# TWO ESSAYS IN FINANCIAL MARKETS

# DEVELOPMENT & ECONOMIC GROWTH:

# AN EMPIRICAL INVESTIGATION

By

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CHAPTER I

## ESSAY 1: FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH FOR OECD COUNTRIES: A SYSTEM APPROACH


### Abstract

In this essay I investigate the long run and short run relationship between financial development and economic growth for 12 high income OECD countries in most efficient manner via system method. ADF, KPSS tests for unit root, Johansen-Juselius cointegration and Parks CCR tests, ECM and SURECM, and Granger causality test in system method are used as empirical evidence. Based on the results of Granger causality test in system method, I found: 1) strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) an evidence of positive causality running from finance to growth when DCBY (the share of domestic credit issued by banks to GDP) is used as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) an evidence of reverse causality relationship, when LLY (the share of liquid liability to GDP) is used as a financial proxy ; 4) selection of control variables does affect the model specification and the direction of causality for European countries and GSY (the ratio of gross domestic savings to GDP) accurately captures causality relationship for European countries than TY (the ratio of total trade to

GDP) due to economic features of the markets; and 5) system method is superior to traditional regression methods. These results are consistent with earlier literature in that the direction of causality may be country specific. However, it does not support King and Levine's (1993a) conclusion that finance is a leading sector to economic growth. These conclusions might shed the light to further guidance as to whether a well-developed financial sector is a necessary condition for a higher growth rates not only for high income countries but for developing countries and provide further policy implication for them.

Keywords: Financial development, economic growth, causality, cointegration, VECM, CCR, SURECM

JEL Classifications: C22, C23, O16, G18, G28

## INTRODUCTION

The main purpose of this study is to investigate the relationship between financial development and economic growth and study the effectiveness of financial development for high income OECD countries by using system approach. In conducting this study, Johansen-Juselius (1991) cointegration test, Park's (1992) Canonical Cointegrating Regression (CCR), Error Correction Model (ECM), as well as Seemingly Unrelated Regression Error Correction Model (SURECM) and Granger (1969) causality tests in a system method are used as empirical evidence. The study will present further evidence concerning the debate over whether financial development leads economic growth in a

Granger causality sense among high income OECD countries. The main contribution of this study is to examine the dynamics and causal relationship between financial development and economic growth in multivariate SURECM setting for countries under the investigation. The empirical evidence from SURECM and Granger causality test provides further evidence on relationship between the financial development and economic growth, because the system method in this study accounts for cross equation correlations among countries and utilizes information in the variance-covariance matrix of residual to improve the efficiency of statistical estimates.

There are conflicting theoretical as well as empirical arguments regarding the role and importance of financial development. The main findings of this study support the hypothesis that two-way causal relationship exists between financial development and economic growth and there is no unidirectional causality exists between finance and growth. Based on the results of ECM, SURECM and Granger causality test, in addition to bidirectional causality we found the evidence of positive causality running from finance to economic growth and reverse causality from growth to finance, which is consistent with conclusions of Demetriades and Luintel (1996), Arestis and Demetriades (1997), Shan, Morris and Sun (2001) conclusions. This result is consistent with earlier literature in that the direction of causality may be country specific.

However, one-way causality results are greatly affected by selection of financial proxy. Positive causality between financial development and economic growth has been mainly observed when DCBY (the share of domestic credit issued by banks to GDP) is used as a measure of financial development and reverse causality relationship, when LLY (the share of liquid liability to GDP) is used as a financial proxy. The main findings in these essays show a little evidence that financial development is a necessary and sufficient precondition to economic growth. Furthermore sensitivity analysis has been done by studying the countries based on geographical region such as European and non-European countries. The main reason to divide countries into two groups is based on rational that even though our sample contains homogeneous countries in terms of income levels and standards of living, however, they are heterogeneous in terms of cultural background, trade barriers, distance to borders, history, membership in European Union and geographical location. In order to remove the heterogeneity issue, the sample size has been divided into two sub-groups such as European and non-European countries. The findings illustrate that European countries have statistically significant point estimates of speed of adjustment coefficients, which show the stronger evidence of cointegration in the region among the high income countries.

Another important contribution of this essay is the econometric method used to examine the relationship between financial development and economic growth. Previous research employed traditional OLS, cross-sectional study or panel cointegration test to examine the causality relationship. However, this is the first attempt in this field to study this relationship using system method. The findings demonstrate that the system method is superior to single equation approach. This essay is organized as follows. Section 1 describes the literature review, Section 2 explains the data, econometric methodology used and model specification, Section 3 contains the empirical results, and finally Section 4 discusses the summary and conclusion. The question might give some further guidance as to whether a well-developed financial sector is a necessary and sufficient condition for a higher growth rates for developing countries and provide an important policy implication both for OECD countries as well as for countries that have financial sectors that are comparatively underdeveloped.

## I.1. REVIEW OF LITERATURE

*Theoretical approach*

Financial development and economic growth is the question of causality and direction of causality, which has been studied both from theoretical and empirical perspectives. There is no common agreement among economists that financial development is beneficial for economic growth. Financial development can influence the economic growth through allocation of resources. This theory has been introduced and discussed by Joseph Schumpeter in 1911, who has emphasized the role of financial development on economic growth. He identifies that financial markets can influence the growth, in particular, financial markets by: 1) reducing the transaction cost and facilitating risk management, 2) mobilizing and pooling savings, 3) facilitating the exchange of goods and services, 4) providing information set for future investment, and 5) monitoring investment and exercising corporate governance. An important part of his discussion is that financial intermediaries make possible technological innovation and economic development.

An alternative view was discussed by Goldsmith (1969), McKinnon (1973) and Shaw (1973), which emphasizes the role of capital accumulation in economic growth. They came to conclusion that the development of financial intermediaries increases capital accumulation and reduces the cost of external finance to firms, which in return leads to overall economic growth. McKinnon and Shaw view that financial development is playing a key role in the process of economic growth. In addition to them, the recent endogenous growth literatures emphasize the role of financial intermediaries by showing that these institutions can contribute to economic development through various aspects of productive activities, which was discussed by Pagano (1993). Levine and Zervos (1998), Levine (2005), pointed out that a more developed financial sector promotes economic growth.

On the contrary, several well-known economists are somewhat skeptical about the role of financial development to economic growth, such as Robinson (1952), Stiglitz (1994), and Singh and Weisse (1998). They concluded that the economic development puts additional demand on financial sector and the finance simply follows the economic growth. This view is mainly described as demand-leading relationship between the financial development and economic growth.

Lucas (1988) expressed that the role of financial development is "over-stressed". According to Lucas, "there is no one pattern of growth to which all economies conform", thus he pointed out that too much attention has given to role of financial development to economic growth.

Recent theorists argue that there is a two-way relationship between financial development and economic growth. Among them, Greenwood and Jovanovic (1990) discuss a model in which both financial sector and economic growth are endogenously determined. The model shows bidirectional causal relationship between financial development and economic growth.

Levine (2005) argued that financial development might stimulate the economy through promoting investment and productivity growth. However, in return an increasing level of real income might create higher demands for financial services from both household and businesses, which is shown in Figure 1. Levine pointed out that financial development is not the only leading and the most important factor of economic growth.

*Empirical approach*

Most of the recent literature examined the causality between the financial development and economic growth from the empirical perspective. Many researchers studied the direction of causality and the role of financial development in single country cases such as Australia, China, Egypt, India, Korea, Malaysia, New Zealand, Poland, Russia, Turkey, and Taiwan. Shan (2003) examined the evidence of financial development on economic growth in China and found the empirical evidence that "financial development and economic growth exhibit a two-way causality and hence it's against the so-called "finance-led growth" hypothesis". Chang and Caudill (2005) examined the relationship between financial development and economic growth in Taiwan from 1962 to 1998 using VAR model and tested the competing hypothesis of demand-following versus supply-leading. The test result revealed a unidirectional causality from financial development to economic growth and supported the supply-leading hypothesis for Taiwanese economy. Abu-Bader and Abu-Qarn (2008) also tested causality in Egypt during the period 1960-2001. Their findings also suggested that financial development Granger causes economic growth "either through increasing investment efficiency or through increasing resources for investment". Liang and Teng (2006) examined the relationship between financial development and economic growth in China during the period of 1952-2001. But their empirical results suggested a totally opposite conclusion: there is a unidirectional reverse causality from economic growth to financial development. Shan and Jianhong (2006) also examined the relationship between financial development and economic growth for China using variance decomposition and impulse response function in the VAR system. Their findings suggested that financial development is the second force (first is contribution from labor input) leading to economic growth and found that there is a two-way causality, which also supported previous studies that “finance-led growth” hypothesis does not hold. Ang and McKibbin (2007) also tested causality from financial development to economic growth or vice versa in the small open economy of Malaysia. Their findings support demand-following hypothesis and suggest that financial development and economic growth are reversely related, and economic growth leads to higher financial development but not vice versa (supports Robinson’s view).

However, recently a great deal of attention given to examine the causality pattern for a group of countries such as Asian economies, Middle Eastern countries, developing economies, OECD countries and post socialist economies as well. The empirical studies to examine the causality between financial development and economic growth employed two broad econometric approaches such as cross-sectional and time-series analysis. King and Levine (1993a) examined a cross-section of 80 countries and concluded that “financial services stimulate economic growth by increasing the rate of capital accumulation and by improving the efficiency with which economies use that capital.” Levine (1997), Levine (1998), and Levine and Zervos (1998) employed cross-sectional modeling framework and the empirical results of these studies supported the hypothesis that the financial development Granger cause economic growth.

Some studies use time-series modeling framework and argue that time-series approach is more fruitful than the cross-sectional approach. Demetriades and Hussein

(1996) found little support to the view that finance is a leading sector in the process of economic development. They findings demonstrated that "causality patterns vary across countries and, therefore, highlights the danger of statistical inference based on cross-section country studies which implicitly treat different economies as homogeneous entities". Arestis and Demetriades (1997) performed a cross-sectional analysis implicitly assuming that countries share similar economic structures, populations and technologies. They obtained positive and significant effect between financial development and real economic growth on German data and didn't get any sufficient proof for US data, which bring out the conclusion that cross country regression may not be a well approach. They suggested that using "time-series methods and taking into accounts individual country circumstance, including the institutional and policy considerations", might produce a better outcome.

Many cross-sectional studies failed to consider the possibility of reverse causality from economic growth to financial development. Levine and Zervos (1998) showed that "stock market liquidity and banking development both positively predict growth, capital accumulation, and productivity" and found "a strong, positive link between financial development and economic growth" and concluded that financial factors are an integral part of the growth process. However, even they recognized reverse causality, but did not test reverse causality hypothesis. Ahmed and Ansari (1998) noted that "some inherent limitations of a pure cross-section study of this type to be able to isolate the causal influence of bank development on growth". Also Gujarati (1995) and Shan and Sun (1998) noted that the failure to consider reverse causality might produce the problem of simultaneity bias and weak theoretical foundations underpinning the models.

Sims (1972) first used time-series studies into financial development and economic growth. He studied feedback effects between income and money for the US data. Demetriades and Hussein (1996) performed the causality tests for 16 developing countries and found bidirectional causality in 8 countries and reverse causality in 8 countries. They came to conclusion that “causality patterns vary across countries and, therefore, highlights the dangers of statistical inference based on cross-section country studies which implicitly treat different countries as homogeneous entities”. Arestis and Demetriades (1997) also got the similar results. Luintel and Khan (1999) studied the long-run relationship between financial development and economic growth by employing multivariate vector autoregression (VAR) method using the data of 10 developing countries. They found the evidence of only bidirectional causality for all countries, which was distinct from all previous studies. Shan, Morris and Sun (2001) estimated a Vector Autoregression (VAR) model for nine OECD countries and China and found bidirectional causality between financial development and economic growth in half of the countries, and reverse causality in three countries, and no evidence of one-way causality. They got a little support that financial development leads to economic growth. Based on these results they suggested that “financial sector is not a leading sector in the course of economic growth”. Shan and Morris (2002) investigated the relationship between financial development and economic growth for 19 OECD countries and China. In investigating causality between financial development and economic growth, when they used total credit as financial proxy, they found evidence of no causality for 10 countries, bidirectional causality for 4 countries, one-way causality from finance to growth for 2 countries, and reverse causality for 4 countries. They found the similar evidence even when they employed the financial efficiency (or the ratio of liquid liabilities to GDP) to measure the financial development: 10 countries with no causality, 6 countries with bidirectional causality, 2 countries with one-way causality running from finance to economic growth, and 2 countries with reverse causality running from economic growth to finance. The empirical evidence gives little support to the hypothesis that financial development "leads" economic growth, and supports the conclusions of Arestis and Demetriades (1997) and Demetriades and Hussein (1996) that the link between financial development and economic growth may be country specific and might be affected by differences in industrial structures and cultures of countries under the investigation. They suggested that the financial development is a not necessary and sufficient precondition to economic growth.

Al-Yousif (2002) examined the nature and direction of causality between the financial development and economic growth using both time-series and panel data from 30 developing countries for the period of 1970-1999. His findings strongly support the view that financial development and economic growth are "mutually causal" or there is bidirectional causality. However, he found some support of positive and reverse causality between the finance and economic growth, and as well as for the view that there is no relationship, but these findings were not strong as with bidirectional causality. Clearly, the empirical results of Al-Yousif's paper were in line with other empirical studies that "the relationship between financial development and economic growth cannot be generalized across countries because economic policies are country specific and their success depends, among other things, on the efficiency of the institutions implementing them”. All these results show there is no one generalized agreement on the role of financial development in the process of economic growth.

On the other hand, many researchers used panel data studies. Calderon and Liu (2003) examined the direction of causality between financial development and economic growth on panel data of 109 developing and industrial countries. They found the evidence that financial development generally leads to economic growth through a more rapid capital accumulation and productivity growth. They got support to the hypothesis that the Granger causality between finance and economic growth coexist. Finally, Calderon and Liu (2003) suggested that “financial deepening contributes more to causal relationships in the developing countries than in the industrial countries”. Christopoulos and Tsionas (2004) examined the long run relationship between the financial development and economic growth by using panel unit root test and panel cointegration analysis for 10 developing countries. The results suggest that there is a strong evidence of long run causality from financial development to growth and no short run causality between financial deepening and output, pointing that the effect is necessary long run in nature. So they have concluded that “policies aiming at improving financial markets will have a delayed effect on growth, but this effect is significant’. Hassan, Sanchez, and Yu (2011) investigated the role of financial development for economic growth in low- and middle-income countries classified by geographic regions by employing panel data. The empirical evidence finds positive relationship between financial development and economic growth in developing countries, bidirectional causality (or two-way causality) for most regions, and reverse (or one-way) causality from growth to finance for the two poorest regions. They also examined the role of other control variables and found that trade and government expenditures play an import role in explaining economic growth. Hassan, Sanchez and Yu (2011) concluded that a well-developed and well-functioning financial system is “a necessary but not sufficient condition to reach economic growth in developing countries”.

The empirical results of previous studies are somewhat ambiguous. On one hand, cross-sectional and panel data analysis find that the causality runs from finance to growth after accounting for other growth determinants such as trade, government spending, gross savings and the inflation rate. However, on the other hand, economist using time-series techniques find evidence of one-way, bidirectional, and no-causality between the financial development and economic growth. Therefore, it’s not certain that there is a relationship between financial development and economic growth exists and what is the direction of this relationship. In order to answer to this question and find the direction of causality, Park’s CCR, SURECM, and Granger causality test in the system method were employed to improve the efficiency of statistical estimates. This study is different from previous literature for number of reasons:

1. The cointergation framework of Johansen-Juselius (1991) and Park’s CCR (1992) are applied to test for multivariate cointegrating relationships. Cointegrating vectors are estimated using Park’s CCR, which allows consistent and efficient estimation of cointegrating vectors.

2. To examine the relationship between the financial development and economic growth, seemingly unrelated regression error correction model (SURECM) and the Granger causality test in a system method are employed. Seemingly unrelated regression

methodology accounts for cross equation correlations among countries in the sample and utilizes the information in the variance-covariance matrix of residual to improve the efficiency of statistical estimates The empirical evidence of this study clearly demonstrates that the system method is superior to single equation approach.

## I.2. METHODOLOGY

### I.2.1 Data

The main objective of this study is to investigate the causal relationship between financial development and economic growth by using data for 12 high income OECD countries such as Australia, Austria, Belgium, Canada, France, Germany, Italy, Japan, Korea, Sweden, United Kingdom and United States over the period of 1971-2006. The sample periods covering 1970 through 2006 are the periods of development of financial institutions and financial liberalization in many countries. This period can also be characterized as periods of output expansion, money growth, trade and investment increase, and globalization. For example, this period is characterized as a period of financial liberalization in the United States, which greatly sped up the consolidation of banking institutions and financial innovation. Since 1999, when The Gramm-Leach-Bliley Financial Modernization Act of 1999 was adopted by US Congress, the way was open to consolidation in terms of not only of number of banks, but also across financial service activities. Banking institutions not only became larger, but also very complex, providing wide array of financial services to their customers. Abolishing Regulation Q, which powers Federal Reserve to set maximum limit of savings deposit interest rate, MacFadden Act of 1927, prohibiting banks from branching across state lines, and erosion of Glass Steagall Act accelerated financial innovation, widened the scope of financial intermediary services by banks, which contributed tremendously to economic growth across United States. On worldwide level, similar developments were recorded in almost every industrialized country. However, the pattern of economic growth and financial development appear to differ over time and across countries.

The data frequency is annual. All the data are obtained from the World Bank *World Development Indicators 2009 (WDI)* database except the data on liquid liabilities, which was obtained from International Monetary Fund *International Finance Statistics (2009)*.

*Indicators to measure the Economic Growth and Financial Development*

The selection of variables in this model is based on the theoretical as well as empirical framework of previous studies. One of the important issues in this study is the selection of proxies to measure financial development and economic growth. For economic development, the natural logarithm of real GDP (LY) is used to measure economic growth and the main reason of using natural logarithm is based on the econometrics method employed in this study to examine the direction of causality in Granger sense based on SURECM. Levine and Zervos (1998) and Arestis, Demetriades, and Luintel (2001) suggested that even though both banks and stock markets could promote the economic growth, the effects of banks are far more significant. Following this conclusion, bank-based measures of financial development variables are used in this study rather than stock market-based financial structures.

There is not a single empirical definition of financial development (Beck, Demirguc-Kunt, and Levine (2009). Previous studies have used various indicators to measure financial development. Following King and Levine (1993a), Levine and Zervos (1998), and Beck, Demirguc-Kunt, and Levine (2009), and the standard literature, three different measures of financial proxy are used. *First* proxy is the domestic credit to private sector provided by banking sector as a percentage of GDP (DCBY) following Levine and Zervos (1998). Higher DCBY indicates higher degree of dependence upon banking sector for financing and this measure of financial development is often argued to be the best measure of financial development, which measures the extent of efficient resource allocation by private sector. *Second* alternative measure of financial development, developed by King and Levine (1993a)), is the ratio of M3 to GDP (LLY) to measure the liquid liabilities in the economy, which is the sum of currency, demand and interest bearing liabilities of banks and other financial intermediaries divided by GDP. This is the broadest available indicator to measure the size of the financial intermediation. M3 is used to measure the financial depth instead of M1 and M2, because in some economies with underdeveloped financial sector M1 and M2 may be poor proxies as money is used as a store of value in the absence of other alternative (Khan and Senhadji, 2000). Higher the ratio of LLY indicates the higher intensity of the banking system. Another alternative measure of financial development based on King and Levine (1993a), is the domestic credit to private sector issued by banks and other non-banks as a percentage of GDP (DCPSY). A high ratio of domestic credit to private sector to GDP shows a higher level of domestic investment, which results in higher output. The regression results and Granger causality test results using DCPSY are not reported in this essay, however can be viewed at request from the author.

*Indicators to measure the real sector or control variables*

It's well-known according to economic theories that factors other than financial development have an impact on economic growth. Following the recent literature on the analysis of financial development and economic growth, four other variables are used to control for other factor associated with economic growth, in addition to logarithm of GDP. *The third* indicator used in this research is the ratio of gross domestic savings to GDP (GSY), which indicates the intensity of the financial intermediaries meaning that more financial services generate more financial development. Based on economic theory, higher gross domestic savings generates higher investment and hence higher economic growth. *The fourth* indicator is the ratio of trade to GDP (TY), which measures the size of real sector and trade policy. *The fifth* indicator is the ratio of government final consumption expenditures to GDP (GOVY) to measure the weight of fiscal policy. *Seventh* indicator is inflation rate (CPI), measured by CPI to measure price (in)stability in the economy.

I.2.2 Model and Econometric Techniques

To investigate long-run relationship between the economic growth and financial development, the following model is used:

$$Y_it = a_0 + \alpha_{1t}F_{it} + \beta_{1t}X_{it} + U_{it} \quad , \qquad (1)$$

where $Y_{it}$ is a measure of economic growth, $F_{it}$ is a measure of financial development, $X_{it}$ is a set of control variables that includes commonly used variables in the literature such as trade volume, government expenditure, gross saving, and the inflation rate, and $U_{it}$ is the error term. Based on the set of financial and control variables, we can re-write the equation (1) as following:

Model1: $LY_{it} = a_0 + a_1\mathbf{DCBY_{it}} + b_1TY_{it} + b_2GOVY_{it} + b_4CPI_{it} + e_{it}$, (2)

Model 2: $LY_{it} = a_0 + a_1\mathbf{DCBY_{it}} + b_2GOVY_{it} + b_3GSY_{it} + b_4CPI_{it} + e_{it}$, (3)

Model 3: $LY_{it} = a_0 + a_1\mathbf{LLY_{it}} + b_1TY_{it} + b_2GOVY_{it} + b_4CPI_{it} + e_{it}$, (4)

Model 4: $LY_{it} = a_0 + a_1\mathbf{LLY_{it}} + b_2GOVY_{it} + b_3GSY_{it} + b_4CPI_{it} + e_{it}$. (5)

where $LY_{it}$ is natural logarithm of real GDP in country *i* and year *t*, $DCBY_{it}$ is the ratio of domestic credit issued by banks to GDP, $LLY_{it}$ is the ratio of liquid liability to GDP, $TY_{it}$ is the ratio of total trade to GDP, $GOVY_{it}$ is the ratio of government spending to GDP, $GSY_{it}$ is the ratio of gross savings to GDP, $CPI_{it}$ is the inflation measured by consumer price index, and $e_{it}$ is an error term.

To investigate long-term and short run relationship between economic growth and financial development as well as the direction of causality, Johansen-Juselius cointegration test, Park's (1992) Canonical Cointegrating Regression (CCR), Vector of Error Correction, and Seemingly Unrelated Regression Error Correction Model (SURECM) and Granger (1969) causality test in a system method are employed.

*Unit root and stationarity tests*

First step in this study is to test the data for stationarity. It's essential to test if variables have the tendency to return to the long term trend following a shock (stationary) or the variables follow a random walk (containing unit root). It's well known that if the variables follow a random walk after any shock, the regression result between variables is spurious and series don't have a finite variance, and as a result OLS will not produce consistent estimates. In this study, in order to test for stationarity, two tests are performed, such as the Augmented Dickey-Fuller (ADF) test, which tests if series exhibit unit root process (6, 7, 8 and 9) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test, which tests if series are stationary (10, 11 and 12).

ADF test tests whether a unit root is present in autoregressive model. Choosing the lag length for the ADF test is an important step for the implementation of the ADF test. If number of lags is too small then the remaining serial correlation in the errors will bias the test. If number of lags is too large then the power of the test will suffer. One possible approach is to examine the t-values on coefficients using General-to-specific approach. An alternative approach is to examine information criteria such as the Akaike information criterion, or Bayesian information criterion. Time series data Yt is non-stationary if its autocorrelation coefficient ρ is one, then series explodes as time progresses and has no finite variance. If this is the case, we call that the series have a unit-root (ρ=1), or in a more technically Yt ~ I(1), meaning that Yt series has to be differenced once to be stationary. If we consider the following regression model:

$$y_t = \rho y_{t-1} + u_t. \tag{6}$$

In order to test for unit root, the basic equation is modified as following equations (with or without intercept and /or trend variables):

$$\Delta y_t = \theta y_{t-1} + u_t, \tag{7}$$

$$\Delta y_t = \alpha + \theta y_{t-1} + u_t, \tag{8}$$

$$\Delta y_t = \alpha + \theta y_{t-1} + \beta t + u_t. \tag{9}$$

These are the basic Dickey-Fuller unit root test equations. In this three equations $\theta = \rho - 1$ and the testable hypothesis is $\rho = 1$ *(or* $\theta = 0$*)*. ADF test tests whether a unit root is present in autoregressive model. The testing procedure for the ADF test is applied to the model as followings (with or without intercept and /or trend variables):

$$\Delta y_t = (\rho_i - 1)y_{t-1} + \sum_{\rho=1}^{\rho} \delta_i \, \Delta y_{t-\rho+1} + u_t, \tag{10}$$

$$\Delta y_t = \alpha + (\rho_i - 1)y_{t-1} + \sum_{\rho=1}^{\rho} \delta_i \, \Delta y_{t-\rho+1} + u_t, \tag{11}$$

$$\Delta y_t = \alpha + (\rho_i - 1)y_{t-1} + \beta t + \sum_{\rho=1}^{\rho} \delta_i \, \Delta y_{t-\rho+1} + u_t. \tag{12}$$

where α is a constant, $t$ is trend variables, β is coefficient for trend variable, $p$ is autoregressive coefficient for series. Unit root is present if $\rho=1$ and the model would be non-stationary. The null hypothesis of the Augmented Dickey-Fuller t-test is followings:

$H_0$: ρ =1 (contain unit, the data is not stationary) versus the alternative hypothesis of

$H_a$: ρ <1 (do not contain unit root, the data is stationary).

On the contrary, KPSS test differs from ADF unit root tests in that the series are assumed to be (trend-) stationary under the null. KPSS test based on residuals from the OLS regression of $Y_t$ on the exogenous $X_t$. Series under KPSS test expressed as the sum of deterministic trend, random walk, and stationary error term and the test is LM test of the hypothesis that random walk has zero variance. As with the ADF test, there are two cases to distinguish between, whether to estimate with or without a linear time trend. The ADF unit root test is for the null hypothesis that a time series $Y_t$ is I(1). Stationarity tests, on the other hand, are for the null that $Y_t$ is I(0). The KPSS test is the most commonly used stationarity test. The KPSS test is derived by starting with the model:

$$y_t = \alpha + \beta x_t + \upsilon_t, \ \upsilon_t \sim iid\ (0, \sigma^2_{\upsilon}), \tag{13}$$

$$x_t = x_{t-1} + \varepsilon_t, \varepsilon_t \sim iid\ (0, \sigma^2_{\varepsilon}), \tag{14}$$

where $x_t$ is non-stationary series and $\upsilon_t$ is stationary. Also $x_t$ is a pure random walk with innovation variance σ2ε. The null hypothesis that $y_t$ is I(0) is formulated as H0 : $\sigma^2_{\varepsilon} = 0$, which implies that $x_t$ is a constant. The hypothesis of KPSS test is following:

$H_0 = \sigma^2_{\varepsilon} = 0$ (variance of I(1) component is zero, series are stationary) versus the alternative hypothesis of

$H_a = \sigma^2_{\varepsilon} > 0$ (variance of I(1) component is not zero, series are not stationary)

The KPSS test statistic is the Lagrange multiplier (LM) and score statistic for testing $\sigma^2_{\varepsilon} = 0$ against the alternative that $\sigma^2_{\varepsilon} > 0$ is given by:

$$KPSS = (T^{-2} \sum_{t=1}^{T} \left(\hat{s}_t 2\right) / \widehat{\lambda^2}, \tag{15}$$

where $\widehat{S_t} = \sum_{j=1}^{t} \widehat{\upsilon_t}$ , $\widehat{\upsilon_t}$ is the residual of a regression of $y_t$ on $x_t$ and $\widehat{\lambda^2}$ is a consistent estimate of the long-run variance of $\upsilon_t$ using $\widehat{\upsilon_t}$. The KPSS stationarity test is a one-sided right-tailed test.

*Cointegration Tests*

When time series variables are non-stationary, it is important to see if there is a certain common trend between those non-stationary series. If two non-stationary series $X_t$~ I(1) and $Y_t$~ (1) have a linear relationship such that $Z_t = Y_t - \gamma X_t$ and $Z_t \sim I(0)$, (Zt is stationary), then we call these two series are cointegrated. Broadly speaking, cointegration test is equivalent to examine if the residuals of regression between two non-stationary series are stationary. If residuals are stationary, two series $X_t$ and $Y_t$ are cointegrated. Next step is to test if series are cointegrated. There are different tests have been employed to test for the presence of cointegration. First method used in this study to test for presence of cointegration is Johansen-Juselius cointegration test.

In 1990, Soren Johansen and Katarina Juselius developed estimation and testing procedure for models with one or more cointegrating relationships. This method estimates one or more error correction equations together, obtaining estimates of the long-run and short-run coefficients in one pass. Johansen's approach is to estimate the Vector Error Correction Model (VECM) by maximum likelihood, under various assumptions about the trend or intercept parameters and the number of cointegrating vectors, and then conduct the likelihood ratio tests. Consider a VAR of order *p*:

$$y_t = \mathrm{A}_1 y_{t-1} + \cdots + \mathrm{A}_\rho y_{t-\rho} + \mathrm{B} x_t + \epsilon_t, \tag{16}$$

where $y_t$ is a $k$ -vector of non-stationary I(1) variables, $x_t$ is a $d$-vector of deterministic variables, and $e_t$ is a vector of innovations. This VAR can be rewritten as following:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{\rho-1} \Gamma_i \, \Delta y_{t-i} + \mathrm{B} x_t + \epsilon_t, \tag{17}$$

where $\Pi = \sum_{i=1}^{\rho} \mathrm{A}\Gamma_i - \mathrm{I}, \quad \Gamma_i = -\sum_{j=i+1}^{\rho} \mathrm{A}_j.$ (18)

Granger's representation theorem implies that if coefficient matrix Π has reduced rank $r<k$, then there exist $k$ x $r$ matrices α and β with rank $r$ such that Π =αβ' and $\beta' y_t$ is I(0). According to Johansen-Juselius method, $r$ is the number of cointegrating relations (the *cointegrating rank*) and each column of β is the cointegrating vector, the elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π. There are two test statistics: the trace statistic and the maximum eigenvalue statistic. The trace statistics test is based on the log-likelihood ratio $\ln[L_{max}(r)/L_{max}(k)]$, tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to $r$ against an alternative that the cointegrating rank is k. The maximum eigenvalue statistics test based on log-likelihood ratio $\ln[L_{max}(r)/L_{max}(r+1)]$, tests the null that the number of cointegrating vectors is $r$ against the alternative $r+1$ cointegrating vectors.

Another alternative way to test for cointegration is to use Park's Canonical Cointergrating Regression (CCR). By employing Park's CCR, we test for long-run relationship by computing cointegrating vectors. The main advantage of using Park's CCR test is this test not only shows the number of cointegrating vectors as well as the presence of deterministic and stochastic cointegrating terms. Consider a cointegrated system where $y_t$ and $x_t$ are difference stationary, and $e_t$ and $v_t$ are stationary with zero mean:

$$y_t = x_t'\gamma + \varepsilon_t, \tag{19}$$

$$\Delta x_t = v_t, \tag{20}$$

$$\omega_t = (\varepsilon_t, \upsilon_t). \tag{21}$$

The CCR procedure assumes that the long run covariance matrix of $\omega_t$ is positive definite, which implies that $x_t$ is not self cointegrated. This conditions assumes that there is a unique cointegrating vector (1, -γ) exist. Park suggested the approach which transforms the model in order to get an asymptotically efficient OLS estimator:

$$y_t^* = y_t + \pi_y{}'\omega_t, \tag{22}$$

$$x_t^* = x_t + \pi_x{}'\omega_t. \tag{23}$$

Based on earlier assumption, $y_t$* and $x_t$* are cointegrated with the same cointegrating vector (1, -γ) as $y_t$ and $x_t$ for any $\pi_y{}'$ and $\pi_x{}'$. In order to transform $y_t$ and $x_t$, the long run covariance parameters are estimated to obtain $\pi_y{}'$ and $\pi_x{}'$, where $\Pi_y = \Sigma^{-1}\Gamma_2\gamma + (0, \Omega_{12}\Omega_{22}^{-1})'$. Then apply Park's G (p, q) tests to CCR residuals for the H (p, q) the null of stationary of OLS regression. The test hypothesis will be as following:

H (0, 1): statistic tests the deterministic cointegrating restriction and,

H (1, q): statistic tests for the presence of stochastic cointegration.

*Error Correction Model and Seemingly Unrelated Regression ECM*

In order to investigate the short run and long-run dynamics between the financial development and economic growth, an Error Correction Model was employed under the assumption of $Z_t = Y_t - \gamma X`_t$ is stationary. Based on results of Johansen-Juselius and Park's CCR tests for cointegration, ECM can be performed knowing that variables are cointegrated. ECM specification restricts the long run behavior of the endogenous variables to converge to their cointegrating relationships still allowing for short run adjustment dynamics. Through error correction term, ECM allows the discovery of Granger Causality relation.

Consider the cointegrating relation $Y_t - \alpha x_t = 0$, which represents a long-term equilibrium relation between $y_t$ and $x_t$ and cointegrating factor $Z_{t,}$ which will be used to measure the deviation from this long-term relation. Engle and Granger suggested the following regression to estimate the value of α:

$$Y_t = \alpha_0 + \alpha_1 x_t + \varepsilon_t. \tag{24}$$

The cointegrating factor $Z_{t,}$ can be estimated if the value of $\alpha_1$ is known by estimating $Z_t = Y_t - \hat{\alpha} x_t$. This model will allow testing for both short-term and long-term relations between two time-series and is known as error correction model or ECM. Then the following ECM estimates the potential short-run and long-run effects of these two variables on each other:

$$x_t - x_{t-1} = a_0 + a_1 \hat{Z}_{t-1} + \sum_{i=1}^{m} b_i \left(y_{t-i} - y_{t-i-1}\right) + \sum_{j=1}^{m} c_j \left(x_{t-j} + x_{t-j-1}\right) + \varepsilon_t, \tag{25}$$

$$y_t - y_{t-1} = \alpha_0 + \alpha_1 \hat{Z}_{t-1} + \sum_{i=1}^{m} \phi_i \left(y_{t-i} - y_{t-i-1}\right) + \sum_{j=1}^{m} \theta_j \left(x_{t-j} + x_{t-j-1}\right) + \mu_t. \tag{26}$$

The ECM equations given by 25 and 26 decompose the dynamic adjustments of the dependent variables X into two components: 1) a long-term components given by cointegrating terms $a_1 \hat{Z}_{t-1}$ and $\alpha_1 \hat{Z}_{t-1}$, or error correction term, and 2) a short-term components given by the summation terms on the right hand side of the equations. Based on the equations 25 and 26, variables $y_t$ and $x_t$ are cointegrated and exhibits the long-term co-movements when at least one of the coefficients $\alpha_1$ and $a_1$ is different from zero. If $a_1$ is different from zero and $\alpha_1$ is zero, then it said that $y_t$ follows and adjusts to $x_t$ in the long run. If both $\alpha_1$ and $a_1$ are different from zero, $x$ and $y$ adjust to one another over the long run. The short run relation between yt and xt are given by coefficients $b_i$ and $\varphi_i$. It's said if $b_i$'s are not all zero and $\varphi_i$ all zero, then $x$ is causing $y$ in the short run. However, if both coefficients are different from zero, then feedback exists and the two variables affect each other in the short run.

In this study, four different models based on number of financial proxies and control variables have been studied (equations 2-5). In each model specification, the error correction term $\hat{Z}_t$ has been estimated using the cointegrating vector obtained from Park's CCR for each 12 countries in the sample. Each system of ECM equations will look as following (example shown in case of model 1):

$$\Delta LYit = \mu_{1i} + \lambda 1Zit - 1 + \sum_{j=1}^{k} \delta 1,\ ij\ \Delta LYit - j + \sum_{j=1}^{k} \delta 2,\ ij\ \Delta DCBYit - j$$

$$+ \sum_{j=1}^{k} \delta 3,\ ij\ \Delta TYit - j + \sum_{j=1}^{k} \delta 4,\ ij\ \Delta GOVYit - j + \sum_{j=1}^{k} \delta 5,\ ij\ \Delta CPIit - j + \upsilon 1, \mathrm{it} \tag{27}$$

$$\Delta DCBYit = \mu_{2i} + \lambda 2Zit - 1 + \sum_{j=1}^{k} \varphi 1,\ ij\ \Delta LYit - j + \sum_{j=1}^{k} \varphi 2,\ ij\ \Delta DCBYit - j$$

$$\sum_{j=1}^{k} \varphi 3,\ ij\ \Delta TYit - j + \sum_{j=1}^{k} \varphi 4,\ ij\ \Delta GOVYit - j + \sum_{j=1}^{k} \varphi 5,\ ij\ \Delta CPIit - j + \upsilon 2, \mathrm{I\ t} \tag{28}$$

$$\Delta TYit = \mu_{3i} + \lambda 3Zit - 1 + \sum_{j=1}^{k} \psi 1,\ ij\ \Delta LYit - j + \sum_{j=1}^{k} \psi 2,\ ij\ \Delta DCBYit - j$$

$$+ \sum_{j=1}^{k} \psi 3,\ ij\ \Delta TYit - j + \sum_{j=1}^{k} \psi 4,\ ij\ \Delta GOVYit - j + \sum_{j=1}^{k} \psi 5,\ ij\ \Delta CPIit - j + \upsilon 3, \mathrm{it} \tag{29}$$

$$\Delta GOVYit = \mu_{4i} + \lambda 4Zit - 1 + \sum_{j=1}^{k} \theta 1,\ ij\ \Delta LYit - j + \sum_{j=1}^{k} \theta 2,\ ij\ \Delta DCBYit - j$$

$$+ \sum_{j=1}^{k} \theta 3,\ ij\ \Delta TYit - j + \sum_{j=1}^{k} \theta 4,\ ij\ \Delta GOVYit - j + \sum_{j=1}^{k} \theta 5,\ ij\ \Delta CPIit - j + \upsilon 4, \mathrm{it} \tag{30}$$

$$\Delta CPIit = \mu_{6i} + \lambda 6Zit - 1 + \sum_{j=1}^{k} \pi 1,\ ij\ \Delta LYit - j + \sum_{j=1}^{k} \pi 2,\ ij\ \Delta DCBYit - j$$

$$+ \sum_{j=1}^{k} \pi 3,\ ij\ \Delta TYit - j + \sum_{j=1}^{k} \pi 4,\ ij\ \Delta GOVYit - j + \sum_{j=1}^{k} \pi 5,\ ij\ \Delta CPIit - j + \upsilon 6, \mathrm{it} \tag{31}$$

In order to get more precise estimates, next step is to run unrestricted and restricted Seemingly Unrelated Regression Error Correction Model (SURECM) using the error correction term $\hat{Z}_t$, which will be estimated using the cointegration vector from Park's CCR. Seemingly unrelated models are called so due to contemporaneous errors, which may be correlated across the system of equation. A single model may contain a number of linear equations. In such a model it is often unrealistic to expect that the equation errors would be uncorrelated. A set of equations that has contemporaneous cross-equation error correlation (i.e. the error terms in the regression equations are correlated) is called a seemingly unrelated regression (SUR) system. At first look, the equations seem unrelated, but the equations are related through the correlation in the errors. Zellner (1962) suggested the Seemingly Unrelated Regression (SUR) model as *p* correlated regression equations and the *p* regression equations are "seemingly unrelated" because taken separately the error terms would follow standard linear OLS linear model form. However, the standard OLS model normally ignores any correlation among the errors across equations. In SUR models the dependent variables are correlated and the design matrices may contain some of the same variables there may be contemporaneous" correlation among the errors across the *p* equations. Therefore, SUR models are often employed when there may be several equations, which appear to be unrelated; however, they may be related by the fact that: (1) some coefficients are the same or assumed to be zero; (2) the disturbances are correlated across equations; and/or (3) a subset of right hand side variables are the same. If all equations in the system have exactly same number of explanatory variables and exactly same lag-length, then there is no efficiency gain for running SUR. Lag-lengths in the system are determined based on BIC. So ECM for all countries in the sample will be investigated as a system of seemingly unrelated equations, which will account for cross-equation correlation of error terms among countries.

*Granger Causality test*

Correlation and cointegration do not necessarily imply the causation in any meaningful sense of this word. Many previous literatures employed one of the two asymptotically equivalent test procedures for testing the null hypothesis of unidirectional causality against the alternative of feedback such as Granger (1969) and Sims (1972) causality tests. In this study, in order to study for causal relationships between the financial development and economic growth and find the direction of causality, the Granger causality test has been adopted. The Granger (1969) method it to question whether $x_t$ causes $y_t$ and see how much of the current value of $y_t$ can be explained by past values of $y_t$ and then to see whether adding lagged values of $x_t$ can improve the explanation of $y_t$. In order words, Granger causality test can be interpreted as following: $y_t$ said to be Granger-caused by $x_t$ if $x_t$ helps in prediction of $y_t$ and the coefficients of lagged values of $x_t$ are statistically significant. By running Granger causality test we investigate the following hypothesis:

$H_0$: X does not cause Y (or $H_0$: $\beta_1 = \beta_2 = \ldots = \beta_m = 0$; from the VAR model $Y_t = \sum \alpha_i Y_{t-i} + \sum \beta_i X_{t-i} + \varepsilon_t$), against alternative hypothesis of

Ha: X Granger cause Y.

Rejection of null hypothesis implies that current and past lagged values of $x_t$ help predict the current values of $y_t$. Analogically, this technique can be used in investigating whether or not $y_t$ causes $x_t$. In this study regular VAR based Granger causality test and

Granger causality test based on SURECM in system method were employed to compare the results of regular Granger test versus system method.

## I.3. EMPIRICAL RESULTS

This section gives the description of data analysis and discusses the results of various tests to investigate the relationship between the financial development and economic growth and find the direction of causality. The results of all tests are discussed in the separate subsections.

*Unit root tests*

Before proceeding to the identification of a possible relationship, it’s important to verify that all variables are integrated of order one in levels or they are I(1) process. In this study, two tests are performed to test for unit root or stationarity, such as the Augmented Dickey-Fuller (ADF) test, which tests if series exhibit unit root and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test, which tests if series are stationary.

ADF test regresses the first difference of variable against a set of lagged variables of itself. The null hypothesis is that the series contain a unit root against the alternative no unit root. Selection of lag length is an important step in the ADF test. If number of lags is too small then the remaining serial correlation in the errors will bias the test. If number of lags is too large then the power of the test will suffer. One possible way is to examine the t-values on coefficients using General-to-specific method also known as Hall’s method. An alternative approach is to examine the Akaike or Bayesian information criterion. Table 1.1 describes ADF test results with three different results for lag-length for 12 high-income OECD countries during the period 1971-2006 for eight variables such as LY (log of real GDP), DCBY (the ratio of domestic credit issued by banks to GDP), LLY (the share of liquid liabilities to GDP), TY (the ratio of total trade to GDP), GSY (the ratio of gross domestic savings to GDP), GOVY ( the ratio of government expenditures to GDP), and CPI (the inflation rate measured by CPI). In all cases, all variables for each country, we fail to reject the null hypothesis that they contain unit root. ADF test results confirm that almost all variables are non-stationary at 5 % significance level with the exception of GSY for Germany, DCBY, DCPSY, and GOVY for France, log of GDP for Italy, and TY for Korea, and GOVY for Australia, Austria, Belgium and France (which are already stationary in levels) and they are stationary after first differencing.

On the contrary the null hypothesis of KPSS test is that the series are stationary versus an alternative of non-stationary. The results of the KPSS tests are in Table 1.2 and they clearly indicate that the investigated variables are not stationary or trend-stationary, since in almost every case the null hypothesis at a significance level of 5% was rejected with exception of GSY for Sweden and CPI for Belgium (there are stationary in levels). Since the data selected in this study are non-stationary in levels and stationary in first differencing, we can now test for presence of cointegration among series.

*Cointegration Test*

It is not sufficient to conclude that the variables contain a unit root or they are non-stationary. It's necessary to test for cointegration preliminary ECM, SURECM and Granger causality test. After determining that the data series are integrated by means of unit root tests, it is now essential to verify whether they do form a cointegrated system of variables. If time-series variables are non-stationary, the next step is to see if there is a certain common trend between those non-stationary series. When two non-stationary series $X_t$~ I(1) and $Y_t$~ (1) have a linear relationship, which is expressed as $Z_t = Y_t - \gamma X_t$ and $Z_t$ ~ I(0), (Zt is stationary), then we say that these two series are cointegrated. Cointegration test is equivalent to examine if the residuals of regression between two non-stationary series, $Z_t$, are stationary. If residuals are stationary, two series $X_t$ and $Y_t$ are cointegrated. In this study, there are two different methods were used to test for presence of cointegration or test if series are cointegrated.

First, we employed Johansen-Juselius test for multivariate cointegration. The Johansen-Juselius cointegration approach produces two test statistics such as the trace, $\lambda_{trace,}$ and maximum eigenvalue statistics, $\lambda_{max}$. We proceed sequentially from $r = 0$ to $r = k - 1$, where $k$ is the number of endogenous variables, until fail to reject to determine the number of cointegrating relations, $r$. The two tests of the null hypothesis of $r$ cointegrating relations against the alternative of $k$ cointegrating relations, for r = 0, 1,…, $k$-$1$ are reported in the results tables 1.3-1.6 for all four models. Based on the results of trace and maximum eigenvalue statistics, we can conclude that all models exhibit at least one cointegrating relations. However, Johansen-Juselius test for cointegration does not provide information whether the series present stochastic or deterministic cointegrating terms. In this regard, we run Park's CCR to test for long run relationship and presence of deterministic and stochastic cointegrating terms, and estimate the cointegrating vector for every single variable for each country and each four models. In order to run Park's CCR, we adopted Masao Ogaki's Gauss code for Park's CCR and modified it for our data set and model specifications. The results of CCR are shown in Tables 1.7-1.10, which display the cointegrating vectors for every single country and variables in each model. In

CCR result for model 1 the stochastic cointegrating restrictions are failed to reject at 5% significant level for all countries except Korea and US, which show the presence of deterministic cointegrating restrictions. In model 2 all countries exhibit the presence of stochastic cointegrating restriction, which are failed to reject at 5 % significant level. Furthermore, in model 3 in case of France and Japan the stochastic cointegrating restrictions are rejected at 5 % significant level, however the deterministic cointegrating restrictions are failed reject for these countries. Finally, model 4 shows that almost all countries are cointegrated through stochastic cointegrating restrictions except Japan, where deterministic cointegration is failed to reject at 5 % significant level. The magnitude and the signs of cointegrating vectors of all four models are consistent with the economic theories and our expectations.

*ECM and SURECM*

Based on CCR results we estimate the cointegrating vectors for our models under the investigation. Now, next step in this study is to investigate short-run and long-run dynamics between the financial development and economic growth by running Error Correction Model (ECM) and Seemingly Unrelated Regression Error Correction Model (SURECM) in the system method. Through error correction term, ECM and SURECM allow the discovery of Granger Causality relation between the financial development and economic growth for twelve OECD countries for models 1 through 4. The estimation results of ordinary ECM and SURECM are reported in Tables 1.11 - 1.14.

The results of ordinary ECM and SURECM for model 1 are reported in Table 1.11, which show that we have statistically significant $\hat{\lambda}_0$ for only three countries based on ECM results and six countries based on SURECM. This significant improvement has been obtained due to system method, which is more efficient than ordinary methods. More specifically, when markets have a close relationship with one another, SURECM approach accounts for cross equation correlations among the countries in the system. SURECM method utilizes the information in the variance-covariance matrix of residuals in the system to improve the efficiency. In addition to running iterative SURECM, we have also run the restrictive SURECM by applying the restrictions that all countries have same coefficient for speed of adjustment. The restrictive model result shows that $\hat{\lambda}_0$ is statistically significant at 5 % level, which is fairly same as we run panel error correction model assuming that countries in this sample are homogeneous. The results of restrictive SURECM show that we reject the null hypothesis that speed of adjustment coefficients are same for all countries. This means that even though OECD countries are homogeneous in terms of their economic development, financial system and standards of living, but they are not homogeneous, revealing the heterogeneity of countries in this study. Also we have run SURECM and restrictive SURECM for sub-group of European and non-European countries. However, the results of these SURECM's didn't perform any better with fewer cases of cointegration and not significant point estimates for speed of adjustment in non-restrictive models. These results mainly happened due to selection bias issues, because in the European region, these economies trade, interact and cointegrated with many more other middle income European countries, members of EU and their neighbors, which are not included in this sample and sub-group. However, the results of SURECM for financial variables are weakly exogenous for most countries, which can be interpreted as LY dominates the short run dynamics.

Furthermore, the ordinary ECM and iterative SURECM results for model 2 is reported in Table 1.12. Here, only France and Italy exhibit statistically significant estimates for speed of adjustment in regular ECM, saying that there are only two countries out of twelve display long run relations between economic growth and the financial development, which has been improved significantly after running the same model in the system method. The results of iterative SURECM show that seven countries such as Belgium, Canada, France, Germany, Italy, Japan, and Korea, have long run relationship between finance (expressed as the ratio of domestic credit issued by banks to GDP) and growth. Model 2 differs from model 1 in that it has a different set of control variables, which accounts for the role of gross domestic savings instead of role of international trade as one of the growth factors. The inclusion of GSY instead of TY as one of the control variables improved the results of estimation. The restrictive SURECM for model 2 shows that $\hat{\lambda}_0$ was rejected at 5 % level, which indicates the heterogeneity of markets. Models 1 and 2 both employ DCBY (the ratio of domestic credit issued by banks to GDP) or the degree of dependence upon banking sector as financial proxy. However, it's worth to note that non-restrictive and restrictive SURECM results for sub-group of European and non-European countries have been improved significantly. These improvements show the importance of control variables in model specification. Based on recent development of European economies, the widening debt crisis became one of the major concerns for economic policy makers and governments. Especially recent default of Greece created further concern in the region. Spain, Italy, and Portugal all have economic and debt dynamic that somewhat mirror Greece. Even though these countries are not the object of study in this essay, however they do affect entire euro zone and have a hidden effect on seven countries in this essay. Based on this reasoning, selection of control variables is very important for European countries case. Especially, the results demonstrates that gross domestic savings is one of the influential and important control variables to detect the causality relationship in euro zone.

Finally, ECM and SURECM results for models 3 and 4 are reported in Tables 1.13 and 1.14. These two models employ LLY (the ratio of liquid liabilities to GDP) as financial proxy and again using the same sets of control variables as before in models 1 and 2. LLY is the measure of financial depth or the size of financial intermediation. In model 3 the results of ordinary ECM show that Belgium, Germany, Italy and Sweden have long-run relationship between finance and growth, however the results have been improved significantly in the system method presenting seven countries such as Australia, Canada, France, Germany, Japan, Korea, and Sweden with statistically significant estimates for speed of adjustment coefficient. Similar improvement has been shown when we run SURECM for sub-group of countries based on geographical location and closeness of economies such as European countries and non-European countries. The cross-equation restriction under the hull hypothesis for $\hat{\lambda}_0$ was rejected at 5 % significant level, which supports the results of non-restrictive model that countries are not homogenous in this study. ECM and SURECM results for model 4, as before have been improved by employing system method. We have statistically significant $\hat{\lambda}_0$ for Austria, France, Germany and US for ordinary ECM, and for Belgium, France, Germany, Italy, Korea and US in SURECM. The restrictive SURECM also produced statistically significant point estimates for speed of adjustment which was rejected at 1 % level both for European and non-European sub-group, which support the results from previous three models.

Based on above mentioned results of ordinary ECM and SURECM, we can say that there are not big differences in our results depending on selection of financial proxy. We may conclude that the long run relationship between financial development and economic growth are not sensitive to selection of financial variables. However, the link between economic growth and financial development might be sensitive to selection of control variables to detect the role of other factors affecting the growth. It's worthwhile to note that we have better estimates when GSY is used as one of control variables instead of TY. Finally, based on results of SURECM, there is strong evidence that LY dominates the short run dynamics due to presence of weak erogeneity issue for all financial variables and this is also true for European and non-European sub-groups as well.

*Granger Causality test*

Final test in this study is to test for contemporaneous causality relation between financial development and economic growth. Granger causality test based on ordinary VAR and Granger causality test based on SURECM methods are employed to test for contemporaneous causality and find the direction of causality. The results of VAR and system based Granger causality tests are reported in Tables 1.15 – 1.18. According to Granger causality tests for Model 1 in Table 1.15, we found no evidence of causality in either direction between total bank credit and economic growth for five countries (Belgium, Canada, France, Korea, and Sweden); evidence of two-way causality in three countries (Austria, Germany, and UK); evidence of positive causality running from finance to growth in four countries (Australia, Italy, Japan, and the US). The results of VAR based Granger causality test of model 1 provide a weak support for the hypothesis that Levine and King discussed that financial development ‘leads’ economic growth.

The results of VAR based Granger causality test for model 2 provide similar evidence as in model 1: we found the evidence of no causality in six countries (Belgium, Canada, France, Korea, and Sweden); the evidence of positive causality in four countries (Australia, Austria, Japan, and the US); the evidence of reverse causality running from economic growth to finance in UK only; and bidirectional causality for Germany only. Again these results do not provide sufficient evidence to support the hypothesis that financial development ‘leads’ productivity growth and, consequently, the economic growth. The results of models 1 and 2 are consistent with the earlier empirical literature such as Shan and Morris (2002) and Hassan, Sanchez and Yu (2011), who also examined the causality pattern by employing ordinary Granger causality test or panel Granger causality test.

Tables 1.17 and 1.18 report VAR based Granger causality test results for model 3 and 4. In model 3 we found the evidence of positive causality in two countries (Australia and Japan), reverse causality in three countries (Canada, France and UK), two-way causality in Italy and no causality for six countries (Austria, Belgium, Germany, Korea, Sweden and US). We got the similar results for model 4 as well: the evidence of positive causality in Japan, reserve causality in four countries (Australia, Austria, Canada, and UK), bidirectional causality in Italy and no causality in six countries (Belgium, France, Germany, Korea, Sweden and the US). The results of model 3 and 4 are consistent with previous studies where VAR based Granger causality method was employed. These results however are in sharp contrast to those of King and Levine (1993a) and Rajan and Zingales (1998) who applied cross sectional approach and concluded that financial development is a necessary precursor of economic growth. Based on the results of these four models, we can conclude that: 1) the pattern of causality between the financial development and economic growth may be country specific; 2) Granger causality test results greatly affected by selection of variables, specifically financial proxy and control variables; 3) the direction of causality might be different due to selection of econometric methods used to examine the causality itself. Our empirical evidence of VAR based Granger causality test is consistent with previous literature, where VAR method was employed and contradicts the findings of studies where cross sectional or panel data approach were used.

Next we run Granger causality test based on SURECM method to see if there are any improvements in our results if system method is applied. The results of SURECM based Granger causality tests are reported in Tables 1.15 - 1.18. In addition to running system-based Granger causality test for all countries, we have also run the test in sub-groups for European and non-European countries. Granger causality test results for all four models and two sub-groups of countries have brought interesting empirical evidence, which will be discussed below in separate sub-sections.

- *Granger causality test: evidence on DCBY versus LLY case*

According to SURECM based Granger causality tests in Table 1.15 for model 1, we found the evidence of positive and bidirectional causality between finance and economic growth for all countries except Austria, which displays the evidence of reverse causality. These results imply that the financial development leads economic growth in seven countries (Australia, Belgium, France, Italy, Sweden, UK and US) and there are two-way causality exists in four countries. The empirical evidence of model 1 suggests that financial development occurs simultaneously with economic growth and we found strong support to hypothesis that finance leads economic growth. The similar results were obtained when we run Granger causality test for two sub-groups of countries: European and non-European countries. There are 3 cases of positive causality, one case of reverse causality and one case of bidirectional causality in European sub-group. For non-European countries, there are 2 countries with bidirectional causality and the rest demonstrate somewhat mixed directions of causality. However, there are still some countries with no causality in European sub-group such as Belgium and Italy and in non-European sub-group such as Korea. The Granger causality test results in these two cases might be negatively affected due to decrease in number of equation in the system. However, the Granger causality test for all 12 countries provides strong evidence that there are some causality exists between the financial development and economic growth, more specifically, there are positive and directional causality between finance and growth. If we summarize the main findings from model1, there are more cases of bidirectional and positive causality between financial development and economic growth.

In this context, it's interesting to look at model 3 (table 1.17), which utilizes LLY as financial proxy and exactly same set of control variables. Granger causality test for model 3 shows that there are evidence of bidirectional causality in six countries out of twelve and somewhat mixed results of reverse, positive and no causality cases in remaining six countries such as Italy and Austria have evidence of positive causality, Sweden and UK have evidence of reverse causality, and no causality in two countries, Canada and Germany. Clearly, we can detect a significant improvement over ordinary Granger causality test results, where we had seven countries with no causality versus two. However, Granger causality test results for European countries exhibit the presence of more countries with positive causality then for all countries. Non-European countries have very mixed results.

We can also compare the results of model 2 and 4 since they also use same set of control variables, GOVY, GSY and CPI, and different measures of financial development. In model 2 for all countries (table 1.16), we have seven countries in the sample with positive causality, Austria has evidence of reverse causality and four countries with bidirectional causalities such as Canada, Germany, Japan, and Korea. For European sub-group majority of countries have evidence of positive causality and bidirectional causality, and only Belgium does not have any causality between finance and growth. Non-European sub-group also reveals bidirectional causality mainly and somewhat mixed results. The Granger causality results of model 4 shown in table 1.18, where there are 7 countries out of 12 have bidirectional causality and the remaining countries have either positive or reverse causality. In European sub-group the majority of countries have presence of bidirectional and positive causality. However, non-European sub-group of countries has reserve and positive causalities.

If we compare models 1 and 3, and models 2 and 4, there are differ from each other only by selection of financial proxy. Model 1 (2) uses DCBY and model 3 (4) uses LLY as a measure of financial development. When we use DCBY as financial proxy, there is strong tendency of positive and bidirectional causality case. However, we cannot precisely say this conclusion about LLY. Model 3 and 4 show the evidence of bidirectional causality in most of the cases.

- *Granger Causality test: evidence on TY versus GSY*

In this context, we can compare models 1 and 2, and models 3 and 4, because models 1(3) and 2(4) use same financial proxy; however they have a different set of control variables. Test results of model 1 provide stronger evidence of positive causality in seven countries and bidirectional causality in four countries. In European sub-group 2 countries with positive and 2 countries with reverse causality. However in non-European sub-group the results are mixed. But in model 2, when use GSY instead of TY, there are more cases of bidirectional and positive causalities observed than in model 1. European countries have a strong evidence of positive and directional causalities than in model 1 as well. Similarly, we can compare models 3 and 4, where LLY is used as financial proxy and different set of control variables. The result of this analysis shows that when GSY used as control variable instead of TY, we have more cases of bidirectional causality. So the sensitivity analysis shows that selection of control variables is important among similar income groups. In case of high income OECD countries as well as European countries, GSY is one of the key control variables to correctly detect the direction of causality relationship between financial development and economic growth due to euro zone recent economic problems related to debt crisis of its member countries.

Finally, there are significant improvements in Granger causality test results after running SURECM, which highlights that system method is superior to the conventional regression methods. SURECM based Granger causality test reveals the evidence of bidirectional causality and the fact that direction of causality may be country specific. We can conclude that the system method in this study clearly provides a better estimates for $\hat{\lambda}_0$, which in return also improves Granger causality test results because the system method accounts for cross equation correlations among countries and utilizes information in the variance-covariance matrix of residual to improve the efficiency of statistical estimates.

## I.4. SUMMARY AND CONCLUSION

In order to investigate the relationship between financial development and economic growth and study the effectiveness of financial development in OECD countries economic growth, we have employed Johansen-Juselius cointegration test, Park's CCR, ordinary ECM, SURECM and Granger causality in the system method. The essay present further evidence concerning the debate over whether financial development leads economic growth in a Granger causality sense among high income OECD countries.

We mentioned earlier that there are conflicting theoretical as well as empirical arguments regarding the role and importance of financial development. Based on the results of ECM, SURECM and Granger causality test, we found the evidence of bidirectional and positive causality running from finance to economic growth, which is consistent with conclusions of Demetriades and Luintel (1996), Arestis and Demetriades (1997), Shan, Morris and Sun (2001) conclusions. So the conclusion of Granger causality test is consistent with earlier literature that the direction of causality may be country specific. This suggests that financial development is not necessarily a leading sector to generate growth. However, it’s essential to mention the importance of it both theoretically and for economic policy considerations.

The study also found that the selection of financial and control variables are important to accurately examine the pattern of causality. The empirical results of Granger causality test suggest that bank credit (DCBY) and the financial depth (LLY) variables perform well to study the causality relationship. On the other hand, evidence shows that trade is not as important factor of growth as gross domestic savings for high income OECD countries, especially for euro zone area. Another important conclusion of this study is that the selection of econometric techniques does play an important role in examining the causality pattern. We employed Park’s CCR to estimate cointegrating vectors and run SURECM and Granger causality test in the system method, which significantly improves the power of the test and provides more accurate information on directions of causality.

However, one-way causality results are greatly affected by selection of financial proxy. Positive causality between financial development and economic growth has been mainly observed when DCBY (the share of domestic credit issued by banks to GDP) is used as a measure of financial development and reverse causality relationship, when LLY (the share of liquid liability to GDP) is used as a financial proxy. The main findings in these essays show a little evidence that financial development is a necessary and sufficient precondition to economic growth. Also the sensitivity analysis has been done by studying the countries based on geographical region such as European and non-European countries. The main reason to divide countries in to two groups is based on reasoning that even though our sample contains homogeneous countries in terms of income levels and standards of living, however, they are heterogeneous in terms of cultural background, trade barriers, distance to borders, history, membership in European Union and geographical location. In order to remove the heterogeneity issue the sample size has been divided into two sub-groups such as European and non-European countries. Our findings illustrate that European countries have statistically significant point estimates of speed of adjustment coefficients, which show the stronger evidence of cointegration in the region among the high income countries. Another important contribution of this essay is the econometric method used to examine the relationship between financial development and economic growth. Previous research employed traditional OLS, cross-sectional study or panel cointegration test to examine the causality relationship. However, this is the first attempt in this field to study this relationship using system method. The findings demonstrate that the system method is superior to single equation approach.

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**APPENDIX A**: Tables and Figures for Chapter I

Table 1.1 Univariate Unit Root tests: ADF

| country | GSY: t-tests for unit-roots, lags were determined using: | | | | | | DCBY:t-tests for unit-roots, lags were determined using: | | | | | | DCPSY:t-tests for unit-roots, lags were determined using: | | | | | | GOVY: t-tests for unit-roots, lags were determined using: | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | |
| Australia | -2.093 | 0 | 2.093 | 0 | 2.093 | 0 | 2.194 | 0 | 2.194 | 0 | 2.194 | 0 | 2.847 | 0 | 2.847 | 0 | 2.847 | 0 | -3.144 ** | 0 | -3.144 ** | 0 | -3.144 ** | 0 |
| Austria | -2.598 | 0 | 2.598 | 0 | 2.598 | 0 | -2.857 * | 0 | -2.404 | 1 | -2.857 * | 0 | -0.729 | 0 | -0.729 | 0 | -0.729 | 0 | -3.093 ** | 0 | -3.093 ** | 0 | -3.093 ** | 0 |
| Belgium | -2.736 * | 0 | -2.033 | 1 | -2.033 | 1 | -1.264 | 0 | -1.264 | 0 | -1.264 | 0 | -0.577 | 0 | -0.577 | 0 | -0.577 | 0 | -2.813 * | 0 | -2.738 * | 1 | -2.813 * | 0 |
| Canada | -1.313 | 0 | -1.313 | 0 | -1.313 | 0 | 0.052 | 0 | 0.052 | 0 | 0.052 | 0 | -0.021 | 0 | -0.021 | 0 | -0.021 | 0 | -2.075 | 1 | -2.075 | 1 | -2.075 | 1 |
| France | -2.718 * | 1 | -2.048 | 0 | -2.048 | 0 | -3.881 ** | 0 | -3.881 ** | 0 | -3.881 ** | 0 | -4.106 ** | 0 | -4.106 ** | 0 | -4.106 ** | 0 | -2.612 * | 0 | -2.612 * | 0 | -2.612 * | 0 |
| Germany | -3.415 ** | 0 | -3.415 ** | 0 | -3.415 ** | 0 | -1.978 | 2 | -1.978 | 2 | -1.978 | 2 | -1.074 | 0 | -1.074 | 0 | -0.832 | 1 | -2.230 | 1 | -2.230 | 1 | -2.230 | 1 |
| Italy | -1.366 | 0 | -1.366 | 0 | -1.366 | 0 | -0.509 | 1 | -1.113 | 1 | -1.113 | 1 | -0.385 | 1 | -0.385 | 1 | -0.385 | 1 | -1.002 | 0 | -1.002 | 0 | -1.002 | 0 |
| Japan | -1.927 | 0 | -2.109 | 1 | -2.109 | 1 | -1.443 | 0 | -1.443 | 0 | -1.443 | 0 | -1.301 | 1 | -1.301 | 1 | -1.301 | 1 | -0.995 | 0 | -1.412 | 1 | -1.412 | 1 |
| Korea | -2.380 | 0 | -2.380 | 0 | -2.380 | 0 | 0.395 | 0 | 0.030 | 1 | 0.395 | 0 | 0.480 | 0 | -0.007 | 1 | 0.480 | 0 | -1.101 | 0 | -1.101 | 0 | -1.101 | 0 |
| Sweden | -2.308 | 1 | -2.308 | 1 | -2.308 | 1 | -2.756 * | 1 | -1.932 | 1 | -2.756 * | 0 | -2.637 * | 0 | -1.748 | 1 | -2.637 * | 0 | -3.021 ** | 1 | -2.367 | 0 | -3.021 ** | 1 |
| UK | -2.448 | 0 | -2.448 | 0 | -2.448 | 0 | 0.312 | 1 | 0.312 | 1 | 0.312 | 1 | 0.568 | 0 | 0.568 | 0 | 0.568 | 0 | -3.201 ** | 1 | -1.904 | 0 | -3.201 ** | 1 |
| US | 1.311 | 0 | 1.311 | 0 | 1.311 | 0 | 1.325 | 0 | 1.325 | 0 | 1.325 | 0 | 1.587 | 0 | 1.587 | 0 | 1.587 | 0 | -1.486 | 0 | -1.486 | 0 | -1.486 | 0 |

| country | LOG GDP: t-tests for unit-roots, lags were determined using: | | | | | | TY: t-tests for unit-roots, lags were determined using: | | | | | | LLY: t-tests for unit-roots, lags were determined using: | | | | | | CPI: t-tests for unit-roots, lags were determined using: | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | |
| Australia | 0.715 | 0 | 0.715 | 0 | 0.715 | 0 | -0.937 | 0 | -0.937 | 0 | -0.937 | 0 | 2.764 | 2 | 1.986 | 0 | 1.986 | 0 | -1.558 | 0 | -1.558 | 0 | -1.558 | 0 |
| Austria | -1.634 | 0 | -1.634 | 0 | -1.634 | 0 | 1.140 | 0 | 1.140 | 0 | 1.140 | 0 | -2.567 | 0 | -2.567 | 0 | -2.567 | 0 | -1.502 | 0 | -1.502 | 0 | -1.502 | 0 |
| Belgium | -1.405 | 0 | -1.405 | 0 | -1.405 | 0 | -0.908 | 0 | -0.908 | 0 | -0.908 | 0 | -0.567 | 2 | -1.291 | 0 | -1.291 | 0 | -2.263 | 1 | -2.263 | 1 | -2.263 | 1 |
| Canada | -1.198 | 0 | -1.198 | 0 | -1.198 | 0 | -1.456 | 1 | -1.456 | 1 | -1.456 | 1 | -1.358 | 1 | -1.358 | 1 | -1.358 | 1 | -1.436 | 0 | -1.436 | 0 | -1.436 | 0 |
| France | -2.287 | 0 | -2.287 | 0 | -2.287 | 0 | -1.777 | 0 | -1.777 | 0 | -1.777 | 0 | -1.114 | 1 | -1.114 | 1 | -1.114 | 1 | -0.943 | 0 | -1.250 | 1 | -0.943 | 0 |
| Germany | -1.797 | 0 | -1.797 | 0 | -1.797 | 0 | 1.610 | 0 | 1.610 | 0 | 1.610 | 0 | -0.144 | 1 | -0.144 | 1 | -0.144 | 1 | -3.415 ** | 0 | -2.557 | 1 | -2.557 | 1 |
| Italy | -3.387 ** | 0 | -3.402 ** | 0 | -3.402 ** | 0 | -1.346 | 0 | -1.346 | 0 | -1.346 | 0 | -1.934 | 1 | -1.934 | 1 | -1.934 | 1 | -1.164 | 0 | -1.164 | 0 | -1.164 | 0 |
| Japan | -3.779 ** | 0 | -1.875 | 1 | -3.779 ** | 0 | -1.259 | 0 | -1.760 | 1 | -1.259 | 0 | -1.785 | 1 | -1.785 | 1 | -1.785 | 1 | -2.099 | 0 | -2.099 | 0 | -2.099 | 0 |
| Korea | -1.847 | 0 | -1.847 | 0 | -1.847 | 0 | -2.739 * | 0 | -2.739 * | 0 | -2.739 * | 0 | 0.184 | 0 | -0.171 | 1 | -0.171 | 1 | -2.472 | 0 | -2.472 | 0 | -2.472 | 0 |
| Sweden | 1.029 | 0 | 1.029 | 0 | 1.029 | 0 | -0.595 | 0 | -0.595 | 0 | -0.595 | 0 | -1.583 | 1 | -1.583 | 1 | -1.583 | 1 | -1.583 | 0 | -1.583 | 0 | -1.583 | 0 |
| UK | 0.430 | 1 | 0.430 | 1 | 0.430 | 1 | -3.041 ** | 0 | 1.664 | 2 | -3.041 ** | 0 | 0.387 | 2 | -0.305 | 1 | -0.305 | 1 | -1.829 | 0 | -1.829 | 0 | -1.829 | 0 |
| US | -0.485 | 0 | -0.485 | 0 | -0.485 | 0 | -1.224 | 0 | -1.224 | 0 | -1.224 | 0 | -1.736 | 1 | -1.736 | 1 | -1.736 | 1 | -1.470 | 2 | -1.470 | 2 | -1.859 | 0 |

Rejection of the null hypothesis by the ADF tests suggests the evidence of no unit root.

** and * represent significance at 5% and 10% levels, respectively

The critical values for t-statistics with 50 observations are -2.93and -2.60 for 5 % and 10 % significant levels, respectively.

Table 1.2 Univariate Unit Root tests: KPSS

| country | GSY: lags were determined using: | | | DCBY:lags were determined using: | | | DCPSY: lags were determined using: | | | GOVY: lags were determined using: | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC |
| Australia | 2.677 ** 0 | 2.677 ** 0 | 2.677 ** 0 | 3.370 ** 0 | 3.370 ** 0 | 3.370 ** 0 | 3.434 ** 0 | 3.434 ** 0 | 3.434 ** 0 | 1.198 ** 0 | 1.198 ** 0 | 1.198 ** 0 |
| Austria | 0.955 ** 0 | 0.955 ** 0 | 0.955 ** 0 | 3.247 ** 0 | 1.691 ** 1 | 3.247 ** 0 | 3.468 ** 0 | 3.468 ** 0 | 3.468 ** 0 | 1.496 ** 0 | 1.496 ** 0 | 1.496 ** 0 |
| Belgium | 0.546 ** 0 | 0.319 1 | 0.319 1 | 2.787 ** 0 | 2.787 ** 0 | 2.787 ** 0 | 3.178 ** 0 | 3.178 ** 0 | 3.178 ** 0 | 0.609 ** 0 | 0.336 1 | 0.609 ** 0 |
| Canada | 0.708 ** 0 | 0.708 ** 0 | 0.708 ** 0 | 2.843 ** 0 | 2.843 ** 0 | 2.843 ** 0 | 2.738 ** 0 | 2.738 ** 0 | 2.738 ** 0 | 0.611 ** 1 | 0.611 ** 1 | 0.611 ** 1 |
| France | 0.773 ** 1 | 1.442 ** 0 | 1.442 ** 0 | 0.630 ** 0 | 0.630 ** 0 | 0.630 ** 0 | 0.372 * 0 | 0.372 * 0 | 0.372 * 0 | 2.547 ** 0 | 2.547 ** 0 | 2.547 ** 0 |
| Germany | 0.860 ** 0 | 0.860 ** 0 | 0.860 ** 0 | 1.217 ** 2 | 1.217 ** 2 | 1.217 ** 2 | 3.483 ** 0 | 3.483 ** 0 | 1.792 ** 1 | 0.560 ** 1 | 0.560 ** 1 | 0.560 ** 1 |
| Italy | 2.655 ** 0 | 2.655 ** 0 | 2.655 ** 0 | 0.628 ** 0 | 0.348 * 1 | 0.348 * 1 | 0.591 ** 1 | 0.591 ** 1 | 0.591 ** 1 | 2.198 ** 0 | 2.198 ** 0 | 2.198 ** 0 |
| Japan | 2.286 ** 0 | 1.225 ** 1 | 1.225 ** 1 | 3.570 ** 0 | 3.570 ** 0 | 3.570 ** 0 | 1.453 ** 1 | 1.453 ** 1 | 1.453 ** 1 | 2.672 ** 0 | 1.419 ** 1 | 1.419 ** 1 |
| Korea | 2.134 ** 0 | 2.134 ** 0 | 2.134 ** 0 | 3.111 ** 0 | 0.631 ** 1 | 3.111 ** 0 | 3.275 ** 0 | 1.702 ** 1 | 3.275 ** 0 | 2.042 ** 0 | 2.042 ** 0 | 2.042 ** 0 |
| Sweden | 0.312 1 | 0.312 1 | 0.312 1 | 1.223 ** 0 | 0.760 ** 1 | 1.223 ** 0 | 1.460 ** 0 | 0.909 ** 1 | 1.460 ** 0 | 0.319 1 | 0.586 ** 0 | 0.319 1 |
| UK | 2.387 ** 0 | 2.387 ** 0 | 2.387 ** 0 | 1.725 ** 1 | 1.725 ** 1 | 1.725 ** 1 | 3.419 ** 0 | 3.419 ** 0 | 3.419 ** 0 | 0.241 1 | 0.430 * 0 | 0.241 1 |
| US | 2.160 ** 0 | 2.160 ** 0 | 2.160 ** 0 | 3.413 ** 0 | 3.413 ** 0 | 3.413 ** 0 | 3.252 ** 0 | 3.252 ** 0 | 3.252 ** 0 | 2.173 ** 0 | 2.173 ** 0 | 2.173 ** 0 |

| country | LOG GDP: lags were determined using: | | | TY: lags were determined using: | | | LLY: lags were determined using: | | | CPI: lags were determined using: | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC |
| Australia | 3.585 ** 0 | 3.585 ** 0 | 3.585 ** 0 | 3.256 ** 0 | 3.256 ** 0 | 3.256 ** 0 | 1.208 ** 2 | 3.328 ** 0 | 3.328 ** 0 | 2.677 ** 0 | 2.677 ** 0 | 2.677 ** 0 |
| Austria | 3.580 ** 0 | 3.580 ** 0 | 3.580 ** 0 | 2.779 ** 0 | 2.779 ** 0 | 2.779 ** 0 | 0.471 ** 0 | 0.471 ** 0 | 0.471 ** 0 | 0.955 ** 0 | 0.955 ** 0 | 0.955 ** 0 |
| Belgium | 3.553 ** 0 | 3.553 ** 0 | 3.553 ** 0 | 2.852 ** 0 | 2.852 ** 0 | 2.852 ** 0 | 0.998 ** 2 | 2.539 ** 0 | 2.539 ** 0 | 0.319 1 | 0.319 1 | 0.319 1 |
| Canada | 3.519 ** 0 | 3.519 ** 0 | 3.519 ** 0 | 1.548 ** 1 | 1.548 ** 1 | 1.548 ** 1 | 1.537 ** 1 | 1.537 ** 1 | 1.537 ** 1 | 0.708 ** 0 | 0.708 ** 0 | 0.708 ** 0 |
| France | 3.536 ** 0 | 3.536 ** 0 | 3.536 ** 0 | 2.392 ** 0 | 2.392 ** 0 | 2.392 ** 0 | 0.683 ** 1 | 0.683 ** 1 | 0.683 ** 1 | 1.442 ** 0 | 0.773 ** 1 | 1.442 ** 0 |
| Germany | 3.595 ** 0 | 3.595 ** 0 | 3.595 ** 0 | 2.710 ** 0 | 2.710 ** 0 | 2.710 ** 0 | 1.362 ** 1 | 1.362 ** 1 | 1.362 ** 1 | 0.492 ** 1 | 0.492 ** 1 | 0.492 ** 1 |
| Italy | 3.485 ** 0 | 3.485 ** 0 | 3.485 ** 0 | 1.625 ** 0 | 1.625 ** 0 | 1.625 ** 0 | 0.989 ** 1 | 0.989 ** 1 | 0.989 ** 1 | 2.655 ** 0 | 2.655 ** 0 | 2.655 ** 0 |
| Japan | 3.483 ** 0 | 1.830 ** 1 | 3.483 ** 0 | 0.582 ** 0 | 0.333 1 | 0.582 ** 0 | 1.799 ** 1 | 1.799 ** 1 | 1.799 ** 1 | 2.286 ** 0 | 2.286 ** 0 | 2.286 ** 0 |
| Korea | 3.608 ** 0 | 3.608 ** 0 | 3.608 ** 0 | 0.869 ** 0 | 0.869 ** 0 | 0.869 ** 0 | 3.453 ** 0 | 1.781 ** 1 | 1.781 ** 1 | 2.134 ** 0 | 2.134 ** 0 | 2.134 ** 0 |
| Sweden | 3.479 ** 0 | 3.479 ** 0 | 3.479 ** 0 | 2.577 ** 0 | 2.577 ** 0 | 2.577 ** 0 | 0.515 ** 1 | 0.515 ** 1 | 0.515 ** 1 | 0.551 ** 0 | 0.551 ** 0 | 0.551 ** 0 |
| UK | 1.861 ** 1 | 1.861 ** 1 | 1.861 ** 1 | 0.596 ** 0 | 0.323 2 | 0.596 ** 0 | 1.108 ** 2 | 3.010 ** 0 | 1.578 ** 1 | 2.387 ** 0 | 2.387 ** 0 | 2.387 ** 0 |
| US | 3.594 ** 0 | 3.594 ** 0 | 3.594 ** 0 | 3.056 ** 0 | 3.056 ** 0 | 3.056 ** 0 | 1.227 ** 1 | 1.227 ** 1 | 1.227 ** 1 | 0.857 ** 2 | 0.857 ** 2 | 2.160 ** 0 |

Rejection of the null hypothesis by the KPSS tests suggests the evidence of non-stationarity.

** and * represent significance at 5% and 10% levels, respectively

The critical values are 0.463 and 0.347 for 5% and 10% levels of significance, respectively.

Table 1.3 Johansen-Juselius test for cointegration
MODEL 1 LY = f(DCBY TY GOVY CPI)

Trace Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 104.07 ** | 90.61 ** | 92.09 ** | 82.59 ** | 112.41 ** | 132.10 ** | 110.32 | 101.10 ** | 80.20 ** | 78.46 ** | 104.43 ** | 96.78 ** | 68.52 | 76.07 |
| At most 1 | 48.98 * | 51.19 * | 44.18 | 41.90 | 60.15 ** | 67.67 ** | 44.28 | 58.03 ** | 46.95 | 42.24 | 49.98 * | 48.31 * | 47.21 | 54.46 |
| At most 2 | 19.30 | 27.66 | 24.54 | 21.07 | 31.46 * | 26.38 | 19.05 | 32.05 * | 25.12 | 21.21 | 30.15 * | 21.18 | 29.68 | 35.65 |
| At most 3 | 6.49 | 7.83 | 6.67 | 9.09 | 10.10 | 4.20 | 8.04 | 13.42 | 11.14 | 7.52 | 13.29 | 6.08 | 15.41 | 20.04 |
| At most 4 | 0.26 | 0.23 | 1.84 | 3.33 | 3.98 * | 0.03 | 0.01 | 3.35 | 5.21 * | 0.50 | 3.65 | 0.25 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Max-Eigen Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 55.09 ** | 39.42 ** | 47.90 ** | 40.69 ** | 52.26 ** | 64.43 ** | 66.04 | 43.06 ** | 33.25 | 36.22 * | 54.45 ** | 48.47 ** | 33.46 | 38.77 |
| At most 1 | 29.68 * | 23.52 | 19.64 | 20.83 | 28.69 ** | 41.29 ** | 25.23 | 25.98 | 21.83 | 21.03 | 19.83 | 27.13 * | 27.07 | 32.24 |
| At most 2 | 12.81 | 19.84 | 17.87 | 11.99 | 21.36 * | 22.17 * | 11.01 | 18.63 | 13.97 | 13.69 | 16.86 | 15.09 | 20.97 | 25.52 |
| At most 3 | 6.23 | 7.59 | 4.83 | 5.76 | 6.13 | 4.17 | 8.03 | 10.06 | 5.94 | 7.02 | 9.64 | 5.83 | 14.07 | 18.63 |
| At most 4 | 0.26 | 0.23 | 1.84 | 3.33 | 3.98 * | 0.03 | 0.01 | 3.35 | 5.21 * | 0.50 | 3.65 | 0.25 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table 1.4 Johansen-Juselius test for cointegration
MODEL 2 LY = f(DCBY GOVY GSY CPI)

Trace Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 99.85 ** | 85.16 ** | 110.20 ** | 106.02 ** | 112.53 ** | 131.53 ** | 132.75 ** | 86.47 ** | 117.98 ** | 87.17 ** | 73.24 * | 90.96 ** | 68.52 | 76.07 |
| At most 1 | 48.52 * | 54.17 * | 63.40 ** | 59.43 ** | 61.42 ** | 78.81 ** | 77.46 ** | 43.02 | 67.24 ** | 54.97 ** | 40.13 | 61.43 ** | 47.21 | 54.46 |
| At most 2 | 23.09 | 30.21 * | 31.07 * | 27.57 | 31.11 * | 41.94 ** | 35.45 * | 23.00 | 31.95 * | 32.07 * | 19.36 | 35.85 * | 29.68 | 35.65 |
| At most 3 | 6.62 | 7.83 | 11.33 | 6.96 | 7.35 | 17.31 * | 15.72 * | 8.61 | 13.40 | 12.77 | 6.08 | 17.24 | 15.41 | 20.04 |
| At most 4 | 0.72 | 0.08 | 0.84 | 0.71 | 0.88 | 0.78 | 4.01 * | 2.95 | 2.52 | 0.38 | 0.81 | 4.43 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Max-Eigen Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 51.34 ** | 30.99 | 46.81 ** | 46.59 ** | 51.11 ** | 52.71 ** | 55.29 ** | 43.45 ** | 50.74 ** | 32.20 | 33.11 | 29.53 | 33.46 | 38.77 |
| At most 1 | 25.43 | 23.97 | 32.32 ** | 31.86 * | 30.31 * | 36.87 ** | 42.01 ** | 20.02 | 35.28 ** | 22.90 | 20.78 | 25.58 | 27.07 | 32.24 |
| At most 2 | 16.47 | 22.37 * | 19.74 | 20.61 | 23.76 * | 24.63 * | 19.73 | 14.39 | 18.56 | 19.30 | 13.27 | 18.61 | 20.97 | 25.52 |
| At most 3 | 5.90 | 7.76 | 10.50 | 6.25 | 6.46 | 16.53 * | 11.71 | 5.66 | 10.88 | 12.39 | 5.27 | 12.81 | 14.07 | 18.63 |
| At most 4 | 0.72 | 0.08 | 0.84 | 0.71 | 0.88 | 0.78 | 4.01 * | 2.95 | 2.52 | 0.38 | 0.81 | 4.43 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table 1.5 Johansen-Juselius test for cointegration
MODEL 3 LY = f(LLY TY GOVY CPI)

Trace Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 97.72 ** | 94.09 ** | 118.82 ** | 95.73 ** | 90.29 ** | 105.45 ** | 92.13 ** | 115.11 ** | 78.64 ** | 93.94 ** | 83.77 ** | 107.21 ** | 68.52 | 76.07 |
| At most 1 | 54.79 ** | 51.79 * | 58.81 ** | 54.68 ** | 47.88 * | 40.14 | 41.26 | 57.06 ** | 45.32 | 50.30 * | 39.00 | 56.61 ** | 47.21 | 54.46 |
| At most 2 | 26.97 | 25.79 | 26.62 | 18.29 | 15.24 | 20.73 | 16.96 | 30.26 * | 20.37 | 22.73 | 19.53 | 26.35 | 29.68 | 35.65 |
| At most 3 | 8.58 | 8.98 | 7.47 | 8.35 | 6.48 | 7.75 | 7.41 | 16.24 * | 10.06 | 6.31 | 7.69 | 9.97 | 15.41 | 20.04 |
| At most 4 | 0.00 | 0.23 | 0.10 | 1.15 | 0.09 | 1.92 | 0.60 | 4.87 * | 2.47 | 0.05 | 2.32 | 0.06 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Max-Eigen Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 42.93 ** | 42.30 ** | 60.01 ** | 41.05 ** | 42.41 ** | 65.32 ** | 50.87 ** | 58.05 ** | 33.31 | 43.65 ** | 44.77 ** | 50.60 ** | 33.46 | 38.77 |
| At most 1 | 27.83 * | 26.00 | 32.19 * | 36.39 ** | 32.63 ** | 19.40 | 24.30 | 26.79 | 24.95 | 27.57 * | 19.48 | 30.26 * | 27.07 | 32.24 |
| At most 2 | 18.39 | 16.82 | 19.15 | 9.94 | 8.77 | 12.99 | 9.55 | 14.03 | 10.31 | 16.42 | 11.84 | 16.39 | 20.97 | 25.52 |
| At most 3 | 8.58 | 8.75 | 7.37 | 7.19 | 6.38 | 5.83 | 6.81 | 11.37 | 7.60 | 6.26 | 5.37 | 9.91 | 14.07 | 18.63 |
| At most 4 | 0.00 | 0.23 | 0.10 | 1.15 | 0.09 | 1.92 | 0.60 | 4.87 * | 2.47 | 0.05 | 2.32 | 0.06 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table 1.6 Johansen-Juselius test for cointegration
MODEL 4 LY = f(LLY GOVY GSY CPI)

Trace Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 124.45 ** | 119.64 ** | 124.64 ** | 100.48 ** | 98.47 ** | 117.42 ** | 112.26 ** | 138.18 ** | 114.38 ** | 85.70 ** | 79.74 ** | 91.10 ** | 68.52 | 76.07 |
| At most 1 | 70.16 ** | 57.11 ** | 63.66 ** | 50.81 * | 57.78 ** | 69.94 ** | 66.30 ** | 61.70 ** | 69.32 ** | 52.74 * | 40.29 | 44.34 | 47.21 | 54.46 |
| At most 2 | 29.20 | 31.15 * | 33.40 * | 28.52 | 25.05 | 35.38 * | 31.85 * | 34.60 * | 34.94 * | 26.22 | 17.31 | 23.39 | 29.68 | 35.65 |
| At most 3 | 6.36 | 7.20 | 11.57 | 12.92 | 9.77 | 9.87 | 10.06 | 12.59 | 14.61 | 6.64 | 6.55 | 9.65 | 15.41 | 20.04 |
| At most 4 | 2.02 | 0.10 | 0.25 | 0.10 | 1.28 | 0.35 | 2.69 | 3.22 | 1.36 | 0.87 | 1.44 | 0.26 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Max-Eigen Statistics

| Hypothesized no. of CE (s) | Australia | Austria | Belgium | Canada | France | Germany | Italy | Japan | Korea | Sweden | UK | US | 5% CV | 1% CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| None | 54.28 ** | 62.52 ** | 60.98 ** | 49.67 ** | 40.68 ** | 47.48 ** | 45.96 ** | 76.48 ** | 45.06 ** | 32.96 | 39.45 ** | 46.76 ** | 33.46 | 38.77 |
| At most 1 | 40.96 ** | 25.96 | 30.26 * | 22.30 | 32.73 ** | 34.57 ** | 34.45 ** | 27.10 * | 34.38 ** | 26.52 | 22.97 | 20.95 | 27.07 | 32.24 |
| At most 2 | 22.84 * | 23.96 * | 21.83 * | 15.59 | 15.28 | 25.51 * | 21.79 * | 22.01 * | 20.33 | 19.58 | 10.77 | 13.74 | 20.97 | 25.52 |
| At most 3 | 4.33 | 7.09 | 11.33 | 12.83 | 8.49 | 9.52 | 7.36 | 9.36 | 13.25 | 5.77 | 5.11 | 9.39 | 14.07 | 18.63 |
| At most 4 | 2.02 | 0.10 | 0.25 | 0.10 | 1.28 | 0.35 | 2.69 | 3.22 | 1.36 | 0.87 | 1.44 | 0.26 | 3.76 | 6.65 |
| At most 5 | | | | | | | | | | | | | | |

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Table 1.7 Park's CCR test results

MODEL 1 LY = f(DCBY, TY, GOVY, CPI)

| | β [(a)] | | | | | | |
|---|---|---|---|---|---|---|---|
| | DCBY | TY | GOVY | CPI | H(0,1)[(b)] | H(1,2)[(b)] | H(1,3)[(b)] |
| Australia | 0.006 | -0.022 | 0.018 | 0.001 | 6.743 | 0.165 | 5.456 |
| | (0.001) | (0.004) | 0.003 | (0.003) | (0.009) | (0.685) | (0.065) |
| Austria | 0.008 | 0.022 | 0.006 | 0.006 | 3.363 | 0.005 | 0.626 |
| | (0.001) | (0.004) | (0.001) | (0.005) | (0.067) | (0.942) | (0.731) |
| Belgium | 0.002 | 0.004 | 0.009 | -0.013 | 15.300 | 1.933 | 2.146 |
| | (0.000) | (0.002) | (0.001) | (0.003) | (0.000) | (0.164) | (0.342) |
| Canada | 0.004 | -0.026 | 0.010 | -0.008 | 1.077 | 0.237 | 4.002 |
| | (0.000) | (0.005) | (0.002) | (0.006) | (0.299) | (0.626) | (0.135) |
| France | -0.002 | -0.028 | 0.025 | -0.026 | 1.739 | 0.999 | 1.007 |
| | (0.001) | (0.007) | (0.003) | (0.004) | (0.187) | (0.318) | (0.605) |
| Germany | 0.008 | 0.019 | 0.005 | 0.004 | 5.140 | 0.330 | 13.904 |
| | (0.001) | (0.004) | (0.002) | (0.006) | (0.023) | (0.566) | (0.001) |
| Italy | 0.009 | -0.085 | 0.012 | -0.010 | 0.889 | 0.013 | 0.732 |
| | (0.002) | (0.007) | (0.003) | (0.002) | (0.346) | (0.908) | (0.693) |
| Japan | 0.005 | 0.014 | 0.005 | -0.008 | 0.451 | 4.823 | 7.011 |
| | (0.000) | (0.006) | (0.003) | (0.003) | (0.502) | (0.028) | (0.030) |
| Korea | 0.029 | 0.064 | -0.007 | 0.007 | 5.456 | 0.072 | 0.519 |
| | (0.002) | (0.004) | (0.003) | (0.005) | (0.020) | (0.788) | (0.771) |
| Sweden | 0.0049 | 0.004 | 0.014 | -0.013 | 3.423 | 0.888 | 1.136 |
| | (0.001) | (0.004) | (0.001) | (0.004) | (0.064) | (0.346) | (0.567) |
| UK | 0.003 | -0.061 | 0.017 | 0.002 | 0.002 | 5.477 | 6.531 |
| | (0.000) | (0.014) | (0.003) | (0.003) | (0.969) | (0.019) | (0.038) |
| US | 0.002 | -0.030 | 0.046 | -0.014 | 1.481 | 0.043 | 0.156 |
| | (0.000) | (0.003) | (0.003) | (0.002) | (0.224) | (0.835) | (0.925) |

**LY:** log of GDP; **DCBY:** domestic credit issued by bank/GDP;
**LLY:** liquid liabilities/GDP;**TY:** trade/GDP; **GOVY**: government expenditure/GDP;
**GSY:** gross savings/GDP; **CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and

Table 1.8 Park's CCR test results
MODEL 2 LY = f(DCBY, GOVY, GSY, CPI)

| | $\beta$ [(a)] | | | | | | |
|---|---|---|---|---|---|---|---|
| | DCBY | GOVY | GSY | CPI | H(0,1)[(b)] | H(1,2)[(b)] | H(1,3)[(b)] |
| Australia | 0.007 | 0.019 | 0.044 | -0.006 | 3.357 | 0.306 | 2.322 |
| | (0.001) | (0.002) | (0.005) | (0.002) | (0.067) | (0.580) | (0.313) |
| Austria | 0.011 | 0.004 | -0.053 | 0.011 | 2.143 | 2.813 | 6.270 |
| | (0.001) | (0.001) | 0.0099 | (0.005) | (0.143) | (0.094) | (0.043) |
| Belgium | 0.002 | 0.007 | 0.006 | -0.014 | 12.205 | 0.456 | 0.501 |
| | (0.000) | (0.001) | (0.008) | 0(.004) | (0.000) | (0.499) | (0.778) |
| Canada | 0.003 | 0.013 | 0.054 | -0.021 | 5.707 | 1.552 | 4.170 |
| | (0.000) | (0.002) | (0.012) | (0.005) | (0.017) | (0.213) | (0.124) |
| France | -0.002 | 0.022 | 0.048 | -0.023 | 0.009 | 1.810 | 4.937 |
| | (0.001) | (0.003) | (0.010) | (0.003) | (0.926) | (0.178) | (0.085) |
| Germany | 0.007 | 0.005 | -0.019 | -0.001 | 2.007 | 1.255 | 15.341 |
| | (0.001) | (0.002) | (0.008) | (0.007) | (0.157) | (0.263) | (0.000) |
| Italy | -0.004 | 0.018 | 0.071 | -0.017 | 13.173 | 2.676 | 2.758 |
| | (0.002) | (0.002) | (0.013) | (0.002) | (0.000) | (0.102) | (0.252) |
| Japan | 0.006 | -0.001 | -0.028 | 0.200 | 1.618 | 2.277 | 2.345 |
| | (0.000) | (0.003) | (0.007) | (0.003) | (0.203) | (0.131) | (0.310) |
| Korea | 0.016 | -0.002 | 0.253 | -0.049 | 22.134 | 3.464 | 4.544 |
| | (0.005) | (0.006) | (0.074) | (0.009) | (0.000) | (0.063) | (0.103) |
| Sweden | 0.004 | 0.012 | 0.004 | -0.017 | 1.888 | 2.135 | 2.215 |
| | (0.001) | (0.001) | (0.005) | (0.003) | (0.169) | (0.144) | (0.330) |
| UK | 0.005 | 0.014 | 0.022 | -0.007 | 8.360 | 0.176 | 2.470 |
| | (0.000) | (0.002) | (0.005) | (0.002) | (0.004) | (0.675) | (0.291) |
| US | 0.005 | 0.049 | 0.069 | -0.006 | 5.325 | 0.898 | 1.198 |
| | (0.001) | (0.010) | (0.029) | (0.009) | (0.021) | (0.343) | (0.549) |

**LY:** log of GDP; **DCBY:** domestic credit issued by bank/GDP;
**LLY:** liquid liabilities/GDP;**TY:** trade/GDP; **GOVY**: government expenditure/GDP;
**GSY:** gross savings/GDP; **CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests the stochastic cointegration.

* countries with no cointegration

Table 1.9 Park's CCR test results

MODEL 3 LY = f(LLY, TY, GOVY, CPI)

| | β [a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | LLY | TY | GOVY | CPI | H(0,1)[b] | H(1,2)[b] | H(1,3)[b] |
| Australia | 0.019 | -0.026 | 0.010 | 0.005 | 16.198 | 2.055 | 2.266 |
| | (0.002) | (0.006) | (0.005) | (0.004) | (0.000) | (0.152) | (0.322) |
| Austria | 0.013 | -0.018 | 0.009 | -0.090 | 6.810 | 0.100 | 1.248 |
| | (0.005) | (0.008) | (0.002) | (0.013) | (0.009) | (1.751) | (0.536) |
| Belgium | 0.010 | -0.001 | 0.005 | -0.023 | 24.406 | 2.824 | 5.216 |
| | (0.002) | (0.004) | (0.001) | (0.003) | (0.000) | (0.093) | (0.074) |
| Canada | 0.030 | 0.006 | 0.002 | -0.025 | 12.367 | 0.213 | 2.003 |
| | (0.003) | (0.006) | (0.002) | (0.004) | (0.000) | (0.645) | (0.367) |
| France | 0.000 | -0.005 | 0.032 | -0.031 | 0.841 | 5.823 | 5.966 |
| | (0.000) | (0.007) | (0.003) | (0.003) | (0.359) | (0.016) | (0.051) |
| Germany | 0.009 | -0.083 | -0.043 | -0.178 | 6.729 | 2.227 | 2.285 |
| | (0.001) | (0.017) | (0.007) | (0.016) | (0.009) | (0.136) | (0.319) |
| Italy | -0.003 | -0.054 | 0.015 | -0.006 | 8.565 | 0.000 | 2.488 |
| | (0.001) | (0.008) | (0.002) | (0.003) | (0.003) | (0.996) | (0.288) |
| Japan | 0.009 | 0.019 | 0.001 | -0.006 | 0.369 | 7.251 | 13.984 |
| | (0.000) | (0.003) | (0.002) | (0.003) | (0.543) | (0.007) | (0.001) |
| Korea | 0.015 | 0.026 | 0.006 | -0.007 | 5.009 | 0.145 | 7.669 |
| | (0.001) | (0.006) | (0.003) | (0.007) | (0.025) | (0.704) | (0.022) |
| Sweden | -0.002 | 0.011 | 0.014 | -0.030 | 6.818 | 2.044 | 7.686 |
| | (0.008) | (0.023) | (0.016) | (0.037) | (0.009) | (0.153) | (0.021) |
| UK | 0.005 | -0.027 | 0.015 | -0.007 | 47.594 | 0.026 | 0.789 |
| | (0.000) | (0.004) | (0.001) | (0.001) | (0.000) | (0.872) | (0.674) |
| US | 0.008 | -0.016 | 0.068 | -0.034 | 2.728 | 0.271 | 4.931 |
| | (0.002) | (0.004) | (0.003) | (0.002) | (0.099) | (0.602) | (0.085) |

**LY:** log of GDP; **DCBY:** domestic credit issued by bank/GDP;
**LLY:** liquid liabilities/GDP;**TY:** trade/GDP; **GOVY**: government expenditure/GDP;
**GSY:** gross savings/GDP; **CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests the stochastic cointegration.

* countries with no cointegration

Table 1.10 Park's CCR test results
MODEL 4 LY = f(LLY, GOVY, GSY, CPI)

| | β [a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | LLY | GOVY | GSY | CPI | H(0,1)[b] | H(1,2)[b] | H(1,3)[b] |
| Australia | 0.022 | 0.009 | 0.048 | -0.005 | 11.810 | 1.331 | 1.333 |
| | (0.002) | (0.003) | (0.006) | (0.003) | (0.001) | (0.249) | (0.514) |
| Austria | 0.013 | 0.008 | 0.049 | -0.072 | 6.094 | 0.002 | 2.722 |
| | (0.008) | (0.003) | (0.021) | (0.018) | (0.014) | (0.967) | (0.256) |
| Belgium | 0.008 | 0.005 | 0.010 | -0.029 | 19.835 | 1.414 | 6.247 |
| | (0.002) | (0.001) | (0.008) | (0.004) | (0.000) | (0.234) | (0.044) |
| Canada | 0.028 | 0.001 | -0.021 | -0.025 | 9.045 | 0.352 | 0.598 |
| | (0.003) | (0.002) | (0.014) | (0.004) | (0.003) | (0.553) | (0.742) |
| France | 0.000 | 0.023 | 0.032 | -0.028 | 0.185 | 1.724 | 2.701 |
| | (0.000) | (0.003) | (0.008) | (0.002) | (0.667) | (0.189) | (0.259) |
| Germany | -0.001 | 0.090 | 0.166 | -0.025 | 18.922 | 0.453 | 1.874 |
| | (0.003) | (0.027) | (0.032) | (0.045) | (0.000) | (0.501) | (0.392) |
| Italy | -0.004 | 0.018 | 0.072 | -0.006 | 2.945 | 0.151 | 0.556 |
| | (0.000) | (0.002) | (0.009) | (0.002) | (0.086) | (0.698) | (0.757) |
| Japan | 0.008 | -0.002 | -0.037 | -0.006 | 0.804 | 8.092 | 10.050 |
| | (0.000) | (0.001) | (0.004) | (0.002) | (0.370) | (0.004) | (0.007) |
| Korea | 0.014 | -0.012 | 0.201 | 0.013 | 13.296 | 0.003 | 7.295 |
| | (0.001) | (0.004) | (0.046) | (0.006) | (0.000) | (0.955) | (0.026) |
| Sweden | -0.007 | 0.001 | 0.002 | -0.003 | 1.012 | 0.557 | 2.553 |
| | (0.009) | (0.011) | (0.028) | (0.012) | (0.314) | (0.456) | (0.279) |
| UK | 0.006 | 0.016 | -0.001 | -0.011 | 0.118 | 1.080 | 2.522 |
| | (0.000) | (0.001) | (0.005) | (0.002) | (0.731) | (0.299) | (0.283) |
| US | 0.008 | 0.075 | 0.019 | -0.045 | 0.009 | 1.317 | 3.199 |
| | (0.003) | (0.002) | (0.009) | (0.002) | (0.924) | (0.251) | (0.202) |

**LY:** log of GDP; **DCBY:** domestic credit issued by bank/GDP;
**LLY:** liquid liabilities/GDP;**TY:** trade/GDP; **GOVY**: government expenditure/GDP;
**GSY:** gross savings/GDP; **CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests the stochastic cointegration.

* countries with no cointegration

Table 1.11 ECM and SURECM Results

| MODEL 1 | | | | | LY = f(DCBY, TY, GOVY, CPI) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| countries | | | | | | | | λ: | | | | | |
| | | REGULAR | | | | | | | SURECM: | | | | |
| | | ECM: | | | a) ALL | | | b) EUROPE | | | c) NON-EUROPE | | |
| Australia | LY | 0.005 | (0.010) | | -0.015 | (0.008) | * | | | | 0.002 | (0.010) | |
| | DCBY | 5.378 | (2.590) | | 7.603 | (1.837) | | | | | 4.655 | (2.029) | |
| Austria | LY | 0.029 | (0.026) | | 0.006 | (0.011) | | 0.015 | (0.016) | | | | |
| | DCBY | -4.713 | (4.941) | | -5.296 | (3.324) | | -5.056 | (3.731) | | | | |
| Belgium | LY | -0.018 | (0.036) | | -0.024 | (0.024) | | -0.026 | (0.031) | | | | |
| | DCBY | 46.623 | (54.372) | | 63.275 | (37.434) | | 130.372 | (38.171) | | | | |
| Canada | LY | -0.003 | (0.007) | | -0.017 | (0.004) | *** | | | | 0.001 | (0.007) | |
| | DCBY | 14.336 | (6.548) | | 17.438 | (4.740) | | | | | 9.737 | (5.797) | |
| France | LY | -0.030 | (0.013) | ** | -0.010 | (0.005) | * | -0.010 | (0.006) | | | | |
| | DCBY | -0.209 | (12.675) | | -2.614 | (11.839) | | 2.360 | (11.864) | | | | |
| Germany | LY | 0.015 | (0.012) | | 0.030 | (0.013) | | 0.041 | (0.014) | | | | |
| | DCBY | 11.342 | (4.282) | | 15.322 | (3.038) | | 17.817 | (2.852) | | | | |
| Italy | LY | -0.013 | (0.005) | ** | -0.004 | (0.003) | | -0.009 | (0.004) | ** | | | |
| | DCBY | 1.807 | (1.264) | | 1.571 | (1.109) | | 1.276 | (1.150) | | | | |
| Japan | LY | -0.060 | (0.029) | ** | -0.055 | (0.031) | * | | | | -0.087 | (0.038) | ** |
| | DCBY | 12.460 | (22.859) | | 1.099 | (14.936) | | | | | 7.211 | (15.164) | |
| Korea | LY | 0.007 | (0.010) | | -0.020 | (0.005) | *** | | | | -0.008 | (0.008) | |
| | DCBY | 0.681 | (0.996) | | 1.622 | (0.845) | | | | | 1.519 | (0.921) | |
| Sweden | LY | -0.015 | (0.024) | | -0.017 | (0.016) | | -0.005 | (0.019) | | | | |
| | DCBY | 53.838 | (25.761) | | 46.364 | (19.710) | | 67.578 | (22.405) | | | | |
| UK | LY | 0.018 | (0.010) | | 0.004 | (0.007) | | 0.023 | (0.009) | | | | |
| | DCBY | 0.168 | (6.087) | | -0.859 | (4.751) | | 0.120 | (4.858) | | | | |
| US | LY | -0.012 | (0.010) | | -0.011 | (0.006) | * | | | | -0.002 | (0.008) | |
| | DCBY | 6.267 | (3.676) | | 9.235 | (2.647) | | | | | 10.536 | (2.895) | |
| with restrictions | LY | | | | -0.004 | (0.002) | ** | -0.001 | (0.002) | | -0.001 | (0.005) | |
| | DCBY | | | | 4.169 | (0.629) | | 2.810 | (0.940) | | 2.714 | (0.846) | |
| chi2 (p-value) | LY | | | | 65.090 | (0.000) | | 25.170 | (0.000) | | 7.770 | (0.101) | |
| | DCBY | | | | 36.250 | (0.000) | | 37.940 | (0.000) | | 12.530 | (0.014) | |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.
Numbers in the paranthesis represent standard errors.

Table 1.12 ECM and SURECM Results

| MODEL 2 | | | LY = f(DCBY, GOVY, GSY, CPI) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| countries | | | | | | | | λ: | | | | | |
| | | REGULAR ECM: | | | | | | SURECM: | | | | | |
| | | | | | a) ALL | | | b) EUROPE | | | c) NON-EUROPE | | |
| Australia | LY | 0.001 | (0.010) | | -0.006 | (0.007) | | | | | 0.003 | (0.009) | |
| | DCBY | 3.340 | (2.208) | | 2.573 | (1.912) | | | | | 4.777 | (2.066) | |
| Austria | LY | -0.009 | (0.022) | | 0.005 | (0.005) | | -0.006 | (0.007) | | | | |
| | DCBY | 1.236 | (2.611) | | -1.245 | (1.433) | | 0.340 | (1.805) | | | | |
| Belgium | LY | -0.039 | (0.036) | | -0.035 | (0.015) | ** | -0.022 | (0.020) | | | | |
| | DCBY | 18.195 | (30.388) | | 28.092 | (22.911) | | 15.839 | (23.335) | | | | |
| Canada | LY | -0.031 | (0.021) | | -0.016 | (0.009) | * | | | | -0.016 | (0.014) | |
| | DCBY | 17.351 | (13.965) | | 40.773 | (9.810) | | | | | 28.745 | (12.758) | |
| France | LY | -0.046 | (0.016) | *** | -0.019 | (0.006) | *** | -0.021 | (0.008) | *** | | | |
| | DCBY | -10.699 | (20.554) | | -8.870 | (17.536) | | -19.899 | (19.028) | | | | |
| Germany | LY | -0.001 | (0.043) | | -0.03 | (0.010) | *** | -0.025 | (0.012) | ** | | | |
| | DCBY | 11.951 | (6.398) | | 8.713 | (3.370) | | 13.773 | (4.218) | | | | |
| Italy | LY | -0.064 | (0.018) | *** | -0.041 | (0.006) | *** | -0.042 | (0.009) | *** | | | |
| | DCBY | 8.817 | (4.294) | | 11.311 | (2.608) | | 7.477 | (3.059) | | | | |
| Japan | LY | -0.011 | (0.007) | | -0.023 | (0.003) | *** | | | | -0.014 | (0.004) | *** |
| | DCBY | -2.407 | (2.868) | | -3.465 | (1.811) | | | | | -1.840 | (2.056) | |
| Korea | LY | 0.001 | (0.005) | | -0.006 | (0.003) | ** | | | | -0.000 | (0.004) | |
| | DCBY | -0.227 | (0.492) | | -0.392 | (0.368) | | | | | -0.238 | (0.461) | |
| Sweden | LY | 0.001 | (0.024) | | 0.038 | (0.012) | | 0.020 | (0.015) | | | | |
| | DCBY | 31.067 | (21.365) | | 53.469 | (15.287) | | 48.665 | (19.556) | | | | |
| UK | LY | 0.059 | (0.050) | | 0.12 | (0.019) | | 0.087 | (0.033) | | | | |
| | DCBY | 39.011 | (18.713) | | 50.219 | (13.790) | | 57.525 | (14.232) | | | | |
| US | LY | -0.015 | (0.015) | | -0.007 | (0.007) | | | | | 0.004 | (0.010) | |
| | DCBY | 10.517 | (4.236) | | 11.85 | (2.872) | | | | | 12.175 | (3.276) | |
| with restrictions | | LY | | | -0.009 | (0.001) | *** | -0.017 | (0.004) | *** | -0.007 | (0.003) | *** |
| | | DCBY | | | 0.358 | (0.329) | | 5.156 | (1.494) | | 0.228 | (0.437) | |
| chi2 (p-value) | | LY | | | 131.150 | (0.000) | | 24.210 | (0.001) | | 10.940 | (0.027) | |
| | | DCBY | | | 77.910 | (0.000) | | 26.360 | (0.000) | | 19.090 | (0.001) | |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.
Numbers in the paranthesis represent standard errors.

Table 1.13 ECM and SURECM Results

| MODEL 3 | | LY = f(LLY, TY, GOVY, CPI) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| countries | | | | | | | | λ: | | | | | |
| | | REGULAR ECM: | | | SURECM: a) ALL | | | b) EUROPE | | | c) NON-EUROPE | | |
| Australia | LY | 0.001 | (0.014) | | -0.014 | (0.009) | * | | | | 0.005 | (0.008) | |
| | DCBY | 2.959 | (0.723) | | 2.928 | (0.428) | | | | | 2.699 | (0.507) | |
| Austria | LY | -0.024 | (0.015) | | -0.006 | (0.007) | | -0.004 | (0.007) | | | | |
| | DCBY | 5.706 | (2.195) | | 7.477 | (0.779) | | 6.144 | (1.045) | | | | |
| Belgium | LY | -0.055 | (0.030) | * | -0.014 | (0.016) | | -0.008 | (0.019) | | | | |
| | DCBY | 12.679 | (7.018) | | 24.405 | (2.537) | | 11.795 | (4.018) | | | | |
| Canada | LY | -0.040 | (0.050) | | -0.039 | (0.019) | ** | | | | -0.101 | (0.024) | *** |
| | DCBY | 6.599 | (3.324) | | 11.094 | (1.309) | | | | | 4.825 | (1.354) | |
| France | LY | -0.037 | (0.027) | | -0.029 | (0.011) | ** | -0.022 | (0.012) | * | | | |
| | DCBY | -11.672 | (63.547) | | -39.907 | (20.381) | | -43.260 | (29.755) | | | | |
| Germany | LY | -0.024 | (0.011) | ** | -0.011 | (0.005) | ** | -0.011 | (0.006) | * | | | |
| | DCBY | -3.733 | (7.369) | | -0.627 | (1.908) | | -4.384 | (2.288) | | | | |
| Italy | LY | -0.024 | (0.010) | ** | -0.005 | (0.004) | | -0.017 | (0.005) | *** | | | |
| | DCBY | 8.202 | (3.767) | | 13.574 | (1.816) | | 4.405 | (2.319) | | | | |
| Japan | LY | -0.071 | (0.047) | | -0.046 | (0.024) | * | | | | -0.06 | (0.028) | ** |
| | DCBY | 8.005 | (6.988) | | 15.162 | (3.327) | | | | | 11.999 | (4.787) | |
| Korea | LY | -0.035 | (0.023) | | -0.041 | (0.014) | *** | | | | -0.028 | (0.016) | * |
| | DCBY | 8.255 | (3.051) | | 7.827 | (1.041) | | | | | 11.323 | (2.495) | |
| Sweden | LY | -0.137 | (0.037) | *** | -0.073 | (0.021) | *** | -0.058 | (0.023) | ** | | | |
| | DCBY | 2.173 | (4.204) | | 1.315 | (2.585) | | 2.275 | (3.444) | | | | |
| UK | LY | 0.022 | (0.016) | | 0.022 | (0.013) | | 0.021 | (0.017) | | | | |
| | DCBY | 7.711 | (6.890) | | 19.911 | (4.672) | | 12.613 | (5.343) | | | | |
| US | LY | -0.007 | (0.010) | | 0.011 | (0.006) | | | | | -0.001 | (0.006) | |
| | DCBY | 0.678 | (0.587) | | -0.048 | (0.339) | | | | | 0.965 | (0.374) | |
| with restrictions | | LY | | | -0.005 | (0.002) | ** | -0.012 | (0.004) | *** | -0.009 | (0.003) | *** |
| | | DCBY | | | 3.153 | (0.224) | | 4.359 | (0.822) | | 1.856 | (0.208) | |
| chi2 (p-value) | | LY | | | 36.880 | (0.000) | | 77.990 | (0.000) | | 17.920 | (0.001) | |
| | | DCBY | | | 161.890 | (0.000) | | 36.820 | (0.000) | | 58.410 | (0.000) | |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.
Numbers in the paranthesis represent standard errors.

Table 1.14 ECM and SURECM Results

| MODEL 4 | | LY = f(LLY, GOVY, GSY, CPI) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| countries | | λ: | | | | | | | | | | | |
| | | REGULAR ECM: | | | SURECM: a) ALL | | | b) EUROPE | | | c) NON-EUROPE | | |
| Australia | LY | 0.009 | (0.013) | | -0.007 | (0.008) | | | | | 0.001 | (0.011) | *** |
| | DCBY | 3.272 | (0.888) | | 3.097 | (0.599) | | | | | 3.367 | (0.726) | |
| Austria | LY | -0.116 | (0.042) | ** | 0.001 | (0.000) | | -0.008 | (0.013) | | | | |
| | DCBY | 11.78 | (3.564) | | 6.906 | (1.475) | | 5.241 | (1.500) | | | | |
| Belgium | LY | -0.040 | (0.032) | | -0.024 | (0.014) | * | -0.018 | (0.019) | | | | |
| | DCBY | 12.993 | (10.110) | | 21.194 | (2.149) | | 11.737 | (3.758) | | | | |
| Canada | LY | 0.003 | (0.005) | | 0.001 | (0.000) | | | | | -0.046 | (0.020) | ** |
| | DCBY | 3.608 | (2.300) | | 4.371 | (0.846) | | | | | 1.328 | (1.188) | |
| France | LY | -0.059 | (0.021) | *** | -0.040 | (0.012) | *** | -0.029 | (0.014) | ** | | | |
| | DCBY | -4.688 | (65.909) | | -48.46 | (22.096) | | -116.804 | (27.377) | | | | |
| Germany | LY | -0.04 | (0.013) | *** | -0.041 | (0.004) | *** | -0.037 | (0.006) | *** | | | |
| | DCBY | 10.576 | (10.235) | | 10.491 | (2.021) | | 6.391 | (2.135) | | | | |
| Italy | LY | -0.039 | (0.014) | ** | -0.040 | (0.006) | *** | -0.051 | (0.010) | *** | | | |
| | DCBY | 5.451 | (7.589) | | 9.613 | (2.935) | | 12.466 | (3.032) | | | | |
| Japan | LY | 0.043 | (0.043) | | 0.000 | (0.000) | | | | | -0.088 | (0.024) | *** |
| | DCBY | 13.472 | (5.543) | | 6.04 | (2.705) | | | | | 6.472 | (3.914) | |
| Korea | LY | 0.006 | (0.010) | | -0.009 | (0.003) | *** | | | | 0.004 | (0.006) | |
| | DCBY | -0.562 | (1.190) | | -0.028 | (0.306) | | | | | 1.115 | (0.988) | |
| Sweden | LY | 0.001 | (0.013) | | 0.014 | (0.013) | | 0.002 | (0.015) | | | | |
| | DCBY | 4.798 | (2.101) | | 4.792 | (1.164) | | 5.833 | (1.553) | | | | |
| UK | LY | -0.033 | (0.026) | | 0.001 | (0.000) | | -0.002 | (0.039) | | | | |
| | DCBY | 36.278 | (15.041) | | 24.355 | (5.823) | | 32.17 | (8.477) | | | | |
| US | LY | -0.068 | (0.038) | * | -0.017 | (0.006) | *** | | | | -0.014 | (0.007) | * |
| | DCBY | 0.614 | (0.653) | | 1.084 | (0.488) | | | | | 0.792 | (0.518) | |
| with restrictions | | LY | | | -0.007 | (0.001) | *** | -0.037 | (0.006) | *** | -0.006 | (0.004) | |
| | | DCBY | | | -0.000 | (0.011) | | 4.707 | (0.886) | | 1.884 | (0.335) | |
| chi2 (p-value) | | LY | | | 383.150 | (0.000) | | 20.340 | (0.002) | | 11.180 | (0.025) | |
| | | DCBY | | | 39.790 | (0.001) | | 52.800 | (0.000) | | 9.280 | (0.055) | |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.
Numbers in the paranthesis represent standard errors.

Table 1.15 Granger Causality Test MODEL 1 LY= f(DCBY, TY, GOVY, CPI)

| country | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance to growth | | Growth to finance | | Two-way/one-way | Finance to growth | | Growth to finance | | Two-way/one-way |
| | χ2 -stat | p-value | χ2 -stat | p-value | | χ2 -stat | p-value | χ2 -stat | p-value | |
| Australia | 12.424 | 0.002 | 1.246 | 0.536 | One-way | 72.170 | 0.000 | 3.920 | 0.141 | One-way |
| Austria | 6.050 | 0.049 | 5.079 | 0.079 | Two-way | 0.570 | 0.751 | 10.160 | 0.006 | One-way |
| Belgium | 4.458 | 0.108 | 0.148 | 0.929 | None | 6.100 | 0.047 | 0.820 | 0.663 | One-way |
| Canada | 0.017 | 0.899 | 0.973 | 0.324 | None | 31.130 | 0.000 | 9.710 | 0.002 | Two-way |
| France | 0.446 | 0.504 | 0.034 | 0.853 | None | 46.910 | 0.000 | 0.000 | 0.989 | One-way |
| Germany | 7.792 | 0.020 | 8.177 | 0.017 | Two-way | 26.020 | 0.000 | 12.300 | 0.002 | Two-way |
| Italy | 5.045 | 0.025 | 0.422 | 0.516 | One-way | 2.910 | 0.088 | 1.000 | 0.317 | One-way |
| Japan | 12.285 | 0.002 | 4.329 | 0.115 | One-way | 199.530 | 0.000 | 11.310 | 0.004 | Two-way |
| Korea | 2.221 | 0.136 | 0.257 | 0.613 | None | 71.320 | 0.000 | 6.510 | 0.039 | Two-way |
| Sweden | 1.721 | 0.190 | 0.043 | 0.826 | None | 16.870 | 0.000 | 0.820 | 0.366 | One-way |
| UK | 5.787 | 0.055 | 5.201 | 0.074 | Two-way | 20.700 | 0.000 | 2.940 | 0.230 | One-way |
| US | 5.416 | 0.067 | 1.520 | 0.468 | One-way | 93.550 | 0.000 | 3.880 | 0.144 | One-way |

Granger Causality Test for European countries

| country | Finance to growth | | Growth to finance | | Two-way/one-way |
|---|---|---|---|---|---|
| | χ2 -stat | p-value | χ2 -stat | p-value | |
| Austria | 1.110 | 0.573 | 5.710 | 0.058 | One-way |
| Belgium | 2.130 | 0.345 | 3.580 | 0.167 | None |
| France | 5.710 | 0.017 | 0.020 | 0.883 | One-way |
| Germany | 26.900 | 0.000 | 17.290 | 0.002 | Two-way |
| Italy | 0.180 | 0.671 | 0.860 | 0.353 | None |
| Sweden | 8.730 | 0.003 | 0.470 | 0.491 | One-way |
| UK | 5.770 | 0.056 | 3.500 | 0.174 | One-way |

Granger Causality Test for non-European countries

| country | Finance to growth | | Growth to finance | | Two-way/one-way |
|---|---|---|---|---|---|
| | χ2 -stat | p-value | χ2 -stat | p-value | |
| Australia | 26.710 | 0.000 | 0.260 | 0.878 | One-way |
| Canada | 0.410 | 0.524 | 4.090 | 0.043 | One-way |
| Japan | 36.990 | 0.000 | 9.610 | 0.008 | Two-way |
| Korea | 1.870 | 0.393 | 2.920 | 0.232 | None |
| US | 11.900 | 0.003 | 5.320 | 0.070 | Two-way |

Rejection of Null Hypothesis by Granger causality test suggests the evidence of causality

Table 1.16 Granger Causality Test MODEL 2 LY= f(DCBY, GSY, GOVY,CPI)

| | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| country | Finance to growth | | Growth to finance | | Two-way/one-way | Finance to growth | | Growth to finance | | Two-way/one-way |
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| Australia | 12.854 | 0.000 | 1.629 | 0.202 | One-way | 72.170 | 0.000 | 3.920 | 0.141 | One-way |
| Austria | 4.930 | 0.085 | 2.409 | 0.300 | One-way | 0.570 | 0.751 | 10.160 | 0.006 | One-way |
| Belgium | 2.839 | 0.242 | 0.194 | 0.908 | None | 6.100 | 0.047 | 0.820 | 0.663 | One-way |
| Canada | 0.133 | 0.716 | 0.258 | 0.611 | None | 31.130 | 0.000 | 9.710 | 0.002 | Two-way |
| France | 0.129 | 0.719 | 0.126 | 0.722 | None | 46.910 | 0.000 | 0.000 | 0.989 | One-way |
| Germany | 8.632 | 0.013 | 10.366 | 0.006 | Two-way | 26.020 | 0.000 | 12.300 | 0.002 | Two-way |
| Italy | 3.205 | 0.201 | 0.766 | 0.682 | None | 2.910 | 0.088 | 1.000 | 0.317 | One-way |
| Japan | 10.595 | 0.005 | 3.566 | 0.168 | One-way | 199.530 | 0.000 | 11.310 | 0.004 | Two-way |
| Korea | 0.315 | 0.575 | 1.681 | 0.195 | None | 71.320 | 0.000 | 6.510 | 0.039 | Two-way |
| Sweden | 0.743 | 0.389 | 0.016 | 0.900 | None | 16.870 | 0.000 | 0.820 | 0.366 | One-way |
| UK | 3.878 | 0.144 | 11.682 | 0.003 | One-way | 20.700 | 0.000 | 2.940 | 0.230 | One-way |
| US | 5.313 | 0.070 | 2.557 | 0.278 | One-way | 93.550 | 0.000 | 3.880 | 0.144 | One-way |

Granger Causality Test for European countries

| country | Finance to growth | | Growth to finance | | |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| Austria | 0.770 | 0.380 | 2.810 | 0.094 | One-way |
| Belgium | 0.270 | 0.602 | 1.470 | 0.226 | None |
| France | 3.740 | 0.053 | 0.040 | 0.833 | One-way |
| Germany | 57.380 | 0.000 | 15.470 | 0.000 | Two-way |
| Italy | 20.820 | 0.000 | 4.360 | 0.113 | One-way |
| Sweden | 30.240 | 0.000 | 0.140 | 0.705 | One-way |
| UK | 9.750 | 0.008 | 19.120 | 0.000 | Two-way |

Granger Causality Test for non-European countries

| country | Finance to growth | | Growth to finance | | |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| Australia | 9.320 | 0.002 | 1.310 | 0.253 | One-way |
| Canada | 4.650 | 0.031 | 3.960 | 0.047 | Two-way |
| Japan | 53.250 | 0.000 | 7.490 | 0.024 | Two-way |
| Korea | 0.480 | 0.488 | 1.830 | 0.176 | None |
| US | 2.550 | 0.280 | 7.340 | 0.025 | One-way |

Rejection of Null Hypothesis by Granger causality test suggests the evidence of causality

Table 1.17 Granger Causality Test MODEL 3 LY= f(LLY, TY, GOVY, CPI)

| country | Standard Granger Causality Test: Finance to growth | | Growth to finance | | Two-way/one-way | SURECM based Granger Causality Test: Finance to growth | | Growth to finance | | Two-way/one-way |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| Australia | 7.508 | 0.023 | 4.311 | 0.116 | One-way | 16.100 | 0.000 | 69.900 | 0.000 | Two-way |
| Austria | 0.396 | 0.820 | 4.129 | 0.127 | None | 22.700 | 0.000 | 0.280 | 0.870 | One-way |
| Belgium | 0.078 | 0.781 | 0.341 | 0.559 | None | 10.170 | 0.001 | 3.560 | 0.059 | Two-way |
| Canada | 0.113 | 0.945 | 6.356 | 0.042 | One-way | 1.130 | 0.569 | 4.110 | 0.128 | None |
| France | 0.090 | 0.956 | 9.597 | 0.008 | One-way | 9.660 | 0.008 | 12.240 | 0.002 | Two-way |
| Germany | 3.411 | 0.182 | 0.070 | 0.966 | None | 0.070 | 0.964 | 3.400 | 0.183 | None |
| Italy | 18.271 | 0.000 | 5.179 | 0.075 | Two-way | 70.160 | 0.000 | 0.640 | 0.728 | One-way |
| Japan | 8.377 | 0.015 | 0.558 | 0.757 | One-way | 32.390 | 0.000 | 50.900 | 0.000 | Two-way |
| Korea | 1.498 | 0.221 | 0.293 | 0.588 | None | 6.520 | 0.011 | 33.180 | 0.000 | Two-way |
| Sweden | 1.688 | 0.194 | 1.281 | 0.258 | None | 0.060 | 0.812 | 14.280 | 0.000 | One-way |
| UK | 3.282 | 0.194 | 7.721 | 0.021 | One-way | 1.510 | 0.470 | 56.530 | 0.000 | One-way |
| US | 1.593 | 0.451 | 4.522 | 0.104 | None | 26.190 | 0.000 | 14.650 | 0.001 | Two-way |

Granger Causality Test for European countries

| country | Finance to growth | | | Growth to finance | |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | | $\chi2$ -stat | p-value |
| Austria | 14.990 | 0.001 | 4.180 | 0.124 | One-way |
| Belgium | 4.480 | 0.034 | 1.720 | 0.190 | One-way |
| France | 12.530 | 0.002 | 0.820 | 0.663 | One-way |
| Germany | 4.040 | 0.133 | 3.480 | 0.176 | None |
| Italy | 27.240 | 0.000 | 8.260 | 0.016 | Two-way |
| Sweden | 0.890 | 0.346 | 1.090 | 0.296 | None |
| UK | 1.750 | 0.417 | 6.750 | 0.034 | One-way |

Granger Causality Test for non-European countries

| country | Finance to growth | | Growth to finance | | |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| Australia | 19.310 | 0.000 | 40.520 | 0.000 | Two-way |
| Canada | 5.530 | 0.063 | 0.086 | 0.651 | One-way |
| Japan | 24.130 | 0.000 | 1.200 | 0.548 | One-way |
| Korea | 2.100 | 0.147 | 0.000 | 0.993 | None |
| US | 31.330 | 0.000 | 25.010 | 0.000 | Two-way |

Rejection of Null Hypothesis by Granger causality test suggests the evidence of causality

Table 1.18 Granger Causality Test MODEL 4 LY= f(LLY, GSY, GOVY, CPI)

| country | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance to growth | | Growth to finance | | Two-way/one-way | Finance to growth | | Growth to finance | | Two-way/one-way |
| | χ2 -stat | p-value | | χ2 -stat | p-value | χ2 -stat | p-value | | χ2 -stat | p-value |
| Australia | 2.235 | 0.327 | 6.896 | 0.032 | One-way | 17.950 | 0.000 | 17.580 | 0.000 | Two-way |
| Austria | 1.315 | 0.518 | 7.620 | 0.022 | One-way | 7.030 | 0.030 | 12.060 | 0.002 | Two-way |
| Belgium | 1.156 | 0.561 | 0.104 | 0.949 | None | 24.700 | 0.000 | 0.040 | 0.838 | One-way |
| Canada | 0.102 | 0.950 | 5.453 | 0.065 | One-way | 0.730 | 0.693 | 45.220 | 0.000 | One-way |
| France | 0.127 | 0.722 | 1.691 | 0.193 | None | 3.890 | 0.485 | 11.310 | 0.001 | One-way |
| Germany | 3.140 | 0.208 | 0.048 | 0.976 | None | 55.060 | 0.000 | 44.250 | 0.000 | Two-way |
| Italy | 18.956 | 0.000 | 5.800 | 0.055 | Two-way | 29.770 | 0.000 | 6.530 | 0.038 | Two-way |
| Japan | 5.401 | 0.067 | 1.130 | 0.568 | One-way | 11.460 | 0.003 | 5.610 | 0.060 | Two-way |
| Korea | 0.528 | 0.467 | 0.064 | 0.801 | None | 1.540 | 0.215 | 22.890 | 0.000 | One-way |
| Sweden | 3.880 | 0.144 | 0.299 | 0.861 | None | 34.150 | 0.000 | 3.510 | 0.173 | One-way |
| UK | 4.338 | 0.114 | 13.412 | 0.001 | One-way | 14.110 | 0.001 | 370.350 | 0.000 | Two-way |
| US | 1.593 | 0.451 | 4.522 | 0.104 | None | 48.800 | 0.000 | 10.170 | 0.006 | Two-way |

Granger Causality Test for European countries

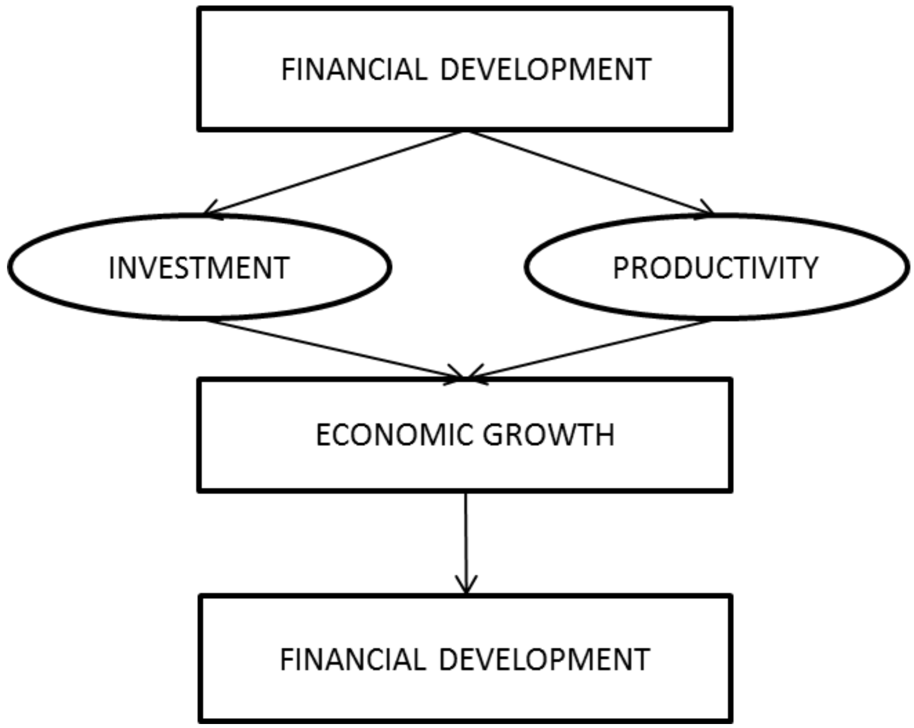
| country | Finance to growth | | | Growth to finance | |
|---|---|---|---|---|---|
| | χ2 -stat | p-value | | χ2 -stat | p-value |
| Austria | 9.830 | 0.007 | 20.810 | 0.000 | Two-way |
| Belgium | 5.650 | 0.059 | 9.200 | 0.010 | One-way |
| France | 2.830 | 0.243 | 0.760 | 0.683 | None |
| Germany | 42.920 | 0.000 | 9.620 | 0.008 | Two-way |
| Italy | 5.600 | 0.061 | 9.750 | 0.008 | Two-way |
| Sweden | 0.510 | 0.776 | 11.370 | 0.003 | One-way |
| UK | 27.350 | 0.000 | 2.530 | 0.282 | One-way |

Granger Causality Test for non-European countries

| country | Finance to growth | | | Growth to finance | |
|---|---|---|---|---|---|
| | χ2 -stat | p-value | χ2 -stat | p-value | |
| Australia | 15.790 | 0.000 | 0.950 | 0.623 | One-way |
| Canada | 5.750 | 0.057 | 10.060 | 0.007 | Two-way |
| Japan | 8.680 | 0.013 | 1.430 | 0.490 | One-way |
| Korea | 3.090 | 0.079 | 5.250 | 0.022 | Two-way |
| US | 15.000 | 0.001 | 3.260 | 0.196 | One-way |

Rejection of Null Hypothesis by Granger causality test suggests the evidence of causality

Figure 1. A Theoretical Approach to Channels to Economic Growth



CHAPTER II

## ESSAY 2: FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH FOR ASIAN ECONOMIES: A SYSTEM APPROACH


### Abstract

In this essay I investigate the long run relationship between financial development and economic growth for 16 Asian economies with different levels of income in most efficient manner via system method. In addition, we employ Parks CCR test to estimate cointegrating vectors and run ordinary ECM as well as SURECM. Based on the results of Granger causality test in system method, I found: 1) strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) an evidence of positive causality running from finance to growth when DCBY is used as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) a tendency of reverse causality running from growth to finance when BM is used as financial proxy, pointing out to the important role of formal bank intermediation for economic growth; 4) cases of one-way causality such as positive and reverse causality are more prominent for middle to low income countries; 5) an evidence that China has a huge impact on Asian economy and more precisely it has a significant impact on developing economies such as middle and low income countries; 6) selection of control variables does not affect the model specification and the direction of causality; and 7) system method is superior to traditional regression methods. These results are consistent with earlier literature in that the direction of causality may be country specific. However, it does not support King and Levine's (1993a) conclusion that finance is a leading sector to economic growth. The question might give some further guidance as to whether a well-developed financial sector is a necessary condition for a higher growth rates for developing countries and provide an important policy implication both for OECD countries as well as for countries that have financial sectors that are comparatively underdeveloped.

Keywords: Financial development, economic growth, causality, cointegration, VECM, CCR, SURECM

JEL Classifications: C22, C23, O16, G18, G28

## INTRODUCTION

The main purpose of this essay is to investigate the relationship between financial development and economic growth and study the effectiveness of financial development on economic growth for 16 Asian economies by using system approach. In conducting this study, Johansen-Juselius (1991) cointegration test, Park's (1992) Canonical Cointegrating Regression (CCR), Error Correction Model (ECM), as well as Seemingly Unrelated Regression Error Correction Model (SURECM) and Granger (1969) causality tests in a system method are used as empirical evidence. The study will present further evidence concerning the debate over whether financial development leads economic growth in a Granger causality sense among high income, middle income and low income countries from Asian region. The main contribution of this study is to examine the long run dynamics and causality between financial development and economic growth in multivariate SURECM setting for countries under the investigation. SURECM and Granger causality test will provide further evidence on relationship between the financial development and economic growth, because the system method in this study accounts for cross equation correlations among countries and utilizes information in the variance-covariance matrix of residual to improve the efficiency of statistical estimates. There are conflicting theoretical as well as empirical arguments regarding the role and importance of financial development. The empirical results of this study clearly supports the hypothesis that there are bidirectional relationships exists between financial development and economic growth.

Based on the results of Granger causality test in system method, I found: 1) strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) an evidence of positive causality running from finance to growth when we use DCBY as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) a tendency of reverse causality running from growth to finance when BM is used as financial proxy, pointing out to the important role of formal bank intermediation for economic growth; 4) cases of one-way causality such as positive and reverse causality are more prominent for middle to low income countries.; 5) an evidence that China has a huge impact on Asian economy and more precisely it has a significant impact on developing economies such as middle and low income countries; and 6) selection of control variables does not affect the model specification and the direction of causality. These results are consistent with conclusions of Demetriades and Luintel (1996), Arestis and Demetriades (1997), Shan, Morris and Sun (2001) conclusions. The main findings of this study show little evidence that financial development is a necessary and sufficient precondition to economic growth.

Furthermore, findings suggest that the selection of econometric method used to examine the relationship between financial development and economic growth is very important. The findings clearly demonstrate that the directions of causality vary across countries and emphasis that the system method is superior to single equation approach. The question might give some further guidance as to whether a well-developed financial sector is a necessary and sufficient condition for a higher growth rates for developing countries and provide an important policy implication both for OECD countries as well as for countries that have financial sectors that are comparatively underdeveloped.

The question of causality is a long-standing issue and brings up all kinds of controversies. However, it's very important for economists and policy makers to be able to use estimated models for policy purposes. This essay is organized as follows. Section 1 discusses the literature review. Section 2 describes the data, model and methodology used to conduct this study. Section 3 discusses empirical results and finally section 4 discusses summary and conclusion.

## II.1. REVIEW OF LITERATURE

*Theoretical literature*

This essay examines the relationship between financial development and economic growth using time series data for 16 Asian economies with different income levels such as high income, middle income and low income countries. The topic has been comprehensively studied in the theoretical and empirical literature. The theoretical foundation of this relationship can be traced back to the work of Shumpeter (1911) and later Goldsmith (1969), McKinnon (1973) and Shaw (1973). Economists hold controversial opinions regarding the role of financial system for economic growth. Based on Levine (2005), financial systems facilitate the trading, hedging, diversifying, and pooling of risk, allocate resources, monitor managers and exert corporate control, mobilize savings, and facilitate the exchange of goods and services. Every single functions of financial system can affect national savings and investment decision. Basically there are three main opposing theoretical views on the relationship between financial development and economic growth. Joseph Shumpeter argues that "well-functioning banks spur technological innovation by identifying and funding those entrepreneurs with best chances of successfully implementing innovative products and production processes". An important part of his discussion is that financial intermediaries make possible technological innovation and economic development. McKinnon and Shaw discussed that government repression of financial system through interest rate ceilings and directed credit slows down financial development, which they claim is critical for economic growth. Thus they argue that a more liberalized financial system will induce savings and investment, which in return promotes economic growth. So called "Goldsmith-McKinnon-Shaw" hypothesis claims that financial liberalization in the form of an appropriate rate of return on real cash balances is a vehicle of promoting economic growth.

The endogenous growth literature also talks about the importance of financial development for long-run economic growth through impact of financial sector services on capital accumulation and technological innovation. Famous economists such as Robinson (1952), Kuznets (1955) and Lucas (1988), argue that the role of financial sector is overstated or that financial development follows expansion of the real sectors of the economy. For example, Robinson writes that “where enterprise leads, finance follows” – it is economic development which creates the demand for financial services. Lucas (1988) expressed that the role of financial development is “over-stressed”. According to Lucas, “there is no one pattern of growth to which all economies conform”, thus he pointed out that too much attention has given to role of financial development to economic growth. These arguments indicate endogenous growth theorists’ view that causality runs from growth to financial development, which is in contrast to McKinnon and Shaw hypothesis.

Recent theorists argue that there is a two-way relationship between financial development and economic growth. Among them, Greenwood and Jovanovic (1990) discuss a model in which both financial sector and economic growth are endogenously determined. The model shows bidirectional causal relationship between financial development and economic growth.

*Previous empirical research for high-, middle- and low income countries*

Most of the recent literature examined the causality between the financial development and economic growth from the empirical perspective. Many researchers studied the direction of causality and the role of financial development on individual country cases such as Australia, China, Egypt, India, Korea, Malaysia, New Zealand, Poland, Russia, Turkey, and Taiwan. Wide array of previous empirical research has been discussed in first essay. However, in this essay main emphasis is given to studies, which examined relationship between financial development and economic growth for high income countries as well as developing countries with middle to low income cases. Since the main purpose of this essay is to study the causal relationship between financial development and economic growth of group of Asian economies, more specifically with different income levels.

Shan, Morris and Sun (2001) estimated a Vector Autoregression (VAR) model for nine OECD countries and China. Their found bidirectional causality between financial development and economic growth in half of the countries, and reverse causality in three countries, and no evidence of one-way causality. They got a little support that financial development leads to economic growth. Based on these results they suggested that "financial sector is not a leading sector in the course of economic growth". Shan and Morris (2002) investigated the relationship between financial development and economic growth for 19 OECD countries and China. In investigating causality between financial development and economic growth, when they used total credit as financial proxy, they found evidence of no causality for 10 countries, bidirectional causality for 4 countries, one-way causality from finance to growth for 2 countries, and reverse causality for 4 countries. They found the similar evidence even when they employed the financial efficiency (or the ratio of liquid liabilities to GDP) to measure the financial development: 10 countries with no causality, 6 countries with bidirectional causality, 2 countries with one-way causality running from finance to economic growth, and 2 countries with reverse causality running from economic growth to finance. The empirical evidence gives little support to the hypothesis that financial development "leads" economic growth and supports the conclusions of Arestis and Demetriades (1997) and Demetriades and Hussein (1996) that the link between financial development and economic growth may be country specific and might be affected by differences in industrial structures and cultures of countries under the investigation. They suggested that the financial development is a not necessary and sufficient precondition to economic growth.

Patrick (1966) discusses two alternative hypothesis of the possible causal relationship between financial development and economic growth in developing countries such as supply-leading and demand-following. Increases in the supply of financial services leads to real economic growth and the causal relationship runs from finance to growth and it's known as supply-leading causality. In contrast, as the real economy grows, an increasing demand for financial services induces the expansion of the financial sector is demand-following causality. He also suggests further hypothesis known as stages of development hypothesis, which says that the direction of causality between financial development and economic growth changes during the stages of development. For example, in the early stages of development supply-leading spur promotes real investment and growth. However, as financial development and economic growth take place, supply-leading impetus becomes less important and demand-following response becomes more dominant. He also points out about the possibility of bidirectional causality between financial development and economic growth at this stage.

Demetriades and Hussein (1996) performed the causality tests for 16 developing countries and found bidirectional causality in 8 countries and reverse causality in 8 countries. They came to conclusion that "causality patterns vary across countries and, therefore, highlights the dangers of statistical inference based on cross-section country studies which implicitly treat different countries as homogeneous entities".

Luintel and Khan (1999) studied the long-run relationship between financial development and economic growth by employing multivariate vector autoregression (VAR) method using the data of 10 developing countries. They found the evidence of only bidirectional causality for all countries, which was distinct from all previous studies.

Al-Yousif (2002) examined the nature and direction of causality between the financial development and economic growth using both time-series and panel data from 30 developing countries for the period of 1970-1999. His findings strongly support the view that financial development and economic growth are "mutually causal" or there is bidirectional causality. However, he found some support of positive and reverse causality between the finance and economic growth, and as well as for the view that there is no relationship, but these findings were not strong as with bidirectional causality. Clearly, the empirical results of Al-Yousif's paper were in line with other empirical studies that "the relationship between financial development and economic growth cannot be generalized across countries because economic policies are country specific and their success depends, among other things, on the efficiency of the institutions implementing them". All these results show there is no agreement on the role of financial development in the process of economic growth.

Christopoulos and Tsionas (2004) examined the long run relationship between the financial development and economic growth by using panel unit root test and panel cointegration analysis for 10 developing countries. The results suggest that there is a strong evidence of long run causality from financial development to growth and no evidence of bidirectional causality between financial deepening and output, pointing that the effect is necessary long-run in nature. So they have concluded that "policies aiming at improving financial markets will have a delayed effect on growth, but this effect is significant'.

## II.2. METHODOLOGY

### II.2.1. Data

The main objective of this study is to investigate the causal relationship between financial development and economic growth by using time series data for 16 Asian economies with high-, middle, and low-income levels such as Australia, Bangladesh, China, India, Indonesia, Japan, Korea, Malaysia, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, and Thailand over the period of 1980-2010. The sample periods covering 1980 through 2010 are the periods of development of financial institutions and financial liberalization in many countries in Asian region. This period can also be characterized as periods of rapid economic growth of Asian tigers, output expansion, money growth, trade and investment increase, and globalization. However, the recent Asian crisis, which has slowed the growth and in some countries negative growth has been observed, may have created a new topic of discussion. It's now recognized that the Asian "melt-down" was partially results of excessive financial liberalization in those countries. Demirgue-Kunt and Detragiache (1998) discuss that financial liberalization was so extensive that financial regulations were unable to prevent the collapse, especially where institutions are weak. In addition to this, China, one of the largest producer and exporter, has been included in this study to examine the role of Chinese economy in the regional economy. Even though, countries in this study are from same geographic region, but the pattern of economic growth and financial development appear to differ over time and across countries. The data set of selected Asian countries represents the homogeneity of countries within the region and heterogeneity of cross-countries and income groups. The data frequency used in this study is annual. All the data are obtained from the World Bank *World Development Indicators 2011 (WDI)* database except the data on broad money, which was obtained from International Monetary Fund *International Finance Statistics (2011)*.

*Indicators to measure the Economic Growth and Financial Development*

The selection of variables in this model is based on the theoretical as well as empirical framework of previous studies. One of the important issues in this study is the selection of proxies to measure financial development and economic growth. For economic development, the natural logarithm of real GDP (LY) is used to measure economic growth and the main reason of using natural logarithm is based on the econometrics method employed in this study to examine the direction of causality in Granger sense based on SURECM. Levine and Zervos (1998) and Arestis, Demetriades, and Luintel (2001) suggested that even though both banks and stock markets could promote the economic growth, the effects of banks are far more significant. Following this conclusion, bank-based measures of financial development variables are used in this study rather than stock market-based financial structures.

There is not a single empirical definition of bank-based financial development (Beck, Demirguc-Kunt, and Levine (2009)). Previous studies have used various indicators to measure financial development. Following King and Levine (1993a), Levine and Zervos (1998), and Beck, Demirguc-Kunt, and Levine (2009), and the standard literature, two different measures of financial proxy are used. *First* proxy is domestic credit to private sector provided by banking sector as a percentage of GDP (DCBY) following Levine and Zervos (1998). Higher DCBY indicates higher degree of dependence upon banking sector for financing and this measure of financial development is often argued to be best measure of financial development, which measures the extent of efficient resource allocation by private sector. *Second* alternative measure of financial development, developed by King and Levine (1993a)), is the ratio of M2 to GDP (BM) to measure the broad money in the economy, which is the sum of currency, demand and interest bearing liabilities of banks and other financial intermediaries divided by GDP. This is very popular and widely used indicator to measure the size of the financial intermediation. Higher ratio of broad money to GDP indicates the higher intensity of the banking system and financial intermediation. Another measure of financial development based on King and Levine (1993a), is the domestic credit to private sector issued by banks and other non-banks as a percentage of GDP (DCPSY). A high ratio of domestic credit to private sector to GDP shows a higher level of domestic investment, which results in higher output. The regression and Granger causality test results using DCPSY are not reported in this essay, however can be viewed at request from the authors.

*Indicators to measure the real sector or control variables*

It's clear that factors other than financial development have an impact on economic growth. Following the recent literature on the analysis of financial development and economic growth, four other variables are used to control for other factor associated with economic growth. *The third* indicator used in this research is the ratio of gross domestic savings to GDP (GSY), which indicates the intensity of the financial intermediaries implying that more financial services generate more financial development. Based on economic theory, higher gross domestic savings generates higher investment and hence higher economic growth. *Fourth* indicator is the ratio of trade to GDP (TY), which measures the size of real sector and trade policy. *Fifth* indicator is the ratio of government final consumption expenditures to GDP (GOVY) to measure the weight of fiscal policy. *Sixth* indicator is inflation rate (CPI), measured by CPI to measure price (in)stability in the economy.

II.2.2.Model and Econometric Techniques

To investigate long-run relationship between the economic growth and financial development, the following model is used:

$$Y_i t = a_0 + \alpha_{1t} F_{it} + \beta_{1t} X_{it} + U_{it} \quad , \tag{32}$$

where $Y_{it}$ is a measure of economic growth, $F_{it}$ is a measure of financial development, $X_{it}$is a set of control variables that includes commonly used variables in the literature such as trade volume, government expenditure, gross saving, and the inflation rate, and $U_{it}$ is the error term.

In this study we examine four different models, which include only one financial variable in each equation, because DCBY and M2 are highly correlated amongst themselves. Also for the purpose of sensitivity analysis, three control variables are used in one equation. Based on the set of control variables and previously mentioned reason, we can rewrite the equation (32) as followings:

$$LY_{it} = a_0 + a_1\mathbf{DCBY_{it}} + b_1TY_{it} + b_2GOVY_{it} + b_4CPI_{it} + e_{it}, \tag{33}$$

$$LY_{it} = a_0 + a_1\mathbf{DCBY_{it}} + b_2GOVY_{it} + b_3GSY_{it} + b_4CPI_{it} + e_{it}, \tag{34}$$

$$LY_{it} = a_0 + a_1\mathbf{BM_{it}} + b_1TY_{it} + b_2GOVY_{it} + b_4CPI_{it} + e_{it}, \tag{35}$$

$$LY_{it} = a_0 + a_1\mathbf{BM_{it}} + b_2GOVY_{it} + b_3GSY_{it} + b_4CPI_{it} + e_{it}. \tag{36}$$

where $LY_{it}$ is natural logarithm of real GDP in country *i* and year *t*, $DCBY_{it}$ is the ratio of domestic credit issued by banks to GDP, $BM_{it}$ is the ratio of broad money to GDP, $TY_{it}$ is the ratio of total trade to GDP, $GOVY_{it}$ is the ratio of government spending to GDP, $GSY_{it}$ is the ratio of gross savings to GDP, $CPI_{it}$ is the inflation measured by consumer price index, and $e_{it}$ is an error term. To investigate long-term relationship between economic growth and financial development as well as the direction of causality, Johansen-Juselius cointegration test, Park's (1992) Canonical Cointegrating Regression (CCR), Vector of Error Correction, and Seemingly Unrelated Regression Error Correction Model (SURECM) and Granger (1969) causality test in a system method are employed.

*Unit root and stationarity tests*

Our next test to run is to test the data for presence of stationarity. It's essential to test if variables have the tendency to return to the long term trend following a shock (stationary) or the variables follow a random walk (containing unit root). It's well known that if the variables follow a random walk after any shock, the regression result between variables is spurious and series don't have a finite variance, and as a result OLS will not produce consistent estimates. In this study, in order to test for stationarity, two tests are performed, such as the Augmented Dickey-Fuller (ADF) test, which tests if series exhibit unit root process and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test, which tests if series are stationary.

ADF test tests whether a unit root is present in autoregressive model. Choosing the lag length for the ADF test is an important step for the implementation of the ADF test. If number of lags is too small then the remaining serial correlation in the errors will bias the test. If number of lags is too large then the power of the test will suffer. One possible approach is to examine the t-values on coefficients using General-to-specific approach. An alternative approach is to examine information criteria such as the Akaike information criterion, or Bayesian information criterion. Time series data Yt is non-stationary if its autocorrelation coefficient ρ is one, then series explodes as time progresses and has no finite variance. If this is the case, we call that the series have a unit-root (ρ=1), or in a more technically Yt ~ I(1), meaning that Yt series has to be differenced once to be stationary.

On the contrary, KPSS test differs from ADF unit root tests in that the series are assumed to be (trend-) stationary under the null hypothesis. KPSS test based on residuals from the OLS regression of $Y_t$ on the exogenous $X_t$. Series under KPSS test expressed as the sum of deterministic trend, random walk, and stationary error term and the test is LM test of the hypothesis that random walk has zero variance. As with the ADF test, there are two cases to distinguish between, whether to estimate with or without a linear time trend. The ADF unit root test is for the null hypothesis that a time series $Y_t$ is I(1). Stationarity tests, on the other hand, are for the null that $Y_t$ is I(0). The KPSS test is the most commonly used stationarity test.

*Cointegration Tests*

When time series variables are non-stationary, it is important to see if there is a certain common trend between those non-stationary series. If two non-stationary series $X_t$~ I(1) and $Y_t$~ (1) have a linear relationship such that $Z_t = Y_t - \gamma X_t$ and $Z_t$ ~ I(0), (Zt is stationary), then we call these two series are cointegrated. Broadly speaking, cointegration test is equivalent to examine if the residuals of regression between two non-stationary series are stationary. If residuals are stationary, two series $X_t$ and $Y_t$ are cointegrated. Next step is to test if series are cointegrated. There are different tests have been employed to test for the presence of cointegration. First method used in this study to test for presence of cointegration is Johansen-Juselius cointegration test. This method estimates one or more error correction equations together, obtaining estimates of the long-run and short-run coefficients in one pass. Johansen's approach is to estimate the Vector Error Correction Model (VECM) by maximum likelihood, under various assumptions about the trend or intercept parameters and the number of cointegrating vectors, and then conduct the likelihood ratio tests. There are two test statistics: the **trace statistic** and the **maximum eigenvalue statistic.** The trace statistics test is based on the log-likelihood ratio $\ln[L_{max}(r)/L_{max}(k)]$, tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to *r* against an alternative that the cointegrating rank is k. The maximum eigenvalue statistics test based on log-likelihood ratio $\ln[L_{max}(r)/L_{max}(r+1)]$, tests the null that the number of cointegrating vectors is *r* against the alternative *r+1* cointegrating vectors.

Another alternative way to test for cointegration is to use Park's Canonical Cointegrating Regression (CCR). By employing Park's CCR, we test for long-run relationship by computing cointegrating vectors. The main advantage of using Park's CCR test is this test not only shows the number of cointegrating vectors as well as the presence of deterministic and stochastic cointegrating terms.

*Error Correction Model and Seemingly Unrelated Regression ECM*

In order to investigate the short run and long-run dynamics between the financial development and economic growth, an Error Correction Model was employed under the assumption of $Z_t = Y_t - \gamma X`_t$ is stationary. Based on results of Johansen-Juselius and Park's CCR tests for cointegration, ECM can be performed knowing that variables are cointegrated. ECM specification restricts the long run behavior of the endogenous variables to converge to their cointegrating relationships still allowing for short run adjustment dynamics. Through error correction term, ECM allows the discovery of Granger Causality relation.

Consider the cointegrating relation $Y_t - \alpha x_t = 0$, which represents a lont-term equilibrium relation between $y_t$ and $x_t$ and cointegrating factor $Z_{t,}$ which will be used to measure the deviation from this long-term relationship. Engle and Granger suggested the following regression to estimate the value of α:

$$Y_t = \alpha_0 + \alpha_1 x_t + \varepsilon_t. \tag{37}$$

The cointegrating factor $Z_{t,}$ can be estimated if the value of $\alpha_1$ is known by estimating $Z_t = Y_t - \hat{\alpha} x_t$. This model will allow testing for both short-term and long-term relations between two time-series and is known as ECM. Then the following ECM estimates the potential short-run and long-run effects of these two variables on each other:

$$x_t - x_{t-1} = a_0 + a_1\hat{Z}_{t-1} + \sum_{i=1}^{m} b_i \left(y_{t-i} - y_{t-i-1}\right) + \sum_{j=1}^{m} c_j \left(x_{t-j} + x_{t-j-1}\right) + \varepsilon_t, \tag{38}$$

$$y_t - y_{t-1} = \alpha_0 + \alpha_1\hat{Z}_{t-1} + \sum_{i=1}^{m} \phi_i \left(y_{t-i} - y_{t-i-1}\right) + \sum_{j=1}^{m} \theta_j \left(x_{t-j} + x_{t-j-1}\right) + \mu_t. \tag{39}$$

The ECM equations given by 38 and 39 decompose the dynamic adjustments of the dependent variables X into two components: 1) a long-term components given by cointegrating terms $a_1\hat{Z}_{t-1}$ and $\alpha_1\hat{Z}_{t-1}$, or error correction term, and 2) a short-term components given by the summation terms on the right hand side of the equations. Based on the equations 38 and 39, variables $y_t$ and $x_t$ are cointegrated and exhibits the long-term co-movements when at least one of the coefficients $\alpha_1$ and $a_1$ is different from zero. If $a_1$ is different from zero and $\alpha_1$ is zero, then it said that $y_t$ follows and adjusts to $x_t$ in the long run. If both $\alpha_1$ and $a_1$ are different from zero, *x* and *y* adjust to one another over the long run. The short run relation between yt and xt are given by coefficients $b_i$ and $\varphi_i$. It's said if $b_i$'s are not all zero and $\varphi_i$ all zero, then *x* is causing *y* in the short run. However, if both coefficients are different from zero, then feedback exists and the two variables affect each other in the short run.

In this study, four different models based on number of financial proxies and control variables have been studied (equations 33-36). In each model specification, the error correction term $\hat{Z}_t$ has been estimated using the cointegrating vector obtained from Park's CCR for each 16 countries in the sample.

Next step in this study is to run Seemingly Unrelated Regression Error Correction Model (SURECM) using the error correction term $\hat{Z}_t$, which can be estimated using the cointegration vector from Park's CCR. Seemingly unrelated models are called so due to contemporaneous errors, which may be correlated across the system of equation. A single model may contain a number of linear equations. In such a model it is often unrealistic to expect that the equation errors would be uncorrelated. A set of equations that has contemporaneous cross-equation error correlation (i.e. the error terms in the regression equations are correlated) is called a seemingly unrelated regression (SUR) system. At first look, the equations seem unrelated, but the equations are related through the correlation in the errors. Zellner (1962) suggested the Seemingly Unrelated Regression (SUR) model as *p* correlated regression equations and the *p* regression equations are "seemingly unrelated" because taken separately the error terms would follow standard linear OLS linear model form. However, the standard OLS model normally ignores any correlation among the residuals across equations. In SUR models the dependent variables are correlated and the design matrices may contain some of the same variables there may be contemporaneous" correlation among the errors across the *p* equations. Therefore, SUR models are often employed when there may be several equations, which appear to be unrelated; however, they may be related by the fact that: (1) some coefficients are the same or assumed to be zero; (2) the disturbances are correlated across equations; and/or (3) a subset of right hand side variables are the same. If the equations in the system have exactly same number of explanatory variables and exactly same lag-length, then there is no efficiency gain for running SUR. The efficiency gain can be obtained only if cross-sectional terms $\Delta y_{1t}, \Delta y_{1t}$ and $\Delta y_{it}$ (in our example DCBY, TY, GOVY, GSY and CPI) are highly correlated with each other. So ECM for all countries in the sample will be investigated as a system of seemingly unrelated equations, which will account for cross-equation correlation of residuals among countries.

*Granger Causality test*

Correlation and cointegration do not necessarily imply the causality in any meaningful sense of this word. Many previous literatures employed one of the two asymptotically equivalent test procedures for testing the null hypothesis of unidirectional causality against the alternative of feedback such as Granger (1969) and Sims (1972) causality tests. In this study, in order to study for causal relationships between the financial development and economic growth and find the direction of causality, the Granger causality test has been adopted. The Granger (1969) method is to question whether $x_t$ causes $y_t$ and see how much of the current value of $y_t$ can be explained by past values of $y_t$ and then to see whether adding lagged values of $x_t$ can improve the explanation of $y_t$. In order words, Granger causality test can be interpreted as following: $y_t$ said to be Granger-caused by $x_t$ if $x_t$ helps in prediction of $y_t$ and the coefficients of lagged values of $x_t$ are statistically significant. By running Granger causality test we investigate the following hypothesis:

$H_0$: X does not cause Y (or $H_0$: $\beta_1 = \beta_2 = \ldots = \beta_m = 0$; from the VAR model $Y_t = \sum \alpha_i Y_{t-i} + \sum \beta_i X_{t-i} + \varepsilon_t$), against alternative hypothesis of

Ha: X Granger cause Y.

Rejection of null hypothesis implies that current and past lagged values of $x_t$ help predict the current values of $y_t$. Analogically, this technique can be used in investigating whether or not $y_t$ causes $x_t$. In this study regular VAR based Granger causality test and Granger causality test based on SURECM in system method were employed to compare the results of regular Granger test versus system method.

## II.3. EMPIRICAL RESULTS

This section provides the description of data analysis and discusses the results of various tests to investigate the relationship between financial development and economic growth and find the direction of causality. The results of all tests are discussed in the separate subsections.

*Unit root tests*

Before proceeding to the identification of a possible relationship, it's important to verify that all variables are integrated of order one in levels or they are I(1) process. In this study, two tests are performed to test for unit root or stationarity, such as the Augmented Dickey-Fuller (ADF) test, which tests if series exhibit unit root and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test, which tests if series are stationary.

ADF test regresses the first difference of variable against a set of lagged variables of itself. The null hypothesis is that the series contain a unit root against the alternative no unit root. Selection of lag length is an important step in the ADF test. If number of lags is too small then the remaining serial correlation in the errors will bias the test. If number of lags is too large then the power of the test will suffer. One possible way is to examine the t-values on coefficients using General-to-specific method also known as Hall's method. An alternative approach is to examine the Akaike or Bayesian information criterion. Table 2.1 describes ADF test results with three different results for lag-length selection for 16 Asian economies during the period 1980-2010 for seven variables such as LY (log of real GDP), DCBY (the ratio of domestic credit issued by banks to GDP), BM the ratio of broad money to GDP), TY (the ratio of total trade to GDP), GSY (the ratio of gross domestic savings to GDP), GOVY ( the ratio of government expenditures to GDP), and CPI (the inflation rate measured by CPI). In most of the cases, we fail to reject the null hypothesis that they contain unit root. ADF test results confirm that almost all variables are non-stationary at 5 % significance level with the exception of BM for Pakistan, GOVY for Australia, Indonesia, Singapore, and Thailand, TY for New Zealand, and GSY for Nepal, New Zealand, and Sri Lanka (which are already stationary in levels) and they are stationary after first differencing.

On the contrary the null hypothesis of KPSS test is that the series are stationary versus an alternative of non-stationary. The results of KPSS test clearly indicate that variables are not stationary or trend-stationary in levels, since in almost every case the null hypothesis at a significance level of 5% was rejected. Since the data selected in this study are non-stationary in levels and stationary in first differencing, we can now test for presence of cointegration among series.

*Cointegration Test*

Once we determine that the data series are integrated by means of unit root tests, it is now essential to verify whether they do form a cointegrated system of variables. If time-series variables are non-stationary, the next step is to see if there is a certain common trend between those non-stationary series. When two non-stationary series $X_t$~ I(1) and $Y_t$~ (1) have a linear relationship, which is expressed as $Z_t = Y_t - \gamma X_t$ and $Z_t$ ~ I(0), (Zt is stationary), then we say that these two series are cointegrated. Cointegration test is equivalent to examine if the residuals of regression between two non-stationary series, $Z_t$, are stationary. If residuals are stationary, two series $X_t$ and $Y_t$ are cointegrated. In this study, there are two different methods were used to test for presence of cointegration or test if series are cointegrated.

First, we employed Johansen-Juselius test for multivariate cointegration. The Johansen-Juselius cointegration approach produces two test statistics such as the trace, $\lambda_{trace}$, and maximum eigenvalue statistics, $\lambda_{max}$. We proceed sequentially from $r = 0$ to $r = k - 1$, where $k$ is the number of endogenous variables, until fail to reject to determine the number of cointegrating relations, $r$. The two tests of the null hypothesis of $r$ cointegrating relations against the alternative of $k$ cointegrating relations, for r = 0, 1,…, $k$-$1$ are reported in tables 2.3, 24, 2.5 and 2.6 for all four models. Based on the results of trace and maximum eigenvalue statistics, we can conclude that all models exhibit at least one cointegrating relations. However, Johansen-Juselius test for cointegration does not provide information whether the series present stochastic or deterministic cointegrating terms. In this regard, we run Park's CCR to test for long-run dynamics, for presence of deterministic or stochastic cointegrating terms and estimate the cointegrating vector for every single variable for each country and each thirteen models. In order to run Park's CCR, we adopted Masao Ogaki's Gauss code for Park's CCR and modified it for the given data set and model specifications. The results of CCR test are shown in tables 2.7, 2.8, 2.9 and 2.10, which display the cointegrating vectors for every single country and variables in each model. CCR results for Model 1, which includes DCBY as financial proxy and TY, GOVY, and CPI as control variables, the stochastic cointegrating restrictions are rejected at 5 % significant level for countries like Australia, India, New Zealand, and Singapore, however, the deterministic cointegrating restrictions are failed to reject at 5% significant level. In model 2, almost all countries have presence of stochastic cointegrating term except India, Indonesia, and New Zealand, where the deterministic cointegrating term are failed to reject at 5 % significant level. CCR results for model 3 shows that all countries exhibit the presence of stochastic cointegrating term except Australia and Singapore, which are showing the deterministic cointegrating term. In model 4, almost in all countries the stochastic cointegrating restriction are failed to reject at 5% significance level, excluding Nepal, New Zealand and Singapore. However, the deterministic cointegrating term are failed to reject at 5 % significant level for these three countries. So based on Park's CCR result, we can conclude that all countries in all four model exhibit the presence of cointegration, either its deterministic or stochastic cointegrating term. In addition to presence of cointegrating term, the magnitude and the signs of cointegrating vectors in all models are consistent with the economic theories and our expectations.

*ECM and SURECM*

Based on CCR results we were able to estimate the cointegrating vectors for our models under the investigation. Now, next step in this study is to investigate the short-run and long-run dynamics between financial development and economic growth by running Error Correction Model (ECM) and Seemingly Unrelated Regression Error Correction Model (SURECM) in the system method. Through error correction term, ECM and

SURECM allow the discovery of Granger Causality relation between the financial development and economic growth for Asian countries. The results of ordinary ECM and SURECM for models 1 and 2 are reported in Tables 2.11 and 2.12.

We do not have statistically significant $\hat{\lambda}_0$ for all countries based on regular ECM results for model 1. However, the results of non-restrictive SURECM indicate that 8 countries out of 16 have statistically significant $\hat{\lambda}_0$. This significant improvement has been obtained due to system method, which is more efficient than ordinary methods. More specifically, when markets have a close relationship with one another, SURECM approach accounts for cross equation correlations among the countries in the system. SURECM method utilizes the information in the variance-covariance matrix of residuals in the system to improve the efficiency. In addition to running non-restrictive SURECM, we have also run the restricted SURECM by applying the restrictions that all countries have same coefficient for speed of adjustment. The results of restrictive model show that we reject the null hypothesis and conclude that $\hat{\lambda}_0$ are not equal for all countries in the system. This result is fairly same as we run panel error correction model assuming that countries in this sample are homogeneous. However the results of restrictive SURECM revealed the heterogeneity of countries in this study. Since the countries in this study are Asian economies which share same geographical location, trading partners and historical-cultural background, however, they are heterogeneous in terms of their income, economic growth and level of financial liberalization. In order to eliminate the heterogeneity issue, we have run SURECM for high-income, middle-income and low-income countries separately. The results of non-restrictive SURECM for different income groups show that none of countries exhibit statistically significant speed of adjustment coefficient for high-income countries group, statistically significant coefficient at 1% and 10% level for middle-income and low-income countries respectively. In addition to this, it was interesting to see the effect of Chinese economy among the countries in the region. So we have run SURECM without China. Based on this result we can see that the results have been worsened significantly and there are only 5 countries with statistically significant speed of adjustment coefficient instead of seven as before. Also number of countries with statistically significant coefficients has been reduced for group of middle-income countries as well. Based on these two different results of SURECM, we can conclude that we cannot imagine world economy, especially, Asian economies without China.

Furthermore, the regular ECM and non-restrictive SURECM results for model 2 is reported in Table 2.12. Here, only Korea, Singapore, Thailand, Bangladesh and India exhibit statistically significant estimates for speed of adjustment, saying that there are only 5 countries out of 16 display long run relations between economic growth and the financial development, which has been improved significantly after running the same model in the system method. The results of non-restrictive SURECM show that 13 countries out of 16 have a long run relationship between finance (expressed as the ratio of domestic credit issued by banks to GDP) and growth.  Model 2 differs from model 1 in that it has a different set of control variables, which accounts for the role of gross domestic savings instead of role of international trade as one of the growth factors. The inclusion of GSY instead of TY as one of the control variables significantly improved the results of estimation. Economic theory recognizes the role of savings for economic development, which is shown in the results of SURECM of Model 2. The restrictive SURECM for model 2 shows that we reject the null hypothesis that speed of adjustment coefficinet $\hat{\lambda}_0$ are same for all 16 countries. The results of non-restrictive SURECM for different income groups show that only 2 countries exhibit statistically significant speed of adjustment coefficient for high-income and middle-income countries and 3 counties in low-income group. However, the results of restrictive SURECM also present the fact of heterogeneity of the markets. Similar results can be said about the role of China in Asian economy. Table 2.12 also shows that there is a reduction in number of countries with statistically significant speed of adjustment coefficient. In this case, we have only 8 countries out of 16 with long run relationship between financial development and economic growth. However, there are not many changes in SURECM results in three income groups. Models 1 and 2 employ DCBY (the ratio of domestic credit issued by banks to GDP) or the degree of dependence upon banking sector (or role of bank loan) as financial proxy.

Similarly, the results of ordinary ECM and SURECM for models 3 and 4 are reported in Tables 2.13 and 2.14, however in these models BM (the ratio of broad money to GDP) has been used as financial proxy with the same sets of control variables as model 1 and 2 such that model 3 includes TY, GOVY, CPI and model 4 includes GOVY, GSY, CPI as control variables. The results of ordinary ECM for model 3 indicate that only India has cointegrating relationship between financial development and economic growth. However, the results of non-restrictive SURECM show that there are 9 countries out of 16 have statistically significant point estimates of speed of adjustment coefficient $\hat{\lambda}_0$, and we reject the null hypothesis in restrictive SURECM model as before. We run sensitivity analysis by running SURECM without China, which shows a slight reduction in number of countries with statistically significant coefficients and fairly similar results for restrictive model.

Finally, ECM and SURECM results for model 4 are reported in Tables 2.14. The result of regular ECM shows only four countries have statistically significant speed of adjustment coefficient, while non-restrictive SURECM shows 9 countries in the sample have statistically significant $\hat{\lambda}_0$, which demonstrates the presence of long-run relationship between financial development and economic growth. The restrictive SURECM displays that speed of adjustment coefficients are not same for all countries, which points out to the fact that countries are not homogenous. We have also run sensitivity analysis for entire system and middle income sub-group without China and as before the number of countries with statistically significant speed of adjustment has been decreased compare to initial SURECM results.

*Granger Causality test*

Final test in this study is to test for contemporaneous causality relationship between financial development and economic growth. Granger causality test based on ordinary VAR and Granger causality test based on SURECM methods are employed to test for contemporaneous causality and find the direction of causality. The results of VAR based Granger causality tests are reported in Tables 2.15, 2.16, 2.17, and 2.18. According to Granger causality tests presented in Table 2.15, we found no evidence of causality in either direction between total bank credit and economic growth for 12 countries, evidence of two-way causality in only one country, evidence of positive causality running from finance to growth in two countries and negative causality running from growth to finance in one country. The results of VAR based Granger causality test of model 1 provide a weak support for the hypothesis that Levine and King discussed that financial development ‘leads’ economic growth.

The results of VAR based Granger causality test for model 2 provide similar evidence as in model 2: we found the evidence of no causality in 8 countries; the evidence of positive causality in four countries; the evidence of reverse causality running from economic growth to finance in two countries; and bidirectional causality for two countries. Again these results do not provide sufficient evidence to support the hypothesis that financial development ‘leads’ productivity growth and, consequently, the economic growth. The results of models 1 and 2 are consistent with the earlier empirical literature such as Shan and Morris (2002) and Hassan, Sanchez and Yu (2011), who also examined the causality pattern by employing ordinary Granger causality test or panel Granger causality test.

VAR based Granger causality test results for model 3 indicate the evidence of no causality in 6 countries, positive causality running from finance to growth in 5 countries, reverse causality running from growth to finance in one country, and bidirectional causality in four countries. VAR based granger causality results for model 4 show the evidence of no causality for 8 countries, the evidence of positive causality for three countries, the evidence of reverse causality for three countries, and bidirectional causality case for Sri Lanka and Thailand only. The results of models 3 and 4 are consistent with previous studies where VAR based Granger causality method was employed. These results however are in sharp contrast to those of King and Levine (1993a) and Rajan and Zingales (1998) who applied cross sectional approach and concluded that financial development is a necessary precursor of economic growth. Based on the VAR based Granger causality test results of these four models we can conclude that: 1) the pattern of causality between the financial development and economic growth may be country specific; 2) Granger causality test results greatly affected by selection of variables, specifically financial proxy and control variables; 3) the direction of causality might be different due to selection of econometric methods used to examine the causality itself. Our empirical evidence of VAR based Granger causality test is consistent with previous literature, where VAR method was employed and contradicts the findings of studies where cross sectional or panel data approach were used.

Next we run Granger causality test based on SURECM method to see if there are any improvements in our results if system method is applied and is there any stylized evidence on causality relationship between financial development and economic growth. The results of SURECM based Granger causality tests are reported in Tables 2.15, 2.16, 2.17, and 2.18, which also contain Granger causality test results for different income groups and with/without China case. SURECM based Granger causality test results brought many interesting empirical evidences and the results vary depending on selection of financial proxy, selection of control variables, including/excluding China, and levels of income group. Due to these facts, the Granger causality test results are summarized in the following subsections.

- *Granger causality test: evidence on DCBY versus BM case*

As mentioned before, in models 1 and 2 DCBY is used as financial proxy and in models 3 and 4 BM is used as financial proxy. Based on Granger causality test results, we found a considerable evidence of bidirectional causality in most of the countries in the sample, which are summarized in tables 2.19 and 2.20. In model 1 we found 11 countries out of 16 with bidirectional causality, 1 country with positive causality running from finance to growth, and 4 countries with reverse causality. First of all, there is a significant improvement from regular VAR based Granger causality test results. For high-income group we have 3 out of 5 countries with bidirectional causality, 1 country with positive causality and 1 country with reverse causality. For middle income countries, 5 countries out of 6 have bidirectional causality and one country with positive causality. For low income countries sub-group, there are 2 countries with bidirectional causality, 2 countries have positive causality, and 1 country with reverse causality. However, the results of model 3, which uses BM as financial variable and exactly same set of control variables as in model 1, are showing different results. As with model 1, Granger causality test for model 3 shows that 10 countries out of 16 have bidirectional causality and 6 countries with reverse causality. Test result for high income group demonstrates 4 countries with bidirectional causality and one country with reverse causality. For middle income country group half of the countries exhibit bidirectional causality and another half have reverse causalities. Low income sub-group also contains the similar results as in middle income group: 3 countries have bidirectional causality and remaining 2 countries have reverse causality. The results of sensitivity analysis for all countries and middle-income group without China for models 1 and 3 have been worsened significantly. In Model 1 for all countries excluding China, Pakistan does not have any causality evidence and 3 countries out of 5 do not exhibit any causality for middle-income sub-group. In model 3 Singapore and Thailand do not have any causal relationship between finance and economic growth.

This evidence clearly demonstrates the importance of Chinese economy in the region, more precisely China is important integral part in the Asian economy, major trade partner and largest producer.

Granger causality test results of model 2 demonstrate that half of the countries have bidirectional causality, 5 countries out of 16 have positive causality, and 3 countries have reverse causality. For high income group there are 2 countries out of 5 have bidirectional causality, one country with positive causality, and 2 countries with reverse causality. Granger causality test for middle income group shows that there are 2 countries with bidirectional causality, 3 countries out of 5 have positive causality, and one country with reverse causality. For low income group there is evidence of bidirectional causality in two countries, positive causality in one country, reverse causality in one country and no causality in one country. The results of model 4 show that 13 countries out of 16 have two-way causal relationship, reverse causality in 2 countries, and no causality in one country (Indonesia). For high income country group, we found the evidence of bidirectional causality in 3 countries out of 5 and positive causality in 2 countries. Granger causality test results for middle income sub-group report that there are 2 countries out of 6 with bidirectional causality, 3 countries with reverse causality, and one country with positive causality. However, the test results for low income countries demonstrate that there are 3 countries out of 5 with bidirectional causality and remaining two countries with reverse causality. As before, the sensitivity analysis for models 2 and 4 without China shows a substantial reduction in number of countries with no causality whatsoever for middle-income group and a small reduction for entire set. According to these results we can conclude that China plays a significant role in the Asian economy and it's not accurate to study the Asian region without China's economy.

Based on these results of model 1 and 3, and model 2 and 4, we can conclude: 1) there is strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) there is an evidence of positive causality running from finance to growth when we use DCBY as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) there is a tendency of reverse causality running from growth to finance when BM is used as financial proxy, pointing out to the important role of formal bank intermediation for economic growth; and 4) cases of positive and reverse causality are more prominent for middle to low income countries.

Moreover, these findings are consistent with empirical evidence of 1st essay, which studies the long-run relationship between financial development and economic growth for high-income OECD countries.

- *Granger causality test: evidence on TY versus GSY case*

In models 1 and 2, DCBY is used as financial proxy, however, in model 1 TY, GOVY, CPI and in model 2 GSY, GOVY, CPI are used as control variables respectively. Comparative summaries of these models are reported in Tables 2.19 and 2.20. The main purpose of running these two sets of different models is to conduct the sensitivity analysis on control variables. When we compare model 1 and 2, there are 11 countries out of 16 in model 1 and 8 countries out of 16 with bidirectional causality, 1 country in model 1 and 5 countries in model 2 with positive causality, and 4 countries in model 1 and 3 countries in model 2 with reverse causality. When we use different set of control variables, the Granger causality test results are about the same with main outcome of bidirectional causality in most cases and positive causality as next evidence when DCBY is used as financial proxy. The sensitivity analysis demonstrates that direction of causality is not sensitive to selection of variables in models 1 and 2. The similar results are obtained in sub-groups of high, middle and low income sub-groups. In high income sub-group, there are 3 countries in model 1 and 2 countries in model 2 with bidirectional causality, 1 country in model 1 and 1 country in model 2 with positive causality, and 1 country in model 1 and 2 country in model 2 with reverse causality. For middle income countries, there is an evidence of bidirectional causality in majority of countries in both models and half of the countries with positive causality in model 2. Finally, for low income sub-group we found bidirectional causality cases in two countries in both models, and strong evidence of positive causality running from finance to growth in model 1. Based on these results we can conclude that the model specification is not sensitive to selection of control variables. In both models 1 and 2, we have a consistency with our previous conclusion that when DCBY is used as financial proxy, the direction of causality is two way and there is a presence of positive causality as a second evidence. Same sensitivity analysis has been conducted for models 3 and 4, where BM is used as financial proxy and TY, GOVY, CPI in model 3 and GSY, GOVY, CPI in model 4 are used as control variables. The results are similar to that of model 1 and 2. We found the evidence of bidirectional causality in majority of countries: 10 countries out of 16 in model 3 and 13 countries out of 16 in model 4. Also the cases of reverse causality as secondary evidence found in all sub-groups in model 3 and 4 with the exception of low income sub-group in model 4,which shows the presence of positive causality. We can summarize that whenever BM is used as financial proxy there is a strong tendency of reverse causality running from growth to finance as secondary evidence after bidirectional causality cases. Sensitivity analysis demonstrates that using TY (the share of total trade to GDP) or GSY (the share of gross savings to GDP) does not affect the model specification and direction of causality.

- *Granger causality test: evidence on with China versus without China case*

Another important part of SURECM based Granger causality test is to conduct the sensitivity test of Chinese economy on Asian economy, trade, investment and financial system. Over the last decade three words seen very often were "made in China". Important evidence found about the role of China or impact of Chinese economy on regional economy. Sensitivity test were conducted for all four models. In model 1, after running SURECM-based Granger causality test, without China, the number of countries with no causality between financial development and economic growth increased from zero to one. Even though this is considered a very small change, but this result still shows the importance of China in the region. In addition to this, Granger causality test without China has been done for group of middle income countries. Granger causality test for this sub-group demonstrates a significant change in causality: now we have three countries with causality, which does not make any economic sense. In today's world economy, we cannot imagine any economy without China effect. So the results of model 1 with and without China highlight the important role and impact of China in the region and this effect is more significant among developing countries, especially for middle income countries.

We found similar results in Model 2, 3 and 4 as well. In model 2 for Granger causality test for all countries without China, this time Australia shows no causality between finance and growth at all versus positive causality in initial test. More dramatic results are obtained in middle income sub-group, when China was excluded from Granger causality test it shows three countries out of five exhibit no causality versus none in initial test. In model 3 Indonesia and Korea have no causality after excluding China from the test and for middle income sub-group 4 countries out of 5 do not have any causality relationship between financial development and economic growth. We can say same conclusion about model 4 as well. For model 4, there are 3 countries now have no causality in middle income sub-group. In summary, China has a huge impact on Asian economy and more precisely it has a significant impact on middle income countries' economy as trade partner, producer and investor.

## II.4. SUMMARY AND CONCLUSION

The main purpose of this study is to investigate the long-run dynamics and the direction of causality between financial development and economic growth for 16 Asian economies with different levels of income and in most efficient manner via system method. In this study ADF and KPSS unit root tests, Johansen-Juselius and Parks CCR test for cointegration, ECM, SURECM and Granger causality test in system method were employed as empirical evidence. Based on the results of Granger causality test in system method, I found: 1) strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) an evidence of positive causality running from finance to growth when we use DCBY as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) a tendency of reverse causality running from growth to finance when BM is used as financial proxy, pointing out to the important role of formal bank intermediation for economic growth; 4) cases of one-way causality such as positive and reverse causality are more prominent for middle to low income countries.; 5) an evidence that China has a huge impact on Asian economy and more precisely it has a significant impact on developing economies such as middle and low income countries; and 6) selection of control variables does not affect the model specification and the direction of causality. These results are consistent with earlier literature in that the direction of causality may be country specific. However, it does not support King and Levine's (1993a) conclusion that finance is a leading sector to economic growth. The findings clearly demonstrate that the directions of causality vary across countries and emphasis that the system method is superior to single equation approach. In addition to this, it's worthwhile to mention that the findings in this essay are consistent with empirical evidence of 1st essay, which studies the long run relationship between financial development and economic growth for high-income OECD countries. The question might give some further guidance as to whether a well-developed financial sector is a necessary condition for a higher growth rates for developing countries and provide an important policy implication both for OECD countries as well as for countries that have financial sectors that are comparatively underdeveloped.

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**APPENDIX B**: Tables for Chapter II

Table 2. 1 Univariate Unit Root tests: ADF

| country | Log GDP: t-tests, lags were determined by | | | | | | DCBY:t-tests, lags were determined by | | | | | | BM: t-tests, lags were determined by | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | |
| Australia | 5.069 | 0 | -1.358 | 1 | -1.252 | 0 | 3.361 | 0 | 3.361 | 0 | 3.361 | 0 | 3.875 | 0 | 3.875 | 0 | 3.875 | 0 |
| Bangladesh | 2.040 | 0 | 2.040 | 0 | 2.040 | 0 | 1.348 | 0 | 1.348 | 0 | 1.348 | 0 | 1.775 | 2 | 1.775 | 2 | 1.775 | 2 |
| China | 4.965 | 2 | 2.057 | 0 | 0.549 | 1 | -0.883 | 0 | -0.883 | 0 | -0.883 | 0 | 0.201 | 0 | -0.133 | 2 | 0.201 | 0 |
| India | 16.320 | 0 | 1.506 | 0 | 1.506 | 0 | 0.901 | 0 | 0.901 | 0 | 0.901 | 0 | 0.753 | 1 | 1.275 | 2 | 0.753 | 1 |
| Indonesia | 4.155 | 0 | -0.445 | 0 | -0.445 | 0 | -1.268 | 0 | -1.268 | 0 | -1.268 | 0 | -1.558 | 0 | -1.558 | 0 | -1.558 | 0 |
| Japan | -2.036 | 0 | -2.929 | 2 | -4.212 * | 0 | -1.468 | 2 | -1.347 | 1 | -1.408 | 0 | -1.704 | 2 | -1.704 | 2 | -1.704 | 2 |
| Korea | 4.839 | 0 | -2.504 | 0 | -2.504 | 0 | 0.360 | 0 | -0.055 | 1 | 0.360 | 0 | -0.600 | 1 | -0.600 | 1 | -0.600 | 1 |
| Malaysia | 4.750 | 0 | -1.421 | 0 | -1.421 | 0 | -1.350 | 0 | -1.350 | 0 | -1.350 | 0 | -1.077 | 0 | -1.077 | 0 | -1.077 | 0 |
| Nepal | 8.341 | 0 | 1.810 | 0 | 1.810 | 0 | 1.784 | 0 | 1.784 | 0 | 1.784 | 0 | 2.659 | 2 | 2.713 | 0 | 2.713 | 0 |
| New Zealand | -0.005 | 1 | 0.229 | 0 | 0.229 | 0 | 0.273 | 0 | 0.273 | 0 | 0.273 | 0 | -0.931 | 1 | -0.931 | 1 | -0.931 | 1 |
| Pakistan | 3.346 | 1 | -2.452 | 0 | -2.452 | 0 | -3.775 | 1 | -3.775 | 1 | -3.775 | 1 | -4.589 ** | 1 | -4.589 ** | 1 | -4.589 ** | 1 |
| Papua N. G. | -1.143 | 1 | -1.761 | 0 | -1.761 | 0 | -1.830 | 0 | -1.830 | 0 | -1.830 | 0 | -0.628 | 0 | -0.628 | 0 | -0.628 | 0 |
| Philippines | 2.624 | 1 | -1.127 | 0 | -1.127 | 0 | -1.735 | 0 | -1.928 | 1 | -1.735 | 0 | 0.388 | 0 | 0.052 | 1 | 0.388 | 0 |
| Singapore | 5.945 | 2 | -2.333 | 0 | -2.333 | 0 | -1.358 | 0 | -1.358 | 0 | -1.358 | 0 | 0.338 | 0 | 0.338 | 0 | 0.378 | 0 |
| Sri Lanka | 10.916 | 0 | 1.431 | 0 | 1.431 | 0 | -2.501 | 0 | -2.501 | 0 | -2.501 | 0 | -0.995 | 0 | -1.343 | 1 | -1.343 | 1 |
| Thailand | 1.813 | 1 | -2.580 | 0 | -2.580 | 0 | -1.081 | 1 | -1.081 | 1 | -1.081 | 1 | -0.607 | 1 | -0.519 | 2 | -0.607 | 1 |

| country | GOVY: t-tests, lags were determined by | | | | | | TY: t-tests, lags were determined by | | | | | | GSY: t-tests, lags were determined by | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | | GTS | | AIC | | BIC | |
| Australia | -2.777 * | 0 | -2.777 * | 0 | -2.777 * | 0 | -0.399 | 0 | -0.399 | 0 | -0.399 | 0 | -1.863 | 0 | -1.863 | 0 | -1.863 | 0 |
| Bangladesh | -2.096 | 0 | -2.096 | 0 | -2.096 | 0 | -0.303 | 0 | -0.303 | 0 | -0.303 | 0 | -0.729 | 1 | -0.729 | 1 | -0.729 | 1 |
| China | -1.740 | 1 | -1.740 | 1 | -1.501 | 0 | -0.924 | 0 | -1.071 | 1 | -0.921 | 0 | -0.464 | 0 | -0.464 | 0 | -0.464 | 0 |
| India | -2.526 | 0 | -2.526 | 0 | -2.526 | 0 | -0.436 | 2 | 1.738 | 1 | 1.271 | 0 | -0.314 | 1 | -0.314 | 1 | -0.314 | 1 |
| Indonesia | -2.972 ** | 0 | -2.972 ** | 0 | -2.972 ** | 0 | -1.802 | 1 | -2.022 | 2 | -1.802 | 1 | -1.676 | 0 | -1.676 | 0 | -1.676 | 0 |
| Japan | -0.264 | 1 | -0.264 | 1 | -0.264 | 1 | -1.802 | 0 | -1.802 | 0 | -1.802 | 0 | -1.120 | 0 | -1.120 | 0 | -1.120 | 0 |
| Korea | -1.763 | 0 | -1.763 | 0 | -1.763 | 0 | -1.047 | 0 | -1.047 | 0 | -1.047 | 0 | -2.514 | 0 | -2.514 | 0 | -2.514 | 0 |
| Malaysia | -2.568 | 0 | -2.568 | 0 | -2.568 | 0 | -0.827 | 1 | -0.827 | 1 | -0.827 | 1 | -1.033 | 2 | -1.033 | 2 | -1.252 | 0 |
| Nepal | -2.332 | 0 | -2.332 | 0 | -2.332 | 0 | -0.879 | 0 | -0.879 | 0 | -0.879 | 0 | -2.809 * | 0 | -2.809 * | 0 | -2.809 * | 0 |
| New Zealand | -1.966 | 0 | -1.966 | 0 | -1.966 | 0 | -3.180 ** | 0 | -3.180 ** | 0 | -3.180 ** | 0 | -4.910 ** | 1 | -4.910 ** | 1 | -4.910 ** | 1 |
| Pakistan | -2.144 | 0 | -2.144 | 0 | -2.144 | 0 | -2.338 | 0 | -2.338 | 0 | -2.338 | 0 | -2.032 | 0 | -2.032 | 0 | -2.032 | 0 |
| Papua N. G. | 0.512 | 2 | 0.512 | 2 | 0.512 | 2 | -2.101 | 1 | -1.753 | 2 | -2.101 | 1 | -2.091 | 0 | -2.091 | 0 | -2.091 | 0 |
| Philippines | -2.245 | 1 | -2.245 | 1 | -2.245 | 1 | -1.519 | 0 | -1.519 | 0 | -1.519 | 0 | -1.729 | 0 | -1.729 | 0 | -1.729 | 0 |
| Singapore | -2.700 * | 0 | -3.233 ** | 1 | -2.700 * | 0 | -1.729 | 0 | -1.729 | 0 | -1.729 | 0 | -2.420 | 0 | -2.420 | 0 | -2.420 | 0 |
| Sri Lanka | -1.106 | 0 | -1.106 | 0 | -1.106 | 0 | -1.322 | 0 | -1.322 | 0 | -1.322 | 0 | -3.241 ** | 0 | -3.241 ** | 0 | -3.241 ** | 0 |
| Thailand | -2.607 * | 1 | -2.607 * | 1 | -2.607 * | 1 | 0.143 | 0 | 0.143 | 0 | 0.143 | 0 | -1.798 | 0 | -1.798 | 0 | -1.798 | 0 |

Rejection of the null hypothesis by the ADF tests suggests the evidence of no unit root.

** and * represent significance at 5% and 10% levels, respectively

The critical values for t-statistics with 50 observations are -2.93and -2.60 for 5 % and 10 % significant levels, respectively.

Table 2. 2 Univariate Unit Root tests: KPSS

| country | Log GDP: t-tests, lags were determined by | | | DCBY:t-tests, lags were determined by | | | BM: t-tests, lags were determined by | | |
|---|---|---|---|---|---|---|---|---|---|
| | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC |
| Australia | 3.597 ** 1 | 1.858 ** 2 | 3.597 ** 1 | 1.632 ** 2 | 1.632 ** 2 | 1.632 ** 2 | 2.753 ** 1 | 1.444 ** 2 | 2.753 ** 1 |
| Bangladesh | 3.956 ** 1 | 2.038 ** 2 | 3.956 ** 1 | 2.613 ** 1 | 2.613 ** 1 | 2.613 ** 1 | 2.685 ** 1 | 2.685 ** 1 | 2.685 ** 1 |
| China | 4.103 ** 1 | 4.103 ** 1 | 4.103 ** 1 | 1.383 ** 2 | 1.383 ** 2 | 1.383 ** 2 | 2.683 ** 1 | 2.683 ** 1 | 2.683 ** 1 |
| India | 2.082 ** 2 | 2.082 ** 2 | 2.082 ** 2 | 4.693 ** 0 | 3.800 ** 1 | 4.693 ** 0 | 4.711 ** 0 | 1.957 ** 2 | 4.711 ** 0 |
| Indonesia | 4.123 ** 1 | 4.123 ** 1 | 4.123 ** 1 | 3.206 ** 0 | 1.316 ** 2 | 3.206 ** 0 | 2.854 ** 1 | 2.854 ** 1 | 2.854 ** 1 |
| Japan | 3.150 ** 1 | 1.629 ** 2 | 3.150 ** 1 | 3.263 ** 1 | 3.263 ** 1 | 3.263 ** 1 | 3.057 ** 1 | 3.057 ** 1 | 3.057 ** 1 |
| Korea | 5.096 ** 0 | 4.116 ** 1 | 5.096 ** 0 | 3.683 ** 1 | 3.683 ** 1 | 3.683 ** 1 | 4.221 ** 0 | 4.221 ** 0 | 4.221 ** 0 |
| Malaysia | 2.115 ** 2 | 2.115 ** 2 | 2.115 ** 2 | 3.618 ** 1 | 1.866 ** 2 | 3.618 ** 1 | 3.619 ** 1 | 3.619 ** 1 | 3.619 ** 1 |
| Nepal | 5.079 ** 0 | 5.079 ** 0 | 5.079 ** 0 | 3.817 ** 1 | 3.817 ** 1 | 3.817 ** 1 | 3.778 ** 1 | 3.778 ** 1 | 3.778 ** 1 |
| New Zealand | 4.104 ** 1 | 2.102 ** 2 | 4.104 ** 1 | 3.841 ** 0 | 1.615 ** 2 | 3.841 ** 0 | 3.700 ** 0 | 3.700 ** 0 | 3.700 ** 0 |
| Pakistan | 3.233 ** 0 | 1.356 ** 2 | 3.233 ** 0 | 0.522 ** 1 | 0.522 ** 1 | 0.522 ** 1 | 0.498 ** 1 | 0.498 ** 1 | 0.498 ** 1 |
| Papua N. G. | 4.111 ** 1 | 4.111 ** 1 | 4.111 ** 1 | 1.530 ** 0 | 1.530 ** 0 | 1.530 ** 0 | 1.070 ** 1 | 0.612 ** 2 | 1.070 ** 1 |
| Philippines | 3.848 ** 1 | 1.995 ** 2 | 3.848 ** 1 | 1.892 ** 1 | 1.892 ** 1 | 1.892 ** 1 | 4.386 ** 0 | 1.803 ** 2 | 4.386 ** 0 |
| Singapore | 3.937 ** 1 | 2.032 ** 2 | 3.937 ** 1 | 3.129 ** 1 | 3.129 ** 1 | 3.129 ** 1 | 3.389 ** 1 | 3.389 ** 1 | 3.389 ** 1 |
| Sri Lanka | 4.114 ** 1 | 4.114 ** 1 | 4.114 ** 1 | 2.309 ** 0 | 1.046 ** 2 | 2.309 ** 0 | 3.768 ** 0 | 3.768 ** 0 | 3.768 ** 0 |
| Thailand | 4.104 ** 1 | 2.102 ** 2 | 4.104 ** 1 | 3.810 ** 1 | 3.810 ** 1 | 3.810 ** 1 | 4.871 ** 0 | 3.926 ** 1 | 4.871 ** 0 |
| country | GOVY: t-tests, lags were determined by | | | TY: t-tests, lags were determined by | | | GSY: t-tests, lags were determined by | | |
| | GTS | AIC | BIC | GTS | AIC | BIC | GTS | AIC | BIC |
| Australia | 1.046 ** 2 | 1.046 ** 2 | 1.046 ** 2 | 3.273 ** 1 | 1.691 ** 2 | 3.273 ** 1 | 1.250 ** 2 | 1.250 ** 2 | 1.250 ** 2 |
| Bangladesh | 1.524 ** 0 | 1.259 ** 1 | 1.524 ** 0 | 2.642 ** 1 | 2.642 ** 1 | 2.642 ** 1 | 3.467 ** 0 | 2.841 ** 1 | 3.467 ** 0 |
| China | 2.945 ** 1 | 2.945 ** 1 | 2.945 ** 1 | 1.575 ** 2 | 1.575 ** 2 | 1.575 ** 2 | 1.481 ** 2 | 1.481 ** 2 | 1.481 ** 2 |
| India | 3.644 ** 0 | 3.644 ** 0 | 3.644 ** 0 | 3.213 ** 1 | 1.656 ** 2 | 3.213 ** 1 | 4.380 ** 0 | 4.380 ** 0 | 4.380 ** 0 |
| Indonesia | 0.507 ** 1 | 0.430 ** 2 | 0.507 ** 1 | 2.798 ** 1 | 2.798 ** 1 | 2.798 ** 1 | 2.974 ** 0 | 2.431 ** 1 | 2.974 ** 0 |
| Japan | 2.688 ** 1 | 2.688 ** 1 | 2.688 ** 1 | 0.484 ** 1 | 0.484 ** 1 | 0.484 ** 1 | 1.411 ** 2 | 1.411 ** 2 | 1.411 ** 2 |
| Korea | 1.498 ** 1 | 0.825 ** 2 | 1.498 ** 1 | 2.848 ** 1 | 1.508 ** 2 | 2.848 ** 1 | 3.179 ** 1 | 3.179 ** 1 | 3.179 ** 1 |
| Malaysia | 1.398 ** 1 | 1.398 ** 1 | 1.398 ** 1 | 1.908 ** 2 | 1.908 ** 2 | 1.908 ** 2 | 4.514 ** 0 | 4.514 ** 0 | 4.514 ** 0 |
| Nepal | 0.901 ** 1 | 0.901 ** 1 | 0.901 ** 1 | 3.128 ** 1 | 3.128 ** 1 | 3.128 ** 1 | 1.824 ** 0 | 1.522 ** 1 | 1.824 ** 0 |
| New Zealand | 0.468 ** 0 | 0.468 ** 0 | 0.468 ** 0 | 0.840 ** 0 | 0.840 ** 0 | 0.840 ** 0 | 0.202 0 | 0.202 0 | 0.202 0 |
| Pakistan | 0.652 ** 0 | 0.652 ** 0 | 0.652 ** 0 | 5.084 ** 0 | 4.111 ** 1 | 5.084 ** 0 | 2.486 ** 0 | 2.058 ** 1 | 2.486 ** 0 |
| Papua N. G. | 0.652 ** 0 | 0.547 ** 1 | 0.652 ** 0 | 4.739 ** 0 | 1.995 ** 2 | 4.739 ** 0 | 3.376 ** 0 | 1.485 ** 2 | 3.376 ** 0 |
| Philippines | 4.473 ** 0 | 0.711 ** 0 | 4.473 ** 0 | 3.937 ** 1 | 3.937 ** 1 | 3.937 ** 1 | 2.425 ** 1 | 2.425 ** 1 | 2.425 ** 1 |
| Singapore | 0.217 ** 0 | 0.217 ** 0 | 0.217 ** 0 | 4.085 ** 1 | 2.095 ** 2 | 4.085 ** 1 | 1.308 ** 2 | 1.308 ** 2 | 1.308 ** 2 |
| Sri Lanka | 0.447 * 2 | 0.447 * 2 | 0.447 * 2 | 4.114 ** 1 | 4.114 ** 1 | 4.114 ** 1 | 1.424 ** 1 | 1.424 ** 1 | 1.424 ** 1 |
| Thailand | 0.934 * 0 | 0.409 * 2 | 0.934 ** 0 | 5.080 ** 0 | 5.080 ** 0 | 5.080 ** 0 | 4.232 ** 0 | 3.441 ** 1 | 4.232 ** 0 |

Rejection of the null hypothesis by the KPSS tests suggests the evidence of non-stationarity.
** and * represent significance at 5% and 10% levels, respectively
Critical values are 0.463 and 0.347 for 5% and 10% levels of significance, respectively.

Table 2.3 Johansen-Juselius test for cointegration
Model 1 LY =f(DCBY, TY, GOVY, CPI)

| | | Trace statistics: Hypothesized no. of CE (s) | | | | | Max-Eigen statistics: Hypothesized no. of CE (s) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | countries | None | At most 1 | At most 2 | At most 3 | At most 4 | None | At most 1 | At most 2 | At most 3 | At most 4 |
| 1 | Australia | 79.992 * | 46.567 | 21.314 | 8.244 | 1.780 | 33.425 * | 25.253 | 13.070 | 6.464 | 1.780 |
| 2 | Bangladesh | 90.117 ** | 57.809 ** | 33.481 * | 16.054 * | 3.059 | 32.308 | 24.328 | 17.426 | 12.995 | 3.059 |
| 3 | China | 122.112 ** | 63.208 ** | 31.966 * | 9.005 | 1.460 | 58.904 ** | 31.242 * | 22.961 * | 7.545 | 1.460 |
| 4 | India | 92.981 ** | 58.961 ** | 28.917 | 8.346 | 3.863 * | 34.021 * | 30.044 * | 20.570 | 4.483 | 3.863 * |
| 5 | Indonesia | 71.427 * | 36.574 | 13.885 | 4.713 | 0.105 | 34.854 * | 22.688 | 9.172 | 4.608 | 0.105 |
| 6 | Japan | 89.347 ** | 44.810 | 22.096 | 6.309 | 0.398 | 44.537 ** | 22.714 | 15.787 | 5.911 | 0.398 |
| 7 | Korea | 69.273 * | 27.623 | 15.418 | 6.509 | 1.647 | 41.651 ** | 12.204 | 8.909 | 4.862 | 1.647 |
| 8 | Malaysia | 74.157 * | 40.731 | 21.560 | 9.288 | 2.937 | 33.426 | 19.171 | 12.272 | 6.350 | 2.937 |
| 9 | Nepal | 112.542 ** | 38.730 | 17.048 | 5.439 | 0.908 | 73.812 ** | 21.683 | 11.609 | 4.530 | 0.908 |
| 10 | New Zealand | 107.583 ** | 50.069 * | 21.565 | 6.802 | 1.803 | 57.514 ** | 28.504 * | 14.763 | 4.999 | 1.803 |
| 11 | Pakistan | 71.649 * | 41.953 | 18.964 | 5.860 | 2.862 | 29.696 | 22.989 | 13.103 | 2.998 | 2.862 |
| 12 | Papua N. G. | 115.544 ** | 52.590 * | 22.354 | 9.174 | 0.070 | 62.954 ** | 30.236 * | 13.181 | 9.103 | 0.070 |
| 13 | Philippines | 70.499 * | 37.332 | 18.711 | 4.967 | 0.463 | 33.167 | 18.621 | 13.744 | 4.504 | 0.463 |
| 14 | Singapore | 90.988 ** | 58.741 ** | 27.606 ** | 13.187 | 5.044 * | 32.247 | 31.135 * | 14.419 | 8.143 | 5.044 * |
| 15 | Sri Lanka | 94.387 ** | 55.818 ** | 27.141 | 10.155 | 0.090 | 38.569 | 28.677 | 16.986 | 10.065 | 0.090 |
| 16 | Thailand | 90.026 ** | 55.302 ** | 31.650 * | 10.590 | 3.720 | 34.724 * | 23.652 | 21.061 | * | 3.720 |
| | | 5% CV | 1% CV | | | | 5% CV | 1% CV | | | |
| | | 68.520 | 76.070 | | | | 33.460 | 38.770 | | | |
| | | 47.210 | 54.460 | | | | 27.070 | 32.240 | | | |
| | | 29.680 | 35.650 | | | | 20.970 | 25.520 | | | |
| | | 15.410 | 20.040 | | | | 14.070 | 18.630 | | | |
| | | 3.760 | 6.650 | | | | 3.760 | 6.650 | | | |

* (**) denotes rejection of the hypothesis at the 5% (1%) level

Table 2.4 Johansen-Juselius test for cointegration
Model 2 LY =f(DCBY, GOVY, GSY, CPI)

| | | Trace statistics: Hypothesized no. of CE (s) | | | | | Max-Eigen statistics: Hypothesized no. of CE (s) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | countries | None | At most 1 | At most 2 | At most 3 | At most 4 | None | At most 1 | At most 2 | At most 3 | At most 4 |
| 1 | Australia | 80.254 ** | 45.177 | 22.263 | 5.260 | 0.007 | 35.077 * | 22.914 | 17.002 | 5.253 | 0.007 |
| 2 | Bangladesh | 179.741 ** | 89.827 ** | 40.851 ** | 11.810 | 0.209 | 89.914 ** | 48.976 ** | 29.041 ** | 11.601 | 0.209 |
| 3 | China | 304.856 ** | 163.624 ** | 70.189 ** | 17.002 * | 1.413 | 141.232 ** | 93.434 ** | 53.187 ** | 15.589 * | 1.413 |
| 4 | India | 78.557 * | 46.819 | 23.214 | 11.269 | 2.755 | 31.738 | 23.605 | 11.945 | 8.515 | 2.755 |
| 5 | Indonesia | 103.079 ** | 56.579 ** | 23.398 | 6.325 | 1.064 | 46.500 ** | 33.181 ** | 17.073 | 5.261 | 1.064 |
| 6 | Japan | 128.889 ** | 48.743 * | 20.819 | 5.321 | 0.079 | 80.146 ** | 27.924 * | 15.498 | 5.242 | 0.079 |
| 7 | Korea | 91.038 ** | 44.996 | 14.295 | 6.627 | 1.639 | 46.042 ** | 30.701 * | 7.667 | 4.988 | 1.639 |
| 8 | Malaysia | 69.968 * | 35.385 | 14.763 | 6.813 | 2.656 | 34.583 * | 20.622 | 7.950 | 4.157 | 2.656 |
| 9 | Nepal | 86.887 * | 41.682 | 16.640 | 5.131 | 1.287 | 45.204 * | 25.042 | 11.509 | 3.844 | 1.287 |
| 10 | New Zealand | 93.987 ** | 56.163 ** | 25.607 | 11.069 | 2.166 | 37.824 * | 30.556 * | 14.538 | 8.903 | 2.166 |
| 11 | Pakistan | 82.421 ** | 48.291 * | 24.211 | 10.242 | 0.105 | 34.130 * | 24.080 | 13.968 | 10.138 | 0.105 |
| 12 | Papua N. G. | 71.710 * | 43.157 | 22.788 | 9.377 | 0.001 | 28.554 | 20.369 | 13.411 | 9.375 | 0.001 |
| 13 | Philippines | 69.886 * | 36.990 | 18.425 | 5.306 | 0.112 | 32.896 | 18.565 | 13.119 | 5.195 | 0.112 |
| 14 | Singapore | 83.576 ** | 58.656 ** | 37.308 ** | 18.838 * | 7.937 ** | 24.921 | 21.348 | 18.470 | 10.901 | 7.937 ** |
| 15 | Sri Lanka | 85.620 ** | 49.614 * | 26.190 | 12.620 | 0.109 | 36.006 * | 23.424 | 13.570 | 12.511 | 0.109 |
| 16 | Thailand | 88.481 ** | 38.250 | 16.228 | 7.815 | 2.171 | 50.231 ** | 22.022 | 8.413 | 5.644 | 2.171 |
| | | 5% CV | 1% CV | | | | 5% CV | 1% CV | | | |
| | | 68.520 | 76.070 | | | | 33.460 | 38.770 | | | |
| | | 47.210 | 54.460 | | | | 27.070 | 32.240 | | | |
| | | 29.680 | 35.650 | | | | 20.970 | 25.520 | | | |
| | | 15.410 | 20.040 | | | | 14.070 | 18.630 | | | |
| | | 3.760 | 6.650 | | | | 3.760 | 6.650 | | | |

* (**) denotes rejection of the hypothesis at the 5% (1%) level

Table 2.5 Johansen-Juselius test for cointegration
Model 3 LY =f(BM, TY, GOVY, CPI)

| | | Trace statistics: Hypothesized no. of CE (s) | | | | | Max-Eigen statistics: Hypothesized no. of CE (s) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | countries | None | At most 1 | At most 2 | At most 3 | At most 4 | None | At most 1 | At most 2 | At most 3 | At most 4 |
| 1 | Australia | 80.544 ** | 51.343 * | 27.286 | 9.758 | 2.743 | 29.201 | 24.057 | 17.528 | 7.016 | 2.743 |
| 2 | Bangladesh | 229.460 ** | 104.050 ** | 64.666 ** | 29.079 * | 4.524 | 125.410 ** | 39.384 ** | 35.586 ** | 24.555 * | 4.524 |
| 3 | China | 233.015 ** | 120.683 ** | 59.525 ** | 22.733 ** | 5.838 * | 112.332 ** | 61.158 ** | 36.792 ** | 16.895 ** | 5.838 * |
| 4 | India | 114.129 ** | 73.897 ** | 40.143 ** | 19.282 * | 3.576 | 40.232 ** | 33.754 ** | 20.861 | 15.707 * | 3.576 |
| 5 | Indonesia | 111.658 ** | 41.275 | 14.345 | 5.189 | 0.000 | 70.383 ** | 26.930 | 9.157 | 5.188 | 0.000 |
| 6 | Japan | 109.658 ** | 53.513 * | 21.909 | 4.867 | 1.012 | 56.144 ** | 31.605 * | 17.042 | 3.855 | 1.012 |
| 7 | Korea | 89.425 ** | 51.379 * | 24.182 | 8.765 | 1.803 | 38.047 * | 27.197 * | 15.417 | 6.962 | 1.803 |
| 8 | Malaysia | 71.776 * | 42.916 | 22.158 | 9.184 | 2.798 | 28.860 | 20.758 | 12.974 | 6.386 | 2.798 |
| 9 | Nepal | 109.735 ** | 43.264 | 15.289 | 6.041 | 1.206 | 66.471 ** | 27.975 * | 9.248 | 4.835 | 1.206 |
| 10 | New Zealand | 123.681 ** | 58.032 ** | 21.275 | 9.470 | 1.192 | 65.649 ** | 36.757 ** | 11.805 | 8.278 | 1.192 |
| 11 | Pakistan | 69.232 ** | 34.853 | 16.122 | 5.337 | 1.161 | 28.379 | 18.731 | 10.784 | 4.176 | 1.161 |
| 12 | Papua N. G. | 81.040 ** | 49.144 * | 27.377 | 9.426 | 0.118 | 31.896 | 21.766 | 17.951 | 9.308 | 0.118 |
| 13 | Philippines | 108.769 ** | 44.658 | 23.452 | 8.007 | 0.474 | 64.111 ** | 21.206 | 15.445 | 7.533 | 0.474 |
| 14 | Singapore | 80.118 ** | 42.475 | 21.101 | 6.591 | 3.064 | 37.644 * | 21.374 | 14.510 | 3.527 | 3.064 |
| 15 | Sri Lanka | 80.423 ** | 40.133 | 21.653 | 8.670 | 1.010 | 40.289 ** | 18.481 | 12.982 | 7.660 | 1.010 |
| 16 | Thailand | 106.251 ** | 56.615 ** | 22.958 | 9.237 | 4.007 * | 49.636 ** | 33.657 ** | 13.721 | 5.230 | 4.007 * |
| | | 5% CV | 1% CV | | | | 5% CV | 1% CV | | | |
| | | 68.520 | 76.070 | | | | 33.460 | 38.770 | | | |
| | | 47.210 | 54.460 | | | | 27.070 | 32.240 | | | |
| | | 29.680 | 35.650 | | | | 20.970 | 25.520 | | | |
| | | 15.410 | 20.040 | | | | 14.070 | 18.630 | | | |
| | | 3.760 | 6.650 | | | | 3.760 | 6.650 | | | |

* (**) denotes rejection of the hypothesis at the 5% (1%) level

Table 2.6 Johansen-Juselius test for cointegration
Model 4 LY =f(BM, GOVY, GSY, CPI)

| | | Trace statistics: Hypothesized no. of CE (s) | | | | | Max-Eigen statistics: Hypothesized no. of CE (s) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | countries | None | At most 1 | At most 2 | At most 3 | At most 4 | None | At most 1 | At most 2 | At most 3 | At most 4 |
| 1 | Australia | 84.958 ** | 51.151 * | 27.701 | 5.549 | 0.010 | 33.807 * | 23.450 | 22.152 * | 5.540 | 0.010 |
| 2 | Bangladesh | 253.140 ** | 123.053 ** | 53.289 ** | 10.474 | 0.530 | 130.087 ** | 69.764 ** | 42.815 ** | 9.944 | 0.530 |
| 3 | China | 305.468 ** | 169.120 ** | 91.173 ** | 30.008 ** | 7.770 ** | 136.348 ** | 77.947 ** | 61.165 ** | 22.237 ** | 7.770 ** |
| 4 | India | 87.109 ** | 53.476 * | 24.103 | 12.395 | 3.145 | 33.633 * | 29.373 * | 11.709 | 9.250 | 3.145 |
| 5 | Indonesia | 98.077 ** | 39.423 | 19.033 | 7.882 | 1.008 | 58.653 ** | 20.390 | 11.151 | 6.874 | 1.008 |
| 6 | Japan | 129.562 ** | 45.505 | 18.475 | 5.424 | 0.437 | 84.057 ** | 27.030 | 13.051 | 4.986 | 0.437 |
| 7 | Korea | 72.860 * | 41.249 | 21.765 | 10.783 | 4.341 * | 31.611 | 19.485 | 10.982 | 6.442 | 4.341 * |
| 8 | Malaysia | 69.369 * | 34.416 | 15.959 | 6.396 | 2.296 | 34.953 * | 18.457 | 9.563 | 4.100 | 2.296 |
| 9 | Nepal | 97.475 ** | 47.365 * | 18.147 | 7.574 | 2.160 | 50.111 ** | 29.217 * | 10.573 | 5.414 | 2.160 |
| 10 | New Zealand | 92.788 ** | 58.037 ** | 26.065 | 11.711 | 0.062 | 34.751 * | 31.972 * | 14.354 | 11.649 | 0.062 |
| 11 | Pakistan | 78.334 ** | 51.184 * | 29.755 * | 11.469 | 0.132 | 27.150 | 21.429 | 18.286 | 11.337 | 0.132 |
| 12 | Papua N. G. | 80.837 ** | 39.128 | 15.987 | 4.168 | 0.009 | 41.708 ** | 23.142 | 11.819 | 4.158 | 0.009 |
| 13 | Philippines | 74.430 * | 37.966 | 14.420 | 6.486 | 0.140 | 36.464 * | 23.546 | 7.934 | 6.346 | 0.140 |
| 14 | Singapore | 87.732 * | 51.198 * | 26.184 | 9.965 | 2.244 | 36.534 * | 25.014 | 16.219 | 7.721 | 2.244 |
| 15 | Sri Lanka | 86.606 ** | 55.363 ** | 30.874 * | 12.620 | 1.015 | 31.243 | 24.489 | 18.254 | 11.606 | 1.015 |
| 16 | Thailand | 91.715 ** | 52.204 * | 23.037 | 8.804 | 3.684 | 39.512 ** | 29.166 * | 14.234 | 5.120 | 3.684 |
| | | 5% CV | 1% CV | | | | 5% CV | 1% CV | | | |
| | | 68.520 | 76.070 | | | | 33.460 | 38.770 | | | |
| | | 47.210 | 54.460 | | | | 27.070 | 32.240 | | | |
| | | 29.680 | 35.650 | | | | 20.970 | 25.520 | | | |
| | | 15.410 | 20.040 | | | | 14.070 | 18.630 | | | |
| | | 3.760 | 6.650 | | | | 3.760 | 6.650 | | | |

* (**) denotes rejection of the hypothesis at the 5% (1%) level

Table 2.7 Park's CCR test results
Model 1 LY =f(DCBY, TY, GOVY, CPI)

| | β [a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | DCBY | TY | GOVY | CPI | H(0,1)[b] | H(1,2)[b] | H(1,3)[b] |
| AUSTRALIA | -0.076 | 0.171 | -0.119 | 0.053 | 0.049 | 5.885 | 12.408 |
| | (0.009) | (0.005) | (0.006) | (0.002) | (0.826) | (0.015) | (0.002) |
| BANGLADESH | -0.162 | 0.050 | -0.039 | 0.026 | 2.513 | 0.100 | 1.256 |
| | (0.041) | (0.009) | (0.012) | (0.008) | (0.113) | (0.752) | (0.534) |
| CHINA | 0.077 | 0.067 | 0.032 | -0.058 | 1.212 | 0.018 | 2.817 |
| | (0.111) | (0.048) | (0.017) | (0.045) | (0.271) | (0.893) | (0.244) |
| INDIA | 0.379 | 0.350 | -0.104 | -0.009 | 2.365 | 43.274 | 96.835 |
| | (0.052) | (0.007) | (0.006) | (0.001) | (0.124) | (0.000) | (0.000) |
| INDONESIA | -0.267 | 0.058 | -0.010 | 0.013 | 1.774 | 4.059 | 4.358 |
| | (0.021) | (0.009) | (0.004) | (0.003) | (0.183) | (0.044) | (0.113) |
| JAPAN | -0.026 | 0.004 | 0.007 | -0.069 | 4.452 | 1.444 | 7.424 |
| | (0.025) | (0.000) | (0.001) | (0.008) | (0.035) | (0.230) | (0.024) |
| KOREA | -0.031 | 0.011 | 0.012 | 0.068 | 2.182 | 2.021 | 2.045 |
| | (0.026) | (0.003) | (0.003) | (0.008) | (0.140) | (0.155) | (0.360) |
| MALAYSIA | -0.187 | 0.282 | -0.166 | 0.014 | 6.348 | 0.180 | 0.360 |
| | (0.025) | (0.025) | (0.025) | (0.001) | (0.012) | (0.672) | (0.835) |
| NEPAL | 0.021 | 0.020 | -0.016 | 0.019 | 0.927 | 2.744 | 43.628 |
| | (0.023) | (0.007) | (0.006) | (0.004) | (0.336) | (0.100) | (0.000) |
| NEW ZEALAND | 0.026 | 0.014 | 0.002 | 0.007 | 0.037 | 6.632 | 7.637 |
| | (0.012) | (0.003) | (0.000) | (0.001) | (0.848) | (0.010) | (0.022) |
| PAKISTAN | 0.122 | -0.012 | -0.025 | 0.047 | 13.422 | 1.024 | 2.369 |
| | (0.048) | (0.009) | (0.011) | (0.010) | (0.000) | (0.312) | (0.306) |
| PAPUA N.G. | -0.013 | 0.026 | 0.013 | 0.018 | 10.420 | 0.150 | 25.282 |
| | (0.009) | (0.001) | (0.000) | (0.001) | (0.001) | (0.699) | (0.000) |
| PHILLIPPINES | 0.436 | -0.010 | -0.095 | -0.015 | 2.852 | 1.736 | 2.012 |
| | (0.040) | (0.010) | (0.008) | (0.001) | (0.091) | (0.188) | (0.366) |
| SINGAPORE | -0.346 | -0.921 | 0.747 | -0.256 | 0.093 | 14.764 | 19.428 |
| | (0.006) | (0.009) | (0.009) | (0.002) | (0.761) | (0.000) | (0.000) |
| SRI LANKA | 0.485 | 0.115 | 0.105 | 0.006 | 0.018 | 0.079 | 0.540 |
| | (0.035) | (0.004) | (0.006) | (0.004) | (0.892) | (0.779) | (0.763) |
| THAILAND | 0.043 | 0.089 | -0.009 | 0.000 | 0.000 | 0.076 | 1.726 |
| | (0.002) | (0.004) | (0.004) | (0.001) | (0.993) | (0.783) | (0.422) |

**LY**: log of GDP; **DCBY:** domestic credit issued by bank/GDP; **BM**: broad money/GDP;
**TY:** trade/GDP; **GOVY**: government expenditure/GDP; **GSY**: gross savings/GDP;
**CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests stochastic cointegration.
* countries with no cointegration

Table 2.8 Park's CCR test results
Model 2 LY =f(DCBY, GOVY, GSY, CPI)

| | β [(a)] | | | | | | |
|---|---|---|---|---|---|---|---|
| | DCBY | GSY | GOVY | CPI | H(0,1)[(b)] | H(1,2)[(b)] | H(1,3)[(b)] |
| AUSTRALIA | -0.104 | -0.002 | 0.068 | 0.049 | 4.416 | 0.529 | 2.164 |
| | (0.004 | (0.003) | (0.003) | (0.001) | (0.036) | (0.467) | (0.339) |
| BANGLADESH | 0.301 | -0.030 | -0.107 | -0.035 | 0.003 | 0.090 | 0.163 |
| | (0.077) | (0.022) | (0.028) | (0.007) | (0.960) | (0.765) | (0.922) |
| CHINA | -0.069 | -0.013 | -0.002 | 0.023 | 0.926 | 6.042 | 12.162 |
| | (0.039) | (0.018) | (0.008) | (0.019) | (0.336) | (0.014) | (0.002) |
| INDIA | 0.187 | 0.193 | -0.034 | -0.002 | 0.008 | 14.233 | 14.252 |
| | (0.051) | (0.006) | (0.006) | (0.001) | (0.930) | (0.000) | (0.001) |
| INDONESIA | 0.115 | -0.029 | 0.006 | 0.000 | 11.236 | 0.395 | 9.297 |
| | (0.018) | (0.005) | (0.002) | (0.002) | (0.001) | (0.529) | (0.010) |
| JAPAN | 0.013 | 0.003 | 0.003 | -0.005 | 1.419 | 2.413 | 10.269 |
| | (0.020) | (0.000) | (0.002) | (0.005) | (0.234) | (0.120) | (0.006) |
| KOREA | -0.376 | 0.002 | 0.052 | 0.385 | 53.975 | 1.429 | 15.273 |
| | (0.024) | (0.002) | (0.002) | (0.004) | (0.000) | (0.232) | (0.000) |
| MALAYSIA | -0.851 | 0.348 | -0.330 | 0.004 | 2.193 | 0.516 | 17.217 |
| | (0.047) | (0.018) | (0.025) | (0.001) | (0.139) | (0.473) | (0.000) |
| NEPAL | -0.022 | 0.069 | 0.002 | 0.020 | 11.135 | 0.389 | 20.748 |
| | (0.026) | (0.011) | (0.010) | (0.002) | (0.001) | (0.533) | (0.000) |
| NEW ZEALAND | -0.046 | -0.012 | 0.000 | 0.002 | 0.003 | 119.171 | 226.133 |
| | (0.011) | (0.004) | (0.001) | (0.001) | (0.958) | (0.000) | (0.000) |
| PAKISTAN | 0.084 | 0.101 | -0.027 | -0.023 | 16.226 | 1.450 | 1.455 |
| | (0.090) | (0.022) | (0.031) | (0.018) | (0.000) | (0.229) | (0.483) |
| PAPUA N.G. | 0.014 | 0.013 | 0.012 | -0.045 | 0.004 | 1.617 | 34.576 |
| | (0.002) | (0.002) | (0.001) | (0.001) | (0.948) | (0.203) | (0.000) |
| PHILLIPPINES | -0.219 | -0.121 | -0.007 | 0.029 | 0.348 | 0.096 | 3.251 |
| | (0.052) | (0.007) | (0.006) | (0.002) | (0.555) | (0.756) | (0.197) |
| SINGAPORE | -0.275 | 0.047 | 0.061 | 0.122 | 0.006 | 2.679 | 18.327 |
| | (0.035) | (0.002) | (0.014) | (0.014) | (0.940) | (0.102) | (0.000) |
| SRI LANKA | 0.316 | -0.014 | 0.059 | 0.080 | 0.267 | 0.022 | 2.297 |
| | (0.027) | (0.006) | (0.003) | (0.009) | (0.605) | (0.881) | (0.317) |
| THAILAND | -0.151 | 0.213 | -0.031 | 0.002 | 6.804 | 1.711 | 3.949 |
| | (0.041) | (0.006) | (0.005) | (0.001) | (0.009) | (0.191) | (0.139) |

**LY**: log of GDP; **DCBY:** domestic credit issued by bank/GDP; **BM**: broad money/GDP;
**TY:** trade/GDP; **GOVY**: government expenditure/GDP; **GSY**: gross savings/GDP;
**CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and the H(1, q) statistic tests stochastic cointegration.
* countries with no cointegration

Table 2.9 Park's CCR test results
Model 3 LY =f(BM, TY, GOVY, CPI)

| | $\beta$ (a) | | | | | | |
|---|---|---|---|---|---|---|---|
| | BM | TY | GOVY | CPI | H(0,1)(b) | H(1,2)(b) | H(1,3)(b) |
| AUSTRALIA | -0.215 | 0.221 | -0.159 | 0.077 | 1.830 | 19.913 | 22.849 |
| | (0.008) | (0.004) | (0.004) | (0.001) | (0.176) | (0.000) | (0.000) |
| BANGLADESH | -0.040 | 0.034 | 0.044 | -0.045 | 108.457 | 0.041 | 5.058 |
| | (0.044) | (0.016) | (0.011) | (0.014) | (0.000) | (0.840) | (0.080) |
| CHINA | -0.118 | 0.014 | -0.039 | 0.085 | 9.454 | 0.002 | 1.602 |
| | (0.054) | (0.009) | (0.028) | (0.036) | (0.002) | (0.964) | (0.449) |
| INDIA | 0.571 | 0.030 | -0.045 | 0.087 | 2.804 | 0.283 | 5.310 |
| | (0.062) | (0.004) | (0.001) | (0.002) | (0.094) | (0.595) | (0.070) |
| INDONESIA | 0.095 | -0.044 | 0.045 | 0.000 | 6.605 | 2.263 | 2.441 |
| | (0.014) | (0.006) | (0.006) | (0.001) | (0.010) | (0.132) | (0.295) |
| JAPAN | 0.022 | 0.006 | 0.011 | -0.047 | 0.097 | 0.011 | 10.937 |
| | (0.022) | (0.000) | (0.001) | (0.010) | (0.755) | (0.915) | (0.004) |
| KOREA | 0.264 | -0.006 | 0.089 | -0.031 | 0.376 | 0.457 | 13.246 |
| | (0.040) | (0.003) | (0.014) | (0.010) | (0.540) | (0.499) | (0.001) |
| MALAYSIA | -0.235 | -0.047 | 0.018 | 0.003 | 0.314 | 1.988 | 26.309 |
| | (0.088) | (0.012) | (0.001) | (0.001) | (0.575) | (0.159) | (0.000) |
| NEPAL | -0.062 | 0.017 | 0.035 | -0.012 | 0.819 | 2.212 | 2.988 |
| | (0.061) | (0.012) | (0.003) | (0.002) | (0.366) | (0.137) | (0.224) |
| NEW ZEALAND | -0.002 | 0.019 | 0.006 | 0.004 | 28.045 | 1.422 | 1.592 |
| | (0.008) | (0.004) | (0.001) | (0.001) | (0.000) | (0.233) | (0.451) |
| PAKISTAN | 0.419 | 0.004 | -0.059 | -0.062 | 6.029 | 0.037 | 0.109 |
| | (0.066) | (0.014) | (0.013) | (0.008) | (0.014) | (0.847) | (0.947) |
| PAPUA N.G. | -0.112 | 0.003 | 0.002 | -0.045 | 0.070 | 0.020 | 3.619 |
| | (0.028) | (0.001) | (0.006) | (0.009) | (0.791) | (0.887) | (0.164) |
| PHILLIPPINES | -0.063 | 0.009 | 0.043 | -0.004 | 0.078 | 0.711 | 34.250 |
| | (0.014) | (0.003) | (0.002) | (0.001) | (0.780) | (0.399) | (0.000) |
| SINGAPORE | -0.137 | 0.022 | 0.043 | -0.006 | 0.352 | 5.307 | 6.348 |
| | (0.011) | (0.003) | (0.001) | (0.000) | (0.553) | (0.021) | (0.042) |
| SRI LANKA | 0.088 | 0.006 | 0.073 | 0.024 | 42.702 | 0.001 | 0.054 |
| | (0.002) | (0.002) | (0.001) | (0.001) | (0.000) | (0.974) | (0.974) |
| THAILAND | -0.192 | -0.015 | -0.011 | 0.033 | 0.494 | 1.655 | 10.463 |
| | (0.017) | (0.005) | (0.003) | (0.003) | (0.482) | (0.198) | (0.005) |

**LY**: log of GDP; **DCBY:** domestic credit issued by bank/GDP; **BM**: broad money/GDP;
**TY:** trade/GDP; **GOVY**: government expenditure/GDP; **GSY**: gross savings/GDP;
**CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests stochastic cointegration.
* countries with no cointegration

Table 2.10 Park's CCR test results
Model 4 LY =f(BM, GOVY, GSY, CPI)

| | β [(a)] | | | | | | |
|---|---|---|---|---|---|---|---|
| | BM | GSY | GOVY | CPI | H(0,1)[(b)] | H(1,2)[(b)] | H(1,3)[(b)] |
| AUSTRALIA | -0.067 | -0.037 | 0.124 | 0.034 | 31.110 | 4.005 | 4.053 |
| | (0.028) | (0.002) | (0.006) | (0.003) | (0.000) | (0.045) | (0.132) |
| BANGLADESH | 0.132 | 0.073 | 0.050 | -0.157 | 10.809 | 0.181 | 5.168 |
| | (0.040) | (0.035) | (0.007) | (0.024) | (0.001) | (0.671) | (0.075) |
| CHINA | -0.123 | 0.007 | -0.016 | 0.086 | 1.268 | 2.492 | 2.496 |
| | (0.055) | (0.008) | (0.023) | (0.015) | (0.260) | (0.114) | (0.287) |
| INDIA | 0.169 | 0.013 | 0.040 | -0.025 | 0.978 | 0.477 | 2.973 |
| | (0.042) | (0.004) | (0.002) | (0.006) | (0.323) | (0.490) | (0.226) |
| INDONESIA | -0.006 | 0.021 | -0.015 | -0.006 | 8.187 | 1.294 | 2.477 |
| | (0.018) | (0.004) | (0.006) | (0.001) | (0.004) | (0.255) | (0.290) |
| JAPAN | 0.006 | 0.003 | 0.000 | 0.006 | 2.752 | 0.380 | 3.051 |
| | (0.018) | (0.000) | (0.002) | (0.004) | (0.100) | (0.538) | (0.218) |
| KOREA | -0.083 | 0.074 | 0.018 | 0.022 | 3.474 | 0.752 | 1.512 |
| | (0.012) | (0.002) | (0.008) | (0.005) | (0.062) | (0.386) | (0.470) |
| MALAYSIA | -0.676 | 0.124 | 0.027 | -0.062 | 7.950 | 3.361 | 3.428 |
| | (0.080) | (0.025) | (0.001) | (0.010) | (0.005) | (0.067) | (0.180) |
| NEPAL | 0.245 | 0.098 | 0.020 | -0.097 | 2.237 | 7.243 | 9.156 |
| | (0.040) | (0.010) | (0.001) | (0.017) | (0.135) | (0.008) | (0.010) |
| NEW ZEALAND | -0.038 | 0.033 | 0.009 | 0.005 | 1.117 | 27.285 | 290.843 |
| | (0.012) | (0.011) | (0.002) | (0.002) | (0.291) | (0.000) | (0.000) |
| PAKISTAN | -0.381 | -0.057 | 0.077 | 0.025 | 18.918 | 0.648 | 2.019 |
| | (0.103) | (0.020) | (0.015) | (0.005) | (0.000) | (0.421) | (0.364) |
| PAPUA N.G. | 0.068 | -0.072 | -0.105 | 0.048 | 11.755 | 0.123 | 1.656 |
| | (0.010) | (0.007) | (0.007) | (0.007) | (0.001) | (0.726) | (0.437) |
| PHILLIPPINES | 0.077 | -0.001 | 0.020 | -0.040 | 1.211 | 0.091 | 0.095 |
| | (0.059) | (0.003) | (0.001) | (0.005) | (0.271) | (0.763) | (0.954) |
| SINGAPORE | 0.263 | 0.262 | -0.014 | 0.044 | 2.263 | 2.804 | 7.702 |
| | (0.007) | (0.003) | (0.003) | (0.001) | (0.133) | (0.094) | (0.021) |
| SRI LANKA | -0.030 | 0.102 | -0.025 | 0.078 | 0.116 | 0.131 | 12.004 |
| | (0.030) | (0.003) | (0.011) | (0.009) | (0.734) | (0.718) | (0.002) |
| THAILAND | -0.129 | 0.041 | 0.029 | 0.015 | 5.480 | 0.169 | 0.894 |
| | (0.035) | (0.006) | (0.000) | (0.004) | (0.019) | (0.681) | (0.640) |

**LY**: log of GDP; **DCBY:** domestic credit issued by bank/GDP; **BM**: broad money/GDP;
**TY:** trade/GDP; **GOVY**: government expenditure/GDP; **GSY**: gross savings/GDP;
**CPI:** inflation measured by CPI.
For column (a): numbers in paranthesis are st.errors.
For column (b): numbers in paranthesis are p-values.
The H(0, 1) statistic tests the determininstic cointegrating restriction and
the H(1, q) statistic tests stochastic cointegration.
* countries with no cointegration

Table 2.11 ECM and SURECM Results

Model 1 LY = f(DCBY, TY, GOVY, CPI)

| countries | Regular ECM: | λ: SURECM: a) all | b) high inc. | c) middle inc. | d) low inc. | e) all w/o China | f) middle inc w/o China |
|---|---|---|---|---|---|---|---|
| Australia | 0.000 | -0.001 | 0.001 | | | -0.002 | |
| | (0.000) | (0.001) | (0.001) | | | (0.001) | |
| Bangladesh | 0.006 | 0.001 | | | 0.001 | 0.001 | |
| | (0.003) | (0.001) | | | (0.001) | (0.001) | |
| China | 0.001 | -0.004 *** | | -0.002 * | | | |
| | (0.002) | (0.001) | | (0.001) | | | |
| India | -0.004 | -0.001 ** | | | -0.005 *** | -0.001 ** | |
| | (0.004) | (0.001) | | | (0.001) | (0.001) | |
| Indonesia | -0.002 | -0.006 *** | | -0.014 *** | | -0.007 *** | -0.002 ** |
| | (0.001) | (0.001) | | (0.002) | | (0.001) | (0.001) |
| Japan | 0.002 | 0.012 | -0.000 | | | 0.011 | |
| | (0.001) | (0.006) | (0.002) | | | (0.006) | |
| Korea | 0.007 | -0.012 *** | -0.003 | | | -0.013 *** | |
| | (0.008) | (0.003) | (0.004) | | | (0.003) | |
| Malaysia | 0.001 | 0.001 | | 0.002 | | 0.001 | 0.000 |
| | (0.000) | (0.001) | | (0.000) | | (0.001) | (0.000) |
| Nepal | -0.031 | -0.025 *** | | | -0.010 | -0.027 *** | |
| | (0.027) | (0.008) | | | (0.013) | (0.008) | |
| New Zealand | 0.013 | -0.001 | -0.012 *** | | | -0.008 | |
| | (0.007) | (0.007) | (0.004) | | | (0.008) | |
| Pakistan | -0.000 | 0.004 | | | 0.003 | 0.005 | |
| | (0.004) | (0.003) | | | (0.003) | (0.003) | |
| PNG | -0.009 | -0.047 ** | | | -0.003 | -0.045 * | |
| | (0.026) | (0.022) | | | (0.032) | (0.026) | |
| Phillippines | 0.000 | -0.001 ** | | -0.003 *** | | -0.000 | -0.001 ** |
| | (0.001) | (0.000) | | (0.000) | | (0.000) | (0.001) |
| Singapore | 0.002 | -0.000 ** | -0.000 * | | | -0.000 ** | |
| | (0.001) | (0.000) | (0.000) | | | (0.000) | |
| Sri Lanka | 0.000 | 0.001 | | -0.002 | | 0.001 | 0.000 |
| | (0.002) | (0.001) | | (0.002) | | (0.001) | (0.001) |
| Thailand | 0.004 | 0.019 | | 0.013 | | 0.019 | 0.003 |
| | (0.002) | (0.003) | | (0.003) | | (0.003) | (0.001) |
| with restrictions | | -0.000 *** | -0.000 ** | -0.001 *** | -0.002 ** | -0.000 *** | -0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) |
| chi2 | | 44.820 | 3.710 | 70.210 | 22.850 | 150.750 | 12.770 |
| p-value | | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.013) |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.

Numbers in the paranthesis represent standard errors.

Table 2.12 ECM and SURECM Results

Model 2 LY= f(DCBY, GOVY, GSY, CPI)

| countries | Regular ECM: | | λ: SURECM: a) all | | b) high inc. | | c) middle inc. | | d) low inc. | | e) all w/o China | | f) middle inc w/o China | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | -0.001 | | -0.002 | *** | -0.000 | | | | | | 0.000 | | | |
| | (0.001) | | (0.001) | | (0.001) | | | | | | (0.001) | | | |
| Bangladesh | -0.002 | ** | -0.003 | *** | | | | | -0.001 | *** | -0.001 | *** | | |
| | (0.001) | | (0.000) | | | | | | (0.000) | | (0.000) | | | |
| China | -0.001 | | -0.002 | *** | | | -0.000 | | | | | | | |
| | (0.001) | | (0.002) | | | | (0.001) | | | | | | | |
| India | -0.004 | * | -0.009 | *** | | | | | -0.007 | ** | -0.009 | *** | | |
| | (0.002) | | (0.002) | | | | | | (0.003) | | (0.002) | | | |
| Indonesia | 0.008 | | -0.000 | *** | | | 0.021 | | | | 0.021 | | 0.006 | |
| | (0.005) | | (0.002) | | | | (0.006) | | | | (0.004) | | (0.003) | |
| Japan | 0.021 | | -0.046 | *** | -0.021 | ** | | | | | -0.088 | *** | | |
| | (0.013) | | (0.015) | | (0.010) | | | | | | (0.012) | | | |
| Korea | -0.001 | * | -0.002 | *** | -0.000 | | | | | | -0.001 | *** | | |
| | (0.001) | | (0.001) | | (0.001) | | | | | | (0.000) | | | |
| Malaysia | -0.000 | | -0.001 | *** | | | -0.000 | | | | -0.001 | *** | -0.000 | |
| | (0.000) | | (0.000) | | | | (0.000) | | | | (0.000) | | (0.000) | |
| Nepal | 0.006 | | -0.026 | *** | | | | | -0.028 | *** | -0.03 | *** | | |
| | (0.007) | | (0.003) | | | | | | (0.006) | | (0.003) | | | |
| New Zealand | 0.003 | | 0.003 | | 0.003 | | | | | | 0.005 | | | |
| | (0.003) | | (0.003) | | (0.002) | | | | | | (0.005) | | | |
| Pakistan | 0.001 | | 0.01 | | | | | | 0.011 | | 0.001 | | | |
| | (0.007) | | (0.006) | | | | | | (0.006) | | (0.004) | | | |
| PNG | 0.021 | | -0.046 | | | | | | 0.001 | | -0.038 | | | |
| | (0.035) | | (0.033) | | | | | | (0.038) | | (0.039) | | | |
| Phillippines | -0.000 | | -0.001 | *** | | | 0.002 | | | | -0.000 | | 0.002 | |
| | (0.001) | | (0.000) | | | | (0.001) | | | | (0.000) | | (0.001) | |
| Singapore | -0.002 | * | -0.007 | *** | -0.005 | *** | | | | | -0.002 | | | |
| | (0.001) | | (0.002) | | (0.001) | | | | | | (0.002) | | | |
| Sri Lanka | 0.000 | | -0.003 | *** | | | -0.007 | ** | | | -0.006 | ** | -0.001 | |
| | (0.001) | | (0.002) | | | | (0.003) | | | | (0.002) | | (0.001) | |
| Thailand | -0.002 | ** | -0.005 | *** | | | -0.006 | *** | | | -0.009 | *** | -0.002 | ** |
| | (0.001) | | (0.001) | | | | (0.002) | | | | (0.001) | | (0.001) | |
| with restrictions | | | -0.001 | *** | -0.001 | ** | 0.000 | | -0.001 | ** | -0.001 | *** | 0.000 | |
| | | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | |
| chi2 | | | 128.020 | | 18.680 | | 41.630 | | 24.25 | | 232.160 | | 12.240 | |
| p-value | | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.016) | |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.

Numbers in the paranthesis represent standard errors.

Table 2.13 ECM and SURECM Results

Model 3 LY = f(BM, TY, GOVY, CPI)

| countries | Regular ECM: | λ: SURECM: a) all | b) high inc. | c) middle inc. | d) low inc. | e) all w/o China | f) middle inc w/o China |
|---|---|---|---|---|---|---|---|
| Australia | 0.002 | 0.002 | -0.002 ** | | | 0.002 | |
| | (0.002) | (0.001) | (0.001) | | | (0.001) | |
| Bangladesh | 0.011 | 0.016 | | | 0.004 | 0.014 | |
| | (0.005) | (0.003) | | | (0.004) | | |
| China | 0.001 | 0.002 | | 0.001 | | | |
| | (0.001) | (0.000) | | (0.001) | | (0.002) | |
| India | -0.003 ** | -0.003 *** | | | -0.004 *** | -0.003 *** | |
| | (0.001) | (0.001) | | | (0.001) | (0.001) | |
| Indonesia | 0.015 | 0.022 | | 0.035 | | 0.018 | 0.016 |
| | (0.011) | (0.004) | | (0.007) | | (0.004) | (0.006) |
| Japan | 0.008 | -0.016 *** | 0.012 | | | -0.02 *** | |
| | (0.006) | (0.003) | (0.004) | | | (0.004) | |
| Korea | 0.004 | 0.005 | 0.003 | | | 0.006 | |
| | (0.002) | (0.001) | (0.002) | | | (0.001) | |
| Malaysia | -0.000 | -0.003 *** | | -0.001 ** | | -0.002 *** | -0.000 |
| | (0.000) | (0.001) | | (0.001) | | (0.001) | (0.000) |
| Nepal | 0.001 | -0.015 *** | | | -0.02 *** | -0.015 *** | |
| | (0.005) | (0.002) | | | (0.004) | (0.002) | |
| New Zealand | 0.017 | -0.051 *** | 0.005 | | | -0.041 *** | |
| | (0.019) | (0.014) | (0.013) | | | (0.014) | |
| Pakistan | 0.002 | -0.005 *** | | | -0.001 | -0.004 ** | |
| | (0.003) | (0.001) | | | (0.003) | (0.002) | |
| PNG | -0.003 | -0.028 *** | | | -0.032 | -0.013 | |
| | (0.014) | (0.010) | | | (0.020) | (0.011) | |
| Phillippines | 0.002 | 0.003 | | 0.02 | | 0.000 | 0.006 |
| | (0.003) | (0.002) | | (0.004) | | (0.002) | (0.003) |
| Singapore | -0.002 | -0.006 *** | -0.004 ** | | | -0.002 | |
| | (0.002) | (0.002) | (0.002) | | | (0.002) | |
| Sri Lanka | 0.004 | 0.006 | | -0.032 ** | | 0.021 | -0.012 |
| | (0.009) | (0.010) | | (0.016) | | (0.010) | (0.012) |
| Thailand | -0.001 | -0.004 *** | | -0.004 | | -0.003 * | -0.001 ** |
| | (0.001) | (0.002) | | (0.002) | | (0.002) | (0.001) |
| with restrictions | | 0.000 | -0.002 *** | -0.001 *** | -0.004 *** | -0.001 *** | -0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) |
| chi2 | | 293.940 | 18.010 | 290.450 | 23.200 | 255.710 | 11.570 |
| p-value | | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.021) |

ificance at the 10%, 5%, and 1 % levels respectively.

anthesis represent standard errors.

Table 2.14 ECM and SURECM Results

Model 4 LY= f(BM, GOVY, GSY, CPI)

| | | λ: | | | | | |
|---|---|---|---|---|---|---|---|
| countries | Regular ECM: | SURECM: a) all | b) high inc. | c) middle inc. | d) low inc. | e) all w/o China | f) middle inc w/o China |
| Australia | 0.002 | 0.001 | -0.001 | -0.001 | | -0.001 | |
| | (0.003) | (0.002) | (0.003) | (0.000) | | (0.002) | |
| Bangladesh | -0.008 ** | -0.011 *** | | | -0.003 * | -0.011 *** | |
| | (0.003) | (0.001) | | | (0.002) | (0.001) | |
| China | 0.001 | 0.000 | | | | | |
| | (0.001) | (0.000) | | | | | |
| India | -0.011 *** | -0.019 *** | | | -0.01 *** | -0.019 *** | |
| | (0.004) | (0.003) | | | (0.002) | (0.002) | |
| Indonesia | -0.019 | -0.063 *** | | -0.029 *** | | -0.061 *** | -0.010 |
| | (0.013) | (0.014) | | (0.009) | | (0.014) | (0.007) |
| Japan | -0.084 * | -0.243 *** | -0.141 *** | | | -0.214 *** | |
| | (0.044) | (0.019) | (0.025) | | | (0.019) | |
| Korea | -0.006 * | -0.010 *** | -0.012 *** | | | -0.010 *** | |
| | (0.003) | (0.003) | (0.003) | | | (0.003) | |
| Malaysia | 0.000 | -0.002 *** | | -0.001 | | -0.002 *** | -0.000 |
| | (0.001) | (0.000) | | (0.001) | | (0.000) | (0.000) |
| Nepal | 0.003 | 0.006 | | | 0.005 | 0.006 | |
| | (0.008) | (0.001) | | | (0.001) | (0.001) | |
| New Zealand | 0.008 | -0.000 | 0.003 | | | -0.006 | |
| | (0.004) | (0.007) | (0.003) | | | (0.008) | |
| Pakistan | -0.003 | 0.001 | | | -0.001 | 0.002 | |
| | (0.002) | (0.002) | | | (0.003) | (0.002) | |
| PNG | -0.009 | -0.063 *** | | | -0.062 *** | -0.066 *** | |
| | (0.011) | (0.020) | | | (0.015) | (0.020) | |
| Phillippines | 0.000 | -0.009 *** | | -0.030 *** | | -0.011 *** | -0.009 *** |
| | (0.000) | (0.003) | | (0.002) | | (0.003) | (0.003) |
| Singapore | 0.002 | -0.001 | 0.003 | | | -0.001 | |
| | (0.001) | (0.001) | (0.001) | | | (0.001) | |
| Sri Lanka | 0.003 | 0.010 | | 0.002 | | 0.010 | 0.003 |
| | (0.004) | (0.006) | | (0.010) | | (0.006) | (0.006) |
| Thailand | -0.002 | -0.006 * | | 0.003 | | -0.005 | -0.001 |
| | (0.001) | (0.003) | | (0.006) | | (0.003) | (0.001) |
| with restrictions | | -0.001 *** | 0.001 | -0.000 | 0.001 | -0.002 *** | 0.000 |
| | | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.000) |
| chi2 | | 426.310 | 25.000 | 288.880 | 76.290 | 229.440 | 13.640 |
| p-value | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.009) |

Note: * , ** and *** denote the significance at the 10%, 5%, and 1 % levels respectively.

Numbers in the paranthesis represent standard errors.

Table 2.15 Granger Causality Test Model 1 LY= f(DCBY, TY, GOVY, CPI)

Granger Causality Test for <u>all countries</u>

| country | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance to growth | | Growth to finance | | Two/one-way | Finance to growth | | Growth to finance | | Two/one-way |
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 2.965 | 0.085 | 0.216 | 0.642 | One-way | 28.940 | 0.000 | 0.590 | 0.443 | One-way |
| BANGLADESH | 0.025 | 0.875 | 2.218 | 0.136 | None | 1.220 | 0.268 | 12.390 | 0.000 | One-way |
| CHINA | 0.000 | 0.993 | 1.732 | 0.188 | None | 25.310 | 0.000 | 5.630 | 0.018 | Two-way |
| INDIA | 3.190 | 0.203 | 2.175 | 0.337 | None | 1.880 | 0.391 | 64.660 | 0.000 | One-way |
| INDONESIA | 0.808 | 0.369 | 0.004 | 0.947 | None | 0.330 | 0.563 | 7.560 | 0.006 | One-way |
| JAPAN | 7.332 | 0.026 | 3.719 | 0.156 | One-way | 35.680 | 0.000 | 50.730 | 0.000 | Two-way |
| KOREA | 4.086 | 0.130 | 3.023 | 0.221 | None | 1.980 | 0.160 | 22.420 | 0.000 | One-way |
| MALAYSIA | 0.422 | 0.810 | 1.105 | 0.576 | None | 5.210 | 0.074 | 134.210 | 0.000 | Two-way |
| NEPAL | 0.280 | 0.869 | 2.184 | 0.335 | None | 11.810 | 0.003 | 101.950 | 0.000 | Two-way |
| NEW ZEALAND | 1.302 | 0.522 | 2.034 | 0.362 | None | 7.840 | 0.020 | 35.640 | 0.000 | Two-way |
| PAKISTAN | 1.150 | 0.563 | 15.310 | 0.000 | One-way | 7.420 | 0.025 | 6.240 | 0.044 | Two-way |
| PAPUA N.G. | 1.191 | 0.275 | 0.525 | 0.469 | None | 62.100 | 0.000 | 11.910 | 0.003 | Two-way |
| PHILLIPPINES | 3.779 | 0.151 | 1.299 | 0.522 | None | 59.610 | 0.000 | 6.400 | 0.041 | Two-way |
| SINGAPORE | 0.834 | 0.659 | 0.611 | 0.737 | None | 19.360 | 0.000 | 119.920 | 0.000 | Two-way |
| SRI LANKA | 0.174 | 0.676 | 0.778 | 0.378 | None | 5.270 | 0.022 | 4.640 | 0.031 | Two-way |
| THAILAND | 7.957 | 0.005 | 9.2219 | 0.002 | Two-way | 53.250 | 0.000 | 257.650 | 0.000 | Two-way |

Granger Causality Test in system setting for <u>all countries (w/o China)</u>

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 32.150 | 0.000 | 0.060 | 0.815 | One-way |
| BANGLADESH | 0.560 | 0.454 | 65.760 | 0.000 | One-way |
| INDIA | 0.940 | 0.626 | 14.830 | 0.001 | One-way |
| INDONESIA | 2.790 | 0.095 | 4.360 | 0.036 | Two-way |
| JAPAN | 20.720 | 0.000 | 45.250 | 0.000 | Two-way |
| KOREA | 0.010 | 0.920 | 55.990 | 0.000 | One-way |
| MALAYSIA | 10.510 | 0.005 | 107.390 | 0.000 | Two-way |
| NEPAL | 15.040 | 0.001 | 38.750 | 0.000 | Two-way |
| NEW ZEALAND | 9.110 | 0.011 | 13.450 | 0.001 | Two-way |
| PAKISTAN | 4.260 | 0.119 | 1.900 | 0.388 | None |
| PAPUA N.G. | 33.430 | 0.000 | 5.820 | 0.054 | Two-way |
| PHILLIPPINES | 33.190 | 0.000 | 13.790 | 0.001 | Two-way |
| SINGAPORE | 34.450 | 0.000 | 96.370 | 0.000 | Two-way |
| SRI LANKA | 2.900 | 0.089 | 7.300 | 0.007 | Two-way |
| THAILAND | 41.000 | 0.000 | 213.300 | 0.000 | Two-way |

Granger Causality Test in system setting for <u>high-income countries</u>

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 10.980 | 0.001 | 0.190 | 0.661 | One-way |
| JAPAN | 0.010 | 0.921 | 6.060 | 0.014 | One-way |
| KOREA | 39.280 | 0.000 | 7.260 | 0.007 | Two-way |
| NEW ZEALAND | 16.390 | 0.000 | 18.370 | 0.000 | Two-way |
| SINGAPORE | 44.260 | 0.000 | 12.640 | 0.002 | Two-way |

Granger Causality Test in system setting for <u>middle-income countries</u>

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| CHINA | 4.230 | 0.040 | 7.170 | 0.007 | Two-way |
| INDONESIA | 7.320 | 0.007 | 0.800 | 0.371 | One-way |
| MALAYSIA | 26.640 | 0.000 | 11.580 | 0.003 | Two-way |
| PHILLIPPINES | 22.750 | 0.000 | 27.230 | 0.000 | Two-way |
| SRI LANKA | 18.680 | 0.000 | 3.540 | 0.060 | Two-way |
| THAILAND | 29.730 | 0.000 | 23.110 | 0.000 | Two-way |

Granger Causality Test in system setting for <u>middle-income countries</u>
(w/o China)

| country | ınce to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| INDONESIA | 0.600 | 0.438 | 0.460 | 0.496 | None |
| MALAYSIA | 0.360 | 0.834 | 3.580 | 0.167 | None |
| PHILLIPPINES | 10.080 | 0.007 | 3.740 | 0.154 | One-way |
| SRI LANKA | 0.060 | 0.805 | 0.170 | 0.683 | None |
| THAILAND | 2.710 | 0.258 | 41.490 | 0.000 | One-way |

Granger Causality Test in system setting for <u>low-income countries</u>

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| BANGLADESH | 3.660 | 0.058 | 0.040 | 0.846 | One-way |
| INDIA | 222.930 | 0.000 | 16.880 | 0.000 | Two-way |
| NEPAL | 120.340 | 0.000 | 3.650 | 0.161 | One-way |
| PAKISTAN | 22.690 | 0.000 | 1.280 | 0.526 | One-way |
| PAPUA N.G. | 12.800 | 0.002 | 5.870 | 0.053 | Two-way |

Table 2.16 Granger Causality Test　　Model 2 LY= f(DCBY, GSY, GOVY, CPI)

Granger Causality Test for <u>all countries</u>

| country | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance to growth | | Growth to finance | | Two/one-way | Finance to growth | | Growth to finance | | Two/one-way |
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 2.410 | 0.121 | 1.036 | 0.309 | None | 0.280 | 0.596 | 7.780 | 0.005 | One-way |
| BANGLADESH | 0.072 | 0.788 | 1.164 | 0.281 | None | 2.740 | 0.098 | 18.890 | 0.000 | Two-way |
| CHINA | 15.423 | 0.000 | 2.017 | 0.156 | One-way | 37.900 | 0.000 | 15.280 | 0.001 | Two-way |
| INDIA | 1.331 | 0.249 | 2.896 | 0.089 | One-way | 29.900 | 0.000 | 1.610 | 0.205 | One-way |
| INDONESIA | 4.088 | 0.130 | 1.230 | 0.541 | None | 0.080 | 0.959 | 10.910 | 0.004 | One-way |
| JAPAN | 6.938 | 0.031 | 3.520 | 0.061 | Two-way | 116.230 | 0.000 | 16.480 | 0.000 | Two-way |
| KOREA | 0.565 | 0.452 | 0.545 | 0.460 | None | 9.570 | 0.008 | 23.380 | 0.000 | Two-way |
| MALAYSIA | 1.802 | 0.179 | 0.391 | 0.532 | None | 3.660 | 0.160 | 13.800 | 0.001 | One-way |
| NEPAL | 5.722 | 0.057 | 0.022 | 0.883 | One-way | 29.110 | 0.000 | 5.240 | 0.073 | Two-way |
| NEW ZEALAND | 1.615 | 0.446 | 0.440 | 0.802 | None | 13.580 | 0.001 | 18.590 | 0.000 | Two-way |
| PAKISTAN | 1.391 | 0.238 | 3.553 | 0.059 | One-way | 17.880 | 0.000 | 0.420 | 0.812 | One-way |
| PAPUA N.G. | 7.376 | 0.025 | 0.066 | 0.797 | One-way | 13.830 | 0.001 | 12.310 | 0.002 | Two-way |
| PHILLIPPINES | 6.691 | 0.035 | 1.358 | 0.507 | One-way | 39.320 | 0.000 | 31.650 | 0.000 | Two-way |
| SINGAPORE | 1.845 | 0.398 | 0.537 | 0.764 | None | 12.990 | 0.002 | 1.610 | 0.447 | One-way |
| SRI LANKA | 0.168 | 0.682 | 1.101 | 0.294 | None | 0.020 | 0.005 | 1.780 | 0.182 | One-way |
| THAILAND | 6.503 | 0.011 | 6.689 | 0.010 | Two-way | 3.970 | 0.046 | 0.000 | 0.956 | One-way |

Granger Causality Test in system setting for all countries (w/o China)

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 0.730 | 0.392 | 1.100 | 0.295 | None |
| BANGLADESH | 0.230 | 0.632 | 5.270 | 0.022 | One-way |
| INDIA | 38.490 | 0.000 | 1.840 | 0.175 | One-way |
| INDONESIA | 5.490 | 0.064 | 5.820 | 0.055 | Two-way |
| JAPAN | 61.920 | 0.000 | 15.540 | 0.000 | Two-way |
| KOREA | 7.610 | 0.022 | 29.750 | 0.000 | Two-way |
| MALAYSIA | 10.520 | 0.005 | 8.210 | 0.017 | Two-way |
| NEPAL | 34.490 | 0.000 | 15.570 | 0.000 | Two-way |
| NEW ZEALAND | 13.760 | 0.001 | 27.510 | 0.000 | Two-way |
| PAKISTAN | 18.390 | 0.000 | 0.180 | 0.916 | One-way |
| PAPUA N.G. | 13.170 | 0.001 | 6.130 | 0.047 | Two-way |
| PHILLIPPINES | 45.930 | 0.000 | 30.560 | 0.000 | Two-way |
| SINGAPORE | 11.660 | 0.003 | 3.950 | 0.139 | One-way |
| SRI LANKA | 12.100 | 0.005 | 0.180 | 0.671 | One-way |
| THAILAND | 6.570 | 0.010 | 0.060 | 0.799 | One-way |

Granger Causality Test in system setting for high-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 2.550 | 0.110 | 4.830 | 0.028 | One-way |
| JAPAN | 4.600 | 0.100 | 9.920 | 0.007 | Two-way |
| KOREA | 1.160 | 0.561 | 13.420 | 0.001 | One-way |
| NEW ZEALAND | 22.940 | 0.000 | 2.250 | 0.324 | One-way |
| SINGAPORE | 117.250 | 0.000 | 10.990 | 0.004 | Two-way |

Granger Causality Test in system setting for middle-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| CHINA | 31.340 | 0.000 | 12.650 | 0.002 | Two-way |
| INDONESIA | 20.540 | 0.000 | 2.420 | 0.298 | One-way |
| MALAYSIA | 76.710 | 0.000 | 5.050 | 0.080 | Two-way |
| PHILLIPPINES | 46.010 | 0.000 | 2.760 | 0.252 | One-way |
| SRI LANKA | 7.600 | 0.006 | 0.000 | 0.954 | One-way |
| THAILAND | 0.750 | 0.387 | 11.060 | 0.001 | One-way |

Granger Causality Test in system setting for middle-income countries (w/o China)

| country | ınce to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| INDONESIA | 0.980 | 0.612 | 1.930 | 0.381 | None |
| MALAYSIA | 2.080 | 0.353 | 2.850 | 0.241 | None |
| PHILLIPPINES | 6.600 | 0.037 | 4.540 | 0.103 | One-way |
| SRI LANKA | 0.800 | 0.372 | 0.910 | 0.339 | None |
| THAILAND | 0.030 | 0.874 | 3.960 | 0.047 | One-way |

Granger Causality Test in system setting for low-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| BANGLADESH | 0.570 | 0.451 | 0.850 | 0.355 | None |
| INDIA | 6.960 | 0.031 | 11.950 | 0.003 | Two-way |
| NEPAL | 4.780 | 0.092 | 4.370 | 0.112 | One-way |
| PAKISTAN | 5.370 | 0.068 | 9.390 | 0.009 | Two-way |
| PAPUA N.G. | 1.820 | 0.402 | 5.060 | 0.080 | One-way |

Table 2.17 Granger Causality Test Model 3 LY= f(BM, TY, GOVY, CPI)

Granger Causality Test for <u>all countries</u>

| country | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Finance to growth | | Growth to finance | | Two/one-way | Finance to growth | | Growth to finance | | Two/one-way |
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| AUSTRALIA | 0.000 | 0.000 | 0.064 | 0.800 | One-way | 218.770 | 0.000 | 29.100 | 0.000 | Two-way |
| BANGLADESH | 0.003 | 0.956 | 3.184 | 0.074 | One-way | 15.360 | 0.000 | 17.590 | 0.000 | Two-way |
| CHINA | 17.162 | 0.000 | 5.560 | 0.062 | Two-way | 24.380 | 0.000 | 25.020 | 0.000 | Two-way |
| INDIA | 8.158 | 0.017 | 5.622 | 0.060 | Two-way | 18.020 | 0.000 | 32.620 | 0.000 | Two-way |
| INDONESIA | 0.230 | 0.632 | 0.287 | 0.592 | None | 1.670 | 0.196 | 45.470 | 0.000 | One-way |
| JAPAN | 0.000 | 0.000 | 11.513 | 0.001 | Two-way | 0.440 | 0.506 | 8.890 | 0.003 | One-way |
| KOREA | 0.123 | 0.940 | 0.565 | 0.452 | None | 1.460 | 0.482 | 115.610 | 0.000 | One-way |
| MALAYSIA | 1.066 | 0.587 | 0.231 | 0.891 | None | 10.420 | 0.005 | 106.420 | 0.000 | Two-way |
| NEPAL | 6.545 | 0.038 | 0.830 | 0.362 | One-way | 13.900 | 0.001 | 24.240 | 0.000 | Two-way |
| NEW ZEALAND | 11.648 | 0.003 | 4.366 | 0.113 | One-way | 55.870 | 0.000 | 31.550 | 0.000 | Two-way |
| PAKISTAN | 0.000 | 0.000 | 3.016 | 0.082 | Two-way | 4.530 | 0.033 | 23.220 | 0.000 | Two-way |
| PAPUA N.G. | 1.651 | 0.199 | 0.060 | 0.806 | None | 23.560 | 0.000 | 30.260 | 0.000 | Two-way |
| PHILLIPPINES | 7.502 | 0.006 | 0.222 | 0.637 | One-way | 0.000 | 0.966 | 21.190 | 0.000 | One-way |
| SINGAPORE | 4.670 | 0.031 | 0.892 | 0.345 | One-way | 1.710 | 0.191 | 6.130 | 0.013 | One-way |
| SRI LANKA | 0.302 | 0.583 | 0.070 | 0.791 | None | 8.220 | 0.004 | 10.040 | 0.002 | Two-way |
| THAILAND | 0.002 | 0.961 | 0.00097 | 0.975 | None | 0.180 | 0.669 | 27.720 | 0.000 | One-way |

Granger Causality Test in system setting for all countries (w/o China)

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| AUSTRALIA | 257.550 | 0.000 | 24.940 | 0.000 | Two-way |
| BANGLADESH | 1.390 | 0.239 | 6.130 | 0.013 | One-way |
| INDIA | 14.020 | 0.001 | 7.670 | 0.022 | Two-way |
| INDONESIA | 3.460 | 0.063 | 18.400 | 0.000 | Two-way |
| JAPAN | 0.000 | 0.994 | 6.570 | 0.010 | One-way |
| KOREA | 1.870 | 0.393 | 44.970 | 0.000 | One-way |
| MALAYSIA | 0.650 | 0.733 | 25.480 | 0.000 | One-way |
| NEPAL | 18.030 | 0.000 | 47.100 | 0.000 | Two-way |
| NEW ZEALAND | 63.460 | 0.000 | 4.640 | 0.098 | Two-way |
| PAKISTAN | 0.230 | 0.636 | 48.420 | 0.000 | One-way |
| PAPUA N.G. | 18.610 | 0.000 | 0.140 | 0.707 | One-way |
| PHILLIPPINES | 0.900 | 0.342 | 11.190 | 0.001 | One-way |
| SINGAPORE | 2.060 | 0.151 | 2.270 | 0.132 | None |
| SRI LANKA | 20.590 | 0.000 | 8.280 | 0.004 | Two-way |
| THAILAND | 2.450 | 0.118 | 0.540 | 0.463 | None |

Granger Causality Test in system setting for high-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| AUSTRALIA | 167.930 | 0.000 | 8.340 | 0.016 | Two-way |
| JAPAN | 0.960 | 0.327 | 8.920 | 0.003 | One-way |
| KOREA | 5.850 | 0.054 | 7.950 | 0.019 | Two-way |
| NEW ZEALAND | 57.170 | 0.000 | 6.540 | 0.038 | Two-way |
| SINGAPORE | 25.120 | 0.000 | 5.250 | 0.022 | Two-way |

Granger Causality Test in system setting for middle-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| CHINA | 11.260 | 0.001 | 27.630 | 0.000 | Two-way |
| INDONESIA | 3.220 | 0.073 | 6.500 | 0.011 | Two-way |
| MALAYSIA | 18.490 | 0.000 | 37.380 | 0.000 | Two-way |
| PHILLIPPINES | 2.210 | 0.137 | 19.040 | 0.000 | One-way |
| SRI LANKA | 0.040 | 0.846 | 4.260 | 0.039 | One-way |
| THAILAND | 0.310 | 0.580 | 3.370 | 0.066 | One-way |

Granger Causality Test in system setting for middle-income countries (w/o China)

| country | ınce to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| INDONESIA | 0.240 | 0.625 | 1.100 | 0.295 | None |
| MALAYSIA | 1.140 | 0.565 | 2.210 | 0.332 | None |
| PHILLIPPINES | 11.050 | 0.001 | 13.480 | 0.000 | Two-way |
| SRI LANKA | 1.440 | 0.230 | 0.200 | 0.657 | None |
| THAILAND | 0.090 | 0.765 | 0.030 | 0.860 | None |

Granger Causality Test in system setting for low-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| BANGLADESH | 0.020 | 0.889 | 11.820 | 0.001 | One-way |
| INDIA | 16.680 | 0.000 | 17.120 | 0.000 | Two-way |
| NEPAL | 16.700 | 0.000 | 6.130 | 0.047 | Two-way |
| PAKISTAN | 0.340 | 0.563 | 4.030 | 0.045 | One-way |
| PAPUA N.G. | 6.960 | 0.008 | 8.990 | 0.003 | Two-way |

Table 2.18 Granger Causality Test Model 4 LY= f(BM, GSY, GOVY, CPI)

Granger Causality Test for <u>all countries</u>

| | Standard Granger Causality Test | | | | | SURECM based Granger Causality Test | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| country | Finance to growth | | Growth to finance | | Two/one-way | Finance to growth | | Growth to finance | | Two/one-way |
| | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | | $\chi2$ -stat | p-value | $\chi2$ -stat | p-value | |
| AUSTRALIA | 0.053 | 0.819 | 0.167 | 0.683 | None | 26.560 | 0.000 | 63.820 | 0.000 | Two-way |
| BANGLADESH | 0.700 | 0.704 | 14.272 | 0.001 | One-way | 39.250 | 0.000 | 48.440 | 0.000 | Two-way |
| CHINA | 0.121 | 0.728 | 0.643 | 0.422 | None | 6.550 | 0.000 | 96.770 | 0.000 | Two-way |
| INDIA | 4.097 | 0.043 | 6.782 | 0.009 | One-way | 10.960 | 0.000 | 27.900 | 0.000 | Two-way |
| INDONESIA | 0.055 | 0.815 | 0.019 | 0.890 | None | 2.020 | 0.155 | 0.000 | 0.979 | None |
| JAPAN | 3.696 | 0.158 | 4.439 | 0.109 | None | 47.310 | 0.000 | 86.690 | 0.000 | Two-way |
| KOREA | 0.022 | 0.989 | 1.792 | 0.408 | None | 10.990 | 0.004 | 168.860 | 0.000 | Two-way |
| MALAYSIA | 0.248 | 0.619 | 0.027 | 0.870 | None | 6.320 | 0.043 | 33.580 | 0.000 | Two-way |
| NEPAL | 2.247 | 0.325 | 0.801 | 0.670 | None | 38.290 | 0.000 | 7.050 | 0.030 | Two-way |
| NEW ZEALAND | 3.477 | 0.176 | 5.884 | 0.053 | One-way | 52.690 | 0.000 | 52.940 | 0.000 | Two-way |
| PAKISTAN | 1.421 | 0.233 | 2.463 | 0.117 | None | 2.820 | 0.093 | 8.060 | 0.005 | Two-way |
| PAPUA N.G. | 9.781 | 0.008 | 2.097 | 0.351 | One-way | 1.260 | 0.532 | 23.920 | 0.000 | One-way |
| PHILLIPPINES | 7.208 | 0.027 | 0.354 | 0.838 | One-way | 12.000 | 0.003 | 27.840 | 0.000 | Two-way |
| SINGAPORE | 10.814 | 0.004 | 3.744 | 0.154 | One-way | 7.570 | 0.023 | 9.280 | 0.010 | Two-way |
| SRI LANKA | 5.636 | 0.060 | 6.581 | 0.037 | Two-way | 0.980 | 0.613 | 24.260 | 0.000 | One-way |
| THAILAND | 10.351 | 0.006 | 5.6088 | 0.061 | Two-way | 3.630 | 0.163 | 45.550 | 0.000 | Two-way |

Granger Causality Test in system setting for all countries (w/o China)

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| AUSTRALIA | 25.780 | 0.000 | 37.330 | 0.000 | Two-way |
| BANGLADESH | 39.670 | 0.000 | 43.280 | 0.000 | Two-way |
| INDIA | 13.990 | 0.000 | 54.500 | 0.000 | Two-way |
| INDONESIA | 2.550 | 0.111 | 0.010 | 0.928 | None |
| JAPAN | 31.900 | 0.000 | 56.400 | 0.000 | Two-way |
| KOREA | 8.410 | 0.015 | 89.820 | 0.000 | Two-way |
| MALAYSIA | 6.230 | 0.044 | 31.930 | 0.000 | Two-way |
| NEPAL | 40.080 | 0.000 | 14.220 | 0.001 | Two-way |
| NEW ZEALAND | 55.690 | 0.000 | 46.030 | 0.000 | Two-way |
| PAKISTAN | 1.110 | 0.292 | 10.780 | 0.001 | One-way |
| PAPUA N.G. | 1.030 | 0.598 | 17.200 | 0.000 | One-way |
| PHILLIPPINES | 12.760 | 0.002 | 21.880 | 0.000 | Two-way |
| SINGAPORE | 7.090 | 0.029 | 5.870 | 0.053 | Two-way |
| SRI LANKA | 0.910 | 0.634 | 528.320 | 0.000 | One-way |
| THAILAND | 3.730 | 0.016 | 26.000 | 0.000 | One-way |

Granger Causality Test in system setting for high-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| AUSTRALIA | 7.640 | 0.022 | 1.570 | 0.457 | One-way |
| JAPAN | 9.570 | 0.008 | 1.280 | 0.527 | One-way |
| KOREA | 16.330 | 0.000 | 16.940 | 0.000 | Two-way |
| NEW ZEALAND | 63.660 | 0.000 | 18.200 | 0.000 | Two-way |
| SINGAPORE | 2.900 | 0.094 | 6.260 | 0.012 | Two-way |

Granger Causality Test in system setting for middle-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| CHINA | 10.570 | 0.005 | 24.590 | 0.000 | Two-way |
| INDONESIA | 8.510 | 0.004 | 0.590 | 0.444 | One-way |
| MALAYSIA | 0.370 | 0.832 | 17.490 | 0.000 | One-way |
| PHILLIPPINES | 189.700 | 0.000 | 1.310 | 0.520 | One-way |
| SRI LANKA | 43.280 | 0.000 | 105.580 | 0.000 | Two-way |
| THAILAND | 2.440 | 0.295 | 740.030 | 0.000 | One-way |

Granger Causality Test in system setting for middle-income countries (w/o China)

| country | ınce to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| INDONESIA | 2.700 | 0.132 | 0.410 | 0.524 | None |
| MALAYSIA | 1.020 | 0.601 | 0.95 | 0.622 | None |
| PHILLIPPINES | 8.680 | 0.013 | 6.390 | 0.041 | Two-way |
| SRI LANKA | 7.140 | 0.028 | 2.660 | 0.265 | One-way |
| THAILAND | 3.630 | 0.162 | 1.060 | 0.588 | None |

Granger Causality Test in system setting for low-income countries

| country | Finance to growth | | Growth to finance | | Two/one-way |
|---|---|---|---|---|---|
| | $\chi 2$ -stat | p-value | $\chi 2$ -stat | p-value | |
| BANGLADESH | 12.940 | 0.002 | 27.050 | 0.000 | Two-way |
| INDIA | 11.290 | 0.008 | 15.060 | 0.000 | Two-way |
| NEPAL | 14.280 | 0.001 | 12.070 | 0.002 | Two-way |
| PAKISTAN | 3.290 | 0.070 | 1.670 | 0.196 | One-way |
| PAPUA N.G. | 6.400 | 0.041 | 1.800 | 0.407 | One-way |

Table 2.19 Summary Table of Granger Causality Test for Models 1 and 3

| Model 1 LY = f(DCBY, TY, GOVY, CPI) | | | Model 3 LY = f(BM, TY, GOVY, CPI) | | |
|---|---|---|---|---|---|
| All | 11/16- bidirectional<br>1/16 – finance to growth<br>4/16 – growth to finance<br>0/16 – none | Bidirectional<br>Reverse | All | 10/16- bidirectional<br>0/16 – finance to growth<br>6/16 – growth to finance<br>0/16 – none | Bidirectional<br>Reverse |
| All w/o China | 10/15-bidirectional<br>1/15- finance to growth<br>3/15-growth to finance<br>1/15-Pakistan | Bidirectional<br>Reverse | All w/o China | 6/15-bidirectional<br>1/15- finance to growth<br>6/15-growth to finance<br>2/15-none (Singapore & Thailand) | Bidirectional<br>Reverse |
| High income | 3/5- bidirectional<br>1/5 – finance to growth<br>1/5 – growth to finance<br>0/5 – none | Bidirectional | High income | 4/5- bidirectional<br>0/5 – finance to growth<br>1/5 – growth to finance<br>0/5 – none | Bidirectional<br>Reverse |
| Middle income | 5/6- bidirectional<br>1/6 – finance to growth<br>0/6 – growth to finance<br>0/6 – none | Bidirectional<br>Positive | Middle income | 3/6- bidirectional<br>0/6 – finance to growth<br>3/6 – growth to finance<br>0/6 – none | Bidirectional<br>Reverse |
| Middle Income w/o China | 0/5- bidirectional<br>1/5 – finance to growth<br>1/5 – growth to finance<br>3/5 – none | None | Middle Income w/o China | 1/5- bidirectional<br>0/5 – finance to growth<br>0/5 – growth to finance<br>4/5 – none | Bidirectional<br>None |
| Low income | 2/5- bidirectional<br>2/5 – finance to growth<br>1/5 – growth to finance<br>0/5 – none | Bidirectional<br>Positive | Low income | 3/5- bidirectional<br>0/5 – finance to growth<br>2/5 – growth to finance<br>0/5 – none | Bidirectional<br>Reverse |

Table 2.20 Summary Table of Granger Causality Test for Models 2 and 4

| Model 2 LY = f(DCBY, GOVY, GSY, CPI) | | | Model 4 LY = f(BM, GOVY, GSY, CPI) | | |
|---|---|---|---|---|---|
| All | 8/16- bidirectional<br>5/16 – finance to growth<br>3/16 – growth to finance<br>0/16 – none | Bidirectional<br>Positive | All | 13/16- bidirectional<br>0/16 – finance to growth<br>2/16 – growth to finance<br>1/16 – none (Indonesia) | Bidirectional<br>Reverse |
| All w/o China | 8/15-bidirectional<br>5/15- finance to growth<br>1/15-growth to finance<br>1/15-none (Australia) | Bidirectional<br>Positive | All w/o China | 10/15-bidirectional<br>/15- finance to growth<br>4/15-growth to finance<br>1/15-none (Indonesia) | Bidirectional<br>Reverse |
| High income | 2/5- bidirectional<br>1/5 – finance to growth<br>2/5 – growth to finance<br>0/5 – none | Bidirectional | High income | 3/5- bidirectional<br>2/5 – finance to growth<br>0/5 – growth to finance<br>0/5 – none | Bidirectional |
| Middle income | 2/6- bidirectional<br>3/6 – finance to growth<br>1/6 – growth to finance<br>0/6 – none | Bidirectional<br>Positive | Middle income | 2/6- bidirectional<br>1/6 – finance to growth<br>3/6 – growth to finance<br>0/6 – none | Bidirectional<br>Reverse |
| Middle Income w/o China | 0/5- bidirectional<br>1/5 – finance to growth<br>1/5 – growth to finance<br>3/5 – none | None | Middle Income w/o China | 1/5- bidirectional<br>1/5 – finance to growth<br>0/5 – growth to finance<br>3/5 – none | None |
| Low income | 2/5- bidirectional<br>1/5 – finance to growth<br>1/5 – growth to finance<br>1/5 – none (Bangladesh) | Bidirectional | Low income | 3/5- bidirectional<br>2/5 – finance to growth<br>0/5 – growth to finance<br>0/5 – none | Bidirectional<br>Positive |

VITA

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Scope and Method of Study:

The main purpose of this study is to investigate the relationship between financial development and economic growth and study the effectiveness of financial development for high income OECD as well as for group of Asian economies with different income levels by using system approach. In conducting this study, ADF, KPSS, Johansen-Juselius (1991) cointegration test, Park's (1992) Canonical Cointegrating Regression (CCR), Error Correction Model (ECM), as well as Seemingly Unrelated Regression Error Correction Model (SURECM) and Granger (1969) causality tests in a system method are used as empirical evidence.

Findings and Conclusions:

We found the evidence that there are: 1) strong evidence that causality exists between the financial development and economic growth, more specifically, direction of causality is bidirectional in most of the cases; 2) evidence of positive causality running from finance to growth when DCBY is used as financial proxy, which highlights the importance of bank loan to promote investment and economic growth; and 3) a tendency of reverse causality running from growth to finance when LLY/BM is used as financial proxy, pointing out to the important role of formal bank intermediation for economic growth; 4) cases of one-way causality such as positive and reverse causality are more prominent for middle to low income countries; 5) an evidence that China has a huge impact on Asian economy and more precisely it has a significant impact on developing economies such as middle and low income countries; 6) selection of control variables does not affect the model specification and the direction of causality for Asian economies, however it is important variable for European sub-group; and 7) system method is superior to traditional regression methods.


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