−29.767***	−20.164***	−15.902***	0
D(SSE)	−11.120***	−8.575***	−10.410***	0
D(POP)	−35.849***	−6.943***	−6.183***	0
D(FINDEV)	−20.458***	−13.319***	−11.105***	0
D[(FINDEV)^2]	−21.358***	−14.794***	−12.541***	0

Notes: The null hypothesis is that all panels contain unit roots. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 4.4: Pesaran (2007) CIPS Test: Whole Sample

With an intercept and a linear trend				
Variables	Lag 1	Lag 2	Lag 3	Integration Order
GDP	−3.759*	0.504	−0.162	1
INVESTMENT	−5.619***	−2.542***	−1.572*	0
SSE	−1.657**	−1.430*	−1.348*	0
POP	−24.485***	5.310	−0.970***	1
FINDEV	−2.585***	0.364	−0.500	1
(FINDEV)^2	−3.224***	−0.522	0.161	1
With an intercept				
Variables	Lag 1	Lag 2	Lag 3	Integration Order
GDP	−1.435*	1.193	0.550	1
INVESTMENT	−3.789***	−0.701	0.064	1
SSE	−4.290***	−5.184***	−4.074***	0
POP	−26.334***	1.485	−5.311***	1
FINDEV	−3.513***	−1.154	−1.885**	1
(FINDEV)^2	−2.830***	−0.924	−0.143	1
D(GDP)	−19.408***	−11.069***	−9.154***	0
D(INVESTMENT)	−25.407***	−17.238***	−13.103***	0
D(SSE)	−10.285***	−7.182***	−7.301***	0
D(POP)	−24.659***	−4.337***	−3.127***	0
D(FINDEV)	−15.268***	−9.775***	−7.489***	0
D[(FINDEV)^2]	−16.242***	−11.433***	−8.751***	0

Notes: The null hypothesis is that the series is a unit root. Cross-section dependence is assumed to be in form of a single unobserved common factor. *** significant at 1%; ** significant at 5%; * significant at 10%.

4.5.2 Full Sample Estimates

Table 4.5 presents results derived from the ECM specification for the full sample. Following Samargandi et al. (2015), a quadratic term of the financial development indicator is included to capture the potential nonlinear association between financial development and economic performance. As stated earlier, it is likely that the MG estimator is sensitive to country outliers and inefficient in a panel with a small cross-country dimension. In comparison, the PMG estimator has been regarded as a popular method in recent growth empirics given its compromise between consistency and efficiency. As a result, the long-run coefficients on economic performance is achieved by the use of the PMG estimator in the table below and those that follow.

The first column in Table 4.5 shows the long-run estimates based on the ARDL model. As mentioned by Loayza and Ranciere (2006), the determination of the lag order of the ARDL model generally involves a tradeoff between sufficient length and over-extension, given a limited time-series dimension. It is worth noting that various scholars have applied different approaches for this lag selection. A number of empirical studies impose a common lag structure for all the countries in the sample. For instance, Chudik et al. (2013) investigated the long-term relationship between growth, debt and inflation for over 40 economies over the period 1965 to 2010. They used the same lag order for all variables in their ARDL estimation. The same strategy of the common lag selection was also employed in Mohaddes and Raissi (2014), who examined the inflation-growth relationship using Indian state level data from 1989 to 2013.

Other studies have argued that the lag order of the ARDL can be selected via consistent information criterion. Specifically, the application of the information criterion is subject to a maximum lag on each of the regressors, which needs to be decided initially by the researchers. In particular, Arnold et al. (2011) set a maximum of 2 lags in their examination of speed of the convergence on an annual panel of 21 OECD countries from 1971 to 2004. Cavalcanti et al. (2015), who

Table 4.5: PMG Estimates of the Long-Run Effects on Economic Performance: Whole Sample

No. of lagged CA VARIABLES	ARDL	CS-ARDL 2	CS-ARDL 3
Long Run Equation			
INVEST	0.756***	0.304***	0.527***
	(0.054)	(0.015)	(0.025)
SSE	0.348***	0.160***	0.134***
	(0.042)	(0.022)	(0.030)
POP	-3.662***	-0.129**	-1.574***
	(0.324)	(0.057)	(0.139)
FINDEV	-0.158**	0.031***	0.071**
	(0.064)	(0.011)	(0.029)
FINDEVˆ2	-0.054***	-0.039***	-0.017***
	(0.008)	(0.005)	(0.005)
Short Run Equation			
ECT	-0.038***	-0.127***	-0.074***
	(0.007)	(0.025)	(0.022)
D(INVEST)	0.083***	0.069***	0.057***
	(0.013)	(0.014)	(0.016)
D(SSE)	0.030	0.030	-0.007
	(0.029)	(0.034)	(0.044)
D(POP)	0.331	0.539	0.979**
	(0.210)	(0.402)	(0.437)
D(FINDEV)	-0.067*	-0.147***	-0.103
	(0.037)	(0.053)	(0.065)
D(FINDEVˆ2)	-0.014	0.000	0.023
	(0.015)	(0.022)	(0.031)
Constant	0.058***	0.555***	0.607***
	(0.008)	(0.107)	(0.173)
Obs	2412	2345	2278
Pesaran CD	15.610	-0.455	-1.561
P-Value	[0.000]	[0.650]	[0.119]

Notes: Estimates based on the error correction model with the first difference of log real per capita as the dependent variable. Standard errors are in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

studied the effect of commodity terms of trade on growth on a sample of annual observations of 118 countries over the 1970 to 2007, also set a maximum of 2 lags in their analysis. For this study, the latter approach is followed and the lag order is selected via the BIC subject to a maximum lag of 2 on each of the explanatory variables in the ARDL model. According to the BIC, ARDL (1, 1, 1, 1, 1, 1) is selected here, as depicted in the first column of the table.

From Column 1, the coefficient on the error correction term is statistically significant at the 1% level with a negative sign. This finding suggests that the system reverts to the long-run values following a shock, and thus there exists cointegration among the variables. Also, per capita output is positively and significantly related to domestic investment and human capital, and negatively related to the corrected rate of population growth. Such findings are generally consistent with the theoretical expectations of the augmented Solow model of Mankiw, Romer and Weil (1992). Meanwhile, the estimated coefficients of both the financial development indicator and of its quadratic term turn out to be significantly negative. Thus, it is implied that the increase in the private credit ratio would lead to a decrease in the long-turn real average output.

The validity of the PMG estimates in Column 1 is essentially based on the assumption that the errors are cross-sectionally independent. In order to test such an assumption, the cross-section dependence (CD) test was conducted. Specifically, this test uses the correlation-coefficients between the time-series for each panel member. Under the null hypothesis of cross-section independence, the CD statistic is standard normally distributed.[4]From the bottom of the column, the null of cross-section independence in the error term is rejected at the conventional significance level. Clearly, failing to account for error cross-country dependence, means that the accuracy of PMG estimates is generally questionable.

The CS-ARDL methodology is then employed, which essentially includes additional lagged cross-sectional averages of the dependent variables and of all re-

[4]The CD statistic is then computed as: $CD = \sqrt{\frac{2T}{N(N-1))}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho_{ij}}$, where $\hat{\rho_{ij}}$ is the pairwise correlation between panel units.

gressors into the estimation. A crucial step in the usage of the CS-ARDL model is the selection of lag order for the cross-sectional averages. Typically, it is widely accepted that the number of lagged cross-section averages should be sufficient in order to overcome the concerns on cross-sectional dependence of the residual. Previous studies, including Chudik and Pesaran (2015) and Eberhardt and Presbitero (2015), hinted at an augmentation with a number of $integer(T^{1/3})$ lagged cross-section averages. Other studies, such as, Chudik et al. (2013), Mohaddes and Raissi (2014), Cavalcanti et al. (2015), and El-Anshasy et al. (2015), collectively set the number of the lagged cross-section averages not to exceed 3. As a result, two scenarios are considered where the lag length of all averaged dependent and explanatory variables are restricted to be 2 or 3.

The next two columns in Table 4.5 show the PMG estimates of these two CS-ARDL model specifications. Noticeably, from the bottom of both columns, the null hypothesis of cross-section independence in the Pesaran CD test is not rejected. It suggests that the cross-sectional dependence caused by common factors, such as the oil crises in the 1970s and the recent global financial crisis, have been ruled out once augmenting the regression with either 2 or 3 extra lagged cross-sectional averages of the dependent variables and the regressors. As issues of cross-country heterogeneity and error cross-country dependence have been properly confronted, the PMG estimates under the CS-ARDL model are therefore preferred in the identification of the effect of financial development on economic performance.

In both Columns 2 and 3, the estimated coefficient of error correction term is, again, negative and significant at the 1% level. Under both specifications, the estimated coefficients of INVEST, SSE, and POP are significant with the expected signs. The results show that a one percent increase in the proportion of domestic investment over output is associated with an average increase in steady-state per capita GDP of over 0.3 percent. Meanwhile, a one percent increase in the rate of secondary school enrollment is associated with an average increase in steady-state level of real per capita output by more than 0.1 percent. A positive and significant

effect of the level of financial development on the level of output performance is observed in both Columns 2 and 3. Meanwhile, the estimated coefficient on the quadratic term of financial development indicator is negative and significant at the 1% level. Such a finding supports pervious empirics, including Shen and Lee (2010), Arcand et al. (2015), and Alexiou et al. (2018). After controlling for cross-country heterogeneity and error cross-country dependence, the relationship between financial development and economic performance is found to be bell-shaped for the 69 countries over the period 1971 to 2007. Based on such a finding, we argue that, more private credit raises output performance at low levels of credit. However, high levels of private credit could exert a detrimental effect on the long-run economic performance. In other words, there is a peak where the extra private credit and a larger financial sector starts to retard output performance. To compute the estimate of such a peak of the bell-shaped relationship, the estimated coefficients in Table 4.5 are used. In particular, this point for private credit is estimated to be about 150% of GDP.[5]Several examples can be listed from the sample used here, where the country's financial development level once exceeded this figure. To start with, the ratio of private credit to GDP of both Malaysia and Thailand reached 150% during the Asian financial crisis of 1997 to 1998. Meanwhile, taking the examples of Canada, Demark, Switzerland, the United Kingdom, and the United States, where private credit grew steadily from the early 2000s and exceeded 150% in 2007, the year before the global financial crisis. Another interesting example is Japan. During the period of its economic crisis from late 1980s to 2007, Japan's private credit ratio never dropped below 1.5. Noticeably, all these countries are democracies according to the binary democracy indices employed earlier, with one exception of Malaysia.

[5]From Column 2, we set the partial derivative of GDP with respect to FINDEV equal to zero: $\partial GDP/\partial FINDEV = 0.031 - 0.078FINDEV = 0$. So, $FINDEV = 0.397$. Using the exponential function, the point estimate of private credit to GDP ratio is $e^{FINDEV} = e^{0.397} = 1.487$. From Column 3, the private credit to GDP ratio is estimated to be 8.069. As we do not have a ratio this big in our sample, finance's negative impact only takes effect outside of our sample range according to Column 3.

4.5.3 Sub-sample Estimates

As stated earlier, two sub-samples can be identified based on the annual value of the binary democracy indices of Cheibub et al. (2010) and Acemoglu et al. (2014). Estimation results for the democratic and non-democratic sub-sample can be found in Tables 4.6 and 4.7, respectively. In common, the first columns of these tables present PMG estimates based on the ARDL (1, 1, 1, 1, 1, 1) model while the last two display the estimates of the CS-ARDL model, where further 2 or 3 lags of the cross-section averages of dependent and explanatory variables are added.

In Table 4.6, the coefficient on the error correction term is always negative and statistically significant. Meanwhile, as expected, the estimated coefficient of domestic investment on average output turns out to be significantly positive in the long run, while that of corrected population growth rate is negative using both ARDL and CS-ARDL approaches.

The PMG estimates in Table 4.6 show mixed results, especially on the measure of financial development. From first two columns, the estimated effect of the level of financial development on long-term economic performance is positive and statistically significant. However, it is worth noting that the null hypothesis of cross-sectional independence under the Pesaran CD test is strictly rejected. Clearly, without ruling out the effect of the common shocks across countries, panel estimates in either column are not preferred. In Column 3, despite another rejection of the null of the CD test, existence of error cross-section dependence is reduced as the Pesaran CD statistic drops dramatically to around -2. Given a sum of three lags of cross-sectional averages of the dependent variables and of the regressors have been added, in our point of view, this column provides the most accurate estimates of the long-term effects on output performance for the 38 democratic economies in this sub-sample. From Column 3, the PMG estimate of domestic financial development on long-run economic performance is negative, but statistically insignificant. Further, from this table, the long-run estimate of squared term of financial development indicator is also insignificant; albeit positive.

Table 4.6: PMG Estimates of the Long-Run Effects on Economic Performance: Democracy Sub-sample

No. of lagged CA VARIABLES	ARDL	CS-ARDL 2	CS-ARDL 3
Long Run Equation			
INVEST	0.552***	0.922***	0.709***
	(0.053)	(0.134)	(0.050)
SSE	0.219***	-0.446***	-0.632***
	(0.042)	(0.106)	(0.074)
POP	-1.225***	-6.414***	-1.877***
	(0.234)	(0.801)	(0.198)
FINDEV	0.965**	1.914***	-0.031
	(0.095)	(0.260)	(0.045)
FINDEVˆ2	0.333***	0.737***	0.018
	(0.032)	(0.106)	(0.019)
Short Run Equation			
ECT	-0.048***	-0.015*	-0.051***
	(0.014)	(0.009)	(0.020)
D(K)	0.118***	0.116***	0.091***
	(0.018)	(0.018)	(0.019)
D(SSE)	0.009	-0.025	0.016
	(0.034)	(0.042)	(0.049)
D(POP)	0.098	0.069	0.621
	(0.307)	(0.386)	(0.564)
D(FINDEV)	-0.023	-0.059	0.032
	(0.046)	(0.064)	(0.074)
D(FINDEVˆ2)	-0.017	0.038	0.069
	(0.023)	(0.037)	(0.042)
Constant	0.403***	0.555***	2.194***
	(0.109)	(0.107)	(0.853)
Obs	1368	1330	1292
Pesaran CD	16.721	8.395	-2.482
P-Value	[0.000]	[0.000]	[0.013]

Notes: Estimates based on the error correction model with the first difference of log real per capita as the dependent variable. Standard errors are in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 4.7 presents the estimates of the non-democracy sub-sample. Noticeably, Column 1 reveals some evidence of a positive, but insignificant, effect of financial system development on long-term economic performance. However, after observing the existence of error cross-section dependence, the CS-ARDL model specification is the preferred approach as it takes account into both issues of cross-country heterogeneity and error cross-section dependence.

Both Columns 2 and 3 suggest that the use of cross-section averages largely reduces residual cross-section dependence. In particular, as the Pesaran CD test statistics drop to around -0.5, no evidence of error cross-section dependence is uncovered in these two columns. Therefore, concerns over the influence of macroeconomic linkages and common shocks have been eliminated via augmenting the ARDL regression with average terms of related variables. From last two columns, the estimated effects on per capita output of physical capital investment and human capital are all statistically significant with the expected signs under the CS-ARDL approach. Also, the estimated coefficient of private credit to GDP on the long-term economic performance is significantly positive in both columns. At the same time, the PMG estimate of the squared term of the ratio of credit to private sector over GDP also turns out to be significantly positive at the conventional significance level.

From Tables 4.6 and 4.7, the PMG estimator yields a statistically significant and positive coefficient of financial development on the long-term economic performance for the non-democractic economies. However, such a coefficient is not significant for the democratic countries. Typically, cross-country heterogeneity and error cross-section dependence have been controlled for using the CS-ARDL specification in which a sufficient number of lagged cross-section averages are included. Also, no evidence is found for the existence of a nonlinear effect of financial development on economic performance in either sub-sample.

Table 4.7: PMG Estimates of the Long-Run Effects on Economic Performance: Non-democracy Sub-sample

No. of lagged CA VARIABLES	ARDL	CS-ARDL 2	CS-ARDL 3
Long Run Equation			
INVEST	0.494***	0.247***	0.192***
	(0.041)	(0.023)	(0.013)
SSE	0.190***	0.366***	0.047*
	(0.022)	(0.048)	(0.026)
POP	-0.952***	-0.833***	1.024***
	(0.169)	(0.172)	(0.083)
FINDEV	0.126	0.584***	0.482***
	(0.083)	(0.065)	(0.058)
FINDEVˆ2	-0.019	0.103***	0.126***
	(0.013)	(0.013)	(0.016)
Short Run Equation			
ECT	-0.070***	-0.114***	-0.174***
	(0.021)	(0.035)	(0.067)
D(INVEST)	0.032*	0.043*	0.009
	(0.019)	(0.024)	(0.026)
D(SSE)	0.064	0.084	0.125
	(0.048)	(0.053)	(0.101)
D(POP)	0.361	0.792	0.518
	(0.276)	(0.581)	(1.199)
D(FINDEV)	-0.169***	-0.275***	-0.070
	(0.055)	(0.097)	(0.160)
D(FINDEVˆ2)	-0.034***	-0.053**	-0.002
	(0.014)	(0.026)	(0.047)
Constant	0.519***	0.744***	-1.641***
	(0.148)	(0.229)	(0.590)
Obs	1044	1015	986
Pesaran CD	2.110	-0.573	-0.426
P-Value	[0.035]	[0.567]	[0.670]

Notes: Estimates based on the error correction model with the first difference of log real per capita as the dependent variable. Standard errors are in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

4.6 Conclusion

This study re-visits the relationship between financial development and economic performance by utilizing annual observations for 67 countries over the period 1971 to 2007. Typically, we note the fact that the assumptions of cross-country homogeneity and error cross-section independence in the previous macro panel data estimation have been questioned over the past years. Various scholars, including Durlauf et al. (2005) and Eberhardt and Teal (2011), stressed that the issues of cross-country heterogeneity and error cross-section dependence which arise from unobserved common factors, should be properly addressed in order to obtain accurate results for policy guidance. Due to the conventional assumptions applied, most existing panel empirics on the finance-growth nexus could be subject to such problems. As a result, newly developed macro panel data techniques have been employed into the examination of the effect of financial development on the long-term output performance. Firstly, considering the potential cross sectional dependence in our panel time series, both IPS and CIP tests were applied to determine whether the variables investigated are non-stationary or not. Secondly, the estimation method is focused on the PMG estimator, which restricts the long-term slope coefficients to be homogeneous over the cross-sections. As it has been widely applied in recent growth empirics, this PMG estimator is normally regarded as a best compromise for consistency and efficiency in a macro panel. Thirdly, after detecting the evidence of error cross-section dependence, the CS-ARDL model specification is preferred because of its ability to account for residual cross-sectional dependence.

The main finding based on the whole sample is that the effect of the level of financial development, measured by the ratio of private credit of financial institutions to GDP, on the long-term output performance is found to be positive and significant after controlling for cross-country heterogeneity and error cross-country dependence. Also, some evidence of a reverse U-shaped relationship between fi-

nancial development and economic performance is observed for the 69 countries over the period 1971 to 2007. In particular, the peak point for private credit is estimated to be about 150% of GDP. Such a finding is generally consistent with Shen and Lee (2006) and Arcand et al. (2015), which supported the existence of a nonlinear impact on output performance of financial system development.

Two sub-samples were constructed based on the binary democracy indices of Cheibub et al. (2010) and Acemoglu et al. (2014). Based on the PMG estimates under the CS-ARDL model, the significantly positive effect of financial development is only found in the 29 non-democratic countries. For the other democratic economies, such an effect is insignificant. In the meantime, the results fail to provide further evidence of a nonlinear finance-growth relationship from two sub-samples. As a result, it is suggested that the overall beneficial impact on the long-term economic performance of financial development could be largely driven by the non-democratic nations.

Despite the efforts in using recent heterogeneous panel estimation methods with cross-section dependence, several aspects should be addressed for the further improvement for this study. The first is on the size of dataset we used. Due to data constraints, the whole sample only covers 69 countries from 1971 to 2007. Given a finite size of annual observations, concerns over the the error cross-section dependence cannot be completely removed as we observed in Table 4.6. The second is on the dichotomous democracy index. The employment of a democracy index in binary form is doubtful considering its inability to accurately portray the nuances of democracy in individual nations. (Jacob and Osang, 2015) Following such ideas, the criteria set in the partition of democratic and non-democratic sub-samples could be conceptually oversimplified.

Appendix: ARDL and CS-ARDL Models

The standard panel ARDL $(p, q, ..., q)$ model following Pesaran (2015) is:

$$y_{it} = \omega_i + \sum_{j=1}^{p} \rho_{ij} y_{i,t-j} + \sum_{j=0}^{q} \varrho_{ij}^{'} x_{i,t-j} + \varepsilon_{it} \tag{4.3}$$

where the number of countries $i = 1, 2, ..., N$; the number of years $t = 1, 2, ..., T$. ω_i are the fixed effects, x_{it} is a $k \times 1$ vector of regressors for country i, ρ_{ij} are scalars, and ϱ_{ij} are k-dimensional coefficient vectors. By assumption, ε_{it} are independently distributed across i and t, with zero means, variances σ_i^2, and are distributed independently of the regressors x_{it}. Phillips and Hansen (1990) and Johansen (1995) stated that the long-term relationship exists only among integrated variables in the context of cointegration. Pesaran and Smith (1995), Pesaran (1997), and Pesaran et al. (1999), however, suggested that the panel ARDL approach is valid irrespective of whether the underlying variables are $I(0)$ or $I(1)$ or a mixture of the two. Also, this method can be applied regardless of whether the regressors are exogenous or not.

As suggested by Pesaran (2015) and Samargandi et al.(2015), the dynamic heterogeneous panel regression can be incorporated into the Error Correction Model (ECM) using the ARDL technique. The ECM representation of the ARDL model above can be then shown as:

$$\Delta y_{it} = \omega_i + \alpha_i (y_{i,t-1} - \theta_i^{'} x_{i,t-1}) + \sum_{j=1}^{p-1} \phi_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{'} \Delta x_{i,t-j} + \varepsilon_{it} \tag{4.4}$$

where $\alpha_i = -(1 - \sum_{j=1}^{p} \rho_{ij})$, $\theta_i = (1 - \sum_{j=1}^{p} \rho_{ij})^{-1} \sum_{j=0}^{q} \varrho_{ij}$, meanwhile, $\phi_{ij} = -\sum_{l=j+1}^{p} \rho_{il}$, and $\delta_{ij} = -\sum_{l=j+1}^{q} \varrho_{il}$. Here, α_i is the error-correcting speed of adjustment term. θ_i represents the long-term equilibrium relationship between x_{it} and y_{it}. Both ϕ_{ij} and δ_{ij} capture the short-term dynamics between variables.

Following Pesaran (2006) and Chudik and Pesaran (2015), the cross-sectionally

augmented autoregressive distributed lag (CS-ARDL) is the model employed here. Starting with a standard panel ARDL $(p, q, ..., q)$ model:

$$y_{it} = \omega_i + \sum_{j=1}^{p} \rho_{ij} y_{i,t-j} + \sum_{j=0}^{q} \varrho_{ij}^{'} x_{i,t-j} + u_{it} \tag{4.5}$$

where all the notations are same as before except for u_{it}, which is assumed to have the multifactor error structure:

$$u_{it} = \lambda_i^{'} f_t + \varepsilon_{it} \tag{4.6}$$

where f_t is a vector of unobserved common shocks, and $\lambda_i^{'}$ is a matrix of country-specific factor loadings. Noticeably, f_t can be stationary and nonstationary as suggested by Kapetanios, Pesaran and Yamagata (2011) and are allowed to be serially correlated and possibly correlated with regressors. By assumption, ε_{it} are independently distributed across i and t, with zero means, variances σ_i^2, and are distributed independently of the regressors x_{it} or the unobserved common factors.

Following the Common Correlated Effect (CCE) method of Pesaran (2006) and Chudik and Pesaran (2015), equations (4.5) and (4.6) are averaged under the assumption that slope coefficients and regressors are uncorrelated and thus:

$$\overline{y}_t = \overline{\omega} + \sum_{j=1}^{p} \overline{\rho}_k \overline{y}_{t-j} + \sum_{j=0}^{q} \overline{\varrho}_j^{'} \overline{x}_{t-k} + \overline{\lambda}^{'} f_t + \overline{\varepsilon}_t \tag{4.7}$$

where $j = 0, 1, ..., p$, $\overline{y}_{t-j} = N^{-1} \sum_{i=1}^{N} y_{i,t-j}$, $\overline{\rho}_j = N^{-1} \sum_{i=1}^{N} \rho_{ij}$, $\overline{\omega} = N^{-1} \sum_{i=1}^{N} \omega_i$, $\overline{x}_{t-j} = N^{-1} \sum_{i=1}^{N} x_{i,t-j}$, $\overline{\varrho}_j = N^{-1} \sum_{i=1}^{N} \varrho_{ij}$, $\overline{\lambda} = N^{-1} \sum_{i=1}^{N} \lambda_i$, and $\overline{\varepsilon}_t = N^{-1} \sum_{i=1}^{N} \varepsilon_{it}$.

Considering that the ε_{it} are assumed to be independently distributed across i and t, $\overline{\varepsilon}_t$ tends to zero in root mean square error as N becomes large. As a result, the cross-sectional correlation in u_{it} is captured via a linear combination of the cross-sectional averages of the dependent variables and of all regressors:

$$\lambda_i^{'} f_t = \vartheta_i \overline{\lambda}^{'} f_t = \eta_i \overline{y}_t + \zeta_i^{'} \overline{x}_t + \sum_{j=0}^{p-1} \nu_{ik} \Delta \overline{y}_{t-j} + \sum_{j=0}^{q-1} \varsigma_{ik}^{'} \Delta \overline{x}_{t-j} - \vartheta_i \overline{\omega} \tag{4.8}$$

where, for some ϑ_i, $\eta_i = \vartheta_i(1-\sum_{j=1}^{p}\overline{\rho}_j)$, $\zeta_i = \vartheta_i(1-\sum_{j=0}^{q}\overline{\varrho}_k)$, $\nu_{ij} = \vartheta_i(\sum_{l=j+1}^{p}\overline{\rho}_l)$, and $\varsigma_{ij} = \vartheta_i(\sum_{l=j+1}^{q}\overline{\varrho}_l)$. Therefore, the panel CS-ARDL can be shown as:

$$\begin{aligned} y_{it} =& \mu_i + \sum_{j=1}^{p}\rho_{ij}y_{i,t-j} + \sum_{j=0}^{q}\varrho_{ij}^{'}x_{i,t-j} \\ &+ \eta_i\overline{y}_t + \zeta_i^{'}\overline{x}_t + \sum_{j=0}^{p-1}\nu_{ik}\Delta\overline{y}_{t-j} + \sum_{j=0}^{q-1}\varsigma_{ik}^{'}\Delta\overline{x}_{t-j} + \varepsilon_{it} \end{aligned} \tag{4.9}$$

The ECM representation of the panel CS-ARDL is:

$$\begin{aligned} \Delta y_{it} =& \mu_i + \alpha_i(y_{i,t-1} - \theta_i^{'}x_{i,t-1} + \alpha_i^{-1}\eta_i\overline{y}_t + \alpha_i^{-1}\zeta_i^{'}\overline{x}_t) + \sum_{j=1}^{p-1}\phi_{ij}\Delta y_{i,t-j} + \sum_{j=0}^{q-1}\delta_{ij}^{'}\Delta x_{i,t-j} \\ &+ \sum_{j=0}^{p-1}\nu_{ik}\Delta\overline{y}_{t-j} + \sum_{j=0}^{q-1}\varsigma_{ik}^{'}\Delta\overline{x}_{t-j} + \varepsilon_{it} \end{aligned} \tag{4.10}$$

where $\mu_i = \omega_i - \vartheta_i\overline{\omega}$, $\alpha_i = -(1-\sum_{j=1}^{p}\rho_{ij})$, $\theta_i = (1-\sum_{j=1}^{p}\rho_{ij})^{-1}\sum_{j=0}^{q}\varrho_{ij}$, $\phi_{ij} = -\sum_{l=j+1}^{p}\rho_{il}$, and $\delta_{ij} = -\sum_{l=j+1}^{q}\varrho_{il}$.

Appendix: Additional Tables

Table A4.1: Recent Studies on the Nonlinear Finance-Growth Relationship

Authors	Method	Period	Countries	Findings
Rioja & Valev (2004a)	PD	1961-1995	74	FD exerts a positive impact on EG in intermediate FD region.
Rioja & Valev (2004b)	PD	1961-1995	74	FD has a strong positive effect on EG in middle-income countries.
Aghion et al. (2005)	CC	1960-1995	71	The positive effect of FD on EG vanishes up to the threshold.
Shen & Lee (2006)	PD	1976-2001	48	The relationship between FD and EG is inverse U-shaped.
Masten et al. (2008)	PD	1996-2004	31	A nonlinear finance-growth relationship.
Huang & Lin (2009)	CC	1960-1995	71	Nonlinearity in finance-growth nexus.
Cecchetti & Kharroubi (2012)	PD	1980-2009	50	FD exerts an inverse bell-shaped effect on EG.
Law & Singh (2014)	PD	1980-2010	87	A threshold effect in the finance-growth relationship.
Arcand et al. (2015)	CC, PD	1960-2010	>100	FD has a negative effect on EG if FD reaches a threshold.
Alexiou et al. (2018)	PD	1998-2004	34	FD adversely affects EG beyond the threshold level.

Note: "FD" stands for financial development and "EG" is economic growth.

Table A4.2: Variables, definitions and data sources

Variables	Definition	Source
GDP growth rate	Per capita GDP growth rate	Penn World Table Version 9.0
GDP level	Per capita real GDP at constant national prices	Penn World Table Version 9.0
Domestic investment (%)	Gross capital formation to GDP	Penn World Table Version 9.0
Secondary School Enrollment Rate (%)	Secondary School Enrollment Rate	Cross-National Time-Series Data Archive
Population growth (%)	Population growth rate plus 0.05	Penn World Table Version 9.0
Private credit (%)	Private credit by financial institutions to GDP	Global Financial Development
Acemoglu et al. (2014) Democracy Indicator	Binary democracy index of Acemoglu et al. (2014)	Self-construction
Cheibub et al. (2010) Democracy Indicator	Binary democracy index of Cheibub et al. (2010)	Cheibub et al. (2010)

Table A4.3: List of Countries

Democracies		**Non-democracies**	
Argentina	Italy	Cameroon	Panama
Australia	Jamaica	Cote D'Ivoire	Peru
Barbados	Japan	Egypt	Saudi Arabia
Bolivia	Korea, Republic of	Ethiopia	Senegal
Brazil	Malta	Fiji	Sierra Leone
Canada	Mauritius	Gabon	Sudan
Chile	New Zealand	Gambia, The	Swaziland
Costa Rica	Paraguay	Ghana	Tanzania
Denmark	Philippines	Haiti	Togo
Dominican Republic	Portugal	Kenya	Uganda
Ecuador	Sri Lanka	Malawi	
El Salvador	Sweden	Malaysia	
Finland	Switzerland	Mali	
Greece	Thailand	Mexico	
Guatemala	Trinidad & Tobago	Morocco	
Honduras	Turkey	Nepal	
India	United Kingdom	Niger	
Ireland	United States	Nigeria	
Israel	Venezuela	Pakistan	

Chapter 5

Concluding Remarks

As an essential component of the modern economy, the role of finance in the socioeconomic progress has attracted massive attention over the last century. In particular, the relationship between financial development and economic performance has been listed among the most hotly debated topics among social scientists and policy makers.

From a theoretical point of view, higher levels of development of financial institutions and markets indicate better functioning of the financial sector in information production, corporate governance, risk diversification, saving mobilization, transaction facilitation etc. Via these improved functions, financial development is normally expected to be capable of stimulating the long-term output performance. At the same time, since the seminal contributions of King and Levine (1993a, b) in the early 1990s, a large body of empirical studies, under cross-country and panel data frameworks in particular, have revealed a significant and positive effect of financial development on long-run economic growth.

However, considering the frequent incidences of excessive speculation and financial crises, scepticism arises as to the hypothesized benefits of deeper financial development. At the theoretical level, an over-sized financial system could result in the excessive speculative activities, financial resource misallocation and economic instability. (Cahuc and Challe, 2012; Beck et al., 2014; Arcand et al., 2015; Cournede and Denk, 2015) Meanwhile, the excessive over-leveraged investment of the financial sector during the economic expansion period could lead to financial instability, financial crises and economic recession. (Minsky, 1982, 1991; Law and Singh, 2014; Cournede and Denk, 2015) Also, as witnessed in the recent 2007-2008 financial crisis, a large and complicated financial sector is likely to alter the managerial incentives and could eventually end up in a "catastrophic meltdown" in the financial system due to the changes in the nature of risks undertaken. (Rajan, 2006) Meanwhile, a strand of empirical evidence over the last decade has revealed a negative, or a potential non-linear, link between finance and economic performance, challenging the expected growth-enhancing role of financial development.

Given the ongoing controversies on the finance-growth nexus, this thesis has provided three chapters of empirical investigation, including both individual country and panel studies, on the link between finance and output performance. Typically, the employment of a wide range of sophisticated time series techniques and recently developed panel data methods has important contribution to make to the debate.

Chapter 2 investigated the finance-growth nexus in China. As the current largest developing country in the world, China has experienced a phenomenal rate of economic growth accompanied by a rapid expansion of the financial sector. By using various time series methods, including Johansen maximum likelihood and the Pesaran autoregressive distributed lag (ARDL) cointegration and causality approaches, a negative effect of China's domestic financial development on its long-term output performance is identified over the period 1952 to 2010. Also, a bi-directional Granger causality was found between the China's economic performance and the country's financial development in this chapter. Collectively, it indicates that China's financial sector failed to promote the nation's economic performance in the long run. Typically, this failure of Chinese financial sector in the fulfillment of its growth-enhancing role is largely due to the issues of government major ownership and the high volume of non-performing loans in the domestic financial system.

Frequently regarded as absent in China, the influence of democracy on economic performance has been on the recent agenda of growth economics. Chapter 3 of this thesis then investigates the role of democracy in the finance-growth nexus. A panel of 171 economies over the period from 1960 to 2014 was constructed to examine whether democracy had an impact on the expected benefits of financial development worldwide. Diverse democracy measures and financial development indicators were employed in this study. Meanwhile, the estimation strategy involved various dynamic panel estimation approaches; such as the first-difference and system Generalised Method of Moments (GMM) estimators. In general, the

baseline results suggested a positive and significant effect of financial development on long-term output growth. Also, limited evidence of a significant effect of democracy or its interaction with financial development was observed. As a result, this chapter conjectures that the beneficial effect of financial development does not require the condition of democracy. Financial development per se has the capacity of promoting long-term economic performance.

Given the technical concerns over the standard dynamic panel estimation used in Chapter 3, Chapter 4 of this thesis provided a re-examination of the finance-growth nexus by applying the recently developed panel estimation methods. With a balanced panel of 67 economies over the period from 1971 to 2007, issues of cross-country heterogeneity and error cross-section dependence were overcome via applying the autoregressive distributed lag (ARDL) and cross-sectionally augmented autoregressive distributed lag (CS-ARDL) models. By and large, a positive and significant effect of financial development on the long-term output performance was found in this chapter. Some evidence of a nonlinear relationship between finance and output performance was also observed. In addition, after dividing the whole sample into two, the beneficial long-run effect of financial development was only observed for the 29 non-democratic countries. For the other democratic economies, however, such an effect is insignificant.

Overall, the weight of the empirical evidence shown in this thesis is in favour of a positive link between financial system and long-term output performance. At the same time, based on the results presented, democracy is not confirmed as a condition for the fulfillment of the expected growth-enhancing role of finance. In particular, these findings are robust to a variety of specific econometric issues, including data averaging, endogeneity, instrument proliferation, cross-country heterogeneity and error cross-section dependence.

Also, the concerns over the influence of the recent 2007-2008 global financial crisis on the finance-growth nexus have been addressed in a variety of ways in this thesis. To be specific, with the implementations of various fiscal and monetary

stimulus programs, China has been listed as one of the first few economies that has weathered the crisis. Typically, Chinese economy still enjoys an annual GDP growth rate of 7%, which is higher than that in the US or Japan, in the post crisis period. (He and Sim, 2015) As a result, we did not choose to impose the financial crisis as an exogenous break point for the financial development or the output level series in Chapter 2. Instead, we used the endogenous breaks detected by Zivot-Andrews (1992) test in the cointegration analyses in this chapter. In Chapter 2, data averaging over five-year intervals was applied. Given the global financial crisis happened in the last five-year period in our sample, fluctuations caused by this crisis in dependent variable and regressors are likely to be smoothed out during the data averaging process. In the third chapter, the influence of financial crisis was regarded as a part of common shocks and cross-country correlations. Such an impact is later controlled for using the CS-ARDL models in the estimation.

Noticeably, despite the overall positive findings in this thesis, the hypothesized benefit of finance was not found to universally apply. In Chapter 2, the link between financial development and output performance in China is essentially a counterexample to the positive relationship generally observed in the literature on finance and growth. Therefore, this thesis calls for the recognitions of the importance and necessity of financial sector reforms in order to fulfill the finance's growth enhancing role. In general, the ongoing reforms on the domestic financial sector in China should continue to be pushed forward. At the same time, effectiveness of such reforms should be carefully evaluated. Typically, some micro-level evidence has indicated the ownership reforms, such as, foreign acquisition and public listing, did not contribute to the improvement of bank efficiency and profitability in China. (Lin and Zhang, 2009) In this sense, the "growth diagnostics" approach of Hausmann, Rodrik, and Velasco (2008) should be highlighted in the set-up of further financial reforms. For policy makers, instead of implementing the all-round but not well-focused reforms, efforts should be made in the identification of the most binding constraints in the domestic financial system, in the sense that their

removal would have the greatest impact on the long-term economic performance. (Hausmann et al., 2008; Rodrik, 2008)

Of course, several avenues can be explored in the future to modify the empirical investigations presented here. The first is the measure of financial development. Apparently, the ratio of private credit of financial intermediaries as a proportion over GDP is the most appropriate indicator available for financial development as suggested by various existing finance-growth empirics. (Beck and Levine, 2004; Beck et al., 2010) However, this indicator is essentially a measure of the size of financial system rather than the quality of the financial intermediation. Also, this financial development indicator only emphasises the level of financial institution development. Nevertheless, the usage of this measure basically overlooks the development of financial markets, the role of which is frequently considered as indispensable, especially for the financial system in developed economies. Indeed, alternative financial development indicators, including commercial bank accounts per thousand adults, net interest margin, and the volatility of stock price index, have been proposed in the literature. Such indicators go some way to quantifying the not only size but individual access, efficiency and stability of both financial institutions and financial markets. (Beck et al., 2010; Cihak et al., 2013) However, these measures can only be traced back to the late 1980s or early 1990s and hence were not suitable for this study.

The second is the index of democracy. Various standard and newly-proposed democracy indicators, have been applied in this thesis. However, continuous democracy measures, the Polity2 score for instance, have been commonly criticised for error fraught measurement and subjectivity in terms of assessment rules and conceptual logic. (Munck and Verkuilen, 2002; Cheibub et al., 2010) Furthermore, the usage of a democracy index in binary form is doubtful given its inability to accurately portray the nuances of democracy in individual nations. (Jacob and Osang, 2015) Following such ideas, the criteria set in the partition of democratic and non-democratic sub-samples in Chapter 4 could also be conceptually oversim-

plified. Overall, questions still remain on the construction and accuracy of different democracy indices.

The third is the potential technical pitfalls. In Chapter 2, estimation of the effect on China's economic performance of the country's financial development is conducted under the multivariate VAR or VECM framework. However, due to the data constraints, concerns over the potential mis-specification may arise in this country-specific study. Meanwhile, following the liberal rule of Roodman (2009a, b), Chapter 3 confronts the issue of "too many instruments" via restricting number of instruments less than the number of countries in the GMM estimation. However, considering a consensus is never reached on the most ideal instrument count in the finite sample, alternative restriction approach may result in distinct GMM estimates.

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