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«Financial Development and Economic Activity in Advanced and Developing Economies: Evidence from Panel Cointegration »

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Abstract

The purpose of this thesis is to re-evaluate the causality issue and the long-run relationship between financial development and economic activity. Using a sample of 75 countries -21 developed and 54 developing- over the period 1975-2015 in annual annual data three panels were constructed. Unit root tests (IPS, LLC, ADF-PP, Breitung) were conducted in order to ensure stationarity. Tests (Pedroni, Johansen and Kao) were, also, employed to seek for cointegrating vectors. The long run relationship was estimated using fully modified OLS and causality using vector error correction model.

In summary, the results of the panel unit root tests indicate that the variables are stationary in their first differences; the cointegration tests show that regardless the proxies for the financial development there is at least one cointegrating vector for all groups. The findings for causality (VECM) detect short-run bidirectional causality for the world group, unidirectional short-run causality from economic activity to financial development for the developing group and unidirectional long-run causality from econonomic activity to finance, and for the developed group bidirectional short-run causality (for two out of three proxies of finance) and unidirectional long-run causality from finance to econonomic activity. Finally, the estimation for the long run relationship indicates a positive relation between economic activity and all three financial development proxies for all groups.

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1. Introduction

The 2007-2008 financial crisis which led to the downturn of economic activity known as the Great Recession of 2008–2012, proved that the finance-growth nexus is for sure existent and that we still have much to learn on the matter and even reconsider prior conclusions. The relationship between financial development and economic growth has been a subject of great interest and debate among economists for many years, both at theoretical and empirical level. But just as societies are ever-changing so is everything that defies them, and thus defining the causal relationship between finance and growth is always crucial.

Conflicting views have been expressed in the literature on the existence and direction of causality between finance and growth. The supply-leading view supports that financial development is an important determinant for economic growth and development. The demand following view states that economic development creates demands for particular types of financial services and the financial system simply responds to these demands. Another view supports mutual impact of finance and growth. Finally, in some opinion there is no relationship at all.

Schumpeter (1911) was the one who emphasized the positive role of financial development on economic growth, arguing that the economic growth of countries depends on financial market sophistication, which enables efficient allocation of financial resources and innovations that enhance economic productivity and meet markets' needs. On the same path, Gurley and Shaw (1955), Goldsmith (1969) and McKinnon (1973) have pointed out the importance of inserting finance on explaining economic growth. Goldsmith (1969) claimed that financial intermediation contributes to economic growth by raising the efficiency of capital accumulation and in turn the marginal productivity of capital. McKinnon (1973) and Shaw (1973) highlighted that increasing the size of savings, improving the efficiency of investment and financial liberalization, cause financial development, which in turn can spur economic growth. King and Levine (1993) demonstrated that financial sector's development contributes to economic growth by increasing innovative activities. Using endogenous growth theory, Levine (1997) showed that financial institutions play a key role in providing firms with information important for investment decisions, contributing to economic growth. Miller (1998) claimed that financial development leads to real internal economic growth thanks to different explanatory variables discarding though to explain how.

Robinson (1952) claimed that financial development facilitates economic growth through various financial channels, and also stated that financial development follows economic growth or "where enterprise leads finance follows". Lewis (1955), Pradhan (2011), Bangake and Eggoh (2011) have supported that there is a bidirectional relationship between finance and growth. On the other hand, Lucas (1988) dismissed the whole idea of the finance–growth nexus believing that the role of financial sector has been exaggerated and stating that there is no relationship at all.

Over the last decades, the subject has been evaluated empirically by many researchers in attempt to define the existence of this relationship, the direction of causality and the long-run effect. Various methods have been used from time-series data to cross-sectional to panel data nowadays. And while there have been dissenting views, by and large, the empirical evidence has demonstrated a convincing causal link and a positive long-run association between finance and growth.

In accordance, the purpose of this thesis is to re-evaluate the causality issue and the long-run relationship between financial development and economic activity using a large sample of 75 countries -21 developed and 54 developing- over the period 1975-2015 and modern econometric techniques. In addition, three groups where constructed in order to profer to the existing literature by validating the results according to the groups' specific features. The econometric model was constructed using representative variables for economic activity and financial development. The panel econometric techniques conducted to estimate the model were the following:

- Panel data unit root tests to examine the stationarity properties of the data.
- Panel cointegration tests to seek for cointegration relationships.
- Pedroni, Johansen and Kao tests were used to estimate the cointegrating vector in a fully modified OLS principle (FMOLS).
- A vector error correction model was estimated to define the causal relationship between economic activity and financial development.

The present thesis is structured as follows: This chapter briefly introduces the subject under investigation. In chapter 2, empirical evidence on the relationship between financial development and economic activity is presented. The data used and the econometric techniques employed are included in chapter 3. The empirical results are analyzed in chapter 4. Finally, in chapter 5 the findings of this study are discussed.

2. Empirical Studies

Apart from the theoretical studies mentioned in the introduction, there is a plethora of empirical studies testing for the relationship between economic growth and financial developement. Initially, studies depended on time-series and cross-sectional data but progressively panel data and threshold techniques were introduced providing more reliable conclusions. In the studies real data are used and the nexus is tested under different model specifications.

The majority of the studies support the existence of the finance – growth nexus, having reached a consensus in which it is thought to be established. What is not established are the channels through which the nexus exists, the direction of causality and the long-term effect. Going through as many studies as possible, one can come to a better realization of the matter. Thus, studies categorized by the method used are cited in this chapter.

2.1. Time-Series Data

Jung (1986) using annual data and a sample of 56 countries, 19 DCs and 37 LDCs tested for the finance-growth nexus. Economic Growth was proxied by GDP or GNP, Financial Development by i) the ratio of currency to M1 and ii) the ratio of M2 to nominal GNP or GDP. The results implied that LDC's follow a supply-leading causality pattern more frequently than a demand-following pattern and were characterized by the causal direction running from financial to economic development. On the contrary DCs were characterized by the reverse causal direction, regardless of which causality concept was employed. The monetization variable did not appear to distinguish DCs from LDCs in terms of causality directions. Countries with a higher-than-average growth rate of GNP (or GDP) were rather strongly associated with a supply-leading phenomenon when the currency ratio was used as a proxy of financial development.

Demetriades and Luintel (1996) tested the relationship among financial development, economic growth and banking sector controls in India. The data were annual and the time period was from 1961 to 1991. Real GDP per capita was used as a proxy for economic growth and the ratio of bank deposit liabilities to nominal GDP for financial depth. In addition, interest rate controls (a fixed deposit rate, a ceiling on the deposit rate, a floor on the deposit rate, a fixed lending rate, a ceiling on the lending rate and a floor on the lending rate all gauged by dummies), population, gross fixed capital formation and retail price index were introduced to the specification. According to the results, a bi-directional causality between financial deepening and economic growth was found.

Demetriades and Hussein (1996) used a sample of 16 countries to test whether financial development causes economic growt. The data were annual but the time period varied having a span of 27 years. They proxied financial development with i) the ratio of bank deposit liabilities to nominal GDP and ii) the ratio of bank claim on the private sector to nominal GDP, and economic development with real GDP per capita. The evidence provided very little support to the view that finance is a leading sector in the process of economic development. On the other hand, there was evidence that in quite a few countries economic growth systematically caused financial development. However, most of the evidence seemed to favour the view that the relationship between financial development and economic growth is bi-directional. The results were very much country specific.

Arestis and Demetriades (1997) used two samples to run their tests. The first sample consisted of 2 countries, USA and Germany and the data were quarterly. The second sample consisted of 1 country South

Korea. For the first sample, economic growth was proxied by real GDP per capita, financial development by i)ratio of stock market value to GDP, ii) index of stock market volatility, iii) ratio of M2 to GDP and iii) the ratio of domestic bank credit to nominal GDP. For the second sample, economic growth was proxied by real GDP per capita, financial development by i) the ratio of bank deposits to GDP, ii) capital stock per head, iii) ex-ante real deposit rate of interest and iv) financial repression index. The results exhibited substantial variation across countries. Important differences in the links between finance and growth were revealed.

Kar and Pentecost (2000) tested for the causality between financial development and economic growth in Turkey. The data were annual and the time period was from 1963 to 1995. As a proxy for economic growth they used the change in per capita GNP and for financial development they used i) the ratio of broad money to gross national product, ii) the ratio of bank deposit liabilities to GNP, iii) the ratio of claims on the private sector to GNP, iv) the share of private sector credits in the domestic credit, and v) the ratio of domestic credit to GNP. The empirical results showed that the direction of causality between financial development and economic growth was sensitive to the choice of measurement for financial development in Turkey and implied that the strength of the causality between financial development and economic growth was much weaker than that between economic growth and financial development.

Shan, Morris and Sun (2001) wondered whether the finance-growth nexus was an egg-and-chicken problem. They tested for a sample of 9 OECD countries and China. The data were annual and varied for each country from 1974 to 1998. Financial Development was proxied by the loans made to the private sector by commercial banks and other deposit taking banks to GDP and economic growth by real GDP per capita. Total factor productivity, trade openness, the ratio of total capital expenditure to GDP, CPI and stock market prices' index were inserted in the model. Evidence of reverse causality was found in some countries and bidirectional in others. No evidence of one way causality was found. The financial sector did not appear to be a leading sector in the course of economic growth. No general conclusions could be made regarding the direction of causality between financial development and economic growth in all countries.

Arestis, Demetriades and Luintel (2001) tested for the role of stock markets on the finance-growth nexus. They used a sample of 5 developed countries. The data were quarterly and the time period varied for each country from 1968 to 1998. Economic growth was proxied by real GDP per capita and financial development by i) the ratio of stock market value to GDP, ii) the ratio of domestic bank credit to nominal GDP and iii) the stock market volatility gauged by an eight-quarter moving standard deviation of the end-of-quarter change of stock market prices. Both stock markets and banks seemed to have made important contributions to output growth (France, Germany and Japan). The link between financial development and growth was found to be statistically weak (USA and UK) and, if anything, to run from growth to financial development. Stock market volatility had negative real effects in Japan and France. In the case of the United Kingdom stock market volatility exerted negative effects both on financial development and output. Finally, the effects of stock market volatility in Germany were found to be insignificant.

Khalifa Al-Yousif (2001) tested for a sample of 30 developing countries using annual data. The time period varied for each country from 1970 to 1999. Real GDP per capita was chosen as the proxy for economic growth and for financial development were chosen i) the ratio of currency to narrow money stock M1 and ii) ratio of broad money stock M2 to GDP. The results supported that the causality between financial development and economic growth was bidirectional one. In all cases, though, causality was country specific and tended to vary with the kind of proxies used to measure financial development.

Liu and Hsu (2004) investigated the role of financial development in economic growth for Taiwan, Korea and Japan from 1981 to 2001. Economic growth was proxied by real per capita GDP and financial development by i) quasi-money, ii) bank claims on the private sector by deposit money banks, iii) deposit money bank domestic assets, iv) central bank domestic assets, v) the total value of listed shares, vi) the value of the trades of shares on domestic exchanges, vii) the stock price index, viii) direct investment abroad, ix) direct investment in domestic, x) portfolio investment assets, and x) portfolio investment liabilities. Inflation rate, government consumption to GDP, export growth, capital outflow to GDP, capital inflow, financial crisis (dummy), foreign exchange system change date (dummy) were used as control variables. The results showed that high investment accelerated economic growth in Japan, while high investment to GDP ratio did not necessarily lead to better growth performance if investment did not have been allocated efficiently or if overinvestment exist, e.g. in Taiwan and Korea cases. Real export growth rate contributed to Taiwan and Korea. The finance-aggregate had positive effects on the economy of Taiwan, but had negative effect on Korea and Japan. One possible reason may be due to the relatively sound financial system and prudentially financial regulation and supervision in Taiwan comparing with those in Korea and Japan. The stock market development had positive effects on economic growth in Taiwan. Taiwanese economy suffered less from the Asian financial crisis. After foreign exchange deregulation, capital outflows had negative effects on all three economies, while the effect of capital inflows is negative but insignificant.

Ghirmay (2004) tested for financial development and economic growth in 13 Sub-Saharan African countries. The data were annual and the time period was 30 years for 11 countries, 29 years for one country and 28 years for one country. Economic Growth was captivated by real GDP growth rate and financial development was proxied by the level of credit to the private sector by the financial intermediaries. In almost all (11 out of 13) of the countries financial development and economic growth were cointegrated over the sample period suggesting that the two variables cannot drift apart in the long run and thus may not be considered independent. There was evidence of financial development causing economic growth in eight countries, economic growth causing financial development (reverse causality) in nine counties, and bidirectional causal relationships in six countries.

Shan (2006) investigated whether financial development 'leads' economic growth or not. He used sample of 10 OECD countries and China. The data were quarterly and the time period was from 1985 to 1998. He used the rate of change of real GDP to captivate the economic growth, the rate of change of total capital expenditure to captivate investment, total credit to the economy to proxy financial development and the rate of change of the main stock market index to proxy stock market development. Furtherome, he used the rate of change of productivity, trade openness, interest rates and CPI. Little evidence was found that financial development "leads" economic growth, nor were substantial differences found between countries that had more developed financial systems and those with less developed. It seemed clear that financial development was no more than a contributing factor and not the most important. Whatever causality may have existed, it was not uniform in direction or strength and highlighted the inappropriateness of cross-sectional analysis in this regard.

Liang and Teng (2006) presented evidence for financial development and economic growth in China. The data were annual and the time period was from 1952 to 1990. Real GDP per capita was used as a proxy for economic growth and i) domestic credit by banking institutions to GDP, and ii) total deposit liabilities of banking institutions to GDP for financial development. They also introduced to the model real interest rates, real per capita fixed capital formation and total values of exports and imports as a share of GDP. Financial development, physical capital stock, international trade and real interest rate were all economically and significantly related to economic growth. However, there existed only a unidirectional causality from economic growth to financial development.

Abu-Bader and Abu-Qarn (2006) tested for Egypt, using annual data from 1960 to 2001. Economic growth was proxied by real GDP per capita and financial development by i) the ratio of money stock M2 to nominal GDP, ii) ratio of money stock M2 minus currency to nominal GDP, iii) the ratio of bank credit to the private sector to nominal GDP, and iv) the ratio of credit issued to non financial private firms to total domestic credit. The results revealed a bi-directional Granger causality between economic growth and financial development using all the financial measures. The evidence of causality from financial development to economic growth after controlling for investment supported the hypothesis that the enhancement of investment efficiency through the rise in private investment led to a rebound in economic performance of Egypt in the 1990s. Furthermore, by the inclusion of the investment/GDP share, an indirect causality from financial development to economic growth was found, through increasing resources for investments.

Ang and McKibbin (2007) tested for the relationship between financial liberalization, financial development and ecomic growth in Malaysia using annual data. They constructed a Financial Development Index using liquid liabilities to nominal GDP, commercial bank assets to commercial bank assets plus central bank assets and domestic credit to private sectors divided by nominal GDP. As a proxy for Economic

Development, the real per capita GDP was used. Moreover, his model specification included the Real Interest Rate, an extension of the Financial Repression Index and dummy variables. According to the results, financial repressionist policies and real interest rates affected financial deepening negatively. Although financial sector reforms had enlarged the financial system, policy changes did not appear to have led to higher long-run growth. Instead, financial deepening was an outcome of the growth process. Economic growth led to higher financial development but not vice versa.

Jenkıns and Katırcıoglu (2008) used the bounds test approach for cointegration and causality between financial development, international trade and economic growth for Cyprus. They used annual data from 1960 to 2005. They proxied economic growth with real GDP, financial development with i) real broad money (M2) and ii) real domestic credit provided by banking sector and trade with i)real exports of goods and services and ii) real Imports of goods and services. The results confirmed long-run equilibrium relationship between real income, exports, imports and M2 whereas domestic credit was not co integrated with the rest of the variables. Growth in real income stimulated growth in international trade and money supply. Growth in imports of goods and services also stimulated an increase in exports of goods and services.

Abu-Bader and Abu-Qarn (2008) presented evidence on financial development and economic growth for six MENA countries. The data were annual and the time period varied for each country from 1960 to 2004. Economic growth was proxied by real GDP per capita and financial development by i) the ratio of money stock M2 to nominal GDP, ii) the ratio of money stock M2 minus currency to nominal GDP, iii) the ratio of bank credit to the private sector to nominal GDP, and iv) the ratio of credit issued to non financial private firms to total domestic credit. Into the specification were, also, used the share of investment in GDP and the share of government expenditures in GDP. The results showed strong evidence for causality running from financial development to economic growth. In general, the causality was unidirectional. Only in the case of Israel no evidence of causality was found. On the other hand, weak evidence of causality from economic growth was detected when ratio of money stock M2 to nominal GDP and ratio of money stock M2 minus currency to nominal GDP were used as financial measures.

Chang and Caudill (2012) tested the nexus for Taiwan, using annual data from 1962 to 1998. GDP Per Capita was used as a proxy for Growth ratio of money stock M2 to GDP for financial development. Exports and imports were used as control variables. Real GDP per capita, financial development, real exports and real imports were cointegrated with one vector. Unidirectional causality running from financial development to economic growth was found. Furthermore, unidirectional causality was also found running from financial development to real exports and from real exports to economic growth.

Dritsakis and Adamopoulos (2014) tested for causality between financial development and ecomic growth in Greece using Granger causality analysis. They used quarterly data from 1960:I to 2000:IV. They proxied Economic Growth with GDP, Financial Development with the ratio of domestic bank credit to nominal GDP and inserted in the model Trade Openness. The results of the cointegration analysis suggested the existence of a cointegration relationship between the three variables, indicating the presence of common trend or long-run relationships among these variables. The results of the causality analysis denoted that there exists a bilateral (strong) causal relationship between financial development and economic growth and between the degree of openness and economic growth.

Roszbachz (2014) tested for causality using quarterly data of a sample of 22 developed countries through the period from 1973 to 2011. GDP Per Capita was used as a proxy for Growth, i) ratio of stock market capitalization to nominal GDP and ii) domestic bank credit to the private sector to nominal GDP for finance. The results indicated that causality patterns between finance and growth differ depending on whether financial development stems from the banking sector or stock markets. Stock market development exerted a causal impact on GDP in 11 of the countries in the sample, while a reverse causal link was present between economic and bank development in 16 countries. The impact of banking sector development appeared less strong at high levels of development.

2.2. Cross-Sectional data

King and Levine (1993) in order to prove Schumpeter was right constructed a sample of 80 countries. Economic growth was proxied by i) real GPD per capita, ii) the rate of physical capital accumulation, iii) the ratio of domestic investment to GDP, iv) a residual measure of improvements in the efficiency of physical capital allocation and financial depth was proxied by i) the ratio of liquid liabilities of the financial system to GDP, ii) the ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets, iii) credit allocated to private enterprises by the financial system, and v) the ratio of claims on the nonfinancial private sector to GDP). It was found that indicators of the level of financial development - the size of the formal financial intermediary sector relative to GDP, the importance of banks relative to the central bank, the percentage of credit allocate to private firms, and the ratio of credit issued to private firms to GDP - were strongly and robustly correlated with growth, the rate of physical capital accumulation, and improvements in the efficiency of capital allocation. The predetermined components of these financial development indicators significantly predict subsequent values of the growth indicators. The data were consistent with the view that financial services stimulate economic growth by increasing the rate of capital accumulation and by improving the efficiency with which economies use that capital. However, specific financial sector policies were not linked with long-run growth.

Levine and Zervos (1996) utilized a sample of 40 countries to test for stock market development and long-run growth over the period from 1976 to 1993.Economic growth was gauged by real per capita growth rate and stock market development index was constructed. Initial income, initial education, political instability, government consumption expenditures, inflation rates and black market exchange rate premium were used as auxiliary variables. There was a significant, positive correlation between the predetermined component of stock market development and real per capita GDP growth. The relationship between stock and growth remained significant whether or not the government consumption ratio, the rate of inflation and the black market exchange rate premium were controlled. Thus, stock market development was positively correlated with economic growth even after controlling for other factors associated with long-run growth.

Beck and Levine (2002) utilized a sample of 40 countries to define the relationship among stock markets, banks and growth over the period is from 1976 to 1998. Economic growth was gauged by real per capita growth, stock market development was proxied by i) value of the trades of shares on domestic exchanges divided by total value of listed shares, ii) value of the trades of domestic shares on domestic exchanges divided by GDP, and iii) value of listed shares divided by GDP and bank development was proxied by bank claims on the private sector by deposit money banks divided by GDP. Initial real GDP per capita, average years of schooling, black market premium, the share of exports and imports to GDP, inflation rates and the ratio of government expenditures to GDP were used as auxiliary variables. The development of stock markets and of banks had both a statistically and economically large positive impact on economic growth. Furthermore, the link between growth and both stock market liquidity and bank development was independent. The data were consistent with theories that emphasize an important positive role for financial development in the process of economic growth.

Hermes and Lensink (2003) tested the relationship between foreign direct investment, financial development and economic growth, using a sample of 67 LCD countries. Per capita GDP growth was used to captivate economic growth and credit to the private sector as a % of GDP was used as a proxy for financial market development. Foreign direct investment, initial level of secondary enrolment rate, initial level of per capita GDP, investment share in GDP, development aid, bank and trade lending, black market premium, index of civil liberties, external debt to GDP, total external debt, uncertainty with respect to inflation, exports of goods and services, government consumption, inflation rates, ndex of political rights and trade openness were used as control variables. The results indicated that an increase in FDI enhances economic growth in countries with improved domestic financial systems.

Khan and Senhadji (2003) used a sample of 159 industrial and developing countries over the period from 1960 to 1999. Economic growth was gauged by growth rate of real GDP and fiinancial depth was proxied by i)domestic credit to the private sector as a share of GDP, ii) domestic credit to the private sector as a share of GDP plus the stock market capitalization as a share of GDP, iii) domestic credit to the private sector as a share of GDP plus the stock market capitalization as a share of GDP plus the private and public bond market capitalization as a share of GDP, and iv) stock market capitalization.Investment as a share of GDP, population growth rate, growth rate of terms of trade and initial income were used as control variables. The results implied a strong positive and statistically significant relationship between financial depth and growth. The result was robust to all four different financial depth indicators, but the size of the effect varies. When a time dimension was introduced into the model the results were generally weaker. The relationship between financial depth and growth was found to be concave.

Law, Azman-Saini and Ibrahim (2013) tested for institutional quality thresholds in the finance-growth nexus. A sample of 85 countries was used for two time periods, from 1980 to 2008 and from 1996 to 2008. Financial development was proxied by i) private sector credit as ratio to GDP, ii) liquid liabilities as ratio to GDP, and iii) commercial bank assets as ratio to GDP. In addition, institutions indicators (control of corruption, rule of law, bureaucratic quality-government effectiveness), initial real GDP per capita, population growth, average years of schooling and investment as a % of GDP were used as control variables. The analysis indicated a significant institutions threshold in the financial development-economic growth nexus. For institutions below the threshold, financial development had an insignificant effect on growth. The growth effect of financial development turned out to be significant and positive for institutions above the threshold level. The financial development-growth nexus was contingent on institutions. A better institutions environment allowed an economy to exploit the benefits of financial development on economic growth. Low quality of institutions tended to distort the ability of financial intermediaries to channel resources to finance productive activities efficiently.

2.3. Panel data

De Gregorio and Guidotti (1995) studied the finance-growth nexus using two samples. The first sample was consisted of 98 countries and the second sample was consisted of 12 Latin American countries. For both samples, the data were annual and the time period was from 1960 to 1985. Economic growth was proxied by GDP per capita and financial intermediation by the ratio of domestic credit to the private sector to GDP. Control variables for the first sample were primary and secondary school enrollment, government spending over GDP, revolutions and coups per year and index of assassinations. For the second sample, investment rates, literacy rates, foreign investment, inflation and government spending over GDP. The results showed that financial development led to improved growth performance. The effect varied across countries and time. The main channel of transmission from financial development to growth was the effect on the efficiency of investment rather than its level.

Levine, Loayza and Beck (1999) studied the causality and causes between financial intermediation and growth. Two samples were used. The first one was consisted of 74 countries and the data are averaged over five year interval over the period from 1960 to 1995. The second one was consisted of 71 countries and the data are averaged over the period from 1960 to 1995, as well. Growth rate of the real GDP per capita was chosen as representative of economic growth and financial intermediation was proxied by i) the overall size of the financial intermediation sector, ii) the conductors of the intermediation, and iii) extension of credit funnel to private sector activities. Legal rights of creditors, soundness of contract enforcement and the level of corporate accounting standards were used as auxiliary variables. The exogenous component of financial intermediary development was found to be positively associated with economic growth. Furthermore, countries with (1) laws that give a high priority to secured creditors getting the full present value of their claims against firms, (2) legal systems that rigorously enforce contracts, including government contracts, and (3) accounting standards that produce high-quality, comprehensive and comparable corporate financial statements tended to have better developed financial intermediaries.

Beck, Levine and Loayza (1999) studied finance and the sources of growth using a sample of 77 countries. The data were annual the time period was from 1960 to 1995. Their model specification included GDP per capita growth rate, GPDI per capita growth rate, capital stock, government consumption, trade openness, government saving, real interest rate, terms of trade, old and young dependency ratios, urbanization ratio, inflation rates, average years of schooling, black market premium, private credit, liquid liabilities, commercial central bank and legal origin. Economically large and statistically significant relation between financial intermediary development and both real per capita GDP growth and total productivity growth were found. Those robust and positive relations were not due to simultaneity bias or country-specific effects. On the other hand, an ambiguous relation between financial intermediary development and both physical capital growth and private savings rates were found. While there tended to be a positive link between them, the results were sensitive to alterations. On the hole, better functioning financial intermediaries improved resource allocation and accelerated total factor productivity growth with positive repercussions for long-run economic growth.

Calderón and Liu (2002) tested for the direction of causality between financial development and economic growth. A sample of 109 developing and industrial countries used and the data covered a 35 year period from 1960 to 1994. Economic Growth was gauged as the real GDP per capita growth rate and financial development was proxied by i) the ratio of broad money M2 to GDP, and ii) the ratio of credits provided by financial intermediaries to the private sector to GDP). Initial human capital, initial income level, government spending to GDP, black market exchange rate premium and groupal dummies were used as control variables. Financial development was found to enhance economic growth for all countries. There was evidence of bidirectional causality when the sample was split into developing and industrial countries. Financial depth contributed more to the causal relationships in developing countries. The longer the sampling interval, the larger the effect of financial development on economic growth had been. Financial development may have enhanced economic growth through both more rapid capital accumulation and technological changes, though it appeared that the productivity channel was stronger.

Apergis, Filippidis and Economidou (2007) tested the linkages between financial deepening and economic growth. They used a sample of 65 countries, 15 OECD and 50 non-OECD. All data were annual, except for human capital data, which were quinquennial. Following Harrigan (1997), they interpolated between five-yearly observations using linear Stata's interpolation function. The time period was from 1975 to 2000. Economi growth was proxied by GDP per capita and financial development by i) liquid liabilities, ii) bank credit, and iii) private sector credit. Average years of schooling, output share of investment, government spending and volume of trade were used as control variables. There was found a positive and statistically significant equilibrium relation between financial development and economic growth for all different financial indicators tested for and in all groups of countries. As for the auxiliary variables, human capital, investment share, and international trade, their impact on growth was found to be positive and statistically significant while government spending exhibited a positive effect for the OECD countries, but a negative effect for the group of non-OECD countries. The results indicated a strong bi-directional causality between financial development and economic growth.

Fung (2009) attempted to find out whether there is convergence or divergence between financial development and economic growth. A sample of 13 industrial countries and 44 developing countries was used over the period 1967 to 2001. Economic Growth was proxied by real per capita GDP and financial development by i) credit allocated to the private sector, and ii) quasi-money. For middle and high income countries, conditional convergence was found not only in economic growth, but also in financial development. The mutually reinforcing relationship between financial development and economic growth was stronger in the early stage of economic development and this relationship diminished as sustained economic growth gets under way. Low income countries with a relatively well developed financial sector were more likely to catch up to their middle and high income counterparts and poor countries with a relatively under-developed financial sector were less likely to catch up.

Kar, Nazlıoğlu and Ağır (2010) tested the financial development and economic growth nexus in the MENA countries through bootstrap panel granger causality analysis. A sample of 15 MENA countries was used. The data were annual and the time period was from 1980 to 2007. Economic growth was proxied by real income and financial development by i) ratio of narrow money to income ratio of quasi money to income, ii) ratio of M2 to income, ratio of deposit money bank liabilities to income, and iii) ratio of private sector to income, ratio of domestic credit to income. The direction of causality between financial development and economic growth was foun to be sensitive to the measurement of financial development in the MENA countries. The financial sector and real sector were interrelated to each other in most cases.

Koetter and Wedow (2010) attempted to define whether it is quantity or quality that matters to the finance-growth nexus in a bank-based economy. They used a sample of 97 districts of Germany. The data were annual and the time period was from 1995 to 2005. Growth was proxied by GDP per worker, financial development quality by the average cost efficiency of banks and financial development volume by the sum of bank loans and securities to GDP. Tertiary education to total workers, constant capital depreciation rate joined with population growth, Hirschman-Herfindahl Indices and Lerner Indices were used as control variables. The quality indicator of financial development was found to have a significantly positive effect on growth. The traditional proxy of credit volume to GDP had no significant effect. The absence of a volume effect of financial development suggested that the availability of credit alone is not the main bottleneck to economic growth. Higher mean mark-ups of banks reduced economic growth by a similar magnitude compared to gains from efficiency improvements. The result of a positive cost efficiency effect on growth was robust. Both quality and quantity measures captured conceptually different channels through which financial development could influence growth.

Bangake and Eggoh (2011) attempted to further provide further evidence on finance-growth causality. A sample of 71 developed and developing countries was used over the period from 1960 to 2004. GDP Per Capita was used as a proxy of growth and i) ratio of liquid liabilities to GDP, ii) ratio of deposit money bank assets to GDP, and iii) ratio of private domestic credit to GDP as proxies for financial development. Government expenditure as ratio to GDP and trade openness was used as control variables. There was found strong evidence in favor of a long-run relationship between financial development and economic growth for all groups of countries (low, middle and high income). Economic growth, financial development and auxiliary variables (government expenditure and trade openness) were cointegrated. A strong bi-directional causality between financial development and economic growth was found across country groups in the long run. In the short run, for low and middle income countries, there was no evidence of short-run effects, while in high income countries economic growth significantly affected finance.

Yilmazkuday (2011) tested for thresholds in the finance-growth nexus. He used a sample of 84 countries. The data were averaged over five-year periods over the period from 1965 to 2004. Growth was gauged by real GDP per capita growth rate and finance was proxied by i) ratio of liquid liabilities to GDP and ii) ratio of (M3-M1) to GDP. Initial GDP per capita, initial secondary enrollment rate, inflation rate, trade openness and government expenditure as a percentage of GDP were used as control variables. The results showed that (i) Inflation rates above 8 percent eliminated the positive effects of financial depth on the long-run growth, (ii) optimal government size (% GDP) for the finance growth nexus was between 11 and 19 percent; government sizes below 11 percent hurted the low-income countries and those above 19 percent hurted the high-income countries, (iii) optimal trade openness for the finance-growth nexus was below about 35 percent for high-income countries, and above about 75 percent for low-income countries, (iv) the catch-up effect through finance-growth nexus started when a country passed the threshold per capita income level of about $665; it had its highest impact when the per capita income was about $1,636; its impact decreased as the per capita income increased, (v) there was evidence to show that financial-depth effects on growth decreased through time, and (vi) the thresholds in the initial per capita income seemed to be more important than other thresholds.

Hassan, Sanchez and Yu (2011) retrieved new evidence on the finance-growth nexus. They used a sample of 168 countries. The data were annual and the time period was from 1980 to 2007. Economic growth was gauged with GDP per capita growth rates and financial development was proxied by i) domestic credit provided by the banking sector as % of GDP, ii) domestic credit to the private sector as % of GDP, iii) liquid liabilities, iv) ratio of gross domestic savings to GDP, v) ratio of trade to GDP and vi) ratio of government final consumption expenditure to GDP. Inflation rate was used as an

auxiliary variable. After controlling for financial and real sector variables, a low initial GDP per capita level was associated with a higher growth rate. Strong long-run linkages between financial development and economic growth were found (domestic gross savings is positively related to growth, domestic credit to the private sector is positively related to growth in East Asia & Pacific, and Latin America & Caribbean, but negatively related to growth in high-income countries). In the short run, there was found a two-way causality between finance and growth in all groups except for Sub-Saharan and East Asia & Pacific. Furthermore, a positive association between finance and economic growth was found for developing countries but contradictory results for high-income countries.
Rousseau and Wachtel (2011) tested the impact of financial deepening on economic growth, using a sample of 84 countries over the period from 1960 to 2004. Economic growth was gauged by the growth rate of real per capita GDP. Financial development was proxied by i) the ratio to GDP of liquid liabilities M3, ii) liquid liabilities M3 less narrow money M1, and iii) credit allocated to the private sector. Initial real per capita GDP, initial secondary school enrollment rate, trade openness and government final consumption to GDP were used as auxiliary variables. Finance-growth relationship that was estimated with data from the 1960s to the 1980s simply disappeared over the subsequent 15 years. The underlying relationship that had been so widely used appeared to be unstable that with additional data it might have reappeared. Financial deepening had a strong impact on growth as long as a country could avoid financial crisis. In crisis episodes, the benefits of financial deepening disappeared. The effect of financial deepening did not weaken when liberalizations occured. The effect of finance still declined after the 1980s even if market capitalization was included.

Bittencourt (2012) tested Schumpeter's theory on financial development and economic growth in Latin America. A sample of 4

Latin American countries was used. The data were annual and the time period was from 1980 to 2007. Real GDP per capita growth rate represented growth and financial development was proxied by i) the ratio of the liquid liabilities to GDP, and ii) private bank credit over bank deposits. Government expenditure, trade openness, the ratio of investment to real GDP, average years of schooling, urbanization rates, inflation tax, government debt, external debt and inflation were used as control variables. The results showed that once the role of macroeconomic performance was taken into account, financial development did play a significant role in generating economic activity, innovation and economic growth.

Zhang, Wang and Wang (2012) tested the relationship between financial development and economic growth for China. They used a sample of 286 Chinese cities for the period from 2001 to 2006. Economic growth was gauged by real GDP growth rate. Financial development was proxied by i) ratio of total loans in the financial system to GDP, ii) ratio of total deposits in the financial system to GDP, iii) ratio of total household savings deposited in the financial system to GDP, iv) share of fixed asset investment financed by domestic loans relative to that financed by state budgetary appropriation, and v) ratio of corporate deposits to total deposits in the financial system. Initial per capita GDP, Initial level of education, share of state-owned entities in total fixed asset investments, CPI, ratio of foreign direct investment to GDP, government expenditure over GDP, business volume of postal and telecommunication services and density of roads were used as auxiliary variables. The results suggested that traditionally used indicators of financial development were generally positively associated with economic growth after controlling for many factors associated with growth. The size and depth of the financial sector spurred economic growth.

Beck, Degryse and Kneer (2014) wondered whether more finance is better for growth. They used a sample of 77 countries over the period from 1980 to 2007. Growth was gauged by GDP per capita growth as the average annual growth of real GDP and growth volatility was gauged as the average growth of real GDP. Financial sector size was proxied by the percentage of its value added share in GDP and financial sector growth as the average annual growth rate of the value added. Initial GDP per capita and education were used as control variables. Inflation, government expenditures to GDP and trade openness were introduced as policy variables. According to the results, In the long run financial intermediation increased growth and reduced growth volatility. The size of the financial sector while controlling for the level of intermediation in an economy did not seem to affect long-run growth or volatility. Although financial system size, especially non-intermediation services, had a positive relationship with volatility in high-income countries, neither the size of the financial sector nor intermediation was associated with higher growth in the medium run. For shorter time horizons, intermediation and size had opposing effects on volatility. Intermediation stabilized the economy in low-income countries, whereas greater financial sector size increased growth volatility in high-income countries.

Law and Singh (2014) wondered whether too much finance harms economic growth. A sample of 87 developed and developing countries was used. The data were averaged over five-year periods and the time period was from 1980 to 2010. Economic growth rate represented economic growth and financial development was proxied by i) private sector credit as a percentage of GDP, ii) liquid liabilities as a percentage of GDP and ii) domestic credit as a percentage of GDP. Real GDP per capita, average years of schooling, population growth, investment as a percentage of GDP, trade openness as a percentage of GDP, institutions (scaled from 0 to 50), government expenditure as a percentage of GDP and inflation were used as auxiliary variables.

Results indicated that there was a finance threshold in the finance-growth nexus. For financial development below the threshold, finance would exert a positive effect on economic growth. On the other hand, if the financial development exceeded the threshold, the impact on growth would turn negative. Knowing the optimal level and efficient channeling of financial resources to productive activities found to be important in ensuring the effectiveness of financial development for growth.

Chortareas, Magkonis, Moschos and Panagiotidis (2015) researched on financial development and economic activity in advanced and developing open economies using a sample of 20 developed and 17 developing countries. The data were annual and the time period was from 1970 to 2007. Economic activity was gauged by real per capita GDP. Financial development was proxied by domestic credit provided by financial institutions to the private sector as a percentage of GDP and financial openness by the stock of total flows of foreign assets and liabilities as % of GDP. Trade openness was used as auxiliary variable. A long-run relationship between financial development and output were not found when cross-sectional dependence was taken into account. It emerged when financial and trade openness indices were included. The effects of different types of openness were not uniform across developing and developed countries. Trade openness along with financial deepening is more important for the developing economies, while financial deepening along with financial openness appeared as more important for the advanced economies. No strong evidence of causality between financial development and output was found in the short run. In the long run there was evidence of causality from financial development to output. In advanced economies causality was unidirectional, while in developing it was bidirectional.

Pradhan, Arvin, Hall and Mahendhir (2016) used a sample of 18 Euro zone countries to test for innovation, financial development and economic growth. All data were annual and the time period was from 1961 to 2013. GDP per capita was used as a proxy for economic growth. A composite index was constructed for finanacial developed (domestic credit to private sector, domestic credit to private sector by banks, domestic credit provided by the financial sector, market capitalization, turnover ratio, total value of traded stocks, listed domestic companies). Innovation (number of patents by residents per 1000, number of patents by nonresidents per 1000, the number of patents by residents and nonresidents per 1000, real R&D expenditure as % of GDP, researchers engaged in activities per 1000000) was used as an auxiliary variable. Innovation, financial development and economic growth were co integrated. There was clear evidence that both financial development and innovation matter in the determination of long-run economic growth.

Durusu, Ispir and Yetkiner (2016) used a sample of 40 countries. The data were yearly and the time period was from 1989 to 2011. Economic Growth was proxied by real GDP per capita, credit market development by bank credit computed as the ratio of domestic credit to private sector to GDP and stock market development by value traded computed as the ratio of the total value of all traded domestic shares in a stock market exchange to GDP. Population growth rate was used as an auxiliary variable. The panel data analyses revealed that both channels had positive long-run effects on steady-state level of GDP per capita, and the contribution of the credit markets was substantially greater. Both credit market development and stock market development had positive long-run effects on steady-state level of GDP per capita. The contribution of credit market development was substantially greater, thus credit market-based financial systems are more likely to promote long-term economic growth than stock market-based ones. Financial development had a positive or insignificant effect on growth in all the financially developed bank-based and stock market-based economies.

Sönmez and Sağlam (2017) implemented a comparative analysis between Euro Area and emerging-developing Europe. A sample of 15 Euro-Area and 8 emerging Europe countries was used. The data were annual and the time period was from 1995 to 2013. They constructed a financial development index using i) liquid liabilities to GDP %, ii) private credit by deposit money banks to GDP %, iii) bank deposits to GDP %, iv) credit to government and state owned enterprises to GDP %, v) deposit money banks' assets to GDP %, central bank assets to GDP %, vi) stock market capitalization to GDP %, and vii) stock market total value traded to GDP %. The results proved that there was a presence of feedback relationship, two way causality between financial development and economic growth, imparting to the support of both demand following and supply-leading hypothesis. There was, also, a negative relationship between economic growth and financial development, when the financial development index increased economic growth decreased for both groups of countries.

3. Data and Methodology

3.1 Data

The selection of proper variables (indicators) is very crucial in order to extract reliable results in an empirical study testing for the finance-growth nexus. In addition, it is very important to select appropriate auxiliary variables to specify the model optimally.

In most of the empirical studies presented on the previous chapter, economic growth is proxied by real GDP per capita. Since in this thesis economic activity is under investigation, real GDP per capita is the most adequate measure. As for financial development, selecting the optimum proxy is not as transaparent. Given the fact that the financial system is consisted of two major sectors, the banking and the financial, it is challenging to select indicators that are sufficient representatives. The ratio of liquid liabilities of the financial system to GDP reflects the size of the financial sector and is ample measure of financial depth, as is the ratio of financial system deposits to GDP. Moreover, the ratio of private credit by deposit money banks and other financial institutions to GDP is used to capture the financial activity. Finally, considering the literature body, trade openness as a percentage of GDP and government expenditure as a percentage of GDP were selected as control variables.

The datasets were obtained from World Bank Indicators database and Cihak et al. dataset. The sample consists of 75 countries, 21 developed and 64 developing. The identification of the countries was based on World Bank's list of 2015. The data frequency is annual and the time span is from 1975 to 2015.

3.2 Methodology

In order to investigate the relationship between economic activity and financial development, the following model was constructed:

$$gdp\_capita_{it} = \beta_{0i} + \beta_{1i}f_{it} + \beta_{2i}t\_o_{it} + \beta_{3i}g\_e_{it} + u_{it} \quad (1)$$

Since the causality is not clear the following model was specified too

$$f_{it} = \beta_{0i} + \beta_{1i}gdp\_capita_{it} + \beta_{2i}t\_o_{it} + \beta_{3i}g\_e_{it} + v_{it} \quad (2)$$

where gdp_capita is the log of real gdp per capita (constant 2010 US$), f represents financial development and is either private credit by deposit money banks and other financial institutions as % GDP or financial system deposits as % GDP or liquid liabilities as % GDP, t_o is trade openness as % of GDP, g_e is government expenditure as % of GDP and u/v are the error terms.

3.2.1. Panel

A panel data set is formulated from a sample that contains N cross-sectional units that are observed at different T time periods. The panel data analysis consists of two categories.

- Balanced Panel: A panel is defined as balanced when the number of time periods T is the same for all units i.
- Unbalanced Panel: A panel is defined as unbalanced when the number of time periods is not the same for all units i.

Generally the linear model is expressed as:

$$y_{it} = \alpha_i + x_{it}\beta_{it} + u_{it} \quad (3)$$

for i = 1,2,…,N sections and t = 1,2,…,T time periods

Where y_{it} is the dependent variable, x_{it} are 1 x k vectors of observations on the independent variables, β_{it} are k x 1 vectors parameters to be estimated for the independent variables x_{it}. The u_{it} is an error term and α_i is the intercept term. The coefficients α_i and β are estimated using three different methods:

- Pooled Regression (OLS)
- Fixed effects method
- Random effects method

3.2.2. Unit Root tests

Testing for stationarity of the series is of crucial importance. If the time-series are not stationary, the estimations may lead to unreliable results. Thus, all series of the model specification used are tested for stationarity in order to determine their degree of integration.

A stochastic process y_t is stationary if:

$$E(y_t) = \mu_y \text{ for all } t \in T$$

$$E(y_t - \mu_y)(y_t - \mu_y) = \sigma^2 < \infty \text{ for all } t \in T$$

$$E[(y_t - \mu_y)(y_{t-h} - \mu_y)] = \gamma_h$$

for all $t \in T$ and all integers h such that $t - h \in T$.

The first condition denotes that all components of a stationary stochastic process have the same constant mean. The second condition ensures that their variance is also time invariant because, for $h = 0$, the variance $\sigma_y^2 = E((y_t - \mu_y)^2] = \gamma_0$ does not depend on t. Moreover, the covariances $E[(y_t - \mu_y)(y_{t-h} - \mu_y)] = \gamma_h$ do not depend on t but just on the distance in time h of the two components of the process (Lütkepohl and Krätzig, 2004:38).

In the present thesis the following tests were implemented:

- **Im-Pesaran-Shin (IPS) test**

Im, Pesaran, and Shin (1997) introduce the following model:

$$y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \varepsilon_{i,t}\ , \qquad t = 1,2, \dots, T$$

IPS test's statistic is based on averaging individual Dickey-Fuller unit root tests according to:

$$t_{IPS} = \sqrt{N}\frac{(\overline{t_N} - \mu)}{\sigma} \rightarrow N(0,1)$$

where

$$\overline{t_N} = \frac{1}{N}\sum_{i=1}^{N} t_i\ ,\ \mu = E(t_i) \text{ and } \sigma^2 = V(t_i)$$

In order to compute μ and σ^2 they use Monte Carlo methods and tabulate them in IPS. The important thing to underline is that the IPS test is a way of combining the evidence on the unit root hypothesis from the N unit root tests performed on the N cross-section units (Maddala and Wu, 1999). The IPS test can be used in cooperation with any parametric unit root test, but only when the panel is balanced and the t-statistics for the unit root in every cross-section have the same variance and mean. Although the IPS test demands a balanced panel, it is the most widely used in practice.

- **Fisher type test: Maddala and Wu**

Panel unit root tests based on a heterogeneous model consist in testing the significance of the results from N independent individual tests (IPS use an average statistic). An alternative testing strategy based on combining the observed significant levels from the individual tests was notably used by Maddala and Wu (1999). According to the following heterogeneous model:

$$\Delta y_{i,t} = a_i + \rho_i y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-z} + \varepsilon_{i,t}$$

They test the same hypothesis as IPS, $H_o: \rho_i = 0$ for all $i = 1,\ldots,N$ against the alternative hypothesis $H_1: \rho_i < 0$ for $i = 1,\ldots,N_1$ and $\rho_i = 0$ for $i = N_1 + 1,\ldots,N$, with $0 < N_1 \leq N$. Under the assumption of pure time series unit root test statistics are continuous, the corresponding p-values, signified as p_i, are uniform (0,1) variables and the critical assumption of cross-sectional independence, Maddala and Wu (1999) propose a statistic defined as:

$$P = -2 \sum_{i=1}^{N} lnp_i$$

The P test is distributed as χ^2 with degrees of freedom twice the number of cross section units.

As Hoang and McNown (2006) claim "the *Maddala and Wu's test is promising for two reasons, firstly, it can be performed with any unit root test on a single time-series and secondly, it does not require a balanced panel as the IPS test does, so T can differ over cross-sections. The main disadvantage of the MW test is that the p-values for each t-statistic in a cross-section have to be derived by Monte Carlo simulation.*" The IPS test suffers from a harsh loss of power when individual trends are contained, and the test is sensitive to the specification of deterministic trends, supplemented by Breitung (1999).

- **Levin, Lin and Chu test**

Levin, Lin, and Chu (LLC), Breitung, and Hadri tests all assume that there is a common unit root process so that ρ_i is identical across cross-sections. The first two tests employ a null hypothesis of a unit root while the Hadri test uses a null of no unit root.

LLC and Breitung both consider the following basic ADF specification:

$$\Delta y_{it} = a y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X_{it}^{'} \delta + \varepsilon_{it}$$

where we assume a common $a = \rho - 1$, but allow the lag order for the difference terms, p_i, to vary across cross-sections. The null and alternative hypotheses for the tests may be written as:

$$H_0: a = 0$$

$$H_1: a = 0$$

Under the null hypothesis, there is a unit root, while under the alternative, there is no unit root.

The method described in LLC derives estimates of a from proxies for Δy_{it} and y_{it} that are standardized and free of autocorrelations and deterministic components. For a given set of lag orders, two additional sets of equations are estimate, regressing both Δy_{it}, and y_{it-1} on the lag terms Δy_{it-} (for $j = 1, \cdots, p_i$) and the exogenous variables X_{it}. The estimated coefficients from these two regressions will be denoted $(\hat{\beta}, \hat{\delta})$

and $(\dot{\beta}, \dot{\delta})$, respectively. $\Delta\bar{y}_{it}$ is defined by taking Δy_{it} and removing the autocorrelations and deterministic components using the first set of auxiliary estimates:

$$\Delta\bar{y}_{it} = \Delta y_{it} - \sum_{j=1}^{p_i} \hat{\beta}_{ij}\, \Delta y_{it-j} - X_{it}^{'}\hat{\delta} \quad (1)$$

Likewise, the analogous $\bar{y}_{it-1}$ may be defied using the second set of coefficients:

$$\bar{y}_{it-1} = y_{it-1} - \sum_{j=1}^{p_i} \dot{\beta}_{ij}\, \Delta y_{it-j} - X_{it}^{'}\dot{\delta}$$

Proxies are obtained by standardizing both $\Delta\bar{y}_{it}$ and $\bar{y}_{it-1}$, dividing by the regression standard error:

$$\Delta\tilde{y}_{it} = \left({\Delta\bar{y}_{it}}/{s_i} \right)$$

$$\tilde{y}_{it-1} = \left({\bar{y}_{it-1}}/{s_i} \right)$$

where s_i are the estimated standard errors from estimating each ADF in equation (1).

Lastly, an estimate of the coefficient a may be obtained from the pooled proxy equation:

$$\Delta\tilde{y}_{it} = a\tilde{y}_{it-1} + \eta_{it}$$

LLC show that under the null, a modified t-statistic for the resulting $\hat{a}$ is asymptotically normally distributed

$$t_a^* = \frac{t_a - (NT)S_N\hat{\sigma}^{-2}se(\hat{a})\mu_{m\tilde{T}^*}}{\sigma_{m\tilde{T}^*}} \to N(0,1)$$

where t_a is the standard t-statistic for $\hat{a} = 0$, $\hat{\sigma}^2$ is the estimated variance of the error term η, $se(\hat{a})$ is the standard error of $\hat{a}$, and:

$$\tilde{T} = T - \left(\sum_i {p_i}/_N \right) - 1$$

The remaining terms, which involve complicated moment calculations, are described in greater detail in LLC. The average standard deviation ratio, S_N, is defined as the mean of the ratios of the long-run standard deviation to the innovation standard deviation for each individual. Its estimate is derived using kernel-based techniques. The remaining two terms, $\mu_{m\tilde{T}^*}$ and $\sigma_{m\tilde{T}^*}$ are adjustment terms for the mean and standard deviation.

The LLC method requires a specification of the number of lags used in each cross-section ADF regression, p_i, as well as kernel choices used in the computation of S_N. In addition, you must specify the exogenous variables used in the test equations. You may elect to include no exogenous regressors, or to include individual constant terms (fixed effects), or to employ individual constants and trends.

- **Breitung test**

The Breitung method differs from LLC in two distinct ways. Firstly, only the autoregressive portion (and not the exogenous components) is removed when constructing the standardized proxies:

$$\Delta\tilde{y}_{it} = {\left(\Delta y_{it} - \sum_{j=1}^{p_i} \hat{\beta}_{ij}\, \Delta y_{it-j}\right)}\Big/_{s_i}$$

$$\tilde{y}_{it-1} = {\left(y_{it-1} - \sum_{j=1}^{p_i} \dot{\beta}_{ij}\, \Delta y_{it-j}\right)}\Big/_{s_i}$$

where $\hat{\beta}$, $\dot{\beta}$, and s_i are as defined for LLC.

Secondly, the proxies are transformed and detrended,

$$\Delta y_{it^*} = \sqrt{\frac{(T-t)}{(T-t+1)}}\left(\Delta\tilde{y}_{it} - \frac{\Delta\tilde{y}_{it+1} + \cdots + \Delta\tilde{y}_{iT}}{T-t}\right)$$

$$y_{it^*} = \tilde{y}_{it} - \tilde{y}_{i1} - \frac{t-1}{T-1}(\tilde{y}_{iT} - \tilde{y}_{i1})$$

The persistence parameter a is estimated from the pooled proxy equation:

$$\Delta y_{it^*} = a y_{it-1^*} + v_{it}$$

Breitung shows that under the null hypothesis the resulting estimator a^* is asymptotically distributed as a standard normal.

The Breitung method requires only a specification of the number of lags used in each cross-section ADF regression, p_i, and the exogenous regressors. Note that in contrast with LLC, no kernel computations are required.

3.2.3. Cointegration tests

The next step is to determine wheter there exists a long-run relationship between $gdp\_capita, financial\ development$ and the ancillary variables $trade\ openness$ and $government\ expenditure$. Cointegration reveals whether a group of variables have a common trend, even though individually they may not be stationary. When variables are cointegrated, then there is a stable linear long run relationship between them (Katos, 2004:1003). Thus, the analysis of cointegration might be considered as a technique that is used for the estimation of the long run equilibrium coefficients, in a relation where the variables are not stationary.

In the present thesis the following tests were implemented:

- **Fischer (combined Johansen) test for cointegration**

The Johansen test for the existence of cointegration is accomplished in the context of a vector autoregressive model (VAR). In order to estimate a VAR model, it is necessary to determinate the order of the model. This determination takes place with the information criteria of Schwartz and Akaike. Johansen (1988) proposes that a vector Y_t which consists of first order integrated variables is expressed of a VAR model with degree k as follows:

$$Y_t = \sum_{j=1}^{k} A_j Y_{t-j} + u_t$$

The model can be written in first differences form with error correction as follows:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{j=1}^{k-1} \Pi_j \Delta Y_{t-j} + u_t$$

where $\Pi = \sum_{j=1}^{k} A_j - I$ and $\Pi_j = -\sum_{i=j+1}^{k} A_i, \quad j = 1,2,\dots,k$

The matrix Π is named equilibrium matrix and its order determines the existence of cointegration among the series. If the rank(Π) = 0, then the variables are not cointegrated. If the rank(Π) = k, then the vector Y_t is stationary and so all the variables are cointegrated of zero degree, while, if rank(Π) = r, where $0 < r < k$, then the variables are cointegrated of order r. For the test of the degree of cointegration, the Johansen's procedure suggests two paths:

- Trace Test.

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{k} \log\big(1 - \hat{\lambda}_j\big), \quad \text{where } r = 0,1,\dots,k-1$$

The hypotheses which are tested sequentially are as follows:

$$H_0: r = 0 \; vs \; H_1: r \geq 1 \; (if \; \lambda\_trace \; (r) > \; critical \; value)$$
$$H_0: r = 1 \; vs \; H_1: r \geq 2 \; (if \; \lambda\_trace \; (r) > \; critical \; value)$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..$$
$$H_0: r = k-1 \; vs \; H_1: r \geq k \; (if \; \lambda\_trace \; (r) > \; critical \; value)$$

where r declares the number of cointegrated relationships and $\lambda_{trace}(r)$ is the likelihood ratio statistic.

- Maximum Eigenvalue Test.

$$\lambda_{max}(r, r+1) = -Tlog(1 - \hat{\lambda}_j), \quad \text{where } r = 0,1,\dots,k-1$$

$\lambda_{max}(r, r+1)$ is the likelihood ratio test statistic and does not have the usual asymptotic χ^2distribution.

The hypotheses which are tested sequentially are as follows:

$$H_0: r = 0 \; vs \; H_1: r = 1 \; (if \; \lambda\_max \; (r) > \; critical \; value)$$
$$H_0: r \leq 1 \; vs \; H_1: r = 2 \; (if \; \lambda\_max \; (r) > \; critical \; value)$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..$$
$$H_0: r \leq k-1 \; vs \; H_1: r = k \; (if \; \lambda\_max \; (r) > \; critical \; value)$$

This is a test using the largest eigenvalue. If the rank of the matrix is zero, the largest eigenvalue is zero and there is no cointegration. If the eigenvalue λ_1 is other than zero, the rank of the matrix is at least one and there might be more cointegrating vectors. After this, the second largest eigenvalue λ_2 is tested whether it is zero. If $\lambda_2 = 0$, there is exactly one cointegrating vector. In the other case that is, $\lambda_2 \neq 0$ the same process continues until the null hypothesis of an eigenvalue equal to zero cannot be rejected (Dwyer, 2015).

The Johansen test suffers from heterogeneity if extended in panel data. In order to eliminate heterogeneity Fisher developed a test which aggregates the p-values of individual Johansen maximum likelihood cointegration test statistics (Maddala and Wu, 1999). Letting p_i be the asymptotic p-value of a unit root test for cross-section i, then we have the result:

$$-2\sum_{i=1}^{n} log\, p_i \sim \chi^2_{2N}$$

according to Maddala and Wu (1999) and Choi(2001).

- **Pedroni test**

Another test for cointegration is that introduced by Pedroni (1999, 2004) and is based on the single equation method of Engle-Granger. Its setup is general and allows for separate intercepts for each group of potentially cointegrating variables and separate deterministic trends (Brooks, 2014:551). For a set of variables $y_{i,t}$ and explanatory variables $x_{m,i,t}$ that are individually integrated of order one $I(1)$ and thought to be cointegrated.

$$y_{i,t} = \alpha_i + \delta_i t + \sum_{m=1}^{M} \beta_{m,i} x_{m,i,t} + e_{i,t}$$

where $m = 1, \ldots, M$, $t = 1, \ldots, T$ and $i = 1, \ldots, N$.

The residuals from this regression (21), $\hat{e}_{i,t}$ are then subjected to separate augmented Dickey-Fuller type regressions for each group of variables to determine whether they are $I(1)$ i.e.:

$$e_{i,t} = \rho_i e_{i,t-1} + \sum_{j=1}^{p_i} \psi_{i,j} \Delta e_{i,t-j} + \upsilon_{i,t}$$

where the hypotheses are:

$$H_o: \rho_i = 1, \forall i, there\ is\ no\ cointegration$$
$$H_1^1: \rho_i = \rho < 1, \forall i, there\ is\ cointegration$$
$$H_1^2: \rho_i < 1, \forall i, there\ is\ cointegration$$

The first alternative hypothesis (H_1^1), proposes that all of the autoregressive dynamic are the same stationary process, hence no heterogeneity is permitted. While, the second alternative hypothesis (H_1^2), proposes that the dynamics from each test equation follow a different stationary process, hence heterogeneity is permitted.

- **Kao test**

The Kao test follows the same basic approach as the Pedroni tests, but specifies cross-section specific intercepts and homogeneous coefficients on the first-stage regressors.

In the bivariate case described in Kao (1999), we have

$$y_{it} = a_i + \beta x_{it} + e_{it}$$

for

$$y_{it} = y_{it-1} + u_{i,t}$$
$$x_{it} = x_{it-1} + \varepsilon_{i,t}$$

for $t = 1, \cdots, T; i = 1, \cdots, N$. More generally, we may consider running the first stage regression equation 19, requiring the a_i to be heterogeneous, β_i to be homogeneous across cross-sections, and setting all of the trend coefficients γ_i to zero.

Kao then runs either the pooled auxiliary regression,

$$e_{it} = \rho e_{it-1} + v_{it}$$

or the augmented version of the pooled specification,

$$e_{it} = \tilde{\rho} e_{it-1} + \sum_{j=1}^{p} \psi_j \Delta e_{it-} \; + v_{it}$$

Under the null of no cointegration, Kao shows that following the statistics,

$$DF_\rho = \frac{T\sqrt{N}(\hat{\rho}-1) + 3\sqrt{N}}{\sqrt{10.2}}$$

$$DF_t = \sqrt{1.25}t_\rho + \sqrt{1.875}N$$

$$DF_\rho^* = \frac{T\sqrt{N}(\hat{\rho}-1) + 3\sqrt{N}\,\hat{\sigma}_v^2 / \hat{\sigma}_{0v}^2}{\sqrt{3 + 36\hat{\sigma}_v^4 / 5\hat{\sigma}_{0v}^4}}$$

$$DF_t^* = \frac{t_\rho + \sqrt{6N}\,\hat{\sigma}_v^2 / (2\hat{\sigma}_{0v}^2)}{\sqrt{\hat{\sigma}_{0v}^2 / (2\hat{\sigma}_v^2) + 3\hat{\sigma}_v^2 / (10\hat{\sigma}_{0v}^2)}}$$

and for $p > 0$ (i.e. the augmented version),

$$ADF = \frac{t_{\tilde{\rho}} + \sqrt{6N}\,\hat{\sigma}_v^2 / (2\hat{\sigma}_{0v}^2)}{\sqrt{\hat{\sigma}_{0v}^2 / (2\hat{\sigma}_v^2) + 3\hat{\sigma}_v^2 / (10\hat{\sigma}_{0v}^2)}}$$

converge to $N(0,1)$ asymptotically, where the estimated variance is $\hat{\sigma}_v^2 = \hat{\sigma}_u^2 - \hat{\sigma}_{u\varepsilon}^2 \sigma_\varepsilon^{-2}$ with estimated long run variance $\hat{\sigma}_{0v}^2 = \hat{\sigma}_{0u}^2 - \hat{\sigma}_{0u\varepsilon}^2 \sigma_{0\varepsilon}^{-2}$.

The covariance of

$$w_{it} = \begin{bmatrix} u_{it} \\ \varepsilon_{it} \end{bmatrix}$$

is estimated as

$$\hat{\Sigma} = \begin{bmatrix} \hat{\sigma}_u^2 & \hat{\sigma}_{u\varepsilon} \\ \hat{\sigma}_{u\varepsilon} & \hat{\sigma}_\varepsilon^2 \end{bmatrix} = \frac{1}{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} \widehat{w}_{it} \widehat{w}_{it}^{'}$$

and the long run covariance is estimated using the usual kernel estimator

$$\hat{\Omega} = \begin{bmatrix} \hat{\sigma}_{0u}^2 & \hat{\sigma}_{0u\varepsilon} \\ \hat{\sigma}_{0u\varepsilon} & \hat{\sigma}_{0\varepsilon}^2 \end{bmatrix}$$

$$= \frac{1}{N} \sum_{i=1}^{N} \left[\frac{1}{T} \sum_{t=1}^{T} \widehat{w}_{it} \widehat{w}_{it}^{'} + \frac{1}{T} \sum_{\tau=1}^{\infty} \kappa(\tau/b) \sum_{t=\tau+1}^{T} \widehat{w}_{it} \widehat{w}_{it-\tau}^{'} + \widehat{w}_{it-\tau} \widehat{w}_{it}^{'} \right]$$

where κ is one of the supported kernel functions and b is the bandwidth.

3.2.5. Long run relationship (FMOLS)

When a long-run equilibrium relationship exists between the dependent and the independent variables, it is critical to calculate the estimators of the long run vectors. A method used to calculate the estimators is fully modified OLS which was originally designed by Phillips and Hansen (1990), Pedroni (1996 and 2000), and Phillips and Moon (1999) to provide optimal estimates of cointegration regressions. According to Kalim and Shahbaz (2009), *"this method utilizes Kernal estimators of the Nuisance parameters that affect the asymptotic distribution of the OLS estimator. In order to achieve asymptotic efficiency, this technique modifies least squares to account for serial correlation effects and test for the endogeneity in the regressors that result from the existence of cointegrating relationships."*

3.2.6. Short run causality (VECM)

Of great importance is to test for the short run causality between the economic activity and the financial development. If two variables Y_t and X_t are cointegrated then by definition $\hat{e}_t \sim I(0)$, $\hat{e}_t = gdp\_cap_t - \hat{\beta}_0 - \hat{\beta}_1 f_t - \hat{\beta}_2 t\_o_t - \hat{\beta}_3 g\_e_t$ and $\hat{v}_t = f_t - \hat{\beta}_0 - \hat{\beta}_1 gdp\_cap_t - \hat{\beta}_2 t\_o_t - \hat{\beta}_3 g\_e_t$.

In this way, the Error Correction Model (ECM) constructed as follows:

$$\Delta gdp\_cap_t = \mu + \sum_{i=1}^{m} a_i \,\Delta gdp\_cap_{t-i} + \sum_{i=1}^{m} b_i \,\Delta f_{t-i} + \sum_{i=1}^{m} c_i \,\Delta t\_o_{t-i} + \sum_{i=1}^{m} d_i \Delta\, pg\_e_{t-i} + \pi \hat{e}_{t-1} + \varepsilon_t$$

$$\Delta f_t = \mu + \sum_{i=1}^{m} a_i \,\Delta f_{t-i} + \sum_{i=1}^{m} b_i \,\Delta gdp\_cap_{t-i} + \sum_{i=1}^{m} c_i \,\Delta t\_o_{t-i} + \sum_{i=1}^{m} d_i \Delta\, pg\_e_{t-i} + \pi \hat{v}_{t-1} + w_t$$

which has the benefit of including both the long-run and the short-run effect. Interpreting π which is the error correction coefficient - the adjustment coefficient – is confoundedly important. That is because π shows how much of the equilibrium error is corrected (Asteriou and Hall, 2015:363) and it should be $-1 < \pi < 0$, while $\hat{e}_{t-1}$ represents the equilibrium error, that is the deviation from the long run relationship and this term (which is the estimated cointegrating vector) includes the long-run information. Since the last equation contains only stationary variables an OLS regression should perform well. After the estimation of the model, if the estimated π is statistically significant then a short-run relationship exists among the variables otherwise not.

In the context of panel the VECM model takes the below:

$$\Delta gdp\_capita_{it} = c_i + \sum_{j=1}^{m} a_j \, \Delta gdp\_cap_{i,t-j} + \sum_{j=1}^{m} b_j \, \Delta f_{i,t-j} + \sum_{j=1}^{m} c_j \, \Delta t\_o_{i,t-j} + \sum_{j=1}^{m} d_j \, \Delta g\_e_{i,t-j} - \pi \hat{e}_{i,t-1} + \varepsilon_{it}$$

$$\Delta f_{it} = c_i + \sum_{j=1}^{m} a_j \, \Delta f_{i,t-j} + \sum_{j=1}^{m} b_j \, \Delta gdp\_cap_{i,t-j} + \sum_{j=1}^{m} c_j \, \Delta t\_o_{i,t-j} + \sum_{j=1}^{m} d_j \, \Delta\_e_{i,t-j} - \pi \hat{e}_{i,t-1} + \varepsilon_{it}$$

4. Empirical Results

4.1 Unit Root Tests

Table 1 Unit Root tests for World Group in Levels

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Level	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	21,772	10,491	5,333	9,644	1,718	2,581
ADF	24,854	27,438	60,789	36,802	84,916	70,778
PP	31,153	23,938	47,540	30,634	86,451	73,459

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 2 Unit Root tests for World Group in Differences

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Diff	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-27,433*	-33,991*	-29,534*	-35,756*	-48,932*	-53,082*
ADF	1230,350*	1445,410*	1191,250*	1539,240*	2673,140*	2891,720*
PP	1397,460*	1524,600*	1251,240*	1687,090*	3627,120*	3562,310*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 3 Unit Root tests for Developing Group in Levels

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Level	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	17,733	9,721	4,333	8,057	-0,682	-0,926
ADF	23,952	21,968	51,146	30,850	71,927	64,387
PP	30,879	20,241	42,008	26,364	71,265	67,147

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 4 Unit Root tests for Developing Group in Differences

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Diff	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-25,540*	-29,609*	-26,812*	-31,914*	-43,962*	-46,1026*
ADF	1010,610*	1071,180*	929,073*	1173,150*	2130,860*	2212,710*
PP	1164,310*	1115,730*	978,271*	1308,960*	3023,020*	2881,290*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 5 Unit Root tests for Developed Group in Levels

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Level	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	13,695	4,980	3,359	5,669	2,419	4,669
ADF	0,902	5,470	9,643	5,952	12,989	6,390
PP	0,275	3,697	5,532	4,271	15,186	6,312

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 6 Unit Root tests for Developed Group in Differences

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
	Diff	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-12,103*	-16,840*	-13,376*	-16,814*	-22,327*	-26,4918*
ADF	219,736*	374,232*	262,173*	366,086*	542,279*	679,012*
PP	233,149*	408,867*	272,970*	378,136*	604,092*	681,029*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

The majority of the unit root tests of Levin, Lin & Chen, Breitung, IPS, ADF and PP, imply that all variables are stationary in their first differences (integrated of order one, I(1)) with a doubt for the government expenditure variable in the world and developing groups. However, given the fact that government expenditure is used as an auxiliary variable it was decided to be included in the cointegration analysis.

4.2 Cointegration tests

Table 7 Cointegration test (Johansen) Specification 1

Group	**Fisher(combined Johansen)-Trace statistic $H_0: rank = r$**			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	472,800*	222,200*	133,700	205,700*
Developed	185,800*	101,100*	55,240***	82,890*
Developing	287,000*	121,100	78,480	122,800
	Fisher(combined Johansen)- Max eigenvalue statistic $H_0: rank = r$			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	364,400*	179,800**	103,300	205,700*
Developed	115,700*	78,340*	38,240	82,890*

Developing	248,700*	101,500	65,050	122,800

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length for the VARs was selected by minimizing the Schwarz criterion plus one.

GDP_CAPITA G_E T_O F_D

Table 8 Cointegration test (Johansen) Specification 2

Group	Fisher(combined Johansen)-Trace statistic $H_0: rank = r$			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	456,200*	215,100*	138,400	212,500*
Developed	193,900*	116,000*	71,990*	79,900*
Developing	264,700*	117,700	79,380	128,700***
	Fisher(combined Johansen)- Max eigenvalue statistic $H_0: rank = r$			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	349,900*	168,800	105,700	212,500*
Developed	110,600*	78,690*	55,640***	79,900*
Developing	222,800*	96,410	65,360	128,700***

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length for the VARs was selected by minimizing the Schwarz criterion plus one.

GDP_CAPITA G_E T_O L_L

Table 9 Cointegration test (Johansen) Specification 3

Group	Fisher(combined Johansen)-Trace statistic $H_0: rank = r$			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	462,400*	226,400*	149,900	238,300*
Developed	175,400*	81,000*	60,010**	92,210*
Developing	287,000*	145,400**	89,920	146,100*
	Fisher(combined Johansen)- Max eigenvalue statistic $H_0: rank = r$			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
World	340,300*	172,700***	107,400	238,300*
Developed	127,200*	53,500	38,230	92,210*
Developing	213,100*	119,200	69,200	146,100*

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length for the VARs was selected by minimizing the Schwarz criterion plus one.

GDP_CAPITA G_E T_O P_C

Three cointegration tests were conducted; Pedroni, Kao (appendix) and Johansen. Kao and Johansen tests indicate that there is at least one cointegrating vector. Due to the fact that Johansen's test defines the number of cointegration vectors, the results are based on this test. According to max-eigenvalue statistic and considering the 5% level of significance the results are:

i) for the first model specification there are two cointegrating vectors for the world group, two cointegrating vectors for the developed group and one cointegrating vector for the developing group,

ii) for the second model specification there is one cointegrating vector for the world, two cointegrating vectors for the developed group and one for the developing group, and

iii) for the third model specification there is one cointegrating vector for all groups.

4.3 Fully Modified OLS estimations

Table 10 FMOLS Specification 1

	FMOLS					
	Dependent GDP_CAPITA			Dependent F_D		
	T_O	**G_E**	**F_D**	**T_O**	**G_E**	**GDP_CAPITA**
World	0,003*	-0,003	0,010*	0,139*	0,382*	30,954*
Developed	0,006*	0,014***	0,007*	0,094***	1,847*	40,476*
Developing	0,002*	-0,004*	0,012*	0,123*	0,272*	24,605*

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

-For the estimation, the Bartlett kernel is used.

Table 11 FMOLS Specification 2

	FMOLS					
	Dependent GDP_CAPITA			Dependent P_C		
	T_O	**G_E**	**P_C**	**T_O**	**G_E**	**GDP_CAPITA**
World	0,004*	-0,002	0,006*	0,151*	0,508*	40,977*
Developed	0,007*	0,013	0,004*	0,051	3,351*	62,315*
Developing	0,003*	-0,003	0,008*	0,117*	0,274**	26,418*

Notes:
-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
-For the estimation, the Bartlett kernel is used.

Table 12 FMOLS Specification 3

	FMOLS					
	Dependent GDP_CAPITA			Dependent L_L		
	T_O	G_E	L_L	T_O	G_E	GDP_CAPITA
World	0,014*	0,319*	0,035*	0,134*	0,501*	28,817*
Developed	0,006*	0,021*	0,006*	0,056	0,821	43,591*
Developing	0,003*	-0,004**	0,009*	0,122*	0,434*	21,021*

Notes:
-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
-For the estimation, the Bartlett kernel is used.

According to the Fully Modified OLS estimation, there is a positive and statistically significant relationship between economic activity and all three financial proxies for all groups, regardless the dependent variable. Commenting on the T_O, the results support a positive relationship between trade openness and both economic activity and financial development with an exception in developed group, in which T_O is not statistically significant when the financial proxy is the dependent variable. In addition, a positive link between G_E and financial proxies is confirmed. However, there is not a clear relation regarding the sign between G_E and economic activity.

4.4 Vector Error Correction Model

Table 13 ECM for World Group Specification 1

Dep. GDP_CAPITA	World		
Model	GDP_CAPITA_L_L	GDP_CAPITA_F_D	GDP_CAPITA_P_C
ECT_{t-1}	0,001*	0,001*	0,002*
$\Delta LGDP_{t-1}$	0,231*	0,229*	0,223*
ΔG_E_{t-1}	-0,001***	-0,001***	0,000
ΔT_O_{t-1}	0,000*	0,000*	0,000*
ΔF_{t-1}	0,000***	0,000***	0,000**

C	0,012*	0,012*	0,012*

Notes:
- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.
- G-C stands for Granger causality Test.

Table 14 ECM for World Group Specification 2

Dep. Fin. Proxy		World	
Model	**GDP_CAPITA_L_L**	**GDP_CAPITA_F_D**	**GDP_CAPITA_P_C**
ECT_{t-1}	0,062*	0,055*	0,084*
$\Delta LGDP_{t-1}$	9,632*	9,378*	18,807*
ΔG_E_{t-1}	0,038	0,014	-0,020
ΔT_O_{t-1}	0,014	0,020**	0,011
ΔF_{t-1}	0,292*	0,294*	0,494*
C	0,390*	0,400*	0,171**

Notes:
- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.

For the world group and given the statistical significance of the variables ΔF_{t-1} (table 13) and $\Delta LGDP_{t-1}$ (table 14), we find that there is bidirectional short-run causality (quaternary models) regardless the financial development proxy. This is also the case for the bivariate models according to granger causality. As for the long-run causality, although the error correction term is statistically significant, its values are above zero and so there is no convergence.

Table 15 ECM for Developing Group Specification 1

Dep. GDP_CAPITA		Developing	
Model	**GDP_CAPITA_L_L**	**GDP_CAPITA_F_D**	**GDP_CAPITA_P_C**
ECT_{t-1}	0,000***	0,000***	0,000*
$\Delta LGDP_{t-1}$	0,198*	0,197*	0,188*
ΔG_E_{t-1}	-0,001***	-0,001***	-0,001
ΔT_O_{t-1}	0,000*	0,000*	0,000*
ΔF_{t-1}	0,000	0,001	0,000
C	0,010*	0,010*	0,011*

Notes:

- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.

Table 16 ECM for Developing Group Specification 2

Dep. Fin. Proxy		Developing	
Model	**GDP_CAPITA_L_L**	**GDP_CAPITA_F_D**	**GDP_CAPITA_P_C**
ECT_{t-1}	0,020*	0,020*	0,020*
$\Delta LGDP_{t-1}$	9,157*	8,498*	14,876*
ΔG_E_{t-1}	0,033	0,010	0,007
ΔT_O_{t-1}	0,017***	0,021**	0,003
ΔF_{t-1}	0,250*	0,261*	0,421*
C	0,331*	0,336*	0,151***

Notes:

- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.

For the developing group, economic activity causes financial development on the short run, regardless the proxy (table 16). However, financial development does not affect economic activity, given the statistical insignificance of the ΔF_{t-1} (table 15). As for the long-run causality, although the error correction term is statistically significant when financial development is the dependend variable, its values are above zero and so there is no convergence (table 16). On the other hand, when economic activity is the dependend variable, the error correction term is both statistically significant and its values are approximately zero, thus there is long-run causality from finance – regardless the proxy – to economic activity (table 15).

Table 17 ECM for Developed Group Specification 1

Dep. GDP_CAPITA		Developed	
Model	**GDP_CAPITA_L_L**	**GDP_CAPITA_F_D**	**GDP_CAPITA_P_C**
ECT_{t-1}	-0,006*	-0,005*	-0,003*
$\Delta LGDP_{t-1}$	0,478*	0,435*	0,416*
$\Delta LGDP_{t-2}$	-0,091**	-----	-----
ΔG_E_{t-1}	-0,001	-0,001	-0,001

ΔG_E_{t-2}	0,001	-----	-----
ΔT_O_{t-1}	0,000*	0,000*	0,000*
ΔT_O_{t-2}	0,000	-----	-----
ΔF_{t-1}	0,000**	0,000	0,000*
ΔF_{t-2}	0,000***	-----	-----
C	0,013	0,012*	0,014*

Notes:

- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.

Table 18 ECM for Developed Group Specification 2

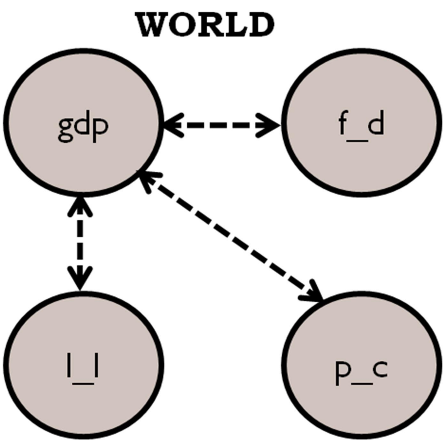
Dep. Fin. Proxy		Developed	
Model	**GDP_CAPITA_L_L**	**GDP_CAPITA_F_D**	**GDP_CAPITA_P_C**
ECT_{t-1}	0,075	-0,040	0,145
$\Delta LGDP_{t-1}$	22,251*	18,189*	52,280*
$\Delta LGDP_{t-2}$	-2,343	-----	-----
ΔG_E_{t-1}	0,487***	0,229	-0,216
ΔG_E_{t-2}	0,118	-----	-----
ΔT_O_{t-1}	0,016	0,015	0,004
ΔT_O_{t-2}	-0,009	-----	-----
ΔF_{t-1}	0,431*	0,336*	0,573*
ΔF_{t-2}	-0,177*	-----	-----
C	0,428***	0,395***	-0,393

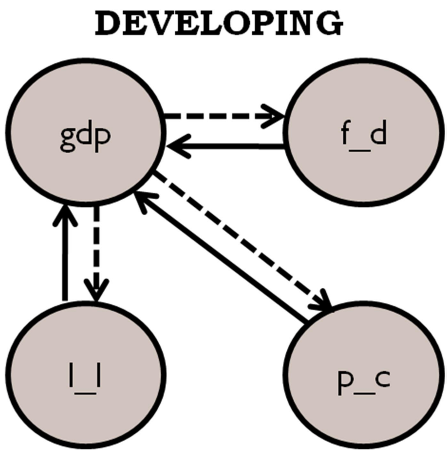
Notes:

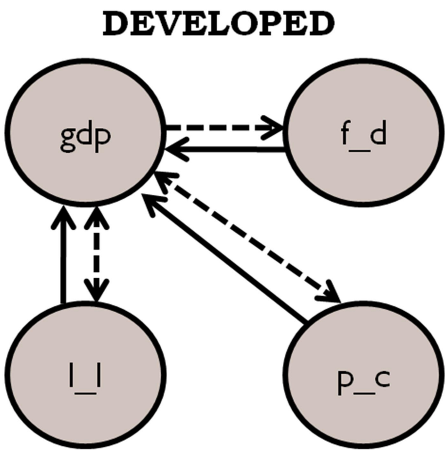
- ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.
- ECT_{t-1} is the Error Correction Term with a lag.

Finally, for the developed group, we find that only the L_L and the P_C proxies of finance cause the economic activity on the short-run given their statistical significance (table 17), while this is not the case for the F_D proxy. Moreover, economic activity causes financial development on the short run, regardless the proxy. On the long-run, given the statistical insignificance of the error correction term (table 17), it can be concluded that there is not cointegration; hence the direction of causality does not run from economic activity to financial development. On the other hand, when economic activity is the depended variable, the error correction term is statistically significant and negative which implies that there is long-run causality from finance to economic activity.

All the above conclusions on causality are summarized in the below diagrams, where the dash lines represent short-run causality, the continuous lines represent long-run causality and the arrows represent the direction.







5. Conclusions

In this thesis, the relationship between economic activity and financial development for 75 countries -21 developed and 54 developing- was re-evaluted. Three different proxies were used for financial development and three groups were constructed.

The panel cointegration test results indicate that there exist cointegrating vectors between financial development and economic activity in all groups regardless the proxy used for financial development. Thus, the results imply that there is a long-run relationship between financial development and economic activity.

In addition, the fully modified OLS estimations have shown that there is a positive and statistically significant relationship between finance and growth. Furthermore, according to the vector error correction model results imply short-run bidirectional causality for the world group. For the developing group the results imply unidirectional short-run causality from economic activity to financial development for the developing group and unidirectional long-run causality from econonomic activity to finance. For the developed group the results imply bidirectional short-run causality (for two out of three proxies of finance) and unidirectional long-run causality from finance to econonomic activity.

Summarizing, the present thesis confirms that the finace-growth nexus is established and indicates that all views expressed in previous studies may be valid. The world group's results on causality confirm mutual impact on the short-run and no impact at all on the long-run. The developed group's results on causality confirm the supply-leading hypothesis on the long-run which postulates a positive causal relationship from financial development to economic activity, while on the short-run the impact is mutual. The developing group's results on causality confirm the demand-following hypothesis on the short-run which posits a positive causal relationship from economic growth to financial development, while on the long-run the supply-leading hypothesis is confirmed. Hence, this thesis supports that although growth and finance are definitely related, the causality between them is not catholic. The channels through which financial development and economic activity facilitate one another may be case specific, which indicates that more research on the matter has to be done in order to reach a general theory.

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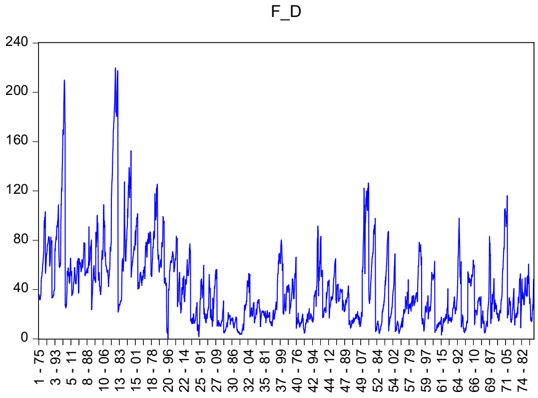
List of Countries

A/A	DEVELOPED COUNTRIES	DEVELOPING COUNTRIES
1	Australia	Algeria
2	Austria	Bahamas, The
3	Belgium	Benin
4	Canada	Bolivia
5	Cyprus	Botswana
6	Denmark	Brazil
7	Finland	Burkina Faso
8	France	Burundi
9	Germany	Cameroon
10	Greece	Central African Republic
11	Iceland	Chile
12	Ireland	Colombia
13	Italy	Costa Rica
14	Japan	Dominican Republic
15	Korea, Rep.	Ecuador
16	Luxembourg	Egypt, Arab Rep.
17	Malta	El Salvador
18	Netherlands	Fiji
19	New Zealand	Gabon
20	Norway	Ghana
21	Portugal	Guatemala
22	Singapore	Guyana
23	Spain	Honduras
24	Sweden	India
25	United States	Jamaica
26	-	Kenya
27	-	Madagascar
28	-	Malawi
29	-	Malaysia

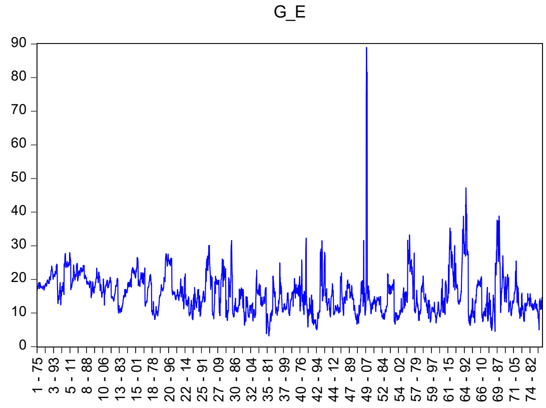
30	-	Mauritius
31	-	Mexico
32	-	Morocco
33	-	Nepal
34	-	Niger
35	-	Oman
36	-	Pakistan
37	-	Panama
38	-	Peru
39	-	Philippines
40	-	Rwanda
41	-	Saudi Arabia
42	-	Senegal
43	-	Seychelles
44	-	Sierra Leone
45	-	South Africa
46	-	Sri Lanka
47	-	Sudan
48	-	Suriname
49	-	Swaziland
50	-	Thailand
51	-	Togo
52	-	Turkey
53	-	Uruguay
54	-	Venezuela, RB

Appendix

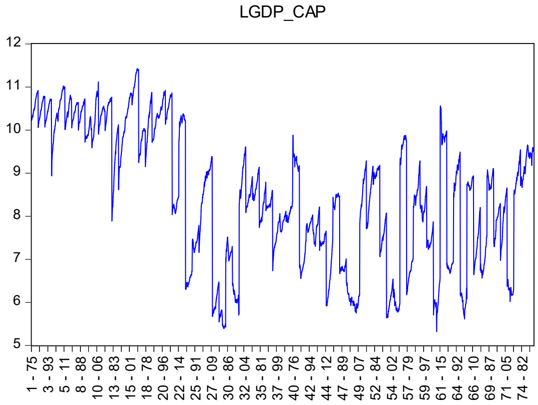
Graph 1 F_D World Levels



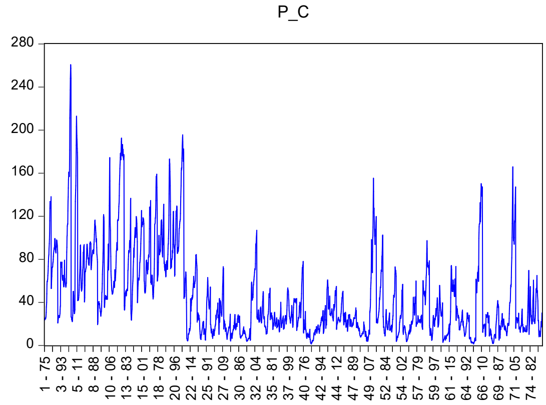
Graph 2 G_E World Levels



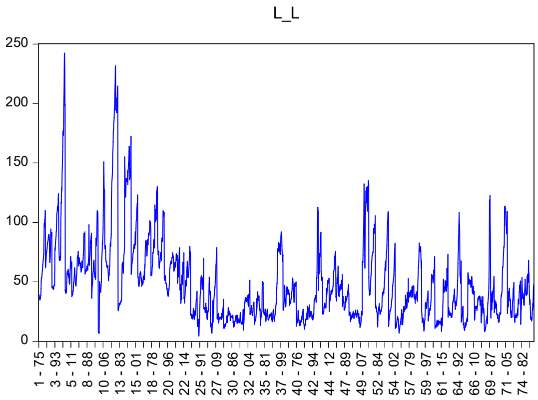
Graph 3 LGDP_CAP World Levels



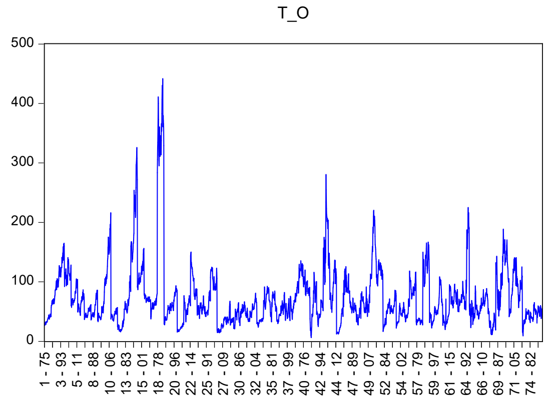
Graph 4 P_C World Levels



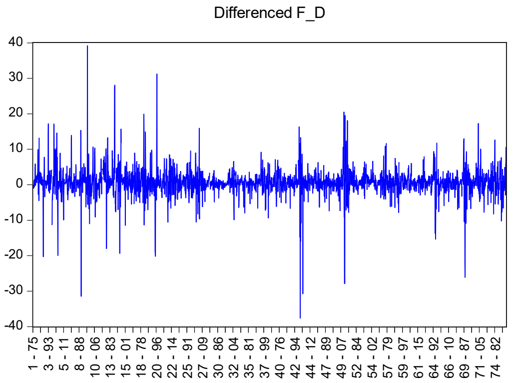
Graph 5 L_L World Levels



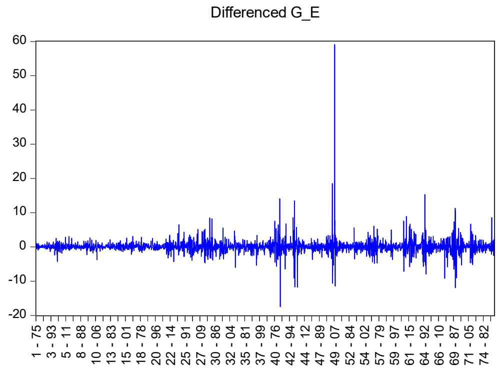
Graph 6 T_O World Levels



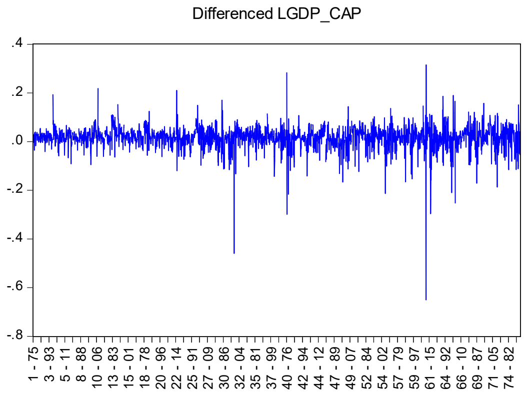
Graph 7 F_D World Returns



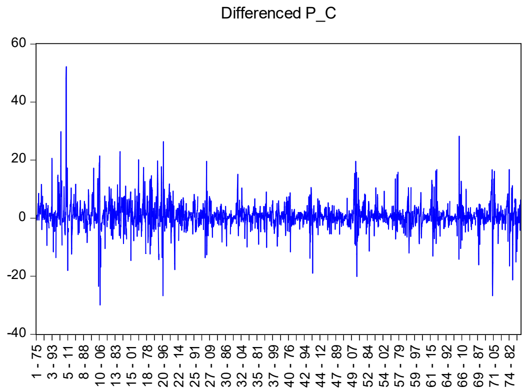
Graph 8 G_E World Returns



Graph 9 LGDP_CAP World Returns



Graph 10 P_C World Returns



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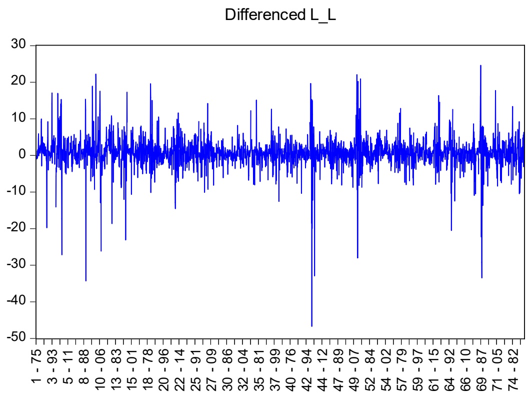
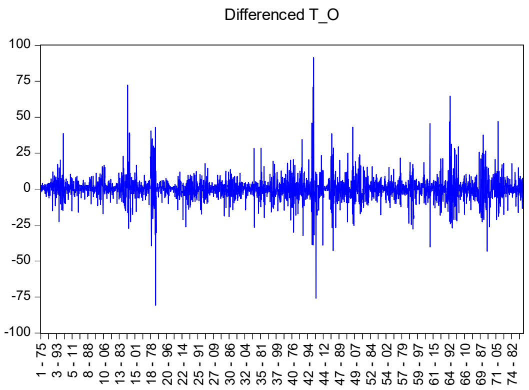
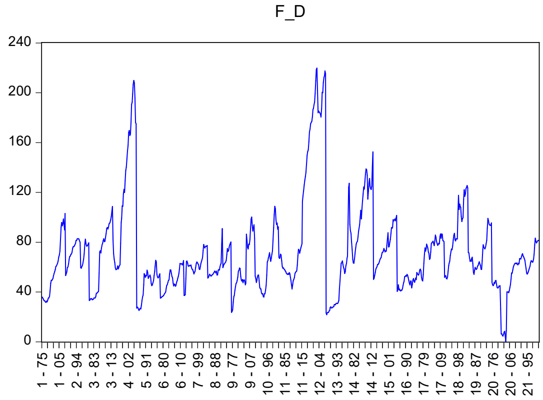


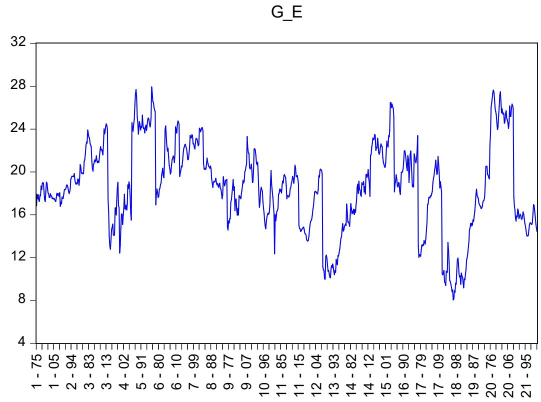
Graph 12 T_O World Returns



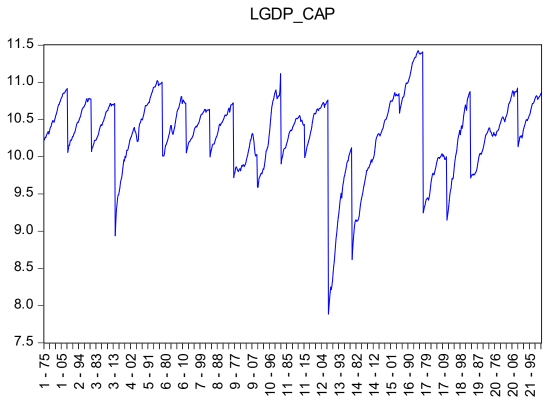
Graph 13 F_D Developed Levels



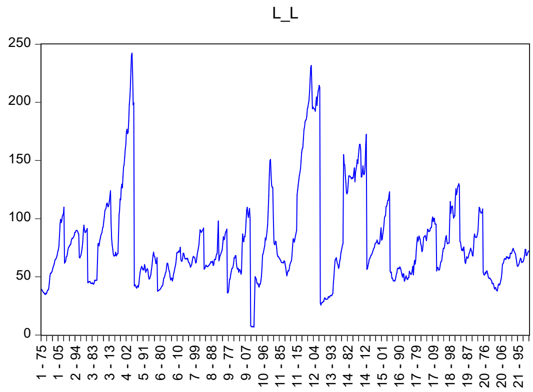
Graph 14 G_E Developed Levels



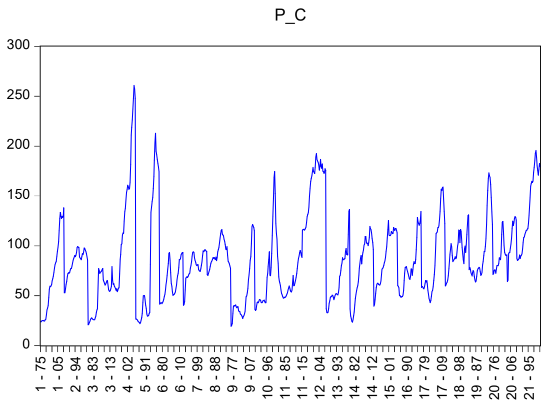
Graph 15 LGDP_CAP Developed Levels



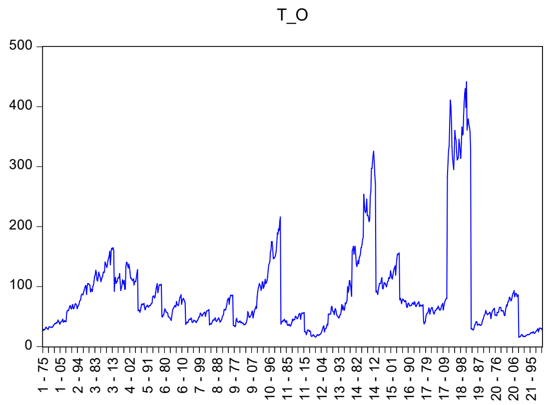
Graph 16 L_LDeveloped Levels



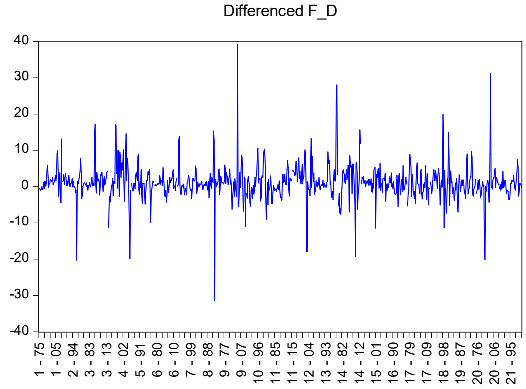
Graph 17 P_C Developed Levels



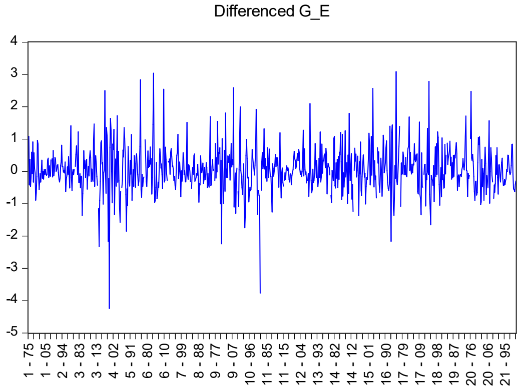
Graph 18 T_O Developed Levels



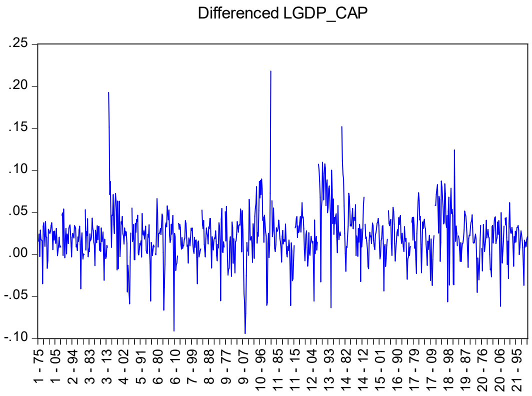
Graph 19 F_D Developed Returns



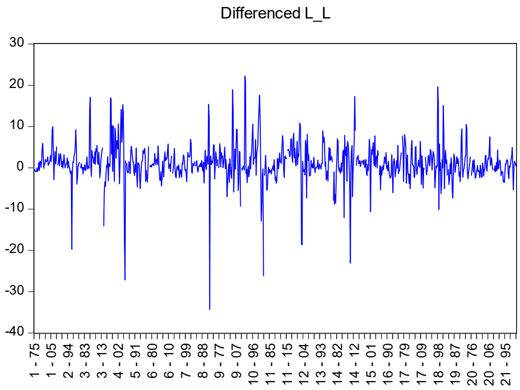
Graph 20 G_E Developed Returns



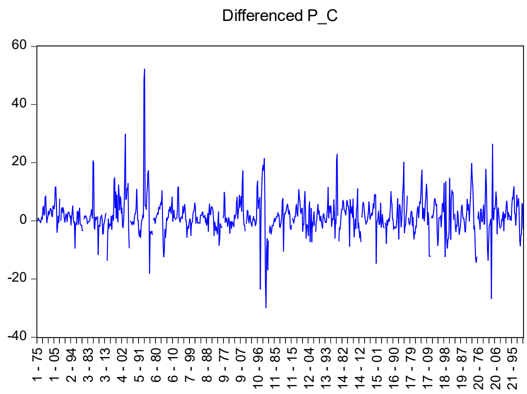
Graph 21 LGDP_CAP Developed Returns



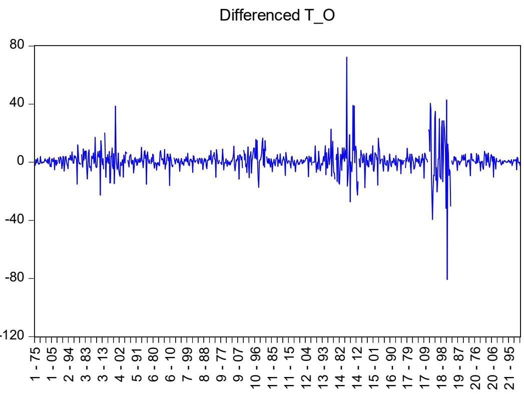
Graph 22 L_L Developed Returns



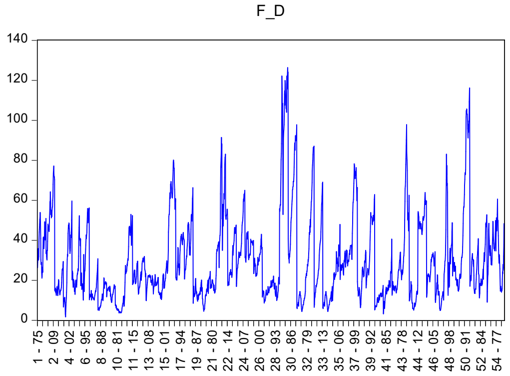
Graph 23 P_C Developed Returns



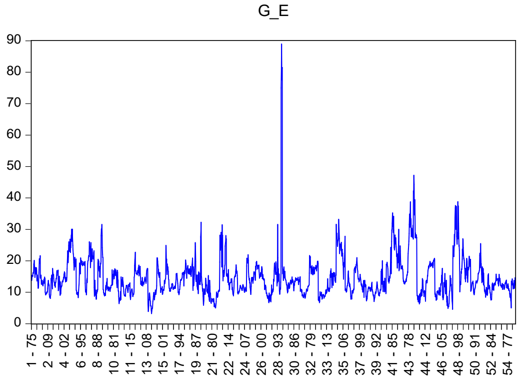
Graph 24 T_O Developed Returns



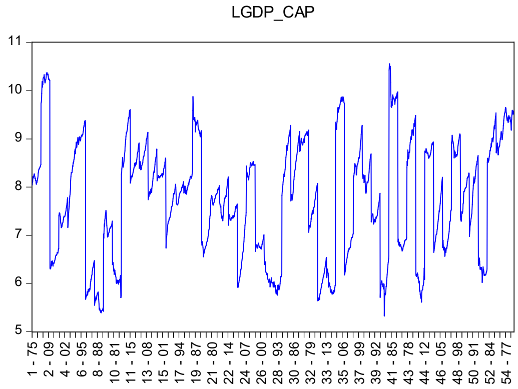
Graph 25 F_D Developing Levels



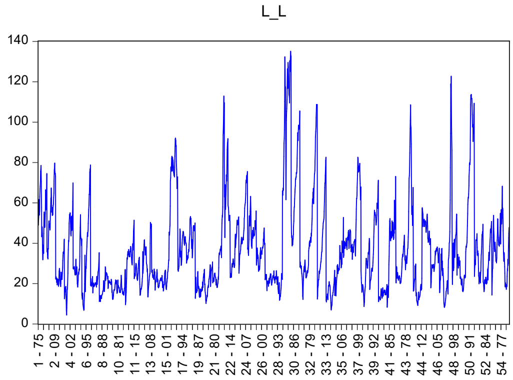
Graph 26 G_E Developing Levels



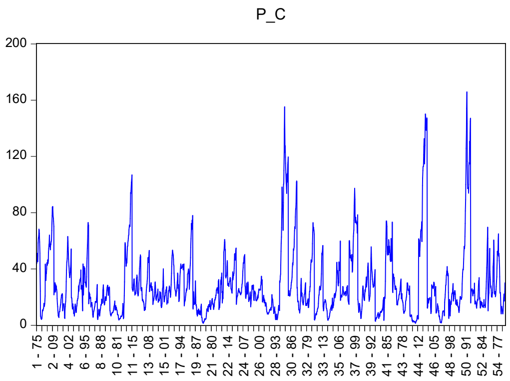
Graph 27 LGDP_CAP Developing Levels



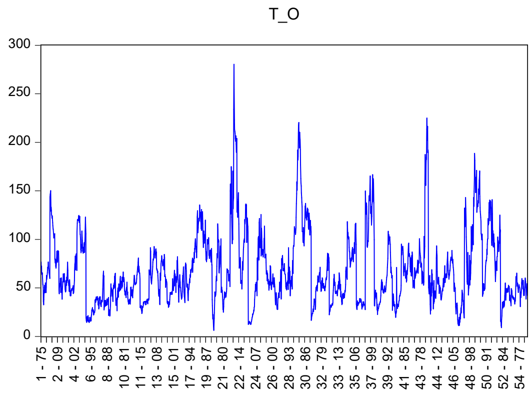
Graph 28 L_L Developing Levels



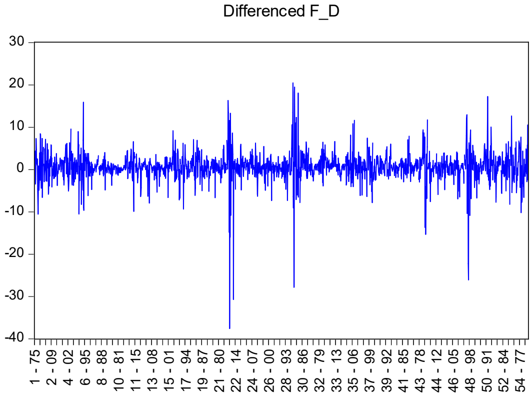
Graph 29 P_C Developing Levels



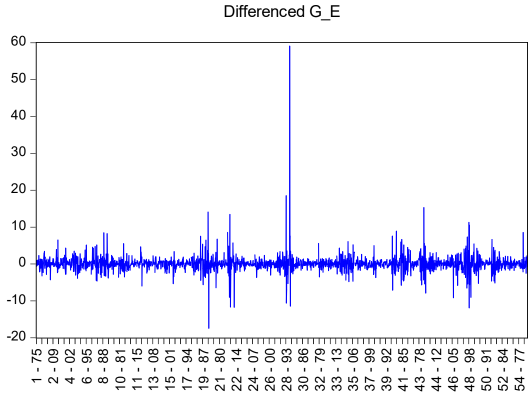
Graph 30 T_O Developing Levels



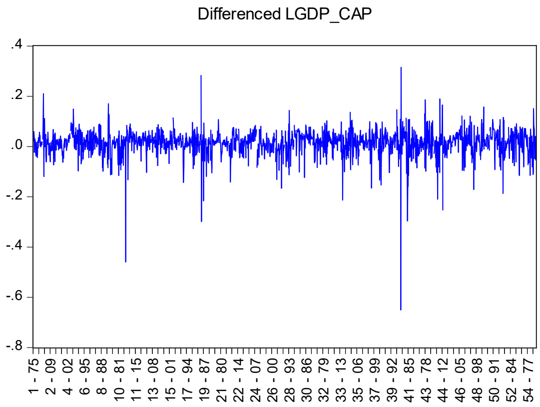
Graph 31 F_D Developing Returns



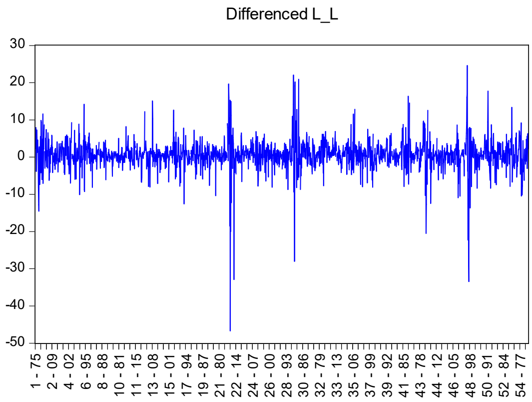
Graph 32 G_E Developing Returns



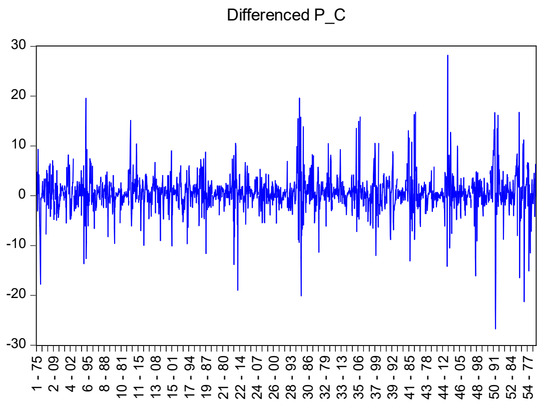
Graph 33 LGDP_CAP Developing Returns



Graph 34 L_L Developing Returns



Graph 35 P_C Developing Returns



Graph 36 T_O Developing Returns

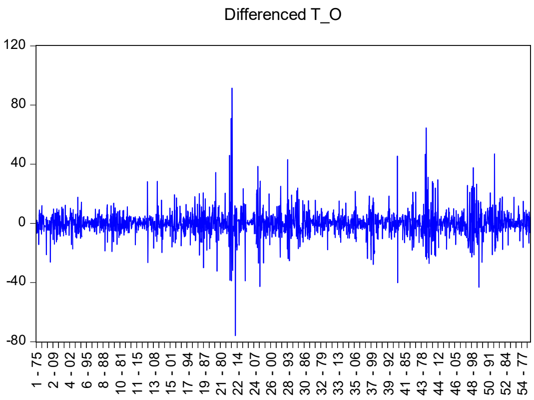


Table 19 Unit Root tests with constant for World Group in Levels

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	-3,591*	3,688	0,184	3,887	-3,424*	-2,177*
IPS	5,559	5,292	2,291	3,947	-4,154*	-1,078
ADF	156,013	114,161	149,782	124,784	214,999*	172,684***
PP	191,429**	82,534	83,747	99,809	220,277*	165,639

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 20 Unit Root tests with constant for World Group in Differences

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-30,443*	-31,302*	-22,812*	-31,459*	-42,790*	-50,089*
IPS	-31,767*	-30,402*	-23,642*	-30,903*	-42,869*	-47,185*
ADF	1177,210*	1121,740*	852,155*	1156,800*	1659,960*	1845,870*
PP	1238,160*	1121,810*	855,338*	1181,300*	1839,220*	2000,930*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 21 Unit Root tests with constant and trend for World Group in Levels

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	-0,448	0,703	-0,807	0,590	-1,972**	-2,607*
Breitung	6,397	0,414	3,354	0,116	-4,173*	-2,620*
IPS	3,704	0,137	0,614	-0,129	-2,302**	-1,559***
ADF	100,318	166,413	166,810	164,351	176,722***	176,385***
PP	79,262	108,776	67,615	112,688	157,883	164,511

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 22 Unit Root tests with constant and trend for World Group in Differences

WORLD	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-29,916*	-29,128*	-20,243*	-29,332*	-38,348*	-45,116*
Breitung	-16,724*	-18,253*	-12,549*	-15,756*	-24,622*	-27,327*
IPS	-31,620*	-26,996*	-20,227*	-27,644*	-39,213*	-42,798*
ADF	1190,470*	919,141*	698,068*	952,950*	1422,590*	1555,500*
PP	1427,160*	1064,860*	709,973*	1390,420*	2773,950*	3083,500*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 23 Unit Root tests with constant for Develeoping Group in Levels

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	3,868	3,440	1,886	2,778	-3,190*	-2,517*
IPS	8,263	4,319	1,986	2,374	-3,961*	-2,617*
ADF	63,949	84,771	109,686	101,284	160,398*	144,510**
PP	77,196	64,482	60,240	80,696	163,260*	143,521**

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 24 Unit Root tests with constant for Developing Group in Differences

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-28,015*	-26,683*	-21,168*	-27,707*	-38,450*	-42,636*
IPS	-28,944*	-26,354*	-21,483*	-27,401*	-38,777*	-40,779*
ADF	916,234*	826,586*	661,205*	876,269*	1281,940*	1354,200*
PP	975,219*	825,879*	668,794*	918,586*	1425,740*	1432,830*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 25 Unit Root tests with constant and trend for Develeoping Group in Levels

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	-0,694	1,327	-0,464	0,672	-1,778**	-1,273
Breitung	6,420	-0,900	2,562	-1,945**	-4,107*	-1,041
IPS	2,672	1,181	0,120	0,038	-1,672**	-0,975
ADF	75,755	105,947	125,389	118,020	118,290	127,969***
PP	62,666	73,121	47,659	79,417	110,545	122,537

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 26 Unit Root tests with constant and trend for Develeoping Group in Differences

DEVELOPING	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-27,956*	-24,796*	-19,387*	-25,406*	-33,735*	-38,892*
Breitung	-17,763*	-15,468*	-12,939*	-13,168*	-24,965*	-22,749*
IPS	-29,163*	-23,177*	-18,944*	-24,150*	-35,811*	-37,798*
ADF	954,344*	670,679*	551,572*	711,064*	1116,990*	1175,590*
PP	1128,340*	692,494*	567,028*	956,535*	2416,300*	2158,960*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 27 Unit Root tests with constant for Develeoped Group in Levels

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	-8,865*	1,358	-1,540***	2,636	-1,548***	-0,332
IPS	-2,723*	3,071	1,145	3,638	-1,501***	2,165
ADF	92,064*	29,389	40,096	23,500	54,602***	28,174
PP	114,234*	18,052	23,507	19,113	57,017***	22,118

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 28 Unit Root tests with constant for Develeoped Group in Differences

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-13,105*	-16,407*	-9,520*	-15,209*	-19,360*	-26,336*
IPS	-13,613*	-15,199*	-10,229*	-14,470*	-18,821*	-23,776*
ADF	260,979*	295,156*	190,950*	280,534*	378,022*	491,675*
PP	262,944*	295,930*	186,544*	262,716*	413,485*	568,095*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 29 Unit Root tests with constant and trend for Develeoped Group in Levels

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Level**	**Level**	**Level**	**Level**	**Level**	**Level**
LLC	0,222	-0,934	-0,716	-0,106	-0,887	-3,071*
Breitung	2,305	1,620	2,190	2,220	-1,527***	-3,907*
IPS	2,723	-1,608***	0,973	-0,302	-1,669**	-1,385***
ADF	24,563	60,467**	41,421	46,331	58,432**	48,416
PP	16,595	35,655	19,956	33,271	47,337	41,974

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 30 Unit Root tests with constant and trend for Develeoped Group in Differences

DEVELOPED	GDP_CAPITA	F_D	P_C	L_L	G_E	T_O
C T	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**	**Diff**
LLC	-11,786*	-15,288*	-7,603*	-14,704*	-18,560*	-22,916*
Breitung	-4,935*	-9,686*	-4,241*	-8,668*	-9,037*	-15,242*
IPS	-12,998*	-13,859*	-7,857*	-13,528*	-16,656*	-20,285*
ADF	236,124*	248,462*	146,496*	241,886*	305,600*	379,912*
PP	298,826*	372,364*	142,945*	433,882*	357,653*	924,545*

Notes: ***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively. C = Constant and T = Trend.

Table 31 Cointegration tests (Pedroni and Kao) Specification 1

	Groups	Pedroni				Kao
		Panel v-Statistic	Panel ρ-Statistic	Panel PP-Statistic	Panel ADF-Statistic	ADF
Model 1	World	-3,540	4,124	2,173	1,921	-2,200**
	Developed	-2,166	2,625	0,721	0,977	-3,650*
	Developing	-2,792	3,181	2,009	1,416	-0,893
Model 2	World	-0,095	3,361	1,826	-0,556	-4,421*
	Developed	-0,487	2,086	1,399	-0,303	-2,581*
	Developing	0,526	2,426	0,967	-0,492	-4,877*

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length was automatically selected based on Schwarz Information Criterion (SIC).

Model 1) GDP_CAPITA G_E T_O F_D

Model 2) F_D G_E T_O GDP_CAPITA

Table 32 Cointegration tests (Pedroni and Kao) Specification 2

	Groups	Pedroni				Kao
		Panel v-Statistic	Panel ρ-Statistic	Panel PP-Statistic	Panel ADF-Statistic	ADF
Model 1	World	-3,462	3,154	0,888	1,402	-1,477***
	Developed	-1,537	1,424	-0,834	-0,164	-2,995*
	Developing	-3,110	2,820	1,447	1,502	0,487
Model 2	World	0,012	3,254	1,610	-0,131	-4,559*
	Developed	-0,504	1,856	0,934	-0,018	-2,333**
	Developing	0,522	2,626	1,283	-0,182	-5,000*

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length was automatically selected based on Schwarz Information Criterion (SIC).

Model 1) GDP_CAPITA G_E T_O L_L

Model 2) L_L G_E T_O GDP_CAPITA

Table 33 Cointegration tests (Pedroni and Kao) Specification 3

	Groups	Pedroni				Kao
		Panel v-Statistic	Panel ρ-Statistic	Panel PP-Statistic	Panel ADF-Statistic	ADF
Model 1	World	-3,941	3,993	2,191	1,180	-1,407***
	Developed	-1,509	1,997	0,994	0,383	-2,674*

	Developing	-3,655	3,451	1,949	1,092	-0,136
	World	-0,924	4,680	4,156	3,426	-3,775*
Model 2	Developed	-0,404	2,802	2,825	2,508	-1,772**
	Developing	-0,962	3,292	2,261	1,505	-4,705*

Notes:

-***, **, * Indicate statistical significance at 10%, 5% and 1%, respectively.

- the optimal lag length was automatically selected based on Schwarz Information Criterion (SIC).

Model 1) GDP_CAPITA G_E T_O P_C

Model 2) P_C G_E T_O GDP_CAPITA