# The Impact of Debt Overhang on Emerging Countries

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# ABSTRACT

Debt overhang may impede a country's investment and growth. The impact of external debt on a country's economic growth through investment has created quite interesting results in the world especially in developing countries where internal and external borrowing have been usual.

This thesis investigates the average impact of economic factors like investment, savings, real interest rates and GDP on real debt in eight countries over a period of 23 years starting in 1981. we employ panel data econometrics estimations to detect the relationship between real debt and economic growth. We explore the dynamic relationship between variables, using a panel cointegration technique, applied on eight emerging economies. Our results indicate that there is a non-linear impact of these factors on real debt. It is concluded that real debt of a country is adversely affected by GDP and positively affected by investment, savings and interest rate in that country.

**Keywords:** D ebt, Time series analysis, GDP, Emerging countries

# ÖZ

Bir ülkenin yatırımlarına ve ekonomik büyümesine, o ülkenin borç stoğu zorlaştırıcı etkide bulunabilir. Dış borcun bir ülkenin ekonomik büyümesi üzerindeki etkisi, tüm dünyada özellikle gelişmekte olan, sürekli hem iç hem dış borçlanmaya yönelen ülkelerde ilginç etkiler yaratmaktadır.

Bu tezde; yatırımlar, tasarruflar, reel faiz oranları ve gayri safi yurt içi hasıla gibi faktörlerin reel borç stoğu üzerindeki ortalama etkisi, seçilen 8 ülkenin 1981'den itibaren 23 yıllık dönemi baz alınarak incelenmiştir. Panel kointegrasyon tekniği 8 ülke üzerinde uygulanarak, değişkenler arasındaki dinamik ilişki araştırılmıştır. Elde edilen sonuçlara göre incelenen faktörlerin reel borç üzerinde doğrusal olmayan bir etkisi olduğu kanısına varılmıştır. Ayrıca elde edilen verilere göre bir ülkenin gayri safi yurt içi hasılasının reel borç stoku üzerinde negatif etkisi olduğu; ancak yatırımlar, tasarruflar ve faiz oranlarının borç stoğu üzerinde pozitif bir etkisi olduğu gözlemlenmiştir.

**Anahtar Kelimeler:** Borç , Zaman serisi analizi , GSYİH , Gelişen ülkeler

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# TABLE OF CONTENTS

# LIST OF TABLES

# Chapter 1

# INTRODUCTION

Government debt has risen noticeably over the recent decades and this trend has been generally occurred with a growth in the size of the government. In many developed countries, the general government expenditure growth was tremendous in the 20th century. As proved by Tanzi and Schuknecht (1997), during 1913 till 1990, on average, there was a 31 % increase in the government size of industrial countries from 12% to 43% of GDP.

From the economic impact perspective, the method of building debt up and also subsequent exit strategy is important. Around a hundred years ago government debts were generally rare and built up mainly in the war periods. This situation changed later. Nowadays government debt can mostly build up in financial and economic crises periods.

The situation that the debt service burden of a country is so huge that a major fraction of the current output arise from foreign lenders, is named “Debt overhang”. It can create discouragement for investment (Krugman, 1988; Sachs, 1989).

According to the hypothesis, if there is a probability that the country is not able to repay the international debt in the future, the expected cost of debt-service would be

a disincentive for foreign and domestic investment. And it can harm the growth of the economy (Pattillo et al., 2002).

The debt Laffer curve suggests that the repayment of expected debt first increases with the increase in the debt stock and then decreases as debt increases. At the peak of this curve, the debt overhang happens.

The high burden of service debt decreases private investment and rises expected future taxes which have to be paid by the private sector. Debt servicing consumes the resources which could be used to fund the investments. Moreover, debt overhang can decrease the quality of investment and therefore deteriorate economic performance. This is about repayment of debt service lead to disincentives and make problems for economic improvement (Clements et al., 2003).

The economic growth of a country is negatively affected by a debt overhang through the negative effect on policy and investment. The adverse effect of high debt on the growth of the economy works mostly through the negative impact on the accumulation of physical capital (Pattillo et al., 2003). The negative effect of debt overhang on growth is generally acknowledged. It has been observed that growth decelerated during 1980s, while accumulating debt and on the other hand growth rate increased during the 1990s while debt reduction (Pattillo et al., 2002).

In order to solve the growing problems made by debt overhang, debt relief programs have been taken into account in international level. The World Bank runs HIPC I and HIPC II to give debt relief to indebted poor countries when they achieve some special criteria like poverty reduction objectives. After debt relief, countries have

more resources to invest in institutions and infrastructures. It creates higher private foreign and domestic investment.

The debt overhang hypothesis has been investigated theoretically and empirically.

Bulow and Rogoff (1991) indicated that if some borrower countries are underdeveloped, it's mainly the result of their economic mismanagement. It is not the result of the external debt burden. Therefore, debt overhang is not the reason of low economic growth. It is a kind of symptom in those indebted countries.

Arslanalp and Henry (2004) proved that the poor countries with high level of debt are not mainly suffering from debt overhang. On the other hand, we cannot say that debt is not effective Cordella et al. (2005).

Although the adverse impacts of debt overhang on economic growth are generally realistic, the empirical reliability of the hypothesis is doubtful. If there is no debt overhang in a country, it is not probable that debt relief can stimulate the economic growth of that country.

One important question is about the economic outcomes of a regime of high and persistent debt. While the rate of economic growth generally has a linear adverse effect on the public debt to GDP ratio.

Therefore, the primary aim of this study is to empirically test the 'debt overhang' hypothesis. We use panel data econometric models.

In this thesis 8 Emerging Countries (Argentina, Brazil, China, India, Indonesia, Turkey, Mexico, South Africa) have been chosen to investigate if there is a negative or positive relationship exist between debt stock and real economic growth during the period between 1981-2013. Data on debt stock, investment /GDP, saving/GDP ratios, growth rates have been gathered from the source of World Bank's Economic Outlook. Panel's methodology has been implemented to estimate the impact of debt overhang on economic growth.

After reviewing the literature in section 2, Section 3 presents the analytic models of estimation employed in the paper. It describes the econometric methodology as well as the variables included in the study. The results and concluding observations are summarized in Sections 4 and 5.

# Chapter 2

# LITERATURE REVIEW

## 2.1 Economic Growth

There are a lot of welfare differences between countries in the world. Why some countries are very rich and some of them are very poor? The economists trying to answer this question over the last century. The first aim of all countries is to have a sustainable economic growth. However, some countries grow faster than the others. Economic growth is an episode for all countries in the world. Economic growth of a country depends on increasing rates of its GDP and average per capita income. If a GDP growth is more than the population growth, then, we can say that there is a positive growth. For recognizing country's welfare, growth we should focus on population growth rate. For example, if per capita income increases highly but income distribution is unequal, then the wealth will not be shared equally.

When we observe the development period of developed countries, the common point is that countries provided this economic growth with industrialization. There are 3 countries which grew with agriculture, namely Canada, Australia and New Zealand. The most important sources of industrialization are capital stock and technological progress. 18th century is the beginning of industry period and also the beginning of capital accumulation. It's commonly known that the technological progress has a revolutionary effect on the economic growth. The level of growth in many countries, depend on their international competitive advantage, and technological progress. In

today's world, countries are separated into two groups such as the ones who creates new technology and the ones who are not. For instance the South Korea's economic growth owes its success to its accumulated capital stock and technological progress. This is because of South Korean government's incentive and forcible technological policies. Without capital accumulation, it's not possible to have any technological progress. First the capital accumulation should increase in a country and then technological progress can follow it. For a sustainable economic growth, the capital stock and technological progress play a vital role.

### 2.1.2 Solow Model

Robert Solow, developed a model to measure the extent to which technological progress accounts for growth. Although the technological progress is difficult to estimate, Solow focused on measuring GDP growth by adding capital accumulation and labor hours, included in the workforce.

'Solow decomposition is a method of accounting for the sources of economic growth. It breaks down in GDP into the sum of growth attributable to changes in the factors of production and growth due to improved production. The latter is called the Solow residual and is usually interpreted as technological change'.

$Y=F(A,K,L)$ $a=\Delta A/A$

Solow residual=$\Delta Y/Y$ output growth due to growth in capital and hours worked. Y stands for GDP growth, K refers to Kapital and L for labor.

Mankiw et al (1992) has proposed to use and augmented Solow Growth model to estimate international differences in income per capita.

Domestic financing and foreign financing are the common problems for all countries. For sustainable economic growth, every country needs reliable sources. How can investments be financed is one of the most important source of economic growth? At that point, savings have pivotal importance. If a country wants to have a sustainable economic growth than savings play a vital role. When income per capita in a country increase, this raises the welfare level of the country. For increasing the income per capita, investments and production capacity should also increase. Every year countries create their own sources and can consume some part of it while they keep some other part of their investments. This part was kept for investments is the real savings of that country. Economic growth requires savings at some levels and for making this savings country must tolerate some difficulties. Everyone of course expects to have a positive relationship between savings and economic growth.

Krugman (2009) investigated has whether the growth of newly industrialized economies hurts more developed (or advanced) economies. In the early 1990s a lot of economists observed that development of newly industrialized countries, causes a threat for affluence of advanced countries. For instance, the European Commission in 1993 observed that other countries started to grow and this has caused some problems in Europe because of their advanced industries developed industries. One can compete with them in their own market with different cost levels. Countries that have low wages, increases their productivity and this would bear down nations that have high wages. Samuelson (2004) gave an example about technological progress of developing countries which can damage the advanced economies. According to Samuelson (2004) a country can hurt because of the growth of the other country, but if that country starts competing with the other sectors than they can manage to export. For example, if China becomes successful in producing goods that it imports

than there will be no competitive advantage and the US lost its earnings from trade. This is just an empirical observation which doesn't mean that China has hurt the advanced economies. The effect of this growth of other economies is about international trade. If this approach is correct, then we should see a lot of losing for advanced countries in terms of trade abroad and a lot of guns for new competitors. If we look at Samuelson observation China's technological progress has deteriorated effect on the US economy because of cancelling their trade.

Borensztein et al. (1998) also estimated the effect of foreign direct investment on economic growth. They found that foreign direct investment is an efficient tool for transferring the technology and plays a significant role in economic growth than domestic investment. Yet foreign direct investment affects economic growth if the host country has enough absorbent capacity of the advanced technologies. Borensztein (Ibid) recommended that more advantageous impact on high foreign direct investment results more efficient than high capital accumulation. Foreign direct investment is a tool for increasing technology level, for economic growth country should educate workers for working with new technologies and also foreign direct investment can affect human capital accumulation.

The key point of sustaining economic growth is to use countries' earnings to increase society's social and cultural development. Sustainable and impetuous growth can be realized with capital accumulation and technological progress.

## 2.2 Debt and Growth Relation

Economic growth is a common problem for all developing and less developed countries. One of the biggest problem the less developed countries and developing

countries is to have lack of financial resources for required industrial investments. For their way to grow their economy, the most important restriction is internal and external financial difficulties. Developing or less developed countries need external debt when domestic savings are not enough to sustain their economic growth, disequilibrium in the balance of payments, which are not available to cover their imports and technological bottlenecks. However, if the quantity of debt is greater than the country can afford, there will be a debt overhang problem.

Governments, private banks or industries get credits from abroad with exchange rate. The role of debts on financing economic growth is the main a discussion topic. During the period that the country gets its debt, this makes an extra revenue for their economy and it will increase the capability of consumption and investment. In the history, countries' experiences imply that especially short term debts cause a threat to sustainable economic growth. Debt to GDP ratio is than attracts the attention of any academic scholar, like us to investigate. Actually for developing countries, the most important thing is not the size of debt but rather is debt sustainability. The external sources of a developing country include mostly short term debts, spontaneous capital outflows which can cause economic crisis.

In 1994, Mexico had a severe economic crisis, which Turkey has followed the similar one in 2001 February. So the countries should have doubts when they want to use these debts for financing economic growth.

Doğan and Bilgili (2014) have recently accentuated that the developing countries, like Turkey, have difficulties to reach financial resources, therefore it pushes them to receive external debts. Because of that external debt has become a very efficient

source for financing domestic capital accumulation, investments, economic growth. With MDMSM they found that the external debt may affect economic growth negatively. And the other studies that in contraction and expansion of time reveal the position of the public debts of a country gets worse than private ones. This could show that the use of public external borrowing is ineffective.

Yenturk et al. (2009) carried out a research and provided an ample evidence that there is an interaction between savings, investments and growth in Turkey. Depending on the previous empirical studies, they studied that the growth has a big impact in determining the differences in both savings and investments. If the economic growth has impacted on investments and savings, then an economic growth can just energize with exogenous shock given to it.

Reinhart and Rogoff (2010) also noted that in advanced and emerging countries, high debt and GDP ratios (90% and more) cause remarkably low growth rates. Furthermore, for emerging countries total external debt and GDP ratios can cause the low rate of growth. Rarely, countries could grew without debt burdens.

Pescatori et al. (2014) recently undertaken a research and found out that debt curve is very important, like debt level for finding future growth probabilities since the countries has high debt level. According to Pescatori et al (2014) higher debt is associated with a higher degree of output volatility.

Blair (2013) has underlined that there is a conflict that debt is both very unsafe and too common. Most of the countries use external debt increases to improve its economic growth. The previous studies that estimate impact of debt stock on

economic growth do not have an exact agreement. Some of the studies have found statistically significant negative relations and whereas some others have found positive relationships between debt stock and economic growth.

## 2.3 Debt Overhang

The definition of debt overhang varies with Krugman's (1988) defining debt overhang approach; such as " A situation in which the expected repayment of foreign debt falls short of the contractual value of the debt"(p.13). If developed countries have a propensity to debt overhang this would illustrate in the long run that each of the Keynesian stimulus are not positive for growth. If there is no debt overhang debt financing will be successful with the program of bailouts. Krugman implied that perhaps debt forgiveness is most efficient.

Eduardo Borensztein (1990) defines debt overhang as: "A situation in which the debtor country benefits very little from the return to any additional investment because of the debt service obligations "(p.13).

In literature, there are lots of studies which investigates whether there is a positive or negative relationship between external debt and economic growth.

Cohen (1993) carried out a study on 81 developing countries between 1965-87 and approximated investment equations that showed debt levels which do not hold great explanatory power. Yet, he found that high debt had a major negative impact on growth in Latin American states and concludes that—uniform with a crowding out story of debt servicing costs—what does matter is the actual stream of net transfers. Another study undertaken by Cohen (1997) approves that holding off a debt can have a substantial risk that lowers growth in a significant proportionate in Latin America

and it is shown this have a significant impact when debt rises above 50 percent of GDP. On the other hand, it debated that for African countries in the 1980s and 1990s, high debt is not a significant cause of the poor economic performance. (Debt overhang or debt irrelevance).

Karagöl (2002) has underlined that Turkey's external debt and growth relation between 1956-1996 with using cointegration and Granger Causality analysis reveal a negative relation between debt stock and growth. Another study by Karagöl (2005) also highlights that countries may have differences in their characteristics (social, economic, political) and debt overhang theory cannot be applicable for all countries unilaterally.

Recently, Doğan and Bilgili (2014) also carried an econometric study to estimate the relationship between external debt and economic growth. By implementing a non parametric model, named Markov-switching model, focused on Turkey from the year 1974 to 2009, which results a nonlinear relationship between external debt and growth in the emerging economies like in Turkey, public sector often resorts to external debt, in order to finance current expenditures.

Jawed and Sahinöz (2005) used a time series analysis to investigate Turkey's external debt relation with growth, investment and export. They found positive, but meaningless relations between external debt and growth, the positive and meaningful relation between debt and exports and negative but economically sound relations between debt and investment.

Hansen (2001) has carried out a study by including 54 developing countries which including Turkey for the period 1974 to 1993, and estimated the possible impact of external debt on economic growth. He used GDP growth rate, as dependent variable and foreign direct investment/GDP, budget surplus, inflation, openness, aids/GDP, debt service/export, external debt/ GDP as independent variables in his model. The negative relation between economic growth and external debt has been found out in Hansen's (IBID) study.

Cordella et al (2005) also investigated that economic growth, and debt relations may vary and depends on level of indebtedness and characteristics of developing countries. They use 79 developing countries from 1970 to 2002 by implementing GMM (General Methods of Moments) method and at intermediate debt levels they found a highly nonlinear relationship between debt and growth but not at very low or high levels.

Keating and the Keating (2003) have undertaken a study on Latin American countries such as Argentina, Brazil, Chile, Colombia, El Salvador, Guatemala, Mexico, Panama, Peru and Venezuela for the years between 1970-1999. They investigated, the sustainability of external debt and the possible relationship between external debt and economic growth. He found that in the Latin American country's growth of external debt increases more than the balance of payments deficits and in this country's sustainability of external debt cannot achieve.

Akujobi (2007) has also studied debt-growth relationships for Nigeria between 1980-2002 and found out that internal debt has positive impact where as external debt has negative impact on economic growth.

Schclarek (2004) has widened the discussions on debt and growth relationships while chasing 59 developing countries and 24 industrialized countries for estimating impact of external debt on economic growth. He figured out that there is a negative and meaningless relationship exist between private debt and public debt.

Recently Blair (2013) has investigated whether debt overhang will take place if a country have an obligation to its creditors more than it can pay. He said " If a country is not able to borrow and doesn't want to stir inflation by printing money, it has to increase its taxes for handling its debt " So debt overhang may cause an increase taxes for the private sector which is good for government yet not for the private sector. Also, this may cause a decrease in aggregate investment in production. So debt overhang is harmful for private sector, which can lose many profitable projects. Investors decide not to invest if all profits are flowing into government. When investment and growth decrease, Debt overhang may hurt lenders but for all countries the best way is to reach a higher average living standard, while decreasing the amount of debt. The most important restriction for increasing living standards is debt. When debt servicing is reduced by debt relief, then the net flow of capital to poor countries does not rise rather it attract grants or new loans fall.

In emerging market debt caused the financial crises (2008-2009) in the US, the UK and other industrialized countries. In order to overcome the financial crises illiquidity and insolvency are two important elements to take into consideration.

Rodrik (2011) has stated that of economic growth country needs a more pragmatic government, which is ready to do everything to sustain private sector. Using markets

and globalization strategy is needed to diversify the domestic economy away from natural resources.

Bilginoğlu and Aysu (2008) have carried out a study about Turkey's external debt and growth relations by using data for the period of 1968-2005 and found negative relationship. This illustrates that the debt overhang problem exists. Country need, debt relief for sustaining an economic growth. Turkey has an enormous debt burden which affects its economic growth negatively. With an effective debt management, external debt service burden can be reduced, risk level can fall, and Turkey can finance its investments.

# Chapter 3

# DATA AND METHODOLOGY

## 3.1 Data and Variables

This study employs annual data on Real Debt, GDP, Investment, Savings and Interest Rate for 8 emerging countries. The panel data set includes 8 countries and the time interval of 23 years (1981–2013). To form our panel data set, we tried to include as many countries as possible according to the requaired time horizon of data. The emerging market category of Morgan Stanley Capital Income (MSCI) has identified the list of emerging countries. At the present time, we define 22 emerging markets in the world, and we selected 8 of them. These countries are Argentina (ARG), Brazil (BRA), Mexico (MEX), Indonesia (IDN), China (CHN), India (IND), South Africa (ZAF), and Turkey (TUR).

The data has been collected from Word Bank data base. According to World Bank the definition of variables is:

Debt service on external debt - Total debt service is the sum of interest and principal repayments paid in goods, services or currency on long-term debt, to the IMF. the figures are in U.S. dollars.

Gross savings (% of GDP)- Gross savings are estimated as total national income subtracted by total consumption, plus net transfers.

Gross fixed investment- Total business spending for fixed assets, for example factories, inventories of raw materials, equipment, machinery, dwellings, dwellings which prepare the fundation for production in the future .

Interest payments on external debt (% of GNI)- Total payments of interest to gross national income.

## 3.2 Stationarity and Unit Root Testing

### 3.2.1 Why are Tests for Non-stationarity Necessary?

There are a few reasons why the idea of non-stationarity is critical and why treating non-stationary and stationary variables differently is essential. With the end goal of the examination, a stationary series can be characterized as a series with a constant mean and also constant autocovariance and variances for every given lag. test of the stationarity for a series is necessary for the following reasons:

1- A non stationary series can emphatically impact its properties and behaviour. For a non-stationary series, 'shocks' to the system can be persistant over time.

2- Employing non-stationary data can creat spurious regressions. If two unrelated variables are trending with the time, regressing them on each other can provide high $R2$ eventhough this regression can be completely valuless.

3- '*t*-ratios' are not based on *t*-distribution, if in the regression variables are not stationary.

### 3.2.2 Two Types of Non-stationarity

There are two models to identify the non-stationarity, the random walk model with drift:

$$y_t = \mu + y_{t-1} + u_t \quad (1)$$

and the trend-stationary process:

$$y_t = \alpha + \beta t + u_t \quad (2)$$

where $u_t$ is error term in both cases.

### 3.2.3 Some more Definitions and Terminology

Consider the simplest stochastic trend model:

$y_t = y_{t-1} + u_t$ or $\Delta y_t = u_t$

we can get a stationary series from a non-stationary one by driving the first difference. If a non-stationary series, $y_t$ must be differenced d times before it becomes stationary, then it is said to be integrated of order d. we write $y_t \sim I(d)$. So if $y_t \sim I(d)$ then

$$\Delta^d y_t \sim I(0) \quad (3)$$

An I(0) series is a stationary series. An I(1) series contains one unit root, e.g.

$$y_t = y_{t-1} + u_t \quad (4)$$

An I(2) series includes two unit roots. Therfore it needs differencing twice to induce stationarity.

### 3.2.4 Testing For a Unit Root

For the first time, Dickey and Fuller (Fuller, 1976; Dickey and Fuller, 1979) invented a thechnique to test for the exictance of unit root. The basic objective of the test is to examine the null hypothesis that φ = 1 in

$$y_t = \varphi y_{t-1} + u_t \quad (5)$$

For ease of interpretation and computation

$$\Delta y_t = \psi y_{t-1} + u_t \quad (6)$$

So that a test of $\varphi = 1$ is equivalent to a test of $\psi = 0$ (since $\varphi - 1 = \psi$).They prepared some critical values and test statistics to test the significance of the lagged *y*. They are defined as

$$test\ statistic = \frac{\widehat{\psi}}{SE\ (\widehat{\psi})} \quad (7)$$

Critical values are calculated based on simulations experiments in Fuller (1976).

Table 1. Critical value for DF test

| Critical Value for DF Test(Fuller,1976,p.373) | | | |
|---|---|---|---|
| Significance Level | 10% | 5% | 1% |
| CV for constant but no trend | -2.57 | -2.86 | -3.43 |
| CV for constant and trend | -3.12 | -3.41 | -3.96 |

The null hypothesis of the test is the existance of unite root in the series.

According to Harris and Sollis (2003), the tests suggested by Levin, Lin and Chu (2002), LLC hereafter; Breitung (2000), Im, Pesaran and Shin (2003) (IPS hereafter); Dickey and Fuller (1979) ; Fisher (1932); and Philips and Perron (1988) have been considered to check for the existence of panel stationarity. Harris and Sollis (2003) have emphasized that all of these tests exhibit unit root problem as the null hypothesis and test against alternatives including stationarity. The unit root tests for a panel employed by Hadri (2000) for heteroscedasticity corrected statistics have also been implemented in this study to check stationarity. Unlike the others, the test proposed by Hadri examines the hypothesis whether the panel data series have any random walk problem.

We examined two moods for testing the unit root on level and first difference. The most popular panel stationarity test is the one by Levin et al. (2005) is represented below:

$$\Delta y_{it} = \alpha_i + \beta_i y_{it-1} + \sum_{j=1}^{pi} p_i \Delta y_{it-j} + e_{it} \quad (8)$$

where $\Delta y_{it}$ denotes the difference of $y_{it}$ for country i, in time period t=1……T. Because the LLC method is based on the assumption of a homogenous panel, $\beta_i$ is identical for all countries. We test the null hypothesis $\beta_i = \beta = 0$ for all countries against the alternative $H_1 : \beta_i = \beta > 0$ which assumes that all series are stationary.

Harris (2003) mentioned "an extended version of the LLC test is the IPS test, which relaxes the homogeneity constraint by estimating the equation (8) with $\beta_i$ free to vary across the *i* individual series in the panel with different lags for the *i* cross sections in the model. With this test, an alternative hypothesis reveals that some or all of the individual series are stationary".

Breitung's (2000) said, "the IPS test can suffer from loss of power due to bias correction and therefore is more suitable when the individual-specific trends have been presented in the tests". Breitung suggests a test involving only an intercept (without fixed effect assumption) in the model and accentuated that stationarity test for panel study is to be considerably more robust and much stronger than the IPS and LLC tests.

The last test considered in this study based on the null of non-stationarity has been proposed by Maddala and Wu (1999), which encourage the use of a Fisher (1932) type test that combines the significance levels for rejecting the null (the *p*-values) obtained when estimating a unit root test (i.e., the ADF and Fisher-PP test, which are also defined by Choi (2001) as the type of non-parametric tests. The test statistic is demonstrated with an equation given below:

$P=-2\sum_{i=1}^{N} ln_{\beta i}$ (9)

The Fisher-type ADF and PP tests are all allowed for individual unit root processes. In Fisher-type tests, "the null hypothesis is that all the panels contain a unit root".

The advantage of using (5) is that it is simple to calculate, does not require a balanced panel for any unit root test statistic (not just DF-type test). Maddala and Wu (1999) also came across that this Fisher-type *P*-test provides much better results than the IPS test, also producing more robust evidences than the LLC test. In addition, Choi (2001) has constructed another model displayed with (eq. 6) below:

$Z=\frac{1}{\sqrt{1}}\sum_{i=1}^{N} \phi^{-1}(\pi_i) \sim N(0,1)$ (10)

where the $\phi^{-1}$ is inverse of the normal cumulative distribution function. As also highlighted by Harris and Sorris (2003), "all of the previous tests are based on a null hypothesis that the individual series in the panel are jointly non-stationary, against alternatives where some or all of these series are stationary". Hadri (2000) has proposed a test and simply stated, "the null that the time series for each *i* are stationary around a deterministic trend, against the alternative hypothesis of a unit root in the panel data, which is a residual-based LM (Lagrange multiplier) test, where the null hypothesis is that the time series for each cross section member are stationary around a deterministic trend".

## 3.3 Cointegration

The combination of two I(1) variables in a regression is usually I(1). The cointegration order of combination of variables with various cointegration orders equals to the maximum cointegration order. When we say the variables are cointegratred, it means we can find a stationary linear combination between them.

### 3.3.1 Panel Cointegration Test

The panel data cointegration test is expected to have the same beneficial effects in terms of power that are present when testing for unit roots using panel data. We conducted the panel cointegration test employed by Pedroni (1992) to estimate possibility of long-run relationship between real debt, growth in GDP, investment, savings and interest rate.

The other panel cointegration approaches, such as those employed by Kao (1999) and Larsson et al. (2001), are tests that are asymptotically distributed under the standard normal distribution and are one-sided negatively tailed tests (i.e., reject the null if the test statistic is a large enough negative number). Harris and Sollis (2003) stated that "all five versions of Kao's tests impose "homogeneity in that the slope coefficient $\beta$ is not allowed to vary across the *i* individual members of the panel. The homogeneity statement has been tranquiled by Pedroni (1992) with an equation constructed below":

$$y_{it} = \alpha_i + \delta_t t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \ldots + \beta_{Ki} x_{Ki,t} + e_{it} \quad (11)$$

With tests for the null of no cointegration being based on the residuals $\hat{e}_{it}$ using:

$$\hat{e}_{it} = \rho_i \hat{e}_{i,t-1} + v_{it} \quad (12)$$

Harris and Sollis (2003) also noted that the $\alpha_i$ and the various $\beta_i$ are alowed to vary across the *i* members of the panel. They said, "this approach allows for considerable short and long-run heterogeneity; in effect the dynamics and fixed effects can differ across the individuals in the panel and the cointegration vector can also differ across members under the alternative hypothesis". The way the dynamics have been taken into account to correct for serial correlation depends on the model that is used (for

details see Harris and Sollis (2003)or Pedroni, (1992)). There are several ways to correct for serial correlation, Pedroni considers different ways to estimate eq. 8, whereas estimators that are based on pooling along the within-dimension or estimators that pool along the between-dimension. The between-group estimator is less restrictive; non-parametric tests have particular strengths when the data have significant outliers. However, latter tests have poor size properties when the residual term has large negative moving average (MA) components. Additionally, a parametric test (i.e., the ADF-type test) has greater power when modelling processes with autoregressive (AR) errors because the regression model captures the AR terms precisely. Thus, using various testing procedures is helpful when underlying data generating process statistics are unknown.

### 3.3.2 Estimating Panel Co-integration Models (FMOLS) and (DOLS)

Panel DOLS and panel FMOLS are most commonly used techniques to estimate the panel coefficients. The numerous estimators available include within- and between-group FMOLS and DOLS estimators. Among several panel estimators, the FMOLS and DOLS are mostly commonly chosen ones. In addition to these two, the traditional Ordinary Least Square (OLS) estimators can also be used to compare the results with FMOLS and DOLS. As underlined by Harris and Sollis (2003) "the FMOLS, a non-parametric approach, examines corrections for serial correlation where as the DOLS, a parametric approach, estimates lagged first-differenced terms. The lags, lead and contemporaneous values of the regressors are augmented when DOLS is used". Pedroni argues that the between-group estimators are preferable to the within-group estimators for a number of reasons. Regarding the superiority of each model, more detail information is available in Pedroni (1992) and Harris and

Sollis (2003). In this study, we implemented Pedroni's (2001) approach and our model is expressed below:

$$\ln(Real\ Debt)_{it} = \alpha_i + \beta_{1i}\ln(INV)_{it} + \beta_{2i}\ln(SAV)_{it} + \beta_{3i}\ln(INTEREST) + \beta_{4i}(\%\ \text{Growth in GDP}) + e_{it};\quad i= 1,\ 2,\ldots,N,\ t=1,\ 2,\ldots,T \tag{13}$$

where $\ln(Real\ Debt)$ and $\ln(INV)$ are cointegrated with slope $\beta_{1i}$ and $\ln(Real\ Debt)_{it}$ and $\ln(SAV)_{it}$ are cointegrated with $\beta_{2i}$, respectively. Additionally, the possibility of homogeneity across $i$ are checked. Pedroni has employed a between-dimension, group means panel DOLS estimator contrary to the non-parametric FMOLS approach.

Although comparing the accuracy of two tests is subjective, Maeso-Fernandez et al. (2006) noted "the FMOLS test provides more robust results than the DOLS test because fewer assumptions are needed". According to Harris and Sollis (2003), on the question of whether FMOLS or DOLS is preferred, the empirical evidence is conflicting. Regarding the superiority of the tests, the type of empirical modelling, number of variables used, amount of data included in the model, the possibility of adding deterministic dummies in a model, etc. matter a lot and may play a significant role in producing robust outcomes. Yet, in this study, our scope is not to test which models give a better result.

## 3.4 Panel Pairwise Causality Analysis

Finding cointegration relationships between the variables also implies the possibility of a causal relationship among the variables. The direction of causality may change with respest to the test results. Along with Ouedraogo (2013), "investigating the Granger causality for the long-run relationship is based on a two-step process. The first estimation is related with the long-run model and the second deals with dynamic

error correction model". We then construct a new equation in this manuscript as follows:

$$\Delta \ln(\text{Real Debt})_{it} =$$

$$\alpha_{1i} + \sum_{k=1}^{q} \theta_{11ik} \Delta \ln(\text{Real Debt})_{it-k} + \sum_{k=1}^{q} \theta_{12ik} \Delta \ln(INV)_{it} +$$

$$\sum_{k=1}^{q} \theta_{13ik} \Delta \ln(INV)_{it-k} + \sum_{k=1}^{q} \theta_{14ik} \Delta \ln(INTEREST)_{it-k} + \lambda_1 EC_{it-1} +$$

$$\mu_{1it}. \quad (14)$$

where $\Delta$ denotes the difference and the EC represents lagged error correction term. According to Mehrara (2009), "the lagged error correction term is derived from the dynamic error correction model, $\alpha_i$ and $\theta_i$, $\lambda_i$ are adjustment coefficients and k is the number of lags determined by AIC". To identify the source of causation, the significance of the lagged dependent variable in the above equation (eq. 17) ($\mathrm{H}_0 = \theta_{11} = \theta_{21} = 0$) has been tested. For the possibility of weak Granger causality, null hypotheses of ($\mathrm{H}_0 = \theta_{12} = \theta_{13} = \theta_{14} = 0$) have been conducted. According to Masih (1977) and Acaravci and Ozturk (2012) "the dependent variable responds only to short-run shocks, then weak Granger causality can be reported as short-run causality".

As stated by Ouedraogo (2013), "to be able to conduct the long-run causality, the significance of the coefficient of error correction term ($\lambda_1$) or ($\lambda_2$) of the null hypothesis ($\mathrm{H}_0 = \lambda_1 = 0$) needs to be tested in a sense that change in endogenous variables is caused not only by changes in theirs lags but also by the change of the previous period's disequilibrium in level. The significance of $\lambda_i$ represents a long-run equilibrium relationship of the cointegration estimation. If $\lambda_i = 0$, it means that the deviations from the long-run equilibrium belong to the previous period, and then

($\lambda_1 = 0$, $\lambda_2$ =0) for all $i$ is equivalent to Granger non-causality in the long-run and referred to as weak exogeneity".

# Chapter 4

# RESULTS

## 4.1 Panel Unit Root Test Results

The panel unit root tests have been employed to study the degree of integration for real debt, GDP growth percentage, savings, investment and interest rate. We used two models to test whether there is unit roots in the panel. First with considering an intercept and a deterministic trend, and then just an intercept with no trend. The results of panel unit roots are illustrated in Table 2.

Table 2. Panel unit roots test

| **Variables** | Levin, Lin and Chu t-stat | Breitung t-stat | Im, Pesaran and Shin W-stat | ADF - Fisher Chi-square | PP-Fisher Chi-square | Hadri z-stat | Heteroscedasticity corrected z-stat |
|---|---|---|---|---|---|---|---|
| Ln GDP% | -3.48161* | -4.38329* | -5.31193* | 57.4932* | 122.786* | 0.73748 | 0.81849 |
| | ( 0.0002) | ( 0.0000) | ( 0.0000) | ( 0.0000) | ( 0.0000) | (-0.2304) | (-0.2065) |
| Ln GDP per capita | 1.22474 | 0.61164 | 4.1777 | 1.76007 | 1.65008 | 9.63920* | 8.6841* |
| | (-0.8897) | (-0.7296) | ( 1.0000) | ( 1.0000) | ( 1.0000) | ( 0.0000) | ( 0.0000) |
| Ln ınvestment | -2.07544** | -0.88293 | -2.10622** | 28.4502** | 20.3065 | 4.31754** | 3.53945** |
| | (-0.019) | (-0.1886) | (-0.0176) | (-0.0279) | (-0.2067) | ( 0.0000) | (-0.0002) |
| Ln saving | -0.76818 | -2.12372** | -0.63225 | 14.4111 | 27.1256** | 4.32451* | 3.64658* |
| | (0.2212) | (-0.0168) | ( 0.2636) | ( 0.5681) | ( 0.0401) | ( 0.0000) | ( 0.0001) |
| Ln interest rate | 0.42587 | 0.17309 | 0.44119 | 9.09720 | 13.6619 | 5.77749* | 4.99438* |
| | (0.6649) | (0.5687) | ( 0.6705) | (0.9094) | ( 0.6239) | (0.0000) | ( 0.0000) |
| Ln real debt | -3.58279* | 1.62916 | -2.41652* | 32.2335* | 58.8001* | 7.39172* | 7.2452* |
| | (0.0002) | (0.9484) | (0.0078) | ( 0.0093) | ( 0.0000) | ( 0.0000) | (0.0000) |
| **First difference** | | | | | | | |
| ΔLn GDP | -4.12591* | -3.33904* | -9.14244* | 105.702* | 191.417* | 0.6859 | 2.36934* |
| | ( 0.0000) | (-0.0004) | ( 0.0000) | ( 0.0000) | ( 0.0000) | (-0.2464) | (-0.0089) |
| ΔLn GDP per capita | -3.32376* | -4.09557* | -3.42328* | 35.815* | 94.3269* | 1.33509*** | 1.92969** |
| | (-0.0004) | ( 0.0000) | (-0.0003) | (-0.0031) | ( 0.0000) | (-0.0909) | (-0.0268) |
| ΔLn ınvestment | -5.68018* | -4.68345* | -5.73092* | 63.165* | 116.107* | 0.50926 | 0.86439 |
| | ( 0.0000) | ( 0.0000) | ( 0.0000) | ( 0.0000) | ( 0.0000) | (-0.3053) | (-0.1937) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ΔLn saving | -1.64308*** | -0.96743 | -4.95282* | 53.4165* | 184.488* | -0.67627 | -0.46601 |
| | (0.0502) | ( 0.1667) | (0.0000) | ( 0.0000) | ( 0.0000) | ( 0.7506) | ( 0.6794) |
| ΔLn interest rate | -1.29469*** | 0.21343 | -5.70085* | 63.9386* | 153.977* | 1.62665*** | 1.69998** |
| | (0.0977) | (0.5845) | ( 0.0000) | (0.0000) | (0.0000) | (0.0519) | (0.0446) |
| ΔLn real debt | 0.22027 | -0.89193 | -2.97684* | 36.7803* | 105.373* | 4.70834* | 2.85522* |
| | (-0.5872) | (0.1862) | (0.0015) | -0.0023 | (0.0000) | ( 0.0000) | (0.0022) |

Note: (*), (**) and (***) indicate that the estimated parameters are significant at the 1%, 5% and 10% confidence interval, respectively. Δ denotes the first differences of variables accordingly. Estimation results are gathered from panel data unit root tests for the period of 1981–2013 on a yearly basis for selected 8 countries. The values in parentheses are the probability values. The probabilities for the Fisher-type tests are computed using asymptotic Chi-square distribution, whereas the others assume asymptotic normality. All tests have been carried out with Eviews-8 econometrics software.

Along with Lee and Chiu (2013), "Fisher-type ADF, the IPS w-test, the LLC and Breitung t-tests, and PP chi-square tests have been examined to check whether there is of panel stationarity or not". According to Harris and Sollis (2003) in all of these tests the null hypothesis is "non-stationarity" and the alternatives includes stationarity.

We also consider Hadri's (1999) z-statistics and heteroscedasticity corrected z-statistics to check panel unit root for our variables.

In the level form, both LLC t-tests and IPS t-tests reject the null hypothesis at the 5% significance level for Ln GDP%, Ln investment, Ln real debt. So they are stationary. According to both ADF – Fisher and PP-Fisher Chi-square, Ln GDP% and Ln real debt are stationary in the level form.

After taking the first difference, we can reject the null hypothesis for all variables at 10% significance level except for Ln saving and Ln interest rate.

As a summary, all of the panel unit root methods except "Breitung t-tests" reject the null hypothesis for the differenced series. So our variables are I(1) or integrated of order one.

## 4.2 Panel Cointegration Results

As we already explained, the following step is to study the long-run relationship between our dependent and independent variables using the Pedroni's panel cointegration method (1992). To check the possibility of cointegration by this approach, we have 7 different statistics.

The first four statistics are called panel cointegration statistics. They are based on homogenous cointegration. The other three statistics are based on heterogeneous cointegration. They are named group panel cointegration statistics.Pedroni's panel cointegration tests results are illustrated in Table 3.

Table 3. Cointegration Tests for Panel Data

**Series 1**

| Methods | Within dimension (panel statistics) (Homogeneous) | | | Between (Hetereogeneous) | | |
|---|---|---|---|---|---|---|
| | Test | Statistics | Prob | Test | Statistics | Prob |
| Pedroni Residual Cointegration | | | | | | |
| | Panel v-Statistic | -2.427576 | 0.9924 | Group rho-Statistic | 1.646114 | 0.9501 |
| | Panel rho-Statistic | 2.310246 | 0.9896 | Group PP-Statistic | -1.163678 | 0.1223 |
| | Panel PP-Statistic | 1.782797 | 0.9627 | Group ADF-Statistic | 2.530225 | 0.9943 |
| | Panel ADF-Statistic | 1.740324 | 0.9591 | | | |

Note: (*) indicates that all the estimated parameters are significant at 1 percent confidence interval. Under the null hypothesis, all the statistics are standard normal distributions. All tests have been carried out with Eviews-8 econometrics software.

**Series 2:** LNREALDEBT, GDPCAPITA, GROWTHPER, LNINV, LNSAV, LNINTERST

| Methods | Within dimension (panel statistics) dimension (Homogeneous) | | | Between (Hetereogeneous) | | |
|---|---|---|---|---|---|---|
| | Test | Statistics | Prob | Test | Statistics | Prob |
| Pedroni Residual Cointegration | | | | | | |
| | Panel v-Statistic | -2.427576 | 0.9924 | Group rho-Statistic | 1.646114 | 0.9501 |
| | Panel rho-Statistic | 2.310246 | 0.9896 | Group PP-Statistic | -1.163678 | 0.1223 |
| | Panel PP-Statistic | 1.782797 | 0.9627 | Group ADF-Statistic | -1.841172 | 0.0328 |
| | Panel ADF-Statistic | -1.00408 | 0.1577 | | | |

**Series 3:** LNREALDEBT, GDPCAPITA, GROWTHPER, LNINV, LNSAV

| Methods | Within dimension (panel statistics) dimension (Homogeneous) | | | Between (Hetereogeneous) | | |
|---|---|---|---|---|---|---|
| | Test | Statistics | Prob | Test | Statistics | Prob |
| Pedroni Residual Cointegration | | | | | | |
| | Panel v-Statistic | -2.630791 | 0.9957 | Group rho-Statistic | 1.867430 | 0.9691 |
| | Panel rho-Statistic | 2.931547 | 0.9983 | Group PP-Statistic | 0.337207 | 0.6320 |
| | Panel PP-Statistic | 3.339054 | 0.9996 | Group ADF-Statistic | 0.302665 | 0.6189 |
| | Panel ADF-Statistic | 3.325995 | 0.9996 | | | |

**Series 4**: LNREALDEBT, LNINV, LNSAV

| Methods | Within dimension (panel statistics) | | | Between dimension | | |
|---|---|---|---|---|---|---|
| | (Homogeneous) | | | (Hetereogeneous) | | |
| | Test | Statistics | Prob | Test | Statistics | Prob |
| Pedroni Residual Cointegration | | | | | | |
| | Panel v-Statistic | -2.264945 | 0.9882 | Group rho-Statistic | 0.922793 | 0.8219 |
| | Panel rho-Statistic | 1.768660 | 0.9615 | Group PP-Statistic | -0.697668 | 0.2427 |
| | Panel PP-Statistic | 1.409700 | 0.9207 | Group ADF-Statistic | -1.058893 | 0.1448 |
| | Panel ADF-Statistic | 1.793073 | 0.9635 | | | |

For all of these coinegration tests, we emphasize that all of the statistics are distributed normally. The calculated test statistics are compared with the related critical values that are available in Pedroni (1992). In summary, the results of both homogeneous and heterogeneous panel cointegration reveal that the null hypotheses of no cointegration are not rejected at the 10% significance level for the panel data. As a result, there is no long-run equilibrium relationship among the variables. The long-run elasticities for Ln(Real GDP), percentage growth in GDP and Ln(Investment)are obtained through DOLS, FMOLS and OLS estimations, which is the following part of this study.

## 4.3 The FMOLS, DOLS Estimation Results

Using panel annual data, the results of FMOLS, DOLS methods has been estimated in Table 4. The figures in the parenthesis are t-statistics. To find both DOLS and FMOLS results, we used Pedroni's homogenous and heterogeneous estimation approaches.

Table 4(a). Panel estimation of price elasticity for the selected emerging countries 1982-2012

| Dependent variable<br>**Ln Real debt** | FMOLS | DOLS |
|---|---|---|
| Heterogeneous | | |
| GDP growth percentage | -0.16 | -0.139 |
| | (-1.571) | (-0.521) |
| Ln Investment | 5.371 | 6.368 |
| | (1.616) | (1.188) |
| Ln Saving | 5.782 | 5.709 |
| | (1.947) | (1.189) |
| Ln interest | 4.233 | 3.257 |
| | (5.476) | (3.414) |
| Homogenous | | |
| GDP growth percentage | -0.078 | -1.018 |
| | (-1.256) | (-2.168) |
| Ln Investment | 5.259 | 23.675 |
| | (2.718) | (1.973) |
| Ln Saving | 5.222 | -3.315 |
| | (3.020) | (-2.278) |
| Ln interest | 4.216 | 5.118 |
| | (9.369) | (2.642) |

Table 4(b). Panel estimation of price elasticity for the selected emerging countries 1982-2012

| Dependent variable<br>**Ln Real debt** | FMOLS | DOLS |
|---|---|---|
| Heterogeneous (lead 1, Lag 1) | | |
| Ln GDP per capita | -1.653 | -2.380 |
| | (-2.435) | (-1.470) |
| Ln Investment | 6.958 | 11.261 |
| | (3.791) | (1.741) |
| Ln Saving | 4.473 | 4.220 |
| | (3.005) | (0.806) |
| Ln interest | 3.762 | 2.614 |
| | (9.189) | (2.253) |
| Homogenous | | |
| Ln GDP per capita | -1.712 | -2.380 |
| | (-1.264) | (-1.470) |
| Ln Investment | 7.496 | 11.261 |
| | (2.048) | (1.741) |
| Ln Saving | 5.281 | 4.220 |
| | (1.781) | (0.806) |
| Ln interest | 4.022 | 2.614 |
| | (4.925) | (2.253) |

Table 4 shows the long-run elasticities are between -2.5 and 7. They are significant at 5% confidence level, except Ln(saving) for homogeneous DOLS estimation. Although panel long-run elasticity for Ln Investment is elastic, the coefficient is positive, which is not expected. The coefficient for percentage growth in GDP heterogeneous FMOLS was found to be significant at the 1% confidence interval, the coefficient sign for that parameter is negative and consistent with expectations. Same is true when we consider the sign of percentage growth in GDP variable with the traditional OLS estimations.According to Ouedraogo (2013), "the DOLS is a more powerful technique but its limitation is lower degrees of freedom because of lags and leads.

## 4.4 Granger Causality Test Results

Table 6 shows the results of long-run and short-run Granger causality tests. Estimated findings are according to yearly panel data for the years 1981-2013. For causality tests, 2 lags was chosen according to vector autoregressive (VAR) best lag order selection criteria which is reported in table 5.

Table 5. Lag order selection test

Endogenous variables: GDPGROWTHPERCENTAGE LNGDPCAPITA LNINTERST LNINV LNREALDEBT LNSAV
Exogenous variables: C
Date: 06/23/15 Time: 12:00
Sample: 1981 2013
Included observations: 196

| Lag | LogL | LR |
|---|---|---|
| 0 | -1366.220 | NA |
| 1 | 660.6529 | 3908.969 |
| 2 | 819.1440 | 295.9579 |
| 3 | 856.6617 | 67.76149* |
| 4 | 880.0496 | 40.80957 |

* indicates lag order selected by the criterion

In panel causality analysis, the calculated F-statistics for the common coefficient indicates that some estimations are significant and we can reject the null hypothesis of no causality between variables. We find out that in 1% significance level, there is a uni-directional causality from ln(saving) to percentage growth in GDP, from ln(interest) to percentage growth in GDP and from ln(saving) to ln(investment). In 5% significance level, there is bi-directional causality between ln(investment) and percentage growth in GDP as well as ln(saving) and percentage growth in GDP. In 10% significance level, there is a uni-directional causality from ln(real debt) to ln(investment).

Another technique employed by Dumitrescu and Hurlin (2012) creates an extreme reverse assumption that all coefficients can be various among cross sections. Z-bar statistics in Pairwise Dumitrescu-Hurlin causality tests can be significant to reject the null hypothesis of no causality between variables. in 1% significance level, there is a uni-directional causality from ln(real debt) to ln(interest) and from ln(interest) to ln(saving). At 5% confidence interval, there are bi-directional causalities between ln(saving) and ln(real debt), between ln(investment) and percentage growth in GDP, and between ln(saving) and ln(investment). In 10% significance level, there is a uni-directional causality from ln(real debt) to ln(investment).

Table 6 a. Pairwise Granger Causality Tests 1

| Pairwise Granger Causality Tests | | | | Pairwise Dumitrescu Hurlin Panel Causality Tests | | | |
|---|---|---|---|---|---|---|---|
| Null Hypothesis | Obs | F-Statistic | Prob. | Null Hypothesis | W-Stat. | Zbar-Stat. | Prob. |
| GDPCAPITAGROWTHPER does not Granger Cause LNREALDEBT | 228 | 1.05098 | 0.3513 | GDPCAPITAGROWTHPER does not homogeneously cause LNREALDEBT | 0.93146 | -1.46944 | 0.1417 |
| LNREALDEBT does not Granger Cause GDPCAPITAGROWTHPER | | 2.41682 | 0.0915 | LNREALDEBT does not homogeneously cause GDPCAPITAGROWTHPER | 2.76998 | 0.66047 | 0.509 |
| LNINV does not Granger Cause LNREALDEBT | 235 | 1.00274 | 0.3685 | LNINV does not homogeneously cause LNREALDEBT | 2.24471 | 0.06241 | 0.9502 |
| LNREALDEBT does not Granger Cause LNINV | | 2.64167 | 0.0734 | LNREALDEBT does not homogeneously cause LNINV | 3.86001 | 1.94923 | 0.0513 |
| LNSAV does not Granger Cause LNREALDEBT | 220 | 0.14664 | 0.8637 | LNSAV does not homogeneously cause LNREALDEBT | 4.08355 | 2.16235 | 0.0306 |
| LNREALDEBT does not Granger Cause LNSAV | | 3.67022 | 0.0271 | LNREALDEBT does not homogeneously cause LNSAV | 4.07289 | 2.15007 | 0.0315 |
| LNINTERST does not Granger Cause LNREALDEBT | 235 | 0.03096 | 0.9695 | LNINTERST does not homogeneously cause LNREALDEBT | 1.25325 | -1.09572 | 0.2732 |
| LNREALDEBT does not Granger Cause LNINTERST | | 0.73682 | 0.4798 | LNREALDEBT does not homogeneously cause LNINTERST | 5.99271 | 4.44042 | 9.00E-06 |
| LNINV does not Granger Cause GDPCAPITAGROWTHPER | 241 | 3.49367 | 0.032 | LNINV does not homogeneously cause GDPCAPITAGROWTHPER | 4.29604 | 2.52458 | 0.0116 |
| GDPCAPITAGROWTHPER does not Granger Cause LNINV | | 10.5716 | 4.00E-05 | GDPCAPITAGROWTHPER does not homogeneously cause LNINV | 4.58622 | 2.87001 | 0.0041 |
| LNSAV does not Granger Cause GDPCAPITAGROWTHPER | 227 | 9.94764 | 7.00E-05 | LNSAV does not homogeneously cause GDPCAPITAGROWTHPER | 4.55740 | 2.79088 | 0.0053 |
| GDPCAPITAGROWTHPER does not Granger Cause LNSAV | | 3.29091 | 0.039 | GDPCAPITAGROWTHPER does not homogeneously cause LNSAV | 2.58599 | 0.47026 | 0.6382 |
| LNINTERST does not Granger Cause GDPCAPITAGROWTHPER | 228 | 7.64142 | 0.0006 | LNINTERST does not homogeneously cause GDPCAPITAGROWTHPER | 2.96521 | 0.88664 | 0.3753 |
| GDPCAPITAGROWTHPER does not Granger Cause LNINTERST | | 0.13764 | 0.8715 | GDPCAPITAGROWTHPER does not homogeneously cause LNINTERST | 1.06111 | -1.31924 | 0.1871 |
| LNSAV does not Granger Cause LNINV | 233 | 9.87062 | 8.00E-05 | LNSAV does not homogeneously cause LNINV | 4.25477 | 2.47032 | 0.0135 |
| LNINV does not Granger Cause LNSAV | | 1.51521 | 0.222 | LNINV does not homogeneously cause LNSAV | 4.48179 | 2.74023 | 0.0061 |
| LNINTERST does not Granger Cause LNINV | 235 | 3.74875 | 0.025 | LNINTERST does not homogeneously cause LNINV | 3.11612 | 1.08029 | 0.28 |
| LNINV does not Granger Cause LNINTERST | | 1.26670 | 0.2837 | LNINV does not homogeneously cause LNINTERST | 3.36866 | 1.37529 | 0.169 |
| LNINTERST does not Granger Cause LNSAV | 220 | 0.30565 | 0.737 | LNINTERST does not homogeneously cause LNSAV | 6.25045 | 4.65692 | 3.00E-06 |
| LNSAV does not Granger Cause LNINTERST | | 2.09884 | 0.1251 | LNSAV does not homogeneously cause LNINTERST | 3.57329 | 1.57492 | 0.1153 |

Table 6 b. Pairwise Granger Causality Tests2

| Pairwise Granger Causality Tests | | | | Pairwise Dumitrescu Hurlin Panel Causality Tests | | | |
|---|---|---|---|---|---|---|---|
| Null Hypothesis | Obs | F-Statistic | Prob. | Null Hypothesis | W-Stat. | Zbar-Stat. | Prob. |
| LNINV does not Granger Cause LNREALDEBT | 235 | 1.00274 | 0.3685 | LNINV does not homogeneously cause LNREALDEBT | 2.24471 | 0.06241 | 0.9502 |
| LNREALDEBT does not Granger Cause LNINV | | 2.64167 | 0.0734 | LNREALDEBT does not homogeneously cause LNINV | 3.86001 | 1.94923 | 0.0513 |
| LNSAV does not Granger Cause LNREALDEBT | 220 | 0.14664 | 0.8637 | LNSAV does not homogeneously cause LNREALDEBT | 4.08355 | 2.16235 | 0.0306 |
| LNREALDEBT does not Granger Cause LNSAV | | 3.67022 | 0.0271 | LNREALDEBT does not homogeneously cause LNSAV | 4.07289 | 2.15007 | 0.0315 |
| LNINTERST does not Granger Cause LNREALDEBT | 235 | 0.03096 | 0.9695 | LNINTERST does not homogeneously cause LNREALDEBT | 1.25325 | -1.09572 | 0.2732 |
| LNREALDEBT does not Granger Cause LNINTERST | | 0.73682 | 0.4798 | LNREALDEBT does not homogeneously cause LNINTERST | 5.99271 | 4.44042 | 9.00E-06 |
| LNGDPCAPITA does not Granger Cause LNREALDEBT | 228 | 0.25917 | 0.7719 | LNGDPCAPITA does not homogeneously cause LNREALDEBT | 1.87072 | -0.38131 | 0.703 |
| LNREALDEBT does not Granger Cause LNGDPCAPITA | | 2.01058 | 0.1363 | LNREALDEBT does not homogeneously cause LNGDPCAPITA | 4.18962 | 2.30511 | 0.0212 |
| LNSAV does not Granger Cause LNINV | 233 | 9.87062 | 8.00E-05 | LNSAV does not homogeneously cause LNINV | 4.25477 | 2.47032 | 0.0135 |
| LNINV does not Granger Cause LNSAV | | 1.51521 | 0.222 | LNINV does not homogeneously cause LNSAV | 4.48179 | 2.74023 | 0.0061 |
| LNINTERST does not Granger Cause LNINV | 235 | 3.74875 | 0.025 | LNINTERST does not homogeneously cause LNINV | 3.11612 | 1.08029 | 0.28 |
| LNINV does not Granger Cause LNINTERST | | 1.26670 | 0.2837 | LNINV does not homogeneously cause LNINTERST | 3.36866 | 1.37529 | 0.169 |
| LNGDPCAPITA does not Granger Cause LNINV | 241 | 11.4331 | 2.00E-05 | LNGDPCAPITA does not homogeneously cause LNINV | 6.38794 | 5.01476 | 5.00E-07 |
| LNINV does not Granger Cause LNGDPCAPITA | | 1.07548 | 0.3428 | LNINV does not homogeneously cause LNGDPCAPITA | 4.50569 | 2.77414 | 0.0055 |
| LNINTERST does not Granger Cause LNSAV | 220 | 0.30565 | 0.737 | LNINTERST does not homogeneously cause LNSAV | 6.25045 | 4.65692 | 3.00E-06 |
| LNSAV does not Granger Cause LNINTERST | | 2.09884 | 0.1251 | LNSAV does not homogeneously cause LNINTERST | 3.57329 | 1.57492 | 0.1153 |
| LNGDPCAPITA does not Granger Cause LNSAV | 227 | 5.12584 | 0.0067 | LNGDPCAPITA does not homogeneously cause LNSAV | 3.68544 | 1.76447 | 0.0777 |
| LNSAV does not Granger Cause LNGDPCAPITA | | 4.26873 | 0.0152 | LNSAV does not homogeneously cause LNGDPCAPITA | 3.61427 | 1.68069 | 0.0928 |
| LNGDPCAPITA does not Granger Cause LNINTERST | 228 | 0.01729 | 0.9829 | LNGDPCAPITA does not homogeneously cause LNINTERST | 4.03274 | 2.12337 | 0.0337 |
| LNINTERST does not Granger Cause LNGDPCAPITA | | 5.54871 | 0.0044 | LNINTERST does not homogeneously cause LNGDPCAPITA | 3.31457 | 1.29137 | 0.1966 |

# Chapter 5

# CONCLUSION

There are few econometric studies regarding real debt, and those that do exist all address the magnitudes and signs of elasticities of debt based on an individual country. Those studies usually explain the effect of debt on economic situation of the countries. For example they analysed the effect of growing government debt on economic growth. Or the effect of external debts on capital formation. But in this study, we analyze the impact of economic variables on external debt.

In view of recent studies examining the empirical reliability of the debt overhang hypothesis,we employed panel data econometrics estimations to detect the relationship between real debt and economic growth.

We explore the dynamic relationship between real debt, investments, savings and interest rate, using a panel cointegration technique, applied on eight emerging economies.

From the policy development perspective, this study will contribute to the related literature as an original work of modelling external debt, measuring the sensitivity of "debt service on external debt" on economic variables for the selected eight countries of which are considerable in size in terns of external debt.By exploiting the panel unit root tests, panel cointegration tests, methods of panel least squares (FMOLS and

DOLS) and panel causality tests for a sample of eight borrower countries over 1981–2013, we understood that real debt is correlated with GDP, investments, savings and interest rate in these countries. panel unit root test results indicate that the variables are mostly integrated as an order one or I(1) process.Considering our choice of economic variables and various methodologies, the negative correlation between real debt and GDP growth seems significant. So the countries with higher GDP growth, experience lower real debt. The positive relationship between interest rate and real debt is robust in all of the regressions. So the countries with the higher interest rate experience higher level of real debt. The coefficient on investment and savings rate is also positive. It means when the level of savings or investment increases in a country, their debt also increases. The first finding is in line with the previous studies as we mentioned in introduction and literature review. But the other findings don't have anything in common with the literature. For example, previous studies showed the increase in the amount of debt in a country leads to higher uncertainty and it can decrease the private investment. But our finding shows that this trend has changed recently. Countries seem to be able to maintain the debt level moderate while achieving noticeable levels of investment.

The results of Pedroni's (1999) panel cointegration test based on both between (heterogeneous) or within (homogeneous) approaches reveal that the null hypotheses of no cointegration are not rejected for the panel data. Thus, there is no long-run relationship between real debt, investment, savings and interest rate.

Lastly, Granger causality test results based on panel yearly data for the common coefficient from the panel causality analysis show that some estimations are significant and reject the null hypothesis that there is no causality among the

variables. We can conclude that at the 1% significance level, there is an uni-directional causality from ln(savings) and ln(interest rate) to percentage growth in GDP. Also at the 5% significance level, there is bi-directional causalities between percentage growth in GDP and ln(savings) and ln(interest rate). The present study identifies macroeconomic policy instruments that play significant role in determining the policies regarding external debt in emerging economies.

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