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Ethiopia's External Debt Sustainability

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A Thesis Submitted to School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Economics (Msc in International Economics)

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Addis Ababa, Ethiopia

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DECLARATION

I, Yabru Ketema Workneh declare that, this study, Ethiopia's External Debt Sustainability is my own work. I have undertaken the research work independently with the guidance and support of the research advisor. This study has not been submitted for any degree or diploma program in this or any other institution. It is in partial fulfillment for the requirement of the program for the degree of Master of Science in International Economics. All sources of material used for the research have been acknowledged.

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ENDORSEMENT

This thesis has been submitted to Addis Ababa University, Collage of Business and Economics for examination with my approval as a university advisor.

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ABSTRACT

This study conducted by aiming to answer the question "is Ethiopian external debt sustainable?" Moreover, the study tries to addresses all inter-temporal mechanisms and tests, which assist to get an efficient and all rounded answer, for the question of external debt sustainability. The study utilized a yearly debt data since 1991 to 2018 sourced from World Bank international debt statics, and performed based on two grand (AR and ARDL) models. On the AR model, a stationary tests were performed on discounted external debt and discounted external surplus by employing ADF,PP , Perron1989 and ZA unit root test. where first two tests ADF and PP assumed no structural break, while the third and the forth (Perron1989 and ZA) assumed one and two structural breaks respectively in the model, however the output resulted from all tests proved that both discounted external debt and discounted external surplus are none stationary which entail the Ethiopian external debt is not sustainable.

On the other hand, Gregory-Hansen and bound test approach of co-integration test employed based on ARDL models. First, co-integration test between external debt GNP ratio and trade balance GNP ratio has conducted with both bound test approach and Gregory-Hansen co-integration test, but none of the tests shown long-run relationship between the two variables. Next in a similar manner, a co-integration test between external debt and trade balance carried out, but again no long-run relationship come across between the underlined variables and finally the study concluded that the Ethiopian external debt is unsustainable.

Key words: ARDL, external debt sustainability, stationarity and co-integration.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS

ADF	Augment- dickey fuller
AR	Auto-regressive lag model
ARDL	Auto-regressive Distributed Lag model
ARIMA	Auto-regressive Integrated Moving Average
BIS	Bank for International settlements
BWIs	Bretton wood Institutions
CPIA	Countries Policy and Institutions Assessment
DSA	Debt sustainability Assessment
DSF	Debt sustainability framework
FSIA	Foreign Sovereign Immunities Act
GNI	Gross National Income
GDP	Gross Domestic Product
HICs	High-income countries
HIPCs	Highly Indebted Poor countries
IDA	International Development Association
IMF	International Monetary Fund
LC	Local currency
LICs	Low Income Countries
LMICs	Lower Middle Income countries
MDRI	Multilateral Debt Relief Initiative
MICs	Middle Income Countries
NGOs	Non-Governmental Organizations
NPV	Net Present Value
OECD	Organization for Economic Co-operation and Development
PV	Present Value
PPP	Purchasing Power Parity
SC	Solvency Condition
PP	philiphs-Perron
TC	Transversality condition
UNCTAD	United Nation Conference on Trade and Development
WB	World Bank
ZA	Zivote and Andrew

Chapter One

1.1. Background of the Study

Debt is an instrument used to smoothing the budget deficit and performs economic activities that enhance welfare by allowing for sudden increases of budgetary expenditure without having an immediate effect on the taxation rate Mustepha and prizzon(2015). The public debt specifically has a tremendous ornamental economic growth booster in the end through productive capital and infrastructural investment. However, debt has a bitter return and penalties, unless it is managed in a well-planned productive manner and it will take to the shed of unsustainability of debt i.e. the debt that debtors are lying in an economic position of unable to finance its accrual debt stock. Mustepha et.al (2015), stated, a debt is sustainable when a country meets its current and future debt service obligations in full, without recourse to debt relief, rescheduling or accumulations of arrears. According to (IMF 2011), Debt is sustainable when a borrower expected to be able to maintain servicing its debt without an unrealistically large alteration to its income and expenditure balance. Debt sustainability thus reflects a countries solvency, liquidity, and adjustment capacity. A debt is either domestic or external; domestic debts are liabilities owed by the residents of the same economy, while external debts are liabilities owed by residents to nonresidents (IMF 2011).

Unable to finance external debt (unsustainable debt) leads to the loss of sovereign autonomy of economic and political policy. In history of debt 1970s and 1980s several low-income countries accumulated external debt, there was a high expectation on both debtors, and creditors that the debt would be paid when the arrangement date reached, but most failed to pay their debt. It makes the international community to provide temporary liquidity relief by scheduling a few years of debt service payments (Mustepha and Prizzon, 2015). This solution did prevent countries from defaulting on their debts; it did not provide any lasting solution to the issue of long-term debt sustainability for poorest, most indebted developing countries. This provided the conception of heavily indebted poor countries (HIPC) initiative; This initiative provides faster, deeper and broader debt relief and strengthens links between debt relief, poverty reduction, and social policies. It supplemented by the multilateral debt relief initiative (MDRI) in 2005 have committed over $100 billion dollars in the form of none payment of current and future debt

obligations (Mustepha and Prizzon 2015). However, this blessing is not like the God's bread (mena) gift falling from heaven for free, it rather twisting the autonomy of a country by obligating to receive structural adjustment in their program or change its policy or simply they took none financial freedoms of a country. Olivier Vallée and Shahin Vallée, 2005, evidenced that the debt relief modus operandi echoes historical events such as Great Britain's 1882 seizure of Egypt in order to assure the repayment of debt, ultimately leading to the departure of the Ottoman Empire in 1914. Venezuela's 1902 default, which resulted in German, British and Italian gunboats blocking the country's ports until the government paid up. What we are witnessing in the 21st century is a similar hijacking of sovereignty in the name of sound economic policy. Superpowers exercise a great deal of control over other nations through debt alleviation and poverty-reduction strategies and programs. Examples are numerous, from Latin American countries that are forced to strip down their public companies to African nations that are heavily constrained by structural adjustment.

Debt in itself is not a sin rather it is means of survival and capital creation mechanism at the time of shortage to finance a necessary economic activities in recession period and or any unfavorable economic situation to re-boost the economic interaction to boom up the growth of a country. No matter how the amount of the money we borrow, but it matters is how we use, invest, longevity of investment lifetime in productive span and earnings of a surplus from the investment, which could make repayment of the borrowing without the contraction of the normal economic path. As Matt Phillips November 13, 2012 reported in quartz global business news from Atlantic media in his writings ; " freedom isn't free America is the US born in debt" in his description America's debt in world war II, its full economy was indebted with debt to GDP ratio reached its all-time record of 113% by the war's end. The debt was $241.86 billion in 1946 about $2087 trillion in current dollar. Phillips in his analysis trying to show America is an economic leading country in the world, born with debt and he emphasized how debt managed and converted to economic growth opportunity.

If debt shines on fostering of development and economic growth in developed nation like Japan and America, why is it a hunger in LICs? Economic set up and social arrangement is a crucial for a change of economic growth ,while in LICs, the basic infrastructures that lead to economic growth and make effectiveness of the loan mostly not established. The repayment of high cost of

debt service arising from interest and exchange rate expense are volatile and un predictable issue to cascade with plan social unrest, corruption and commitment of officials on aggregate make debt more severe of economic damping than economic growth. Christine lagarde, managing director of IMF and a speaker on a conference of IMF entitled with "managing debt vulnerabilities in low income countries" at Washington Dc held on at September 13,2018, why the world has to concentrate on LICs. She stated that, the growing debt burden jeopardized the LICs development goals as governments spend more on debt service and less on infrastructure, health, and education. High debt also creates uncertainty, which deters investment and innovation. As a whole LICs has to worry how to make their debt sustainable.

1.2. Statement of the Problem

External debt crisis is becoming a jam for investment, growth and development of low-income countries. Babacar Ndiaye (1990) endorsed his worry on impact of growing African external debt. He expressed as it is so heavy and become so intractable that, realistically there is little hope for significant social and economic advancement on the continent unless meaningful effective measures are urgently put in place to alleviate it. Most LICs are suffering from their external debt service compounded by emphasized cost of interest and exchange rate payment expenses. External debt accumulation handicapped the domestic investment by bypassing the large share of foreign asset revenues to finance the re-payment of accumulated debt. In this respect, Ethiopia spent on average 21% of its export revenue for annual debt service (IMF 2018) and this multiplied the rolling effect of current account deficit due to its dual effect on trade balance and it obligates a country to require another loan to fill the gap that could put the country in bankruptcy.

A bankrupted country faces a loose of power to monitor and implement national interest developmental economic strategies and policies. Bankruptcy makes a country wicked and leads/obligates/ to default of its debt due to absence/lack/ of foreign resources. In the return, it brings a harsh decision on the side of creditor countries by laying different sanctions, such as blocking financial aids and loans, seized and freeze foreign asset abroad, banned assets on transit, set trade and economic sanction and also loss creditworthiness which devastating a country to make more poorer than ever Obestfeld and Rogoff (1996). Ghani and Zang October 1995, described Ethiopia was severely indebted low income country (SILIC), when the transitional government come to power in may 1991 it also inherited a large debt overhang, compounded by fragile macroeconomic environment. In 1993 the government established a reform and a recovery program supported by IDA, IMF and other donors aimed at a stable macroeconomic environment putting a country sustainable debt path. In addition, Ethiopia gets relief on Paris club debt on Naples terms high, which reduce the debt arrears and debt overhang Ghani et al (1995). From 1995 onwards, Ethiopia identified as debt unsustainable and has received deferent aids to get fully relieved from debt, but still its debt is growing even after a full debt relief by HIPC initiative 2015. Ministry of finance July 8, 2018, reported a countries

external debt reached $27 billion that accounts 30% of GDP after three years of debt cancellation.

Vallee et.al (2005) condemned that debt-relief initiatives does not truly seek the liberty of LICs , while they damp and operate their hidden economic and political interest on poors in the name of poverty alleviation and debt relief program. Vallee et al. strengthening the idea that, the debt-relief mechanism operates as a technology of power, a way through which multilateral institutions, multinational corporations, international creditors, the former colonial powers and NGOs exert influence through the discourse of political economy. In the name of the poor, and with the leverage of a debt-sustainability framework, the Bretton Woods Institutions (BWIs) create a myriad of political relations, with consequences in Africa in areas including state building, sovereignty and independence. From the description of Vallee and from the reality we infer, there is no free lunch that super power countries gave their dollars as blessings in the name of debt relief program. Instead, they impoverish a country's autonomy of economic and political power by knowing every detail of the national interest, and damp their psychological shadow that makes the poor worshiped them and they govern the poor on will. Thus sustainability is not something that we left for others help, rather we shall strive alone to maintain sustainability.

In Ethiopia tremendous studies has conducted related with debt; as a source of finance, economic growth, capital formation and debt management tools and mechanisms. Some of the areas addressed by the studies are, the impact of external debt on economic growth in Ethiopia (Abinet Gebrekidan 2005). On his analysis, the major concentration focused on how the economic growth affected by debt. The other study made by (Gardew Awoke 2006) is the relationship between public external debt and economic growth in Ethiopia: evidence from ARDL approach to co-integration and again a studies on public external debt, capital formation and economic growth by (Teklu Kassu, professor D.K Mishra and Melesse Asfaw ph.d jointly 2014). None of the studies has suggested on sustainability of Ethiopian debt, except Ghani and Zang October 1995, Tolosa Alemayehu 2018, and IMF yearly country report analysis, which comprehensively covers all macroeconomics issues for government consultancy purpose. Tolosa's paper was concentrating on sustainability of east African countries which didn't seen the Ethiopian case alone , and the paper of Ghani and Zang October 1995 is too far to refer the current situation since sustainability is volatile in time. Thus, the major initiative to conduct this

research is to fill these gaps and see the sustainability of the country's external debt with stochastic time series model.

1.3. Objective of the study

1.3.1. General Objective

The grand objective of the study is to test the external debt sustainability of Ethiopia, based on inter-temporal and stochastic concept.

1.3.2. Specific Objectives

- ✓ Identify whether the external debt of Ethiopia is sustainable or not based on the concept of inter-temporal theory and stochastic tests.
- ✓ To test long run sustainability of fiscal policy of the country
- ✓ To prescribe the required recommendation to accommodate the balanced debt path that can make the future debt sustainable.

1.4. Research Question

The study critically investigates the question "is the Ethiopian external debt sustainable?"

1.5. Hypothesis

The null hypothesis of this study specified as "Ethiopian external debt is sustainable" and its alternative hypothesis implied as: "Ethiopia is not found in a debt sustainable position."

1.6. Scope of the study

Due to lack of consistent date availability to be take in to consideration, this study is only limited to Ethiopia, external debt sustainability from 1991 to 2018.

1.7. Significance of the study

As per the knowledge of the investigator, no significant study has been conducted domestically on the sustainability of Ethiopian external debt, thus this study will serve as a reference and framework for those who wants to study on this arena.

Chapter two

2. Review Related Literature

2.1. Theoretical Literature

2.1.1. Definition of External Debt, External Debt Sustainability and Fiscal Sustainability

2.1.1.1. External Debt

The literal meaning of debt is the amount of money borrowed by one party from another party or the amount of money borrowed by one entity form other entity in order to smooth consumption. Mustepha et al(2015). classified debts in three major group i.e. domestic debt, external debt, and contingent liability. He further classified external debt in three possible definitions based on currency, place of issuance and residence. i.e.:-

i. A debt denominated with foreign currency is an external debt based on currency.
ii. An external debt based on place of issuance is a debt where its contract legislation regulated in foreign countries under the jurisdiction of foreign court.
iii. The third classification based on residence, in this regard external debt is a debt owed to non-residents. This definition is the one officially adopted by large organizations, BIS, Eurostat, IMF, OECD, Paris club, UNCTAD and WB.

Mustepha et al.,(2015). explained the of third definition makes a sense from the theoretical point of view since it is transfer of resources from residents and non-residents ; However, it may not be always define external debt based on residence basis. In relatively advanced LICs with open capital accounts, debt issued by the government may be traded on secondary market and passed between residents and none residents. As the consequence, most countries end up reporting figures for external and domestic debts by using the information on the place of issuance and jurisdiction that regulates the debt contracts. The shortcoming of this approach is that the information is misleading because it does not measure what it promises to do. Thus, any write up should disclose which definition is used and should note when there are large divergence in shares of domestic and external debt depending on the definition. In this, paper all definitions used interchangeably.

2.1.1.2. External debt sustainability

External debt sustainability is an ability of a country or an entity or residents that can pay off its debt without the contraction of other economic strategies and activities Mutepha et al.,(2015). A country called bankrupted (unsustainable) when it is in a situation of unable to pay off its foreign obligation at their face value (obestfeld and Rogoff 1996. On IMF 2011 published document for public user guide purpose, define debt sustainability and its implication; Debt is sustainable when a borrower country is continue its servicing its debt without unrealistically large correction to its income and expenditure balance. Thus, debt sustainability reflects a country's solvency, liquidity and adjustment capacity.

According to IMF 2011, a country is solvent if the present value (PV) of its current and future primary expenditure (net of interest) is no greater than the PV of its current and future stream of income receipts. A government is liquid if it is able to rollover its maturing debt obligation in an orderly manner. And a debt sustainability holds the notion that there are social and political limits of adjustments in spending and revenue that determine a country's willingness to pay.

2.1.1.2.1. Solvency

A country or a government or a business is solvent if it is able to service its current debt out of the future income or surpluses Irrania (n,d). This definition emphasizes the ability of the country to repay its debt from the expected future income derived from investment. IMF (2011) defines solvency as a medium to long run concept that ignores constraints that may bind in short run and risk a debtor's ability to honor financial obligations. As we noted from the definitions, solvency is a forward-looking concept where economists employ a test of consistency between public debt and primary balance with solvency using historical data. However arguments arise on econometric tests of solvency, which conducted to show whether the future look like the past that duly create time doubt of perceiving the future like a past. On contrary, the other test that puts solvency in questions is; if we completely ignore the past, it leads to on conclusion in which all debtors could be solvent regardless of the past existing level of debt.

2.1.1.2.2. Liquidity

Liquidity describes the degree to which an asset or security can be quickly converted to cash. An asset, which could easily converted to cash, expressed as a liquid asset. Irrania(n,d) defined liquidity as an availability of assets that can finance and sufficient to meet or rollover its maturing liability. Liquidity is a key to repay or minimize the outstanding maturing liability. A country with high stock of liquid asset has a high power to maintain its debt without extending or re-scheduling the maturity time. A country with quickly declining the volume of its liquid asset possibly difficult to raise cash through borrowing, this situation is termed as liquidity risk. As IMF (2002), defined, pure solvency is not the guarantee to stance of a debt to be sustainable alone; rather a liquid asset should in line with solvency. A country with enough stock of asset may face in difficulty of servicing its outstanding debt due to lack of market access to liquidate its stock of asset, this situation expressed as liquidity crisis.

2.1.1.3. Fiscal sustainability

Mishkin 2004, defined fiscal policy as a decision of a government spending and taxation. a budget deficit is excess of government expenditure over tax revenues for particular time period typically a year, while a budget surplus arises when tax revenues exceed government expenditures. The government must finance any deficit by borrowing, while a budget surplus leads to lower government debt burden.

Fiscal sustainability is often defined in terms of the ability of a government to achieve a balance between its revenue and expenditure inter-temporally (Saed Mahdavi 2014). He explained the fiscal sustainability is the capability that the government pays its borrowing exclusive of adjustment of fiscal policies i.e the current market value of debt less or equals the discounted value expected future surplus. Jan Gottschalk 2014, described fiscal sustainability a situation in which a government is able to achieve a fiscal stance that allows to service public debt in short, medium and long run without debt default or renegotiation and without the need to undertake policy adjustment that are implausible from an economic or political standpoint given financial costs and conditions.

Mustepha et al(2015). link debt sustainability and fiscal sustainability; he described fiscal policy as sustainable if it delivers the ratio of public debt to GDP is stable, and then to calculate primary

budget balance that would achieve that is known as stabilizing primary balance. This is approach is an alternative debt sustainability in which debt is considered to be sustainable when a debt burden indicator is not expected to follow an explosive path over time. If the actual primary balance is less than the debt stabilizing balance, current fiscal policy implies an increasing ratio of public debt to GDP, and is therefore, observed as unsustainable. The difference between the actual and debt stabilizing primary balance indicates the degree of fiscal adjustment that is needed to achieve a constant debt to GDP ratio.

2.1.2. External debt and Economic Growth

As an alternative to taxes, either the government may borrow externally or domestically to finance its budget deficit if the tax receipts and other revenues are less than the proposed expenditure. The role external debt for economic development could easily understand through the explanation of inter-temporal debt analysis and gap growth model. The gap model explains that developing countries face a gap between saving and investment in their economy, which they have to fill it ether from loan or concessional grant or aid. Such countries, mostly starts a huge investment plan while their national saving is below the proposed investment plan as a result they face the gap between saving and investment. Such situation largely discussed in Harrod-Domar growth model.

In Harrod-Domar growth model, savings considered as a center of driving forces to generate and accelerate economic growth. They argue that the new investments financed by savings are equivalent to net additions of capital stocks, which are necessary for economic growth. In addition, they conclude that economic growth determined by an incremental capital output ratio and fixed saving rate. However, under-developed countries' domestic saving rates are usually less than the required level of investment rates to finance the investment project, and thus such binding constraint gaps financed by the mechanisms of foreign aid or external loans, which elaborated in figure 1 below. Overall, from the gap model we recognized that external debt availability is a very necessary instrument to fill foreign saving gap and smooth the required investment project that could launch the country in self-sustaining development in the end.

Mustepha et al. strengthened the Harrod-domar and the gap growth model both theoretically and mathematically. He described that government's borrowing from abroad usually occurs when the national saving is insufficient to finance investment. The government may use foreign debt to fill

an external financing gap if exports and inflows from abroad are insufficient to meet imports and other outflows

Mustepha et al. expressed the macroeconomic identity as follows

$$Y = C + I + G - T + X - M$$

Where,

Y= national output *C= consumption*

I = investment *G = government expenditure*

T = taxes *X= export*

M= imports *S= Y – (C+G) =national saving*

Borrowing can arise when:-

- National saving less than investment : $S - I < 0$
- Exports less than imports : $X - M < 0$
- Government expenditure less than taxes : $G - T > 0$

Thus, external debt has a vital role to fill the foreign resource gap and continue installment proposed investment if the expected surplus obtained from the investment is greater than or equal to the value of today's debt. However, financing external debt from the surplus obtained in the domestic investment may difficult due to currency variation, unless the domestic produced surplus goods are exported abroad or efficient financial market is availed within the economy.

The benefits of external borrowing can be showed by taking the framework of the inter-temporal investment-consumption model adapted to an inter-temporal borrowing/lending model. The latter shows that borrowing allows the possibility of increasing a country's present and future investment and consumption fostering future growth. Additionally, external borrowing can help the country shielding from consumption adverse effects caused by income fluctuations.

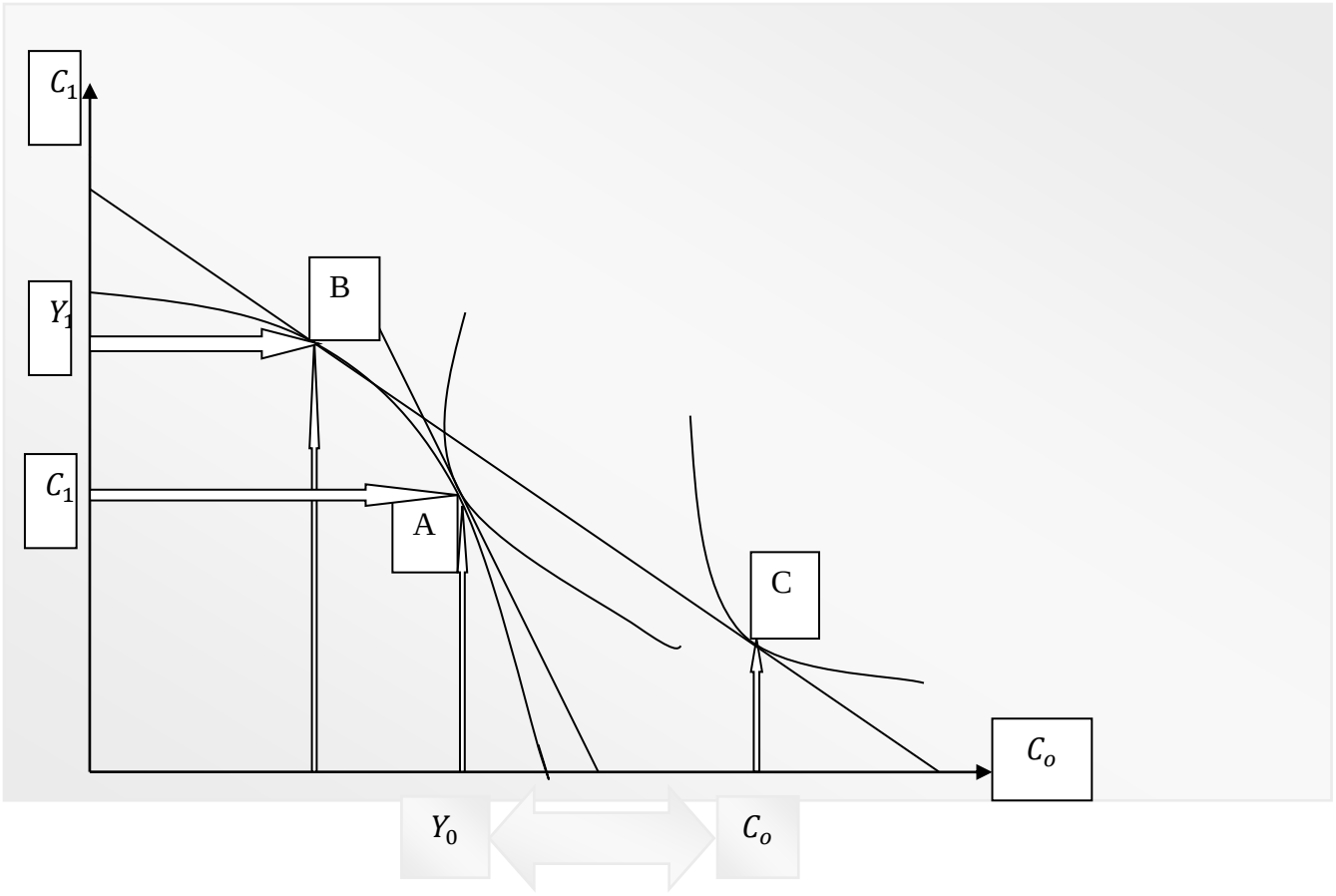


Figure 2.1 Inter-Temporal Borrowing/Lending Model

Obestfeld and Rogof (1996) explain the inter-temporal borrowing/lending using the diagram presented in figure 1. The model is represented in a two period budget constraint with the given levels of income, Y_o and Y_1, and a two-period utility function U(C_o , C_1). An inter-temporal production possibility frontier represents a trade-off between outputs in the two periods. The point A represents autarky position, where a country has no access to international capital markets and faces the domestic interest rate r, which exceeds the world interest rate, r*. The slope of the budget line at point A is - (1+ r), whereas that of the budget line at points B and C is - (1 + r*).

With opening up to international borrowing, two effects emerge: i) the country can divert resources to more future production at B, as it responds to the lower interest rate, r*; and ii) the country enjoys higher current consumption at C, as the higher utility indifference curve through

point C than the one through point A indicates. Thus, external borrowing allows a country to undertake the extra investment (shown by the horizontal distance between points A and B as well as to enjoy the extra first period of consumption (shown by the horizontal distance between points A and C). The sum of the two horizontal distances (the distance between B and C) is the first-period current account deficit that reflects its resource gap. At the same time, whilst a move from A to C reflects trade gains due to a smoothing of the time path of consumption, further trade gains are realized by the change in the economy's production point from A to B.

As we go through the inter-temporal external debt diagram, we conclude that external debt is necessary for both smoothing consumptions with maximized utility and bring economic development.

2.1.3. Frameworks and Thresholds for Debt Sustainability

In current global world, common guidelines and frame-works are required for common understandings of some global issues. As we have looking the current glob, debt is one of alarming issue that emerged to the global economy as a result, some frame working tools and guidelines necessarily designed. Under this section, I present two fundamental issues related with debt; that are DSA for LICs, and thresholds indictors.

2.1.3.1. Debt Sustainability Assessment (Dsa) For Lics

According to World Bank countries income level classification updated at 2019, countries classified in to four major categories. That are, low-income countries (LICs), lower-middle income countries (LMICs), middle-income countries (MICs), upper middle- income countries, and high-income countries (HICs) with GNI per capita (in USD) of less than 1026, between 1026 and 3995 inclusive, between 3996 and 12375 inclusive, and greater than 12375 respectively. For each income group, different frameworks attached to analyze debt sustainability, here under this paper, I used to disuse the frame-works on LICs since my area of study (Ethiopia) lie under this category.

The World Bank and IMF jointly produced a standardized debt sustainability framework for public and external debt sustainability analysis in low-income countries in 2005. This guideline used by both the borrower and lenders. As Mustepha et.al 2015, described the DSF helps to guide the borrowing decisions of low-income countries (LICs), and it provides guidance for

creditors' lending and grant allocation decisions, and help to improve both WB and IMF assessments and policy advice.

DSF sets indicative thresholds that help to the assessments of solvency and liquidity risk. In the framework, the major indication is to forecast the weight of the debt to the repayment in the given period and measured by the ratio of debt stocks and debt service to different economic variables. The ratio of debt stocks relative to repayment capacity indicates that the debt load represented by the prospect re-payment duty of a country and thus it reflects the long-term threat of solvency, where as the debt service ratio indicates the possibility of liquidity problem.

According to Mustepha et.al 2015, DSF established based on two major stances:

The first key assumption that DSF used for analysis is a standardized forward-looking concept. This concept narrate based on the core idea of vulnerability of an external debt shocks measured in two stress tests called alternative scenario and bound tests. Alternative scenarios are permanent modifications to the basic assumptions in the base line scenario while bound tests are short-term shock, which lasts one, or two years after customized variables return to the base line values. The key line that DSF build in is that debt sustainability assessment (DSA), this is an explicit rating of an external debt. DSA gave four ratings of a country level debt distress risk based on the indicative thresholds under the baseline scenario and standardized stress tests. These are:

- Low risk: All the debt burden indicators are well less than the thresholds.
- Moderate risk: where debt burden indicators are under (below) the thresholds in the baseline scenario, but stress tests indicate that the thresholds could be violated if there are external shocks or unexpected changes in macroeconomic policies.
- High risk: One or more debt burden indicators violate the thresholds on a protracted basis under the baseline scenario.
- In debt distress: The country is previously in incident of difficulty in servicing its debt

The LIC DSF has defined the following ratios as indicators of debt sustainability:

NPV of debt to: 1. Exports
2. Fiscal revenues
3. GDP

Debt service to: 4. Exports
5. Fiscal revenues
6. GDP

The ratios chose, shows debt to measures of re-payment capacity. The ratio to exports relate the debt burden to the accessibility of foreign exchange earnings of the economy, the ratio to revenues relate debt burden to the accessibility of home resources, while the ratio to GDP relates the debt burden to the broadest measure of the income-generating ability of the economy (IMF, 2004). The choices of these indicators explain the concern with both the domestic savings gap and the foreign exchange gap as they both help to the countries repayment capacity.

IMF-IDA (2004) and IMF (2007) explains the basis for the choice of the ratios. Debt stock indicators suggest a useful measure of the total future debt-service burden of the outstanding debt. This burden measured using the net present value of (NPV) of debt to capture the concessionality of outstanding debt.

The debt service ratios are taken as the most obvious measure of the *Cash Flow* effect, i.e., the immediate burden that debt imposes on a country by crowding out other important uses of scarce resources by the borrower. NPV debt ratios are summary indicators of the burden represented by the future responsibility of a country and thus reveal long-term risks to solvency, while the time path of debt-service ratios provides an indication of the probability and likely timing of liquidity problems.

2.1.3.2. Debt Sustainability and Threshold Indicators

The thresholds and debt sustainability are useful to introduce an explanation of the Country Policy and Institutional Assessment (CPIA) Concept. The work of Kraay and Nehru (2004) identify the quality of policies and institutions as one of the main determinants of debt distress in developing countries, the IMF-IDA (2004) adopted essentially the same methodology to apply the analysis specifically to LICs. In order to measure countries' quality of policies and institutions the World Bank developed the CPIA measure composed of 16 indicators of policy and institutional quality. The CPIA score ranges from 1 to 6 and divides countries into three performance categories: strong, medium, and poor. The main idea is that policy-dependent external debt-burden indicators are relevant, because the debt levels that LICs can sustain are affected by the quality of their policies and institutions (IDA-IMF, 2004; IMF, 2007).

Quality of policies &institutions (CPIA score)	PV of external debt in percent of			PV total external debt service in percent		Total public debt in percent of
	GDP	Exports	Revenue	Exports	Revenue	GDP
Weak policy CPIA≤3.25	30	100	200	15	18	38
Medium policy 3.25< CPIA<3.75	40	150	250	20	20	56
Strong policy CPIA≥3.75	50	200	300	25	25	74

Source Mustapha and Prizzon (2015)

Table 2.1: Debt Threshold Ratios

2.1.4. Consequences of High External Debt

The major problem of high debt reside to the country has a highly intensified and all rounded devastation in social, economic and political autonomy. A bankrupted country faces a loose of power to monitor and implement national interest developmental economic strategies and policies. Bankruptcy makes a country wicked and leads/obligates/ to default of its debt due to absence/lack/ of foreign resources. In the return, it brings a harsh decision on the side of creditor countries by laying different sanctions, such as blocking financial aids and loans, seized and freeze foreign asset abroad, banned assets on transit, set trade and economic sanction and also loss creditworthiness which devastating a country to make more poorer than ever (obestfeld and Rogoff 1996). In this section, I reviewed the impact of high debt on vulnerability of sudden stop, crowding out investment, loss of policy autonomy, debt over hung effect and debt restructuring.

2.1.4.1. Vulnerability for Sudden Stops

The large accumulation of external debt would lead a country towards high financial crisis of sudden stops, which makes a country fail to finance any kind economic and social activity that requires finance. It is so emphasized for LICs because their interaction between volatile

commodity prices and HIPCs' highly concentrated export base made them at risk to declining terms of trade, which adversely affected their export receipts and stuck their capacity to repay their external debt. Vulnerability is often higher for smaller and emerging market countries due to the result that, their economies tend to be less diversified, have a smaller foundation of domestic financial savings and less developed financial systems, and may be more vulnerable to financial contagion through capital flows. However, events since the global financial crisis in the late 2000s display that larger and developed economies have their own structural susceptibility in regards to exposure to external shocks.

2.1.4.2. Crowding out investment

The other danger face of external debt accumulations lies on taking most of the available resources to the re-payment of the existing debt which hinders new investment. The cash flow reduce decline in public investments and imports necessary for growth promoting public investments due to the large amounts of resources taken to debt servicing. Also, as public investments are matching to private investment its decline will crowd out private investment (Arnone, 2005) Perhaps more vital is the debt overhang hypothesis developed by Krugman (1988) and Sachs(1989). They argue that there is a massive deadweight loss resulting from the way that the current debt overhang discourages investment and economic reforms in the debtor countries even further than its direct budgetary burden. This occurs because of five main reasons:

- Limiting economic reforms become difficult to pertain as the citizens as believe that this will only serve to improve the potential of servicing the debt and not making them had better off.
- Private investment deterrence due to the Cash Flow effects to debt service.
- It becomes gradually more difficult for the debtor countries to access new funds for investment as creditors recognize the higher risk of lending to those countries.
- Investments discouragement due to economy instability as, because of the lost of international creditworthiness, the government will put more pressure and rationing on domestic resources pushing up domestic interest rates, inflation and rising credit rationing. Doubt regarding debt payments and aid flows may also pessimistically affect investment and growth.

• It pushes capital flight, in order to avoid taxation, as the private sector aware that the public sector is starved for funds.

2.1.4.3. THE DEBT OVERHANG EFFECT

Debt overhung is a situation in which creditors do not expect the full re-payment because of the existence of large accumulations of debt stock. Krugman (1988) and Sachs (1989) stated that a country has a debt-overhung problem, when the expected present value of the future income transfer is less than its debt. Once, if a debtor country reached in apposition of debt overhung, the decision that benefit both countries come from the change of debt stocks of the debtor country. This scenario simplified by Krugman (1988). He summarized the channels through which debt relief is good for debtors and creditors postulating the existence of a "debt Laffer curve". In the debtors' viewpoint the Laffer curve shows that once debt reaches its overhang point (point A in the figure 2) more debt will act like a distortionary tax reducing the debtors' economic growth and consequently its capacity of settlement making it go more and more into arrears. It is clear from this analysis that point A in the graph represents the switching point were to the left countries are in a sustainable debt position and to the right debt becomes unsustainable

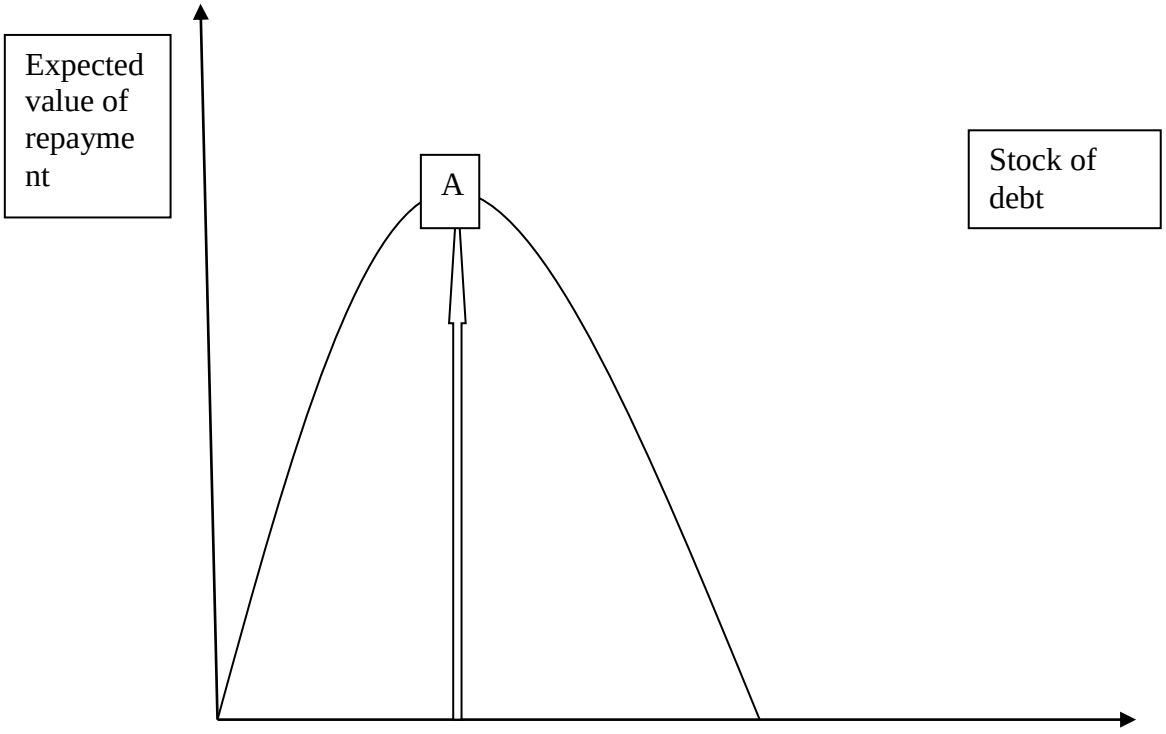


Figure 2.2. Debt Laffer curve

2.1.4.4. Loss of political and policy autonomy

Some researchers argue the developed nations are hijacking the sovereignty of LICs in the name of debt relief initiatives. HIPCs is an initiatives established by World Bank and IMF in 1996, its initiative was to providing debt relief and low interest on loans to cancel or reduce external debt repayments to sustainable level. To be considered for the initiative, countries must face an unsustainable debt burden, which cannot manage in the traditional means. At the time, HIPC considered unsustainable when the ratio of NPV of debt to exports exceeded 200-250%, and NPV of debt to government revenues exceeded 280% which improved to 150% and 250% respectively under the extension of 1999 enhanced HIPC initiative (fact sheets of IMF, January 13, 2010).

Mustepha et al.,(2015) criticize that even though HIPC /MDRI gave a complete debt relief for LICs it could not make pertinent, while it provided LICs a new opportunity for a new debt, because the intervention of HIPC/MDRI to restore debt sustainability does not address the root cause of unsustainable debt accumulation and the challenge remain. And Vallee et al (2005). also condemned that debt-relief initiatives does not truly seek the liberty of LICs , while they damp and operate their hidden economic and political interest on poors in the name of poverty alleviation and debt relief program. Vallee et al (2005). *strengthening* his idea that, the debt-relief mechanism operates as a technology of power, a way through which multilateral institutions, multinational corporations, international creditors, the former colonial powers and NGOs exert influence through the discourse of political economy. In the name of the poor, and with the leverage of a debt-sustainability framework, the Bretton Woods Institutions (BWIs) create a myriad of political relations, with consequences in Africa in areas including state building, sovereignty and independence. From the description of Vallee, Mustepha and from the reality we confess, there is no free lunch that super power countries gave their dollars as a blessing in the name of debt relief program. Instead, they impoverish the autonomy of economic and political power by knowing every detail of the national interest and soggy their psychological shadow that makes the poor worshiped them and they govern the poor on will. Thus sustainability is not something that we left for others help, in its place we shall strive in a way how can stand alone to maintain sustainability.

2.1.4.5. Debt restructuring

Debt restructuring defined as an arrangement between the creditor and debtors, and sometimes the third parties that alter the agreements established for servicing an existing debt Mustepha et al.,2015). The negotiation of the new arrangement held when the debtor countries failed to service its debt with former established deal. The new deal gives a wide opportunity for creditors to impose his interest on borrowers because the debtors already violate the initial agreement as a result the creditor may take some advantages on the new deal as unforeseen punishment. Debt restructuring may give in the form of debt forgiveness, debt rescheduling or refinancing, debt swaps and debt assumptions (IMF 2015).

Debt forgiveness: it is one form of debt restructuring that gives a debt reduction or cancellation by the creditors through contractual agreements with the debtors.

Debt rescheduling ;-it is made by a change in terms and conditions of either by lengthening the maturity time or change the debt instrument for instance loan may change in to bonds.

Debt swaps: defines a new deal in which the creditors request a change of existing debt to something that has economic value. It may do via transmitting the domestic equity to the creditor with discounted or cheap value. Thus, debt restructuring is the other way of taking the autonomy of a debtor country invisibly.

2.1.4.6. Currency crises

A country borrowing a foreign currency has a different risk profile than if it borrows local currency (LC). Deviations from PPP are related with real exchange rate changes. These real exchange rate changes will influence countries dealing in traded and non-traded goods in predictable ways. Specifically, rising in the real value of the local currency will add the foreign currency value of operating cash flows for firms that sell domestically, and face minimal import competition and decrease foreign currency operating cash flows of those firms selling abroad or competing with imports.

A reduction or an increase in the real exchange rate will have the opposite effects in foreign currency cash flows and change in trade balance. When locally currency revalued, it will raise the domestic prices of goods and services related to the abroad prices as a result consumers

choose to buy more imported goods than domestically produced goods, as a result export will discouraged and import appreciated this situation would worsening the trade balance deficit. Hence, it will lead the country to the situation of unable to finance its foreign currency denominated load. This condition indicates that even though a borrowing country has enough economical capacity to re-pay its debt, but due to lack of accessing foreign currency, and it will lead to high future inflation, expected exchange rate and also high interest re-payment on the existing loan, this situation is also referring currency mismatch crises. The currency mismatch is a condition that shows how a change of exchange rate will affect the present discounted value of the future expenditure and income flows. The major source of currency mismatch is more explained by the easy concept called original sin. Eichengreen, Hausmann and Pazinna (2003) first use the term original sin in economics, to explain all developing countries un able to borrow abroad in their own currency. In their work, they explained that if countries where able to borrow the same currency no depreciation of domestic currency and inflations associated with external borrowings followed currency risks due to exchange rate change.

Thus, as used here, the term "currency risk" refers to the possibility that exchange rate changes will alter the expected debt amount of interest and principal the borrower will pay back to the loan. Specifically, there is the risk that exchange rate changes will so increase the debt real cost of the borrower to which leads to default. Even if the real cost of repaying the foreign loan is quite predictable, and PPP holds exactly, the country's capacity to service its loan will be uncertain because of the uncertain foreign currency value of its contractual LC cash flow (C. Shapiro 1985). He argued that a firm with nominal assets and liabilities denominated in more than one currency would allow exchange risk. The more significant element of currency risk for the firm will possibly derive from the effect of deviations from the law of one price on the foreign currency value of the country's operating cash flow. The larger these deviations associated with the larger exchange risk. Giancarlo, (2016) stated the law of one price in which the price of the same commodity in two different countries must be equal when expressed in the same currency. The other key concept that we reveled is if both countries have zero inflation rates and the law of one price holds for all traded goods, the foreign currency denominated loan will not be free from exchange risk. Cornell (1979) justified that because relative price changes can lead to exchange rate changes and the real cost of the country for its foreign loan will remain exist and, therefore, its ability to repay that loan, will be uncertain. From the country's viewpoint,

it is bearing exchange risk even though the true cause of the exchange rate alteration is a change in relative prices. For the loan to be free of currency risk, therefore, an unlikely set of conditions must exist: zero inflation in the creditor country, and in the borrower country, no deviations from the law of one price, and no relative price changes. Thus, countries external borrowing is highly exposed to currency crisis.

The major outcomes of country's currency crisis occurred in one, or a combination, of the followings

- large devaluation
- sharp depreciation
- large increase in interest rates
- large fall in reserves

Irrania(n.d) explain the situation that foreign exchange reserves will run out because of inconsistent policies or due to insufficiency of flow of foreign currency to cover short-term debt and as a result the government devalue and depreciate the domestic currency in order to improve competitiveness.

2.1.5. Why countries pay their high stock of external debt

One of the questions come to any one's mind is; why countries choose no default when they face large stock of external debt? What are the costs linked with default? Which costs more severe for a debtor country default or servicing the debt? At what period the debtor country more feel the costs at short term or long term. Countries always choose to pay their debt than defaulting, because the consequence of defaulting cost is more severe than servicing costs, specifically for developing countries. Some of the reasons explained in the next section.

2.1.5.1. Exclusion from financial markets

In the international market, creditor countries have a limited power to punish a sovereign borrower's country to debt repayment, but creditor can enforce in two ways. The first is consist of direct punishment by making impede or harass in the international trade, seizing borrower's plant and equipments found within creditors country, and the second goes up to gunboats Obestfeld and Rogoff (1996). Eaton and Gersovitz (1981) describe a country that defaults do not have international market access in the event of the default until a new deal made. As a result,

before quarrel has occurred between the creditors and borrowers, which costs both countries, the borrower would request negotiation with the creditor to reduce its costs and solve rather than choosing defaulting. The cost of the borrower from permanent international market access exclusion is higher than the gain from defaulting. To that effect, lenders ceiling cost is the total amount of lent and interest income and its effect die out some times in the future, while the cost of default will accrue in the future. Governments wish to borrow to smooth adverse shocks or to invest in apparently productive spending. Good governments that can prompt long run growth through well-chosen investments are more likely to suffer from exclusion than defaulting.

Thus one of the reasons why countries obligated to pay their debt is, in order to remain in the international market access.

2.1.5.2. Reputation and borrowing costs

Another punishment that affects the willingness to pay is the impact of a default for a country reputation. When there is, uncertainty about a debtor's country willingness to pay, creditors will require a higher risk premium. While, long period of faithful debt service would lead to a gradual reduction of the risk premium. A default will expose the country's unwillingness to pay and this reputation loss will lead to a high premium. Loss of market access is the limit case when the risk premium become infinite or just intolerably high and the same questions arise as in the case of exclusion. The empirical evidence suggests that the borrowing costs increase following a default, once the country can re-access markets.

2.1.5.3. Legal sanctions

This is another means that creditors enforcing their borrowers to re-pay the loan with in the contract time. Long gone creditors use gunboats and other military means to enforce the re-payment, however now lenders use legal mechanism to get back, what they loan. Assets seized, trade forbidden, confiscate imports and exports in transit, either directly by withholding trade credit or by the use of the banking system to settle payments Obestfeld and Rogoff (1996).

When countries reach at dispute level on their loan agreement, the creditors appeal to FSIA, to secure a required legal punishment to the borrower countries. FSIA is an international court

adopted at 1976 in the USA Wyplosz (n,d). Private lenders may take to court sovereign entities (governments and their agencies) in the case of commercial quarrels. Even so, restrictive conditions apply, which makes the legal power far more limited than in the case of quarrel among private entities. Importantly, it may be impossible to enforce judgment decisions. However, seizing assets is a usual. Asset seized include security collateral but also State-owned subsidiaries, exports of state-owned firms, payments for exports, government assets and reserves of central banks Wyplosz (n.d) . Thus, countries search more negotiable agreements than choosing defaults to sustain their external debt.

2.1.5.4. Renegotiation

The other important reason that hinders countries from defaulting is that a continuous negotiation between borrowers and lenders. Both consider what will be lost if they breaking up negotiation and usually an agreement to debt restructure that is beneficial for both. In some cases borrower obtains some debt write-off and serves the rest, which is less costing than consequences of defaulting like sanction. While the lender also receive higher payments than if the relationships breaks down. Thus, negotiation is one reason why countries not defaulting.

2.2. Empirical literature on external debt

After having done the theoretical review, the next job under this section would be looking or reviewing how practitioners and researchers link the theoretical taught to the empirical findings. Theoretical view is much closer to the absolute assumption, which is complicated to implement in its total assumption at practical works, however theoretical reviews are used to the basic framework for practitioners and researchers as a benchmark reference that possibly took to the absolute result. Referring on this assumption, in the next section I discussed empirical findings on external debt, empirical external debt in Ethiopian case and review Ethiopian economy and its debt structure.

2.2.1. Empirical literature related to external debt sustainability

Tremendous studies conducted in the world to verify the concept of debt sustainability, specifically the external debt. Currently one of a very challenging issue in the area of macro and international economics is finding a reconciliation mechanism between importance's of external

debt for economic growth and giving a certified guaranteeing policy that could certainly tackle the problem of external debt sustainability. On this regard many has suggested that an external loan is one of a key factor for economic growth and has no problem of sustainability if countries properly used for productive investments. In the beginning of history of debt, countries do not have the knowledge about debt sustainability they simply deal the contract by hopping the borrowers would not face a challenge to make the repayment, however, the world is not always as expected rather it come up with a new problem to be discovered. Then it gives a lesson for the public of the world to take a corrective remedy after taking a note on the practical existence of the problem. Some the empirical findings on the issue of debt sustainability reviewed in the next paragraphs.

Yilanci and Ozcan (2008), conducted his study to test whether the Turkish external debt is sustainable or not. In his study, he used a method, which allows a joint test of nonlinearity and non-stationarity by employing a quarterly time series data of the ratio of the Turkey's net external debt stock to GDP over the period 1990:$Q_1 - 2007Q_2$. First, he employed a test of linearity of the external-debt ratio against the threshold autoregressive alternative tests using the Wald test and he found non-linear external debt GDP ratio. In his second test, he employed a unit root test on the debt- GDP stock ratio and found a unit root process. At the end, he concludes Turkey's external debt is unsustainable.

F.Presbitero (2005) tested the sustainability of Brazilian external debt by using a quarterly time series data from 1969 to 2000. He performed three tests to see the sustainability of Brazilian external debt. First, he employed ADF and co-integration test to see the stationarity and long run association between the trade balance and import plus net interest expenditure. He found that both variables are none stationary and the co-integration between the two variables does not hold. At this test, he found the Brazilian external debt is unsustainable.
In his second test, he performed a stationary and co-integration test between trade balance and net external debt both in level form. In this work, he performed ADF test in level form to check stationarity of the variables and found both variables are non-stationary process. He also performed Johanson co-integration test for the variables allowing deterministic trend and non-

deterministic trend, in all cases the variables are not co-integrated and he concluded based on this test result the Brazilian external debt is not sustainable.

The third test was performed unit root test on discounted debt; in this test, he assumed the necessary condition for external debt to be sustainable is that discounted debt is stationary however, the ADF test result showed the discounted debt is non- stationary process, hence he passed his conclusion in which the Brazilian external debt is unsustainable. In all the three tests, the Brazilian external debt is not sustainable.

Kraay and Nehru 2006, conducted a study to see the conditions when is an external debt sustainable. They made a sample of 132 low and middle-income countries with in the years of 1970 to 2002. The study analyzes that the determinants of debt distress which defined as periods in which countries choices to any of three forms of exceptional finance: significant arrears on external debt, Paris Club rescheduling, and non-concessional IMF lending. They performed Probit regressions to demonstrate that three factors explaining a considerable fraction of the cross- country and time-series variation in the incidence of debt distress. The debt burden, the quality of policies and institutions, and shocks are the relative significance of these factors varies with the level of development. These results are robust to a variety of other conditions, and the core specifications have considerable out-of-sample predictive power.

Goswami and Hossain (2013), conducted a study on Bangladesh economy to verify the difference between the judgmental projection debt sustainability analysis used by multilateral organization like world bank and IMF, and a time series forecast. The study used time series forecast by using ARIMA method to analyze debt sustainability in Bangladesh. More specifically, macro, fiscal, current account and debt variables predicted according to the condition of debt sustainability framework (DSF) for use in a standard DSA outline. Based on the time series forecast, the study concludes that debt is sustainable for Bangladesh in the period 2013-2033 based on the standard country specific debt burden threshold. The study considered that the findings produced by different methodologies broadly follow similar path. Nevertheless, they reached on a point that a time series forecasts are better economic situation in terms of improved repayment capacity compared with judgmental projection.

Nissanke and ferrarini (2001) conducted a study to examine debt dynamics of Highly Indebted Poor Countries (HIPCs) and identify key factors responsible for their extended debt crisis. On their study, they evaluate economic situation of debt sustainability based on inter-temporal borrowing model, the growth cum debt model and gap models and they noted that conditions of debt dynamics like liquidity problem and insolvency condition. They concluded that, when a debt burden becomes unsustainable, debt forgiveness is a rationale choice for both creditors and debtors to remove the result 'debt overhang' condition.

2.2.2. Empirical literature related with Ethiopian external debt.

Here under this part I tried to review all available works related to the sustainability of Ethiopian public debt as a whole and external debt alone as possible. The first work entitled with Ethiopia's debt sustainability was the work of Ghanzi and Zang 1995. Their study was conducted to analyze the burden and sustainability of Ethiopian public debt as a whole by employing Branson's (1990) debt sustainability model, which applied to analyze for severely indebted poor countries and they develop the government's budget constraint model in real terms as described below.

$$db = (r - n)b + (p - s)$$

Where b is the ratio of debt to GDP, db rate of debt growth per GDP, p is primary deficit after grants as fraction of GDP, r is real interest rate, n is real growth rate of GDP and s is the rate of seignoirage to GDP.

In their analysis, they took b as negative since Ethiopia is a debtor country and they perceived that the sign of the growth factor (r-n) in itself could tell whether the debt process is stable or not. If r-g is positive, it implies the debt ratio is growing by feeding in itself and the country borrows to service its debt, as a result the country could not be sustainable. They final conception was a country to be sustainable, db would need to be none positive and this situation could be satisfied by either the second term and the third term of the equation has to be equal and opposite sign or both terms are negative. In a special case when (r-g)>0, the country is could be debt sustainable only if (p-s) negative and greater than or equal to (r-g) in absolute value, which indicates the amount of seignorage used to finance debt is larger than the primary deficit.

Having all the described conditions above, they performed a test based on the data, which covered from 1990 to 1995 in two phases. The first phase was before economic reforms has been done which includes the period 1990 to 1992, and the second phase was after the reform which contains the period 1993 to 1995. In their test result, they concluded that the country was unsustainable before economic reform action was taken, and then it becomes sustainable after the economic reform with aid of large debt cancellation and grants.

Seid, Minga, Tesfaye and Abu, October 28, 2014, are assessed the Ethiopian economy to gauge the sustainability of its external debt Ethiopian using threshold methods of measurement. In their study they intensively assessed the economy as a whole and gauged the external debt in terms of debt to GDP ratio, debt to export ratio, debt to revenue ratio, trade balance, the primary fiscal gap, debt service to budgetary revenue, interest to GDP ratio; and interest to domestic budgetary revenue.

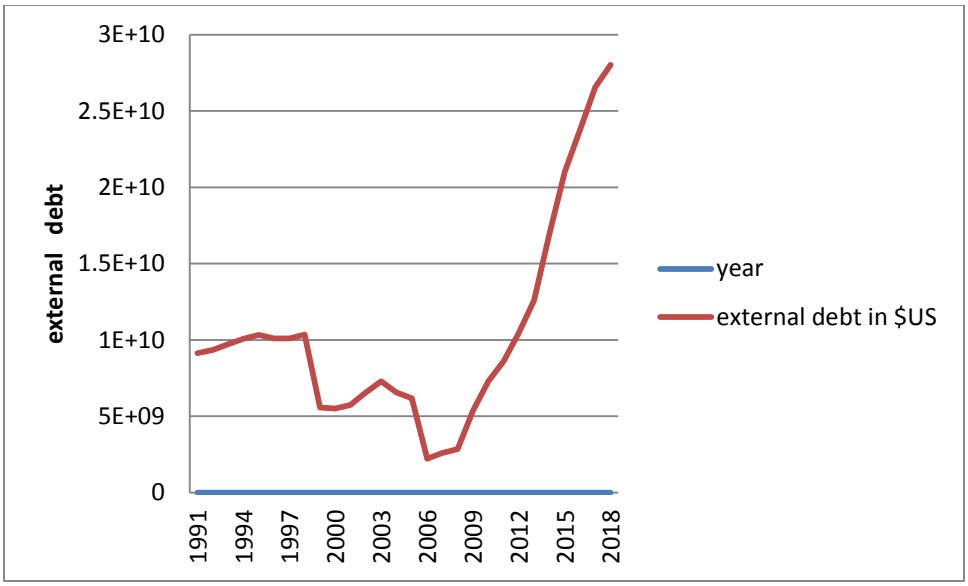
After they checked all the benchmarks used to gauge the level of sustainability, they noted and warned that level the external debt has surpassing the safety level and it showed dramatically high increments even after the write-offs the existing debt. Thus, they alerted that the external debt should be a concern in that its growth rate has to be matched by a vibrant and diversified export sector since external debt sustainability largely depends on how the new funds are allocated and on the expected foreign exchange earnings capacity of the economy.

Tolasa (2018), conducted an external debt sustainability analysis on east African countries including Ethiopia over the period 2000-2016. In his study, he employed univariate unit root test, panel unit root test, and co-integration test between revenue and expenditure including interest payment. First, he performed a stationarity and co-integration test between revenue and expenditure for the individual countries and he found only four countries (Kenya, Eritrea, Sudan and Tanzania) are sustainable while the rest of east African countries are unsustainable. On his second test, he performed a panal root unit and co-integration test between revenue and expenditure on all the nine east African countries and he found that the EACs are unsustainable or weakly sustainable.

2.2.3. Review of Ethiopian External Debt Trend

Ethiopia has passed different debt stress seasons by the aid of international donors grant and using the HIPC and multilateral debt initiatives. Ghani and Zang October 1995, described Ethiopia was severely indebted low income country (SILIC), when the transitional government come to power in may 1991 it also inherited a large debt overhang, compounded by fragile macroeconomic environment. In 1993 the government established a reform and a recovery program supported by IDA , IMF and other donors aimed at a stable macroeconomic environment putting a country sustainable debt path. In addition, Ethiopia gets relief on Paris club debt on Naples terms high debt, which reduce the debt arrears and debt overhang Ghani et al From 1995 onwards, Ethiopia identified as debt unsustainable and has received deferent aids to get fully relieved from debt, but still its debt is growing even after a full debt relief by HIPC initiative 2015. Ministry of finance July 8, 2018, reported a countries external debt reached $28 billion that accounts 30% of GDP after three years of debt cancellation. It is aggressively in greasing with a high rate since 2006 as shown in fig 2.3, even though a debt relief is issued by HIPC on wards.

The continuous growing of the external debt of Ethiopia even after while few years of debt cancellation require a due attention before it reaches above the capacity level of the economy to repay. And as we witnessed from aggressive increment of the debt after the immediate HIPC debt cancellation of a country shows that the HIPC/MRDI has not giving a long last solution for a countries basic economic reform to maintain debt sustainable economy.



Source: WB Debit Statistics

Figure 2.3 Ethiopian External Debt trend since 1991 to 2018

Chapter Three

3. Methodology and model specification

This section largely discuss about sample frame, derivations of debt dynamics, the transversality and solvency condition, method of model selection, reviewing empirical foundation for model selection, and method of testing the model.

3.1. Sample frame and data set

The aim of the study concentrated on testing the sustainability of Ethiopian external debt. As consequence the researcher identified the only favorable sample to conduct the study is the country Ethiopia itself. The data taken for this study is a time series yearly data covered from 1991 to 2018 in European calendars. The major reason for the data frame is to reduce structural breaks in the analysis. The researcher reviewed that government policy has not made significant change; all the policy with in the stated year embodied under the ideology of "Abiwotawi democracy" where all institutional and financial policy was more or less the same. The sources of data are World Bank international debt statics and Federal Reserve economic data.

3.1.1. Debt dynamics and sustainability

3.1.2. Debt dynamics and sustainability in closed economy

According to debt sustainability framework (DSF) set by IMF and WB, the basic nature of debt is starting from the basic equation is as shown below

$$D_t = iD_{t-1} + D_{t-1} - P_{Bt} + OT + ERV \qquad (1)$$

where:

- D_t $is\ stock\ of\ debt\ at\ time\ t$
- D_{t-1} $is\ past\ stock\ of\ debt$
- $P_{Bt} = R_t - G_t$ $is\ primary\ balance$
- iD_{t-1} is interest paid in past stock
- i is nominal interest rate
- R_t is government revenue
- G_t is government expenditure
- OT is other flows
- ERV is exchange rate valuation

In closed economy, debt issued in local currency, so no contribution of ERV while it used in valuation of external debt therefore EVR is zero under closed economy. Other flows (OT), include asset purchases and expenditure items that are not included in government expenditure (G) such as bank recapitalization and assumption of guaranteed state enterprise debt. In addition none debt sources asset sales such as privatization revenue and seigniorage with negative sign are also included in OT.

Without the loss of general truth let OT= 0 and EVR =0 for closed economy, then the total stock of debt becomes as defined in equation two below.

$$D_t = (1+i)D_{t-1} - p_{Bt} \qquad (2)$$

3.1.3. Inter-temporal budget constraint in closed economy and Debt Sustainability

Inter-temporal budget constraint is a constraint that hinders governments to finance their budget deficit through debt sources in the long run. Mathematically it is obtained by forward solving of equation two as follows

$$D_{t+1} = (1+i)D_t - p_{Bt+1} \qquad (3)$$

Now substitute equation 3 in to 2, then it becomes

$$D_{t+1} = (1+i)^2 D_{t-1} - (1+i)p_{Bt} - p_{Bt+1} \qquad (4)$$

Again

$$D_{t+2} = (1+i)D_{t+1} - p_{Bt+2} \qquad (5)$$

In a similar fashion, plug equation four in to equation five we obtain

$$D_{t+2} = (1+i)^3 D_{t-1} - (1+i)^2 p_{Bt} - (1+i)p_{Bt+1} - p_{Bt+2} \qquad (6)$$

By similar way, we form

$$D_{t+N} = (1+i)^{N+1} D_{t-1} - (1+i)^N p_{Bt} - (1+i)^{N-1} p_{Bt+1} - (1+i)^{N-2} p_{Bt+2} - \cdots - p_{Bt+N} \qquad (7)$$

This is equivalent to the next equation;

$$D_{t+N} = (1+i)^{N+1} D_{t-1} - \sum_{j=0}^{N} (1+i)^{N-j} p_{Bt+j} \qquad (8)$$

This equation is called inter- temporal budget constraint, because when N goes larger, all available creditors are already borrowed for the borrower agent as a result they would not re-borrow before they got the re-payment of the previous debt.

After we re-arrange equation 2 and 8 we can derive the following equation

$$D_t = \left(\frac{1}{1+i}\right)^N D_N + \sum_{j=0}^{N} \left(\frac{1}{1+i}\right)^j p_{Bj} \qquad (9)$$

In the analysis of debt sustainability, equation nine has divided in to two parts i.e transversality (none-Ponzi condition) and solvency condition.

$$\lim_{N\to\infty} \left(\frac{1}{1+i}\right)^N D_N = 0 \qquad (10)\ is\ \ called\ TC$$

$$D_t = \sum_{j=0}^{N} \left(\frac{1}{1+i}\right)^j p_{Bj} \qquad (11)\ \text{is called SC}$$

Equation (10) is called transevrsality condition (TC), which implies, it prohibiting issuance of more and more debt without ever re-paying principal and interest on previous stock of debt. Moreover, equation (11) is called solvency condition (SC), which implies, the outstanding initial debt should be covered by the present value of the future primary balance. Debt is sustainable when both TC and SC fulfilled, Irina Yakadina ('n.d').

3.1.4. Debt dynamics in terms of GDP ratio and debt sustainability

One of common and easy ways for measure debt sustainability analysis developed by IMF is expressing the debt dynamics in terms of GDP ratio, which is equal with equation (2) per GDP and expressed as a small letter case.

$$\frac{D_t}{GDP_t} = (1+i)\frac{D_{t-1}}{GDP_t} - \frac{p_{bt}}{GDP_t} \qquad (12)$$

Equation 12 becomes

$$GDP_t = (1+n)GDP_{t-1} \qquad (13)$$

Where n nominal growth rate of GDP

$$d_t = \left(\frac{1+i}{1+n}\right)d_{t-1} - p_{bt} \qquad (14)$$

$$d_t = \left(\frac{1+r}{1+g}\right)d_{t-1} - p_{bt} \qquad (15)$$

Where

$r = (1+i)(1+\pi)$ = real interest rate

$g = (1+n)(1+\pi)$ = real growth rate

Debt is sustainable when g > r, which indicates the marginal product of surplus obtained from debt is larger than interest expense which would paid to the debt service.

3.1.5. External debt dynamics and debt sustainability

External debt arises when the current account balance is reaches negative value. The external debt dynamics in foreign currency expressed as follows.

$$D_t = (1 + i)D_{t-1} - TB_t - TR_t \qquad (16)$$

- ✓ D_t=stock of external debt in foreign currency
- ✓ D_{t-1}=stock of outstanding external debt in foreign currency
- ✓ $TB_t = X_t - M_t$ =trade balance
- ✓ $TR_t = NFI_t - NFO_t$= net transfer
- ✓ $X_t = \text{export}$
- ✓ $M_t = \text{import}$
- ✓ NFI_t=net factor income i.e income transfer from abroad
- ✓ NFO_t=net factor out flow i.e amount of money transfer to abroad

Let re-write equation 16 as follows

$$D_t = (1 + i)D_{t-1} - [(X_t + NFI_t) - (M_t + NFO_t)] \qquad (17)$$

$$D_t = (1 + i)D_{t-1} - S_t \qquad (18)$$

Where $S_t = [(X_t + NFI_t) - (M_t + NFO_t)] = \text{external surplus}$

By solving equation 18 forward, we obtain the equation 19

$$D_t = \left(\frac{1}{1+i}\right)^N D_N + \sum_{j=0}^{N} \left(\frac{1}{1+i}\right)^j S_j \qquad (19)$$

As domestic debt sustainability analyses that I showed in equation 9,10 and 11, the second and the third tem of equation 19 are called TC and SC respectively. Since Pozi games not allowed, when the limit of debt as N→∞, then the debt $D_N \to 0$. As a result the current debt will paid by present value of the future external surplus.

Note

if $\lim_{N\to\infty} \left(\frac{1}{1+i}\right)^N D_N \neq$

0 *implies , the country is paying the old maturity debt by issuing new debt, which reavels that external debt is not sustainbele*

3.2. Empirical review and Model selection

3.2.1. Empirical review for model selection

The model of this paper founded based on analysis of the question raised by Hamilton and Flavin, "how long can government budget deficits continue unchecked?" This question has risen to two separate issues, the first issue was, are the perpetual deficits desirable – are the effects on inflation, investment, and balance of payments ones that we can live with? The second question was, are the perpetual deficit feasible-even if the government wanted budget deficit forever, is this something it really could do? The logical and theoretical answer for the questions is, deficits cannot continually financed by debt without paying the existing debt, if this were possible no one would be willing to work while they would enjoy the free lunch associated with debt. However, the creditors are not willing to borrow for those who are not loyal to repay their debt, and as a result, the debtors face the problem of borrowing constraint. Bearing these arguments, different researchers conducted different methods of sustainability tests to identify condition that a debt is sustainable or solvency.

Governments finance their budget deficit through borrowing, and promising to repay their debt by offsetting their future surpluses obtained from the return of investments of the money that they borrowed. Governments could not finance their debt by another debt i.e Pozi game is impossible. Thus to run sustainable fiscal policy the present value of the expenditure should not exceed the expected present value of the future receipt (surplus) which we call it borrowing constraint.

Many economists addressed the issue of debt sustainability through different methods of analysis. The most famous and basic framework for this studies are works of David.Wilcox (aug,1989), Hamilton and Flavin (sept, 1986) ,Bohn (1998) Chalk and Hemming (2000), Irina Yakadina (Imf instructor 'n.d'), Mahdavi (,2014), Mei-Yin lin (24,2014), Jayme (2000) and Presbitero A.F. (2005). Some of the works are surmised in the next paragraphs.

Hamilton and Flavin 1986, conducted tests on sustainability of US debt. They employ tests of stationarity over discounted debt using Dickey-Fuller tests of unit roots and Flood-Garber tests for stationarity. The basic idea is that debt will be sustainable in the long run, if the discounted debt is stationary. Applying these methodology to US data from 1960 to 1981, and they found that, in the end the US budget balance is sustainable. In precise phrase, Hamilton and Flavin

reached on the consensus, that debt is solvency and sustainable if the solvency condition is stationary in primary balance. In addition, stationary solvency condition implies public debt is also stationary.

Wilcox (1989) expanded the work of Hamilton and Flavin (1986) in order to allow for stochastic real interest rates, none stationarity in the none interest surplus, and stochastic violations of the borrowing constraint. Whereas, under test of Hamilton and Flavin, they consider fixed interest rate, stationary required surplus and any violation of borrowing constraint considered as stochastic. Wilcox found none stationary undiscounted debt, and concluded that the US fiscal policy is not sustainable, in his test result, which is contrary with the work of Hamilton and Flavin (1989).

Trehan And Walsh (1998) agreed, if the discounted debt and primary balance are not stationary or integrated, solvency could satisfied if both series move together or co-integrated with higher debt systematically associated with higher primary balance.

Jayme (2001), conducted three tests on the sustainability of Brazilian external debt. On his first test, he considered the sum of external debt interest payment and import as one variable(MM_t) i.e $MM_t = M_t + (1 + r)D_{t-1}$ and another variable EX_t which is a sum of export (X_t), net transfer (TR_t) and foreign reserve of the past year (RE_{t-1}) i.e $EX_t = X_t + TR_t + RE_{t-1}$. Then he employ a Johanson co integration test between EX_t and MM_t to check whether the linear combination of the two mentioned variable i.e ($EX_t = a + bMM_t + u_t$) are stationary or not. He mentioned if the two variables are co integrated, then debts is sustainable otherwise the opposite is true. Second test was co integration test between net external debt and trade balance in level form and finally on his third test, he performed a unit root test on the discounted debt; at this test he pointed that the necessary condition to the external debt to be sustainable is that the discounted debt is stationary. On his three tests, he found the Brazilian external debt is unsustainable.

3.2.2. Mathematical Model of the Paper

In this paper, I present three mathematical models to test Ethiopian external debt sustainability and to synthesize a testable model equation; it goes through the following analytical approaches.

Mathematical Model 1

The first model analyzed and tasted based on the work of Hamilton and Flavin (1986), Wilcox 1989, and Jayme (2001). This model extended from equation eighteen (18) and discounted by changing nominal exchange rate to real and variable interest rate in-order get a testable equation.

$$D_t = (1 + r_j)D_{t-1} - S_t \qquad (20)$$

Assume the real interest rate is not constant (r_j) and the discounting factor $M_t = \prod_{j=0}^{t-1}(1 + r_j)^{-1}$, and multiply equation 20 by M as follows

$M_t D_t = (1 + r_j)M_{t-1}D_{t-1} - M_t S_t$ and let I use small letter for the discounted value

$$d_t = d_{t-1} - s_t \qquad (21)$$

Now when I solve equation (21) forward recursively, I will get the next equation

$$d_t = d_{t+N} + \sum_{j=1}^{N} s_{t+j} \qquad (22)$$

From the concept of debt sustainability, the current debt paid by the present value discounted future surplus, thus the limit of d_{t+N} as N goes to large and large becomes zero. This concept explains that if the discounted debt equals the sum of discounted external surplus, which implies three things. The first implication is that the discounted debt is stationary; the second implication is that the discounted surplus is also stationary and the third is that both discounted debt and discounted debt move together. These statements analogously abstracted from the work of Hamilton and Flavin (1986), and Chalk and hemming (2000).

By bearing this argument equation 22 reduced to 23

$$d_t = \sum_{j=1}^{N} s_{t+j} \qquad (23)$$

$$\text{where } \lim_{N\to\infty} d_{t+N} = 0$$

Thus, the first mathematical model of the paper set to be as equation twenty-three, and the estimation for this model carried out by performing unit root tests on discounted external debt and discounted external surplus. Unit root tests performed by allowing trend and intercept, intercept and no trend, and no trend and no intercept.

Mathematical Model 2

The conception of the second mathematical model established based on the concept of constant debt GNP ratio. Obstfeld and Rogof (1996) described that an external debt is sustainable when a country maintain constant debt GNP ratio. They defined Current account as change in foreign asset i.e.

$$CA_t = D_t - D_{t-1} = Y_t - C_t - G_t - I_t + rD_{t-1} \quad (24)$$

From equation 23 we derive the next equation

$$D_t - D_{t-1} = TB_t + rD_{t-1} \quad (25)$$

Again from equation 25 we derive the next equation

$$D_t = TB_t + (1 + r)D_{t-1} \quad (26)$$

Where

- CA_t is current account
- D_t is amount of debt stock at period t
- $TB_t = Y_t - C_t - G_t - I_t$ is trade balance at the end of year t
- rD_{t-1} interest payment for the past year
- Y_t is GDP
- $C_t$is gross consumption
- G_t is government expenditure
- I_t is investment

When one divides both sides of equation 26 by Gross national products(GNP_t) , the following results obtained.

$$\frac{D_t}{GNP_t} = \frac{(1+r)D_{t-1}}{GNP_t} + \frac{TB_t}{GNP_t} \quad (27)$$

Here at steady state there are two assumptions, first we assume $GNP_t = (1 + g)GNP_{t-1}$ where g is growth rate of GNP and the second is that both debt and GNP has the same growth rate (g). let re-define equation 27 by small letters.

$$d_t = \left(\frac{1+r}{1+g}\right) d_{t-1} + tb_t \quad (28)$$

Again let re-write equation 28 as follows

$$d_t = \beta d_{t-1} + tb_t \quad (29)$$

$$\text{where } \beta = \left(\frac{1 + r}{1 + g}\right)$$

When equation 29 solved recursively, it gives the next equation.

$$d_{t+N} = \beta^{N+1} d_{t-1} + \sum_{i=0}^{N} B^{N-i}\, tb_{t+i} \qquad (30)$$

From equation thirty if $|\beta|<0$, then logically it is possible to derive the following four facts:

i. When r < g, it indicates the assets found through loan is too productive than interest paid for debt service and it has a potential to repay the debt in the future by the surplus obtained from output of loan investment.

ii. $\lim_{N\to\infty} \beta^{N+1} d_{t-1} = 0$, this shows that the roll over effect of initial loan vanishes to zero in the future.

iii. When N gets large and large, d_t and tb_t will move together because the effect of summations of lags of tb (trade balance GNP ratio) will die out due to the product effect of coefficients of tb_{t+i} that are β^{N-i}.

iv. The debt becomes sustainable since the future surplus income exceeds the current debt.

To test all the above listed facts, equation 29 is a convenient equation. Thus, it is set as the second mathematical model. As Jayme (2001) described, an external debt is sustainable, when both debt to GNP ratio and trade balance to GNP ratio move together. The test employed to the model is co-integration test between external debt GNP ratio and trade balance GNP ratio.

Mathematical model 3,

This mathematical model is designed to test about the long run association between external debt and trade balance. It analyzed by co-integration test between the underlined variables. It is derived at equation 26,

$$D_t = TB_t + (1 + r)D_{t-1} \qquad 31$$

3.2.3. The stochastic model of the paper

In this paper, two stochastic models (AR and ARDL) employed to discuss and perform the econometrics analysis. The merits that the investigator chooses the two models explained in the next sub-section sections.

3.2.3.1. Autoregressive (AR) Model

Autoregressive (AR) is a regression model that relates a time series variable with its past lags (Stock and Watson 2015). Thus, the reason to choose AR model is that it is too recommended for looking the impact of own lags of an economic variable and check its stationarity easily. ADF unit root test employed on discounted external debt and discounted external surplus based on the following stochastic AR models. The AR models are designed to check external debt sustainability concept dictated in mathematical model one. The next two consecutive AR models extended from the concept of mathematical model one.

AR model 1.

$$d_t = \theta + \rho_0 t + \rho_1 d_{t-1} + \rho_2 d_{t-2} + \rho_3 d_{t-3} + \cdots \rho_q d_{t-q} + \varepsilon_t \quad 32$$

AR model 2.

$$s_t = \alpha + \beta_0 t + \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + \ \ldots \ \ \beta_p s_{t-p} + U_t \quad 33$$

Where,

d_t discounted d

d_{t-i} the i th lag of discounted external debt

ρ_i the coefficient of the i th lag of external debt

θ_0 cofficient of time trend t

t time trend

θ constant of the discounted debt

q *order of AR model one*

ε_t disturbance term in the discounted debt

s_t discounted external surpulus

s_{t-i} the i the lag of discounted external surpulus

β_i the coefficient of the i lag of discounted external surpulus

β_0 cofficient of time trend t

α constant term of external surpulus

p *order of AR model two*

U_t distubance term in discounted external surpulu

3.2.3.2. Autoregressive distributed lag model (ARDL).

ARDL model employed to analyze the 2nd and 3rd mathematical models, which stated at equation 29 and 31 respectively.

3.2.3.2.1. ARDL for the second mathematical model

The aim of employing ARDL model for second mathematical model is to check the movement of togetherness or moving together between external debt to GNP ratio and trade balance to GNP ratio. According to Jame (2001), an external debt is sustainable if the two ratios move together, or co-integrated. Kripfganz and Schneider 2018, described that the autoregressive distributed lag (ARDL) model is popular in a fact that co-integration of non-stationary variables is equivalent to an error correction (EC) process. In addition, they pointed out that the ARDL model has a re-parameterization in EC form. The existence of a long run or co-integrating association tested based on the EC process. A bound testing practice is available to draw conclusive output without knowing whether the variables are integrated of order zero or one, *I*(0) or *I*(1), respectively.

Overall, employing ARDL in the 2nd mathematical model is not for performing regression analysis, rather it used only to test the existence of co-integration between the economic variables of debt GNP ratio and trade balance GNP ratio. In the analysis of ARDL co-integration test if the outcome shows co-integrated between the two variables, we conclude the external debt is sustainable.

The ARDL model one below established from extension of mathematical model two and its main objective is to make a testable set up in a stochastic form.

ARDL model one

$$d_t = \iota + \sum_{i=0}^{p} \nu_i d_{t-i} + \sum_{i=0}^{q} \eta_i tb_{t-i} + \Phi_t \qquad 34$$

where

d_t is the debt GNP ratio at time t

d_{t-i} is the i^{th} lag of the debt GNP ratio

ι is the constant term

ν_i coefficient of the i^{th} lag of debt GNP ratio

tb_{t-i} *is the* i^{th} *lag of trade balance GNP ratio*

η_i *coefficient of the* i^{th} *lag of trade balance GNP ratio*

Φ_t *distebance term*

3.2.3.2.2. ARDL for the third mathematical model

The major objective of employing ARDL in the 3rd mathematical model is used to model, expresse and relate the impact of trade balance on external debt, and to forecast the relationship between external debt and trade balance in the future. In addition, it used to as an additional tool to test external debt sustainability. Standing on theoretical foundation, external debt contracted to smoothen and fill the foreign resource gap. Obstfeld and Rogof (1996) describes the situation that an external debt is sustainable if the economy's net debt today equals the present value of future trade surplus. Trehan and Walsh (1998) also stated that, even if debt and primary balance (trade balance in our case) are not stationary (or integrated),solvency is satisfied if both series move together or co-integrated with a higher debt systematically associated with higher trade balance. According to Nkoro and Kelvin Uko 2018, the autoregressive distributed lag (ARDL) model used to model the relationship between time series variables in a single-equation time series setup.

Based on this analysis, the second ARDL model constructed from concepts stated in mathematical model three.

ARDL model 2

$$D_t = \alpha + \sum_{i=0}^{p} \gamma_i D_{t-i} + \sum_{i=0}^{q} \theta_i TB_{t-i} + U_t \qquad 35$$

Where

D_t external deb

TB_t trade balance

θ_i coefficient of trade balanc at time t

γ_i Coefficient of debt lags

U_t error ter

α is constant

The main advantages employing ARDL model as noted by Nkoro and Uko 2018, are

- ✓ Since each of the underlying variables stands as a single equation, endogeneity is less of a problem, because it is free of residual correlation (i.e. all variables are assumed endogenized in the process).

- ✓ When there is a long run relationship, the ARDL procedure can distinguish between dependent and independent variables. That is, the ARDL approach establishes only a single reduced form equation association exists between the dependent variable and the exogenous variables
- ✓ it identify the co-integrating vectors where there are multiple co-integrating vectors.
- ✓ The Error Correction Model (ECM) can be solved from ARDL model through a easy linear transformation, which incorporate short run adjustments with long run equilibrium without losing necessary long run information. The associated ECM model obtain a sufficient number of lags to contain the data generating process in general to specific modeling frameworks.

3.3. Method of testing

As mentioned in the stochastic (econometric) models two methods employed in the paper. The first method used to identify existence of unit root, while the second used to identify the existence of long run relationship between the variables included under the study. These methods identified as unit root and co-integration tests.

3.3.1. ADF unit root test

The augmented dickey fuller (ADF) test performed for testing unit root in an autoregressive (AR) model.

For series $\{Y_t\}$, $Y_t = \beta_0 + \lambda T + \sum_{i=1}^{K} \alpha_i Y_{t-i} + \Psi_t$ is a general form of an autoregressive with k number of lags. Then the series formed by difference of Y_t becomes as follows

$$\Delta Y_t = \beta_0 + \lambda T + \delta Y_{t-1} + \sum_{i=1}^{K} \gamma_i \Delta Y_{t-i} + \Psi_t \qquad 36$$

Equation 36, is a general form of ADF with

$Null\ hypothesis\ \ H_o : \delta = 0, which\ implies\ the\ series\ is\ non\ stationary.$

$Alternative\ hypothesis\ H_1: \delta < 0, which\ implies\ the\ series\ is\ \ stationary$

When the series is non-stationary, then the conventional hypothesis, confidence intervals and forecasts can be unreliable. While if a series is stationary, then the probability distribution does not depend on time and it will have constant mean and constant variance (Stock and Watson 2015). When the series, the future behave like the past and it is possible to forecast the future using the previous historical data.

Nkoro and Uko (2018) stated that, when ADF value less than its critical value, then it shows that the underlying series is non-stationary. Contrarily, when an ADF value that is greater than its critical value shows that the underlying series is stationary. This decision can be verified using other related tests, such as KPSS , Philips-Perron (PP) test. PP test has null hypothesis analogous as an ADF, and its distribution is the same as the ADF test statistic.

ADF remove the problem autocorrelation using the difference lagged dependent variable as explanatory variables and the choice of the number of lags (k) to be included in the unit root test is based on the significant lag of the autocorrelation function (ACF) and the partial autocorrelation function (PACF) graphs of the correlogram and partial correlogram. The optimal number of lags is a lag at which the ACF cuts of or the number of lags of the PACF that are significantly difference from zero. By rule of thumb, the ACF calculated up to one-third to one-quarter of the length of the number of time series data Nkoro and Uko (2018). However, Monte carlo suggested that the initial condition ADF test for autoregressive model is selecting an appropriate lag by the standard lag selection criteria like AIC. All this test doesn't incorporate the problem structural break in the system which could significantly change the result, as consequence the researcher also employed Perron(1989) and, Zivote and Andrews unit root test also be employed in order to remove the problem of unit root test. The detail of this test is specified in chapter four section 4.1.2.

3.3.2. ARDL approach co-integration test (bound test approach)

Two or more time series variables said to be co-integrated if they mimic a long run relationship that converges with time or if they have common stochastic trend. Co-integration test examines how a time series data, which may be individually non-stationary or drift away from equilibrium paired and driven to equilibrium and become stationary. Co-integration is a linear combination of two more variables individually none stationary which integrated to an order of d or I(d) becomes stationary.

Co-integration test is a necessary footstep to establish if a model empirically reveals significant long run relationships. There are different co-integration methods, for this study Autoregressive Distributed Lag (ARDL) approach to cointegration or bound co-integrations are used. Because it performed irrespective of whether the necessary variables are I(0), I(1) or a combination of both. ARDL approach to co-integration helps to recognize the co-integrating vector(s). That is, each of the basic variables set as a particular long run relationship equation.

Nkoro and Uko (2018) described that, If one co integrating vector is established from the underlined variables, then the ARDL model of the co-integrating vector is re-parameterized into ECM. The re-parameterized result gives short-run dynamics (ARDL) and long run association of the variables of a single model. The re-parameterization is possible because the ARDL is a dynamic possibly define as a single model equation and of the matching form with the ECM. Distributed lag Model purely implied the inclusion of unrestricted lag of the regressors in a regression function. If there is no co-integration between the variables we estimate only the short run that is the ARDL value.

3.3.2.1. Reparameterization of error correction model

Nkoro and Uko (2018) described that, When non-stationary variables are regressed in a model it may give results that are spurious and one way of solving this problem by differencing the data (because most data exhibit DSP) in order to achieve stationarity of the variables. However, it capable to solve the problem of spurious regression but the regression equation only give us the short-run relationship between the variables. Thus, to form long run relationship we use the concept of co-integration and the ECM. ECM incorporates both long run and short-run information.

Consider a general ARDL (p,q) model

$$Y_t = c_0 + c_1 t + \sum_{i=1}^{p} \phi_i Y_{t-i} + \sum_{i=0}^{q} b_i X_{t-i} + \omega_t \qquad 37$$

EC model

$$\Delta Y_t = c_0 + c_1 t - \alpha(Y_{t-1} - \beta x_t) + \sum_{i=1}^{p} \rho_i Y_{t-i} + \sum_{i=0}^{q} \sigma_i \Delta X_{t-i} + U_t$$

Where

ρ_i *short run coefficient of dependent variable* (y)

σ_i*short run coefficient of independent variable* (x)

α is speed of adjustment coefficient , $\alpha = 1 - \sum_{i=1}^{p} \phi_i$ and

β is the long run coefficient , $\beta = \frac{\sum_{i=0}^{q} b_i}{\alpha}$

According to Pesaran, Shin, and Smith (2001) bounds test, the *F*-statistic to test the joint null hypothesis for no long-run relationship is $H_o = (\alpha \cap \sum_{i=0}^{q} b_i) = 0$ and alternative $H_1 = (\alpha \cup \sum_{i=0}^{q} b_i) \neq 0$ it has long-run relationship.

3.3.2.2. STEPS IN ARDL CO-INTEGRATION

The procedures to perform co-integration tests are listed under:

1. Obtain the optimal lag length

The issue of finding the proper lag length for each of the underlying variables in the ARDL model is very important because we want to have Gaussian error terms (standard normal error terms) that do not suffer from non-normality, autocorrelation, heteroskedasticity etc.

To find the optimum lag length, we employ the proper lag selection criteria such as Akaike Information Criterion (AIC), Bayesian information Criterion (BIC) or Hannan-Quinn Criterion (HQC). i.e

$$BIC_q = ln\left(\frac{SSR}{T}\right) + (q+1)\frac{lnT}{T}$$

$$AIC_q = ln\left(\frac{SSR}{T}\right) + (q+1)\frac{2}{T}$$

$$HQC_q = ln\left(\frac{SSR}{T}\right) + (q+1)2\frac{\ln(lnT)}{T}$$

Where

$SSR\ is\ the\ estimated\ sum\ of\ squared\ residuals$

$T\ is\ the\ number\ of\ estimated\ parameters$

$q\ is\ the\ optimum\ order\ of\ the\ model\ selected$

2. Check the stationarity of the dependent and the explanatory variable and it has to be either I(0) or I(1) or a combination of it, otherwise ARDL will not performed.
3. Estimate ARDL
4. Perform bound test and check the presence of co-integration if no structural break exist. If there is a structural break we use Gregory-Hansen(1987) co-integration test.
5. From the bound test If the variables are co-integrated specify both short-run(ARDL) and long-run(ECM) or EC. If the variables are not co-integrated specify only the short-run(ARDL)
6. Perform post estimation (diagnostic) tests i.e.
   - ✓ Autocorrelation test ;Durban-Watson and Breusch-Godfrey test
   - ✓ Hetroskedasticity test ;white test
   - ✓ Normality test; Jarque-Bera test
   - ✓ Stability of the model test; cusum test

3.3.3. Gregory-Hansen co-integration test

Gregory-Hansen co-integration test is used to test co-integration in the presence of structural break in the system (model). This test is used a single structural break exist with unknown date of break.

Gregory and Hansen, assumed four assumptions in their co-integration test with structural break, and their specification with two variables for simplicity are the following.

Standard co-integration

$$y_t = c_1 + a_1 x_t + e_t$$

Co-integration with level shift

$$y_t = c_1 + c_2 d_{tk} + a_1 x_t + e_t$$

Co-integration with level shift and trend

$$y_t = c_1 + c_2 d_{tk} + bt + a_1 x_t + e_t$$

Co-integration with regime

$$y_t = c_1 + c_2 d_{tk} + a_1 x_t + d_{tk} x_t + e_t$$

Where

Y is dependent variable

X is independent variable

t time

c is constant

d dummy

k is break date

$$d_{tk} = \begin{cases} 0 & if\ t \leq k \\ 1 & if\ t \geq k \end{cases}$$

The null hypothesis $H_o = no\ cointegration\ with\ the\ structural\ break$

The alternative hypothesis $H_1 = there\ is\ cointegration\ with\ the\ structural\ break$

Three statistics of Gregory-Hansen used in their test are; ADF, Zt and Za. If this values are less than the critical values, then the null hypothesis will be rejected and accept if the opposite happens.

Steps in testing Gregory-Hansen co-integration tests and formulate VECM

1. Select optimal lag
2. Perform unit root test
3. Test co-integration
4. If co-integration exists, form the VECM including with dummy variables.
5. If co-integration doesn't exist VECM doesn't require only formulate short-run model (ARDL)

In this paper, test of co-integration first made by bound co-integration test and then by Gregory Hansen test so that it can used to analyze the variations in the outputs resulted in variations of the method of tests.

CHAPTER FOUR

4. Econometric analysis and results

This section contains two major econometrics analyses, the first section analyze Ethiopian external debt sustainability by performing unit root tests like ADF, PP and perron(1989) unit root test on the autoregressive (AR) models, while the second section analyze Ethiopian external debt by performing co-integration test on ARDL models via employing bound test and Gregory-Hansen co-integration test

4.1. Test on Ethiopian external debt sustainability

External debt sustainability may express in different ways but all the facts lie down under three facts. The first fact states that, an external debt to be sustainable if the discounted external debt equals with the discounted external surplus. Second, an external debt is sustainable if the external debt to GNP ratio vanished or if both external debt GNP ratio and trade balance GNP ratio move together (co-integrated). The third fact that makes an external debt sustainable is presence of stationary external debt and trade balance individually at level or presence of co-integration between the two variables. Each test presented in the next sections.

4.1.1. Stationary test on discounted external debt and discounted external surplus

Hamilton and Flavin (1986) argue that debt is sustainable if solvency condition satisfied i.e. stationary in discounted primary balance implies that the discounted public debt is also stationary", and Jayme (2001) described that the necessary condition for an external debt to be sustainable is that the discounted external has to be stationary. Both explanations purported to prove the condition mentioned in equation 23, i.e. the discounted value of external debt equals the sum of expected discounted value external surplus.

In this paper, both discounted external surplus and external debt stationary tests are performed in order to make all rounded prove of the different conditions mentioned by Hamilton and Flavin (1986), and Jayme (2001.

ADF test in AR model one. $d_t = \beta_0 + \lambda T + \sum_{i=1}^{K} \alpha_i d_{t-i} + \Psi_t$. . . . . ***AR(k)***

The initial condition to perform ADF test is deciding the optimal length either by the rule of thumb ($T^{\frac{1}{4}}$) or by standard lag selection criteria. The optimal lag of the discounted external

debt at level by rule of thumb and lag selection criteria are one and two respectively. Where T =28 is number of observation periods (year).

From the rule of thumb, the optimal lag, $q = T^{\frac{1}{4}} = (28)^{\frac{1}{4}} = 2.300 \approx 2$ and from the table below the optimal lag, by lag selection criteria has shown one. Thus, the researcher tested the stationarity of discounted external debt and discounted external surplus by employing ADF test at one, and two lags..

Stata command, varsoc lndid								
Sample: 1995 – 2018				**Number of obs = 24**				
					Selection-order criteria			
lag	**LL**	**LR**	**df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	**-55**				**6.23331**	**4.66774**	**4.68076**	**4.71682**
1	**-24.8282**	**60.369***	**1**	**0.000**	**.54782***	**2.23568***	**2.26173***	**2.33385***
2	**-24.6337**	**.38903**	**1**	**0.533**	**.586397**	**2.3028**	**2.34187**	**2.45006**
3	**-24.6245**	**.01826**	**1**	**0.893**	**.638035**	**2.38538**	**2.43747**	**2.58172**

Table 4.1. Optimal Lag Selection Criteria For Log Value Of Discounted External Debt

Stata command, varsoc lndid								
Sample: 1995 – 2018				**Number of obs = 24**				
					Selection-order criteria			
lag	**LL**	**LR**	**df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	**-48.1382**				**3.51495**	**4.09485**	**4.10788**	**4.14394**
1	**-25.8639**	**44.549***	**1**	**0.000**	**.597203***	**2.32199***	**2.34804***	**2.42016***
2	**-25.8631**	**.00158**	**1**	**0.968**	**.649662**	**2.40526**	**2.44433**	**2.55252**
3	**-25.51**	**.70615**	**1**	**0.401**	**.686899**	**2.45917**	**2.51126**	**2.65551**
4	**-25.51**	**.70615**	**1**	**0.401**	**.686899**	**2.45917**	**2.51126**	**2.65551**

Table 4.2 optimal lag selection criteria for log value of discounted external surplus.

N.B. As we see from the above tables, the optimal lag for both variables is one, by all lag selection criteria.

→ *The three ADF tests performed on discounted external debt at level:*

1. $ADF stationary\ test\ on\ discounted\ external\ debt\ at\ level\ without\ intercept\ and\ time\ trend$

$\Delta d_t = \delta d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t\ differenced\ equation\ , null\ hypothesis\ H_0: \delta = 0$

$d_t = (1+\delta) d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t\ derived\ from\ differenced\ equation\ above$

$d_t = a d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t\ mixed\ and\ it\ will\ used\ for\ level\ test, null\ hypothesis\ H_0: a = 1$

Augmented Dickey-Fuller test for unit root **Number of observation = 26** **First lag = by lag selection criteria**					**Level test**			
			---------- Interpolated Dickey-Fuller ---------					
	Statistic	**1% Critical**			**5% Critical**		**10% Critical**	
	Test	**Value**			**Value**		**Value**	
Z(t)	**-2.305**	**-2.658**			**-1.950**		**-1.600**	
D.lndid	**Coef**	**Std.Err**	**t**	**p>|t|**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
lndid = natural log value of discounted external debt = dependent variable								
L1. (first lag)	**-.0194336**	**.0084309**	**-2.31**	**0.030**	**-.0368341**			**-.002033**
LD. (lag d/c)	**-.1521788**	**.2012339**	**-0.76**	**0.457**	**-.5675052**			**.2631477**

Table 4.3. ADF test result on discounted external debt at level without trend and intercept.

As the test result shows, the absolute value trace statistics is greater than the critical value at 5% and 10% significant level in absolute value, while it is less than at 1% level of significance. Thus, it is possible conclude that the discounted external debt is non-stationary at 1% significant level. We made Phillips-Perron test for unit root at one lag with no constant in order to fully verify the non-stationarity of discounted external debt without trend and intercept, and we found from the test result, the discounted external debt is fully none stationary at all level of significance.

2. $ADF stationary\ test\ on \log value\ of\ discounted\ external\ debt\ at\ level\ with\ intercept\ and\ no\ time\ trend.$

$\Delta d_t = \theta + \delta d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t$ *differenced equation and used for difference test*

The null $H_0: \delta = 0 \implies$ *the differenced discounted debt is non-stationary*

Alternative $H_1: \delta < 0 \implies$ *the differenced discounted debt are stationary with intercept*

$$d_t = \theta + (1+\delta) d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t \ derived\ from\ differenced\ equation\ above$$

$d_t = \theta + a d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t$ *mixed and it will used for level test*

Null hypothesis $H_0: a = 1$ *implies the discounted external debt is nonststionary*

Alternative hypothesis $H_1: a < 1$ *implies, The discounted debt is stationary with intercept.*

Stata command, dfuller lndid, regress lags(1)					
Number of lags =one by Lag selection criteria					**Level test**
Test type	**Augmented Dickey-Fuller test for unit root**				
	Number of observation = 26				
	---------- Interpolated Dickey-Fuller ---------				
	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**	
Z(t)	**-0.075**	**-3.743**	**-2.997**	**-2.629**	
MacKinnon approximate p-value for Z(t) = 0.9519					
D.lndid	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
lndid					
L1. (1st lag)	**-.0045683**	**.0609759**	**-0.07**	**0.941**	**-.1307066 .12157**
LD. (1st lag d/c)	**-.165481**	**.2122797**	**-0.78**	**0.444**	**-.6046149 .273653**
Constant	**-.2770838**	**1.125206**	**-0.25**	**0.808**	**-2.60475 2.050582**

Table 4.4. ADF test result on discounted Ethiopian external debt at level with intercept.

Here the ADF test has performed as shown in the above table, on a discounted Ethiopian external debt at level, with inclusion of one lag and intercept and the test result exhibits non-stationary result or it has a unit root at 1%, 5% and 10% level of significance. The ADF test with two lags (lags by rule of thumb) has also performed however; no change has shown in the result.

3. $ADF stationary\ test\ on \log value\ of\ discounted\ external\ debt\ at\ level\ with\ intercept\ and\ time\ trend$

$$\Delta d_t = \theta + \rho_0 T + \delta d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t \ , differenced\ equation\ and\ used\ for\ difference\ test$$

The null $H_0: \delta = 0 \Longrightarrow$ *the differenced discounted debt is non- stationary with intercept and trend*

Alternative $H_1: \delta < 0 \Longrightarrow$ *the differenced discounted debt is stationary with intercept and trend*

$$d_t = \theta + \rho_0 T + (1+\delta) d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t \ drived from\ the\ difference\ equation\ above$$

$$d_t = \theta + \rho_0 T + a d_{t-1} + \sum_{i=1}^{q} \sigma_i \Delta d_{t-i} + \varepsilon_t \ mixed\ eqaution\ of\ discounted\ external\ debt\ used\ for\ level\ test$$

The null $H_0: a = 1 \Longrightarrow$ *the discounted external debt is non- stationary with intercept and trend at level*

Alternative $H_1: a < 1 \Longrightarrow$ *the discounted external debt is stationary with intercept and trend alevelt*

Stata command, dfuller lndid, regress lags(1) Number of lags =one by Lag selection criteria						**Level test**
Test type	**Augmented Dickey-Fuller test for unit root Number of observation = 26**					
	---------- Interpolated Dickey-Fuller ---------					
	Test Statistic	**1% Critical Value**		**5% Critical Value**	**10% Critical Value**	
Z(t)	**-2.265**	**-4.371**		**-3.596**	**-3.238**	
MacKinnon approximate p-value for Z(t) = 0.9519						
D.lndid	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
lndid =log of discounted external debt						
L1. (1st lag)	**-.4337362**	**.1914733**	**-2.27**	**0.034**	**-.8308274**	**-.0366449**
LD. (1st lag d/c)	**.0274225**	**.2109062**	**0.13**	**0.898**	**-.4099702**	**.4648152**
Trend	**-.1456158**	**.0621492**	**-2.34**	**0.029**	**-.2745053**	**-.0167263**
Constant	**9.642736**	**4.357108**	**2.21**	**0.038**	**.6066476**	**18.67882**

Table 4.5. ADF test result on discounted Ethiopian external debt at level with intercept and trend.

In the above table, the ADF test results displaying that the level discounted Ethiopian external debt at one lag with both trend and intercept has a unit root or non-stationary. On the other hand, ADF test with two lags (suggested by rule of thumb) has performed, but the result does not revealed any change.

ADF test in AR model two. $s_t = \alpha_o + \rho s_{t-1} + \phi t + \sum_{i=1}^{K} \alpha_i \Delta s_{t-i} + U_t \ ------AR(k)$

In this model, three different ADF tests performed on discounted external surplus at level

1. $ADF\ stationary\ \ test\ \ on\ level\ discounted\ external\ surplus\ allows\ only\ lag\ without\ constant\ and\ time\ trend$

$s_t = \rho s_{t-1} + \sum_{i=1}^{K} \alpha_i \Delta s_{t-i} + U_t$ *the null hypothesis is* $H_0: \rho 0, implies\ discounted\ external\ surplus\ at\ level\ without\ itntercept\ and\ trend\ and\ \ allows\ one\ lag\ is\ none\ stationary$

$Alternative\ hypotesis\ H_1: \rho = 0 < 1$ Implies stationary discounted external surplus

Augmented Dickey-Fuller test for unit root ***Number of observation = 26*** ***First lag = by lag selection criteria***					***Level test***
---------- Interpolated Dickey-Fuller ---------					
	Statistic Test		***1% Critical Value***	***5% Critical Value***	***10% Critical Value***
Z(t)	***-1.837***		***-2.658***	***-1.950***	***-1.600***
D.lndies	***Coef***	***Std.Err***	***t***	***p>|t|***	***[95% Conf. Interval]***
lndies = natural log value of discounted external surplus					
L1. (first lag)	***-.0167377***	***.0091107***	***-1.84***	***0.079***	***-.0355412 .0020658***
LD. (1st lag d/c)	***-.1415443***	***.1954314***	***-0.72***	***0.476***	***-.544895 .2618064***

Table 4.6. ADF test result on discounted Ethiopian external surplus at level without trend and intercept

As test result shown in the above table, the t-statistical value is less than its critical value at all level (1%, 5% and 10%) of significances. It implies that the discounted external surplus at level without intercept and trend with inclusion of first lag is non-stationary. In the same fashion ADF test for second lag (rule of thumb suggestion) has performed, but no result has been changed

2. *ADFstationary test on discouted external surplus at levelwithout time with intercept and no trend*

Stata command, dfuller lndid, regress lags(1) Level test						
Number of lags =one by Lag selection criteria						
Test type	**Augmented Dickey-Fuller test for unit root**					
	Number of observation = 26					
	---------- Interpolated Dickey-Fuller ---------					
	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**		
Z(t)	**0.110**	**-3.743**	**-2.997**	**-2.629**		
MacKinnon approximate p-value for Z(t) = 0.9668						
D.lndies	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
lndies						
L1. (1st lag)	**.0107752**	**.0975564**	**0.11**	**0.913**	**-.1910356**	**.212586**
LD. (1st lag d/c	**-.1656662**	**.2167138**	**-0.76**	**0.452**	**-.613973**	**.2826405**
Constant	**.4722834**	**1.667031**	**0.28**	**0.779**	**-2.976233**	**3.920799**

Table 4.7. ADF test result on discounted Ethiopian external surplus at level with intercept

Again, as we see from table 4.7, the discounted external surplus allowing one lag with intercept is non-stationary since the z statistics is less than its critical value at all level of significances. In the same scenario an ADF test carry out with inclusion of the second lag (rule of thumb suggestion), however no result change has occurred.

3. *ADFstationary test on discouted external surplus at levelwithout time with both intercept and trend*

Stata command, dfuller lndies, regress lags(1) Level test						
Number of lags =one by Lag selection criteria						
Test type	**Augmented Dickey-Fuller test for unit root**					
	Number of observation = 26					
	---------- Interpolated Dickey-Fuller ---------					
	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**		
Z(t)	**-1.232**	**-4.371**	**-3.596**	**-3.238**		
MacKinnon approximate p-value for Z(t) = 0.9037						
D.lndies	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
lndies =log of discounted external surplus						
L1. (1st lag)	**-.2103967**	**.1707769**	**-1.23**	**0.231**	**-.5645663**	**.1437729**
LD. (1st lag d/c)	**-.0849579**	**.2166133**	**-0.39**	**0.699**	**-.5341864**	**.3642706**
Trend	**.0570725**	**.0366765**	**1.56**	**0.134**	**-.01899**	**.1331349**
Constant	**-4.098555**	**3.353405**	**-1.22**	**0.235**	**-11.05309**	**2.85598**

Table 4.8. ADF test result on discounted Ethiopian external surplus at level with intercept and trend

As table 4.8 shows external surplus that has both intercept and trend at the first lag is none stationary, because the critical values of z-statistics is less than its critical value in absolute value. A similar test has performed with two lags (suggested by rule of thumb), but no change has occurred in the result.

4.1.2. Unit root test on discounted external surplus and discounted external debt with structural break

As we have seen from the ADF test in the above tables, and the results from Philphs-Perron (PP) test performed (where the tables not drawn here), all the results showed that both discounted external debt and discounted external surpluses exhibits non-stationary behavior. However, these unit root tests performed by hopping there is no structural break in the system within the data frame year (1991 to 2018).

According to Barunik (2010), both ADF and PP test does not incorporate structural break in their analysis, and he stated the unit root test that solves problem of structural change are Perron (1989) unit root test and, Zivot and Andrews 1992 (ZA 1992) unit root test.

The Perron(1989) unit root test modified from Clemente, Montanes, Reyes unit root tests which allows one structural break. It considers one optimal structural break in the system within the underlined periods and divide the data by trimming the period with specific percentage, and indentifies the one optimal break. Graphically it displays where the optimal break (critical point) lies or the sequence of t-ratio breaks by comparing the break statistics and the differenced data.

The Perron test for stationarity is made with in the presence of a single structural break and the null hypothesis that (rho - 1) is different from zero meaning there is a unit root with structural change. If the critical value greater than the statistical t-value we accept the null hypothesis.

The Zivot and Andrew (1992) unit root test is the same with Perron(1989) unit root test except it allows two structural break. All test producers are the same. So let us use both test for the natural log values of, discounted external debt (lndid) and discounted external surplus (lndies)

The null is $H_o = (rho - 1) \neq 0$, which equivalent to the series has a unit root **Stata command, clemao1 lndid, maxlag(6) trim(0.10) graph**
Clemente-Monta-Reyes unit-root test with single mean shift, AO model
Variable lndid observation T = 22 optimal breakpoint : 2007
AR(0) du1 (rho - 1) const
Coefficient: -4.86556 -0.45853 19.92950
t-statistic: -10.724 -2.666
P-value: 0.000 -3.560 (5% crit. value)

Table 4.9. Perron unit root test output (innovative) on discounted external debt (natural log value)

From the result as we see in table 4.9, the critical value at five percent is greater than the t-statistics in absolute value i.e |-3.560|>|-2.66|, it implies we cannot reject the null hypothesis, rather we accept the null hypothesis. Thus, the discounted external debt at level is none stationary within one structural change(break). This test allows one structural break at 2007 as shown in figure 4.1

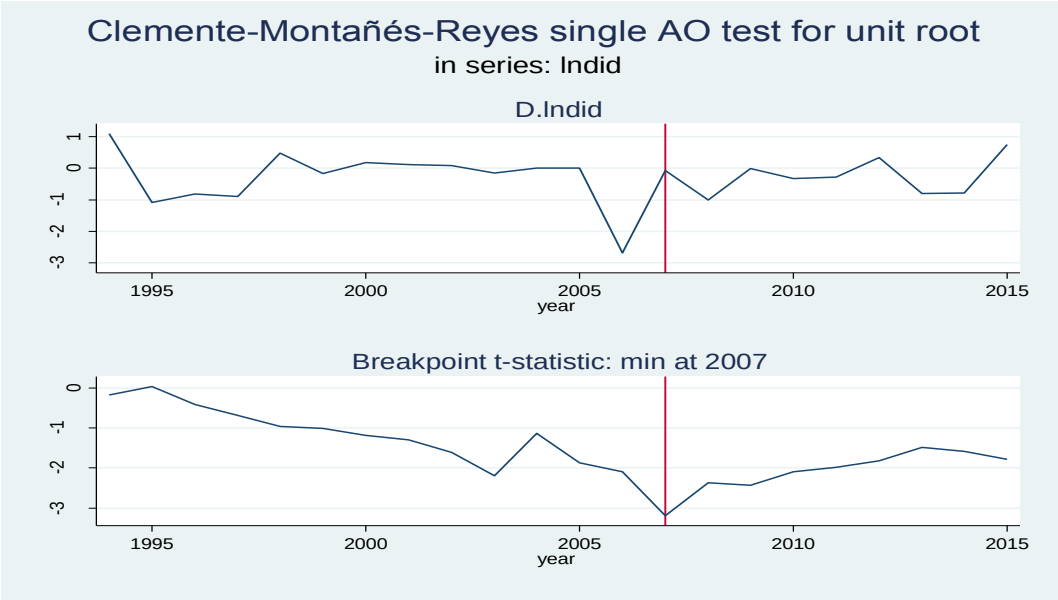


Figure 4.1. A line graph break point statistics and differenced log value of discounted external debt

The null is $H_o = (rho - 1) \neq 0$, which equivalent to the discounted external surplus has a unit root **Stata command, clemio1 lndies, maxlag(6) trim(0.10)**			
Clemente-Monta-Reyes unit-root test with single mean shift, AO model			
Lndies	**T = 22 optimal**	**breakpoint : 2007**	
AR(0)	**du1**	**(rho - 1)**	**const**
Coefficient:	**1.49173**	**-0.35699**	**-6.40591**
t-statistic:	**2.490**	**-2.111**	
P-value: (5% crit. value)	**0.020**	**-4.270**	

Table 4.10. Perron unit root test output (innovative) on discounted external surplus (natural log value)

The innovative perron unit root test that allows one structural break at 2010 shown as figure 4.2, performed as displayed in table 4.8, implying that the discounted external surplus level at is none stationary since the critical value is larger than the t-spastics i.e |-4.270|>|-2.111|.

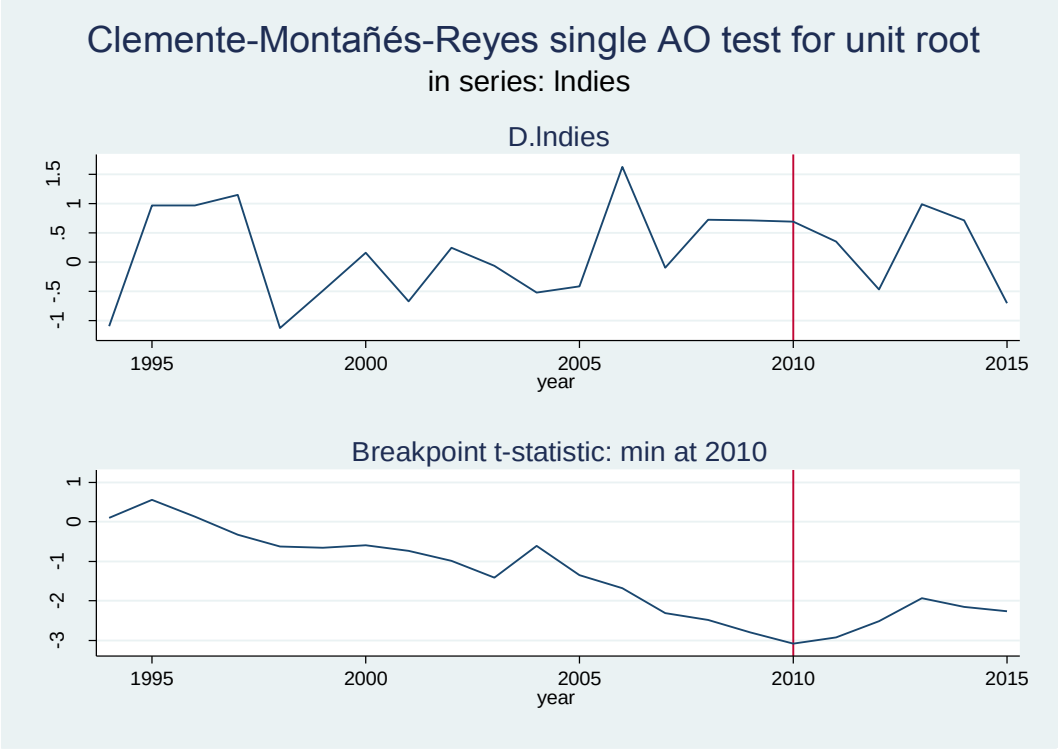


Figure 4.2 A line graph break point statistics and differenced log value of discounted external surplus.

The null is $H_o = (rho - 1) \neq 0$, which equivalent to the series has a unit root

Stata command, clemao2 lndid, trim(0.10) graph

Clemente-Monta-Reyes unit-root test with double mean shifts, AO model					
Variable	**lndid**	**T = 22 optimal**		**breakpoints : 2003 , 2007**	
AR(0)		**du1**	**du2**	**(rho - 1)**	**const**
Coefficients:		**-1.92969**	**-3.38991**	**-0.60881**	**20.38354**
t-statistics:		**-3.419**	**-5.882**	**-3.037**	
P-values: (5% crit. value)		**0.002**	**0.000**	**-5.490**	

Table 4.11. Zivot and Andrews unit root test output (innovative) on discounted external debt (natural log value)

This Zivot and Andrews unit root test is performed on level discounted external debt by allowing two structural breaks at 2003 and 2007, shown in figure 4.3 and it shows the discounted external debt has a unit root since for rho – 1 the critical value is greater than the statistical value at 5% significant level.

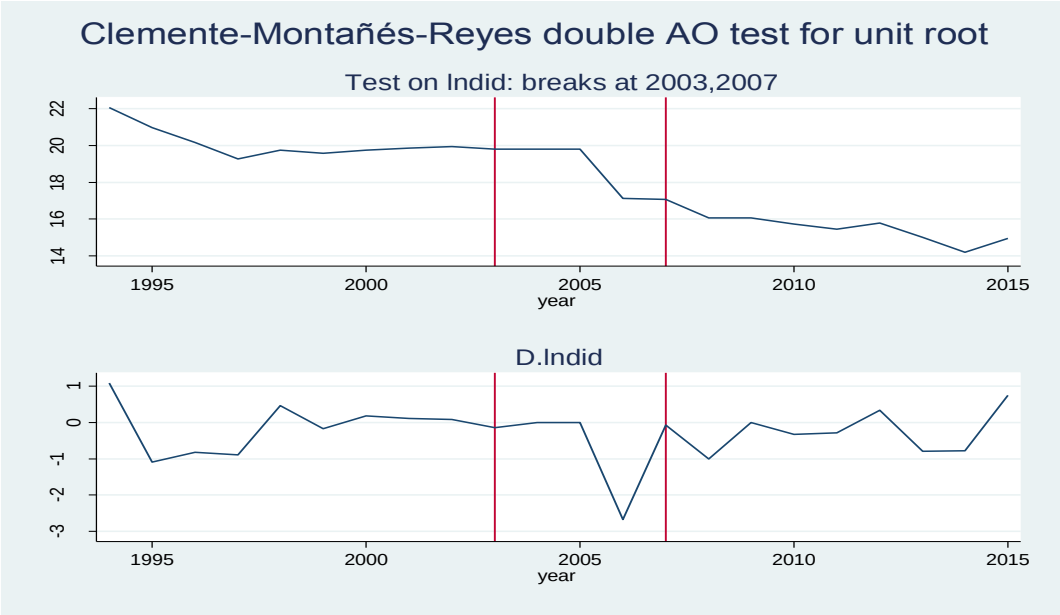


figure 4.3. A structural break test line graph that shows break point statistics for level and differenced log value of discounted external debt

The null is $H_o = (rho - 1) \neq 0$, which equivalent to the series has a unit root Stata command, lemao2 lndies, trim(0.10) graph				
Clemente-Monta-Reyes unit-root test with double mean shifts, AO model				
variable lndies	T = 22 optimal			breakpoints : 2007 , 2010
AR(0)	du1	du2	(rho - 1)	const
Coefficients:	1.91649	1.87274	-0.65789	-18.03887
t-statistics:	3.672	3.319	-3.089	
P-values: (5% crit. value)	0.001	0.003	-5.490	

Table 4.12. Zivot and Andrews unit root test output (innovative) on discounted external surplus (natural log value)

Table 4.12. shows Zivot and Andrews unit root test on discounted external surplus which allows two structural break at 2007 and 2010 which depicted in figure 4.4, and the test result shows that there is a unit root for external surplus at level since the critical value for rho – 1 is greater than its statistical value.

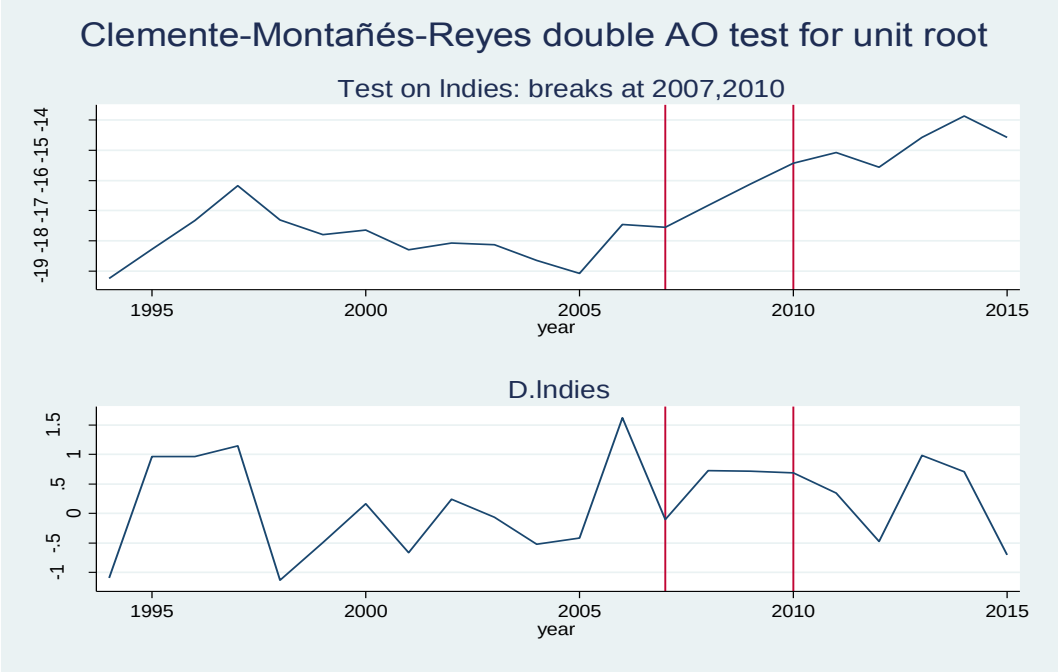


Figure 4.4. A structural break test line graph that shows break point statistics for level and differenced log value of discounted external surplus

4.2. Co-integration test on ARDL model

In this study, co-integration test employed to analyze the long run relationship of an external debt to GNP ratio with the ratio of trade balance to GNP, and trade balance with external debt. Jayme (2001) described that an external debt is sustainable if the two mentioned ratio co-integrated; and Trehan et.al, shown that an external debt is sustainable if trade balance and external debt are co-integrated.

Thus, two co-integration tests performed to see the sustainability an Ethiopian external debt. The tests employed on the two ARDL model stated in chapter three at equation 34 and 35. Both bond test and Gregory-Hansen test employed.

4.2.1. Bound test approach Co-integration test on ARDL model

In this paper, bound co-integration test performed for the two ARDL models, which stated in chapter three and it assumed there is no structural break in the model.

- ✓ **Bound test approach of Co-integration test on ARDL model one**

ARDL(p,q) $d_t = \iota + at + \sum_{i=0}^{p} \nu_i d_{t-i} + \sum_{i=0}^{q} \eta_i tb_{t-i} + \Phi_t$ general form of ARDL

Where

- ✞ d_t is debt GNP ratio at time t, in stata I uesd as "dgnpr"
- ✞ tb_t is trade balance GNP ratio at time , in stata as "tbgnpr"
    - Preconditions for bound test

→ Lags for individual variable stationarity test

To perform ARDL co-integration test, first the underlined variable has to be stationary at level or integrated of order one. In order to perform stationary test of the individual variables, first we choose the optimal lags of the dependent and independent variable so that to perform efficient unit root test.

- ❖ optimal lag for: d_t= dgnpr=1, by all lag selection criteria
- ❖ optimal lag for:tb_t= tbgnpr=3, by all lag selection criteria

→ stationarity test of the individual variables

- ❖ d_t= dgnpr= stationary at first difference I(1), ADF and PP unit root test, with one lag
- ❖ tb_t= tbgnpr= stationary at first difference I(1), ADF and PP unit root test with three lags

→ Optimal lags to the model

After we made stationarity test of the dependent and independent variables, the next steps to perform ARDL regression and bound test is selecting the optimal lags for the ARDL regression.

The optimal lags of the model is (4 4) by AIC criteria which gives the lost values among all lag selection criteria and both ARDL and EC estimation is done with lag combination of (4 4). See the result in appendix one and two.

- Bound test

After ARDL and EC estimation performed with lags (4,4) , then the bound test is done as displayed in table 4.13.

H_o: no level relationship				**F = 2.457** **t = -2.213**
	10%	5%	1%	p-value
	I(0) I(1)	I(0) I(1)	I(0) I(1)	I(0) I(1)
F	4.264 5.353	5.535 6.858	8.914 10.824	0.289 0.414
T	-2.536 -2.938	-2.944 -3.377	-3.826 -4.325	0.166 0.269

Table 4.13. Pesaran, Shin, and Smith (2001) bounds test on debt GNP ratio and trade balance GNP ratio.

Do not reject H0 if Both F and t are closer to zero than critical values for I(0) variables (if p-values > desired level for I(0) variables)

Reject H0 if Both F and t are more extreme than critical values for I(1) variables (If p-values < desired level for I(1) variables)

➢ **Decision**

We cannot reject the null hypothesis because the F and t values is less than and greater than the lower boundary respectively. We conclude there is no long run relationship between debt GNP ratio and trade balance GNP ratio.

- **Diagnostic test**

Since the model has no long run relationship we perform diagnostic tests only short run that is ARDL regression. The model is homskedastic ,stable, has no serial correlation and structural change.

- ✓ **Bound test approach Co-integration test for ARDL model two**

ARDL(p,q) : $D_t = \alpha + \sum_{i=0}^{p} \gamma_i D_{t-i} + \sum_{i=0}^{q} \theta_i TB_{t-i} + U_t$ general ARDL model

Where

- ✞ D_t external debt = used its log value since it is in billion at level =lnD_t
- ✞ TB_ttrade balance =used its log value since it is in billion at leve=lnTB_t

→ Lags for stationarity test

To perform ARDL co-integration test, first the underlined variable has to be stationary at level or integrated of order one and in order to perform stationary test of the individual variable first we choose the optimal lags of the dependent and independent variable so that to perform efficient unit root test.

- ❖ Optimal lag for lnD_t=1, by all lag selection criteria
- ❖ Optimal lag for lnTB_t=1, by all lag selection criteria

→ Statitionarity test

- ❖ lnD_t is Stationary at first difference I(1) with one lag
- ❖ TB_t is stationary at first difference I(1) with one lag

→ Optimal lags to the model

After we made stationarity test of the dependent and independent variables, the next steps, to perform ARDL regression and bound test is selecting the optimal lags for the ARDL regression. From the lag selection criteria AIC is the lowest among all lag selection information criteria and by using using AIC criteria the optimal lag of the model(4 4) is serially correlated as a result I used the alternative BIC criteria to find the optimal lags the model. The optimal lags of the model by BIC is lied on (1 0) thus, both ARDL and EC estimation is done with lag combination of (1 0). See appendix four and five

- Bound test

Both ARDL and EC estimations are made with lag (1 0) and the bound test also done based on this initial conditions. Its test values are shown in table 4.14 below.

H_o: no levels relationship							F = 1.578 t = -0.750	
	10%		5%		1%		p-value	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.8
T	-2.57	-2.91	-2.86	-3.22	-3.13	-3.50	-3.43	-3.82

Table 4.14. Pesaran, Shin, and Smith (2001) bounds test on external debt and trade balance

Do not reject H_o if both F and t are closer to zero than critical values for I(0) variables (if p-values > desired level for I(0) variables)

Reject H_o if both F and t are more extreme than critical values for I(1) variables (if p-values < desired level for I(1) variables).

- **Decision**

We cannot reject the null hypothesis since the value of F-statistics is less than the lower values of its critical value at all level of significance, similarly the t-statistics is higher than the lower bound of its critical value. Therefore, we can conclude that external debt and trade balance has no long run relationship.

- Post estimation test

Since the model has no long run relationship we perform diagnostic tests on for the short run i.e. for ARDL. The model is homskedastic, stable, has no serial correlation and structural change. See appendix 6

4.2.2. ARDL Gregory-Hansen co-integration test

This test employed to test the existence of co-integration between the dependent and independent variables with the assumptions of unknown break inclusion in the model. This test performed for double conformations of the results obtained from bound test co-integration approach, which was performed without considering structural break (except post estimation) test in the model. In addition this test endognize all shocks absorbed in the model, by bearing this variation, we employ Gregory Hansen test for the following two general ARDL models, which is stated in chapter three.

- ✓ **Gregory –Hansen co-integration test for ARDL model one**

ARDL (p,q) $d_t = \iota + at + \sum_{i=0}^{p} \nu_i d_{t-i} + \sum_{i=0}^{q} \eta_i tb_{t-i} + \Phi_t$ general form of ARDL

Where

- ✞ d_t debt GNP ratio at time t, in stata I uesd as "dgnpr"
- ✞ tb_t trade balance GNP ratio at time , in stata as "tbgnpr"
    - Preconditions for bound test

→ Lags for statioarity test of the individual variables

- ❖ optimal lag for: d_t= dgnpr=1, by all lag selection criteria
- ❖ optimal lag for:tb_t= tbgnpr=3, by all lag selection criteria

→ stationarity test

- ❖ d_t= dgnpr= stationary at first difference I(1), ADF and PP unit root test, with one lag
- ❖ tb_t= tbgnpr= stationary at first difference I(1), ADF and PP unit root test with three lags

→ Optimal lags to the model

After we made stationarity test of the dependent and independent variables, the next is selecting the optimal lags for the Gregory-Hansen co-integration test. The optimal lags of the model is (4 4) by AIC criteria which gives the lost values among all lag selection criteria and Gregory-Hansen co-integration test is done with AIC lag selection.

→ Gregory-Hansen test

i. Co-integration test at level shift

Statat command: ghansen dgnpr tbgnpr, break(level) lagmethod(aic)						
***H_o*= no co-integration with structural break** ***H_1*= there is co-integration with structural break**						
Model: Change in Level				**Number of obs =28**		
Lags = 1 chosen by Akaike criterion Maximum Lags =2						
	Test Statistic	**Breakpoint**	**Date**	**Asymptotic Critical Values 1%**	**5%**	**10%**
ADF	**-3.86**	**10**	**2000**	**-5.13**	**-4.61**	**-4.34**
Zt	**-3.62**	**12**	**2002**	**-5.13**	**-4.61**	**-4.34**
Za	**-15.81**	**12**	**2002**	**-50.07**	**-40.48**	**-36.19**

Table 4.15. Gregory-Hansen Test for Co integration between external debt GNP ratio and trade balance GNP ratio with Regime Shifts, change in level

- **Decision**

We cannot reject the null hypothesis since all test statistics (ADF, Zt and Za) are less than the critical values. Therefore, there is no co-integration at level with structural break.

ii. Co-integration test at regime shift

Statat command: ghansen dgnpr tbgnpr, break(regime) lagmethod(aic)						
H_o= no co-integration with structural break **H_1= there is co-integration with structural break**						
Model: Change in Level and trend				**Number of obs =28**		
Lags = 1 chosen by Akaike criterion Maximum Lags =2						
	Test Statistic	**Breakpoint**	**Date**	**Asymptotic Critical Values**		
				1%	**5%**	**10%**
ADF	**-3.79**	**5**	**1995**	**-5.47**	**-4.95**	**-4.68**
Zt	**-3.86**	**5**	**1995**	**-5.47**	**-4.95**	**-4.68**
Za	**-20.17**	**5**	**1995**	**-57.17**	**-47.04**	**-41.8**

Table 4.16. Gregory-Hansen Test for Co integration between external debt GNP ratio and trade balance GNP ratio with Regime Shifts, change in regime

- **Decision**

We cannot reject the null hypothesis because all the test statistics(ADF, Zt and Za) are less than corresponding critical values ,therefore there is no co-integration between variables.

iii. Co-integration test with trend shift

Statat command: ghansen dgnpr tbgnpr, break(trend) lagmethod(aic)						
H_o= no co-integration with structural break H_1= there is co-integration with structural break						
Model: Change in trend				Number of obs =28		
Lags = 1 chosen by Akaike criterion Maximum Lags =2						
	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-4.03	10	2000	-5.45	-4.99	-4.72
Zt	-3.28	12	2002	-5.45	-4.99	-4.72
Za	-14.20	12	2002	-57.28	-47.96	-43.22

Table 4.17. Gregory-Hansen Test for Co-integration between external debt GNP ratio and trade balance GNP ratio with Regime Shifts, change in trend

- **Decision**

We cannot reject the null hypothesis because all the test statistics(ADF, Zt and Za) are less than corresponding critical values ,therefore there is no co-integration between variables.

- ✓ **Gregory –Hansen co-integration test for ARDL model two**

ARDL (p,q) : $D_t = \alpha + \sum_{i=0}^{p} \gamma_i D_{t-i} + \sum_{i=0}^{q} \theta_i TB_{t-i} + U_t$ general ARDL model

Where

- ✞ D_t external debt = used its log value since it is in billion at level =lnD_t
- ✞ TB_ttrade balance =used its log value since it is in billion at leve=lnTB_t

→ Lags

- ❖ Optimal lag for lnD_t=1, by all lag selection criteria
- ❖ Optimal lag for lnTB_t=1, by all lag selection criteria

→ Statitionarity test

- ❖ lnD_t is Stationary at first difference I(1) with one lag
- ❖ TB_t is stationary at first difference I(1) with one lag

→ Optimal lags to the model

After we made stationarity test of the dependent and independent variables, the next steps, to perform Gregory-Hansen co-integration test is selecting the optimal lags. From the lag selection

criteria AIC is the lowest among all lag selection information criteria and by using using AIC criteria the optimal lag of the ARDL model(4 4) is serially correlated as a result I used the alternative BIC criteria to find the optimal lags of the model. The optimal lags of the model by BIC is used for Gregory-Hansen co-integration test.

In a similar way with ARDL model one, Gregory-Hanson test is also done for the second ARDL model and all the test results with different shifts the null hypothesis is not rejected, it indicates that there is no co-integration between external debt and trade balance. See the stata output in the appendix 7.

CHAPTER FIVE

5.1. Conclusion and Recommendation

5.1.1. Conclusion

This paper has studied the sustainability of Ethiopia the external debt by taking a historical yearly data from 1991 to 2018. As it discussed earlier, a sustainable external debt has defined as a countries ability to finance its current external debt bill from the present value of the future external surplus. This definition extended for econometrical analysis which equivalently define that an external debt is sustainable when three things are satisfied. The first is that an external debt is sustainable, when both discounted external surplus and discounted external debts are stationary. Second, when external debt GNP ratio and trade balance GNP ratio has long-run relationship (co-integrated). Finally, when the external debt and trade has shown long-run relationship (co-integrated).

In the this paper all econometric external debt sustainability criteria's has checked, but none of the sustainability conditions has satisfied as it is conformed from the econometrical test results. This condition shows that Ethiopia laying into being in apposition of owning unsustainable external debt and this result proves the joint work of IMF and IDA 2018 that alerting the external debt distress position of Ethiopia is highly risky.

Thus, this study deduces that Ethiopia's external debt is unsustainable.

5.1.2. Recommendation

Sustainability of an external debt is equivalent with free autonomy of deciding the liberty of a country without any interference and aggression. Olliver Vallee and Shain Vallee described that sustainability is identical to an authority, a new ideology and a new religion. A country with unsustainable external debt has no political autonomy, economical autonomy, cultural autonomy, religious autonomy and territorial autonomy. Over all, a country with unsustainable external debt is simply equivalent to a sub-country of other country or a colonized country.

Thus from the respect of severity of high external debt, the government officials, citizens and publics as a whole has to be consciously concerned to reduce external debt.

In order to alleviate the problem with in time, this study recommended the following general points:

- ✓ The government should reduce unproductive external loan
- ✓ The government should reduce foreign purchases
- ✓ The government has to promote indigenous products to substitute the foreign purchases
- ✓ The government has sanctioned the un necessary imports
- ✓ The government has to create citizens who loves his/her country so that it enables them to respect the government policy without a tight controlling system
- ✓ The citizens have to choose local goods and stop mal operations like black markets and send the remittance through official transactors.

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Appendix 1

OPTIMAL LAG SELECTION FOR ARDL MODEL TWO VARIBLES, DEBT GNP(DGNP) RATIO AND TRADE BALNCE GNP (TBGNPR) RATIO

```
. varsoc dgnpr tbgnpr

   Selection-order criteria
   Sample:  1995 - 2018                              Number of obs      =         24
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-182.676				16547.7	15.3897	15.4157	15.4878
1	-151.726	61.901	4	0.000	1755.79	13.1438	13.2219	13.4383*
2	-147.039	9.373	4	0.052	1674.41	13.0866	13.2168	13.5774
3	-144.675	4.728	4	0.316	1962.65	13.2229	13.4052	13.9101
4	-135.804	17.742*	4	0.001	1363.97*	12.817*	13.0514*	13.7005

```
   Endogenous:  dgnpr tbgnpr
    Exogenous:  _cons

. ardl dgnpr tbgnpr, lags(. .) aic maxlags(. .) matcrit(lagcombs)

ARDL(4,4) regression

Sample:     1995 -     2018                   Number of obs      =         24
                                              F(   9,     14)    =      55.39
                                              Prob > F           =     0.0000
                                              R-squared          =     0.9727
                                              Adj R-squared      =     0.9551
Log likelihood = -78.702874                   Root MSE           =     8.4136
```

dgnpr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dgnpr						
L1.	.9582675	.2008589	4.77	0.000	.527468	1.389067
L2.	-.0266522	.2339063	-0.11	0.911	-.5283314	.4750269
L3.	-.6951467	.1869638	-3.72	0.002	-1.096144	-.2941493
L4.	.4404769	.1318082	3.34	0.005	.1577764	.7231775
tbgnpr						
--.	-1.387727	.657406	-2.11	0.053	-2.797723	.0222689
L1.	-3.647393	.6890146	-5.29	0.000	-5.125183	-2.169604
L2.	3.182387	1.002085	3.18	0.007	1.033127	5.331646
L3.	-.3873534	.8063745	-0.48	0.638	-2.116855	1.342148
L4.	-.6757552	.3361485	-2.01	0.064	-1.396722	.0452116
_cons	-7.667868	4.68196	-1.64	0.124	-17.70967	2.373937

Appendix 2

ARDL AND EC ESTIMATION AND BOUND TEST FOR DEBT GNP AND TRADE BALANCE GNP RATIO

```
. ardl dgnpr tbgnpr, lags(4 4) ec

ARDL(4,4) regression

Sample:     1995 -     2018                 Number of obs     =         24
                                            R-squared         =     0.8364
                                            Adj R-squared     =     0.7312
Log likelihood = -78.702875                 Root MSE          =     8.4136
```

D.dgnpr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
dgnpr						
L1.	-.3230544	.146006	-2.21	0.044	-.6362061	-.0099028
LR						
tbgnpr	-9.025854	1.514571	-5.96	0.000	-12.27428	-5.777423
SR						
dgnpr						
LD.	.281322	.1617656	1.74	0.104	-.0656307	.6282746
L2D.	.2546697	.1250121	2.04	0.061	-.0134547	.5227941
L3D.	-.4404769	.1318082	-3.34	0.005	-.7231775	-.1577764
tbgnpr						
D1.	1.528115	1.420593	1.08	0.300	-1.518754	4.574984
LD.	-2.119278	1.211478	-1.75	0.102	-4.717641	.479084
L2D.	1.063109	.8703014	1.22	0.242	-.8035024	2.929719
L3D.	.6757552	.3361485	2.01	0.064	-.0452116	1.396722
_cons	-7.667868	4.68196	-1.64	0.124	-17.70967	2.373937

```
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship              F =  2.457
                                        t = -2.213

Critical Values (0.1-0.01), F-statistic, Case 3
```

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_1	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.84

```
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors
```

Appendix 3

POST ESTIMATION TEST OF BOUND TEST CO-INTEGRATION APPROACH AND ARDL ESTIMATION ON DEBT GNP RATIO AND TRADE BALANCE GNP RATIO

```
. estat bgodfrey, lags(4)

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
4	7.493	4	0.1120

H0: no serial correlation

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(23)     =     24.00
         Prob > chi2  =    0.4038

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	24.00	23	0.4038
Skewness	7.46	9	0.5895
Kurtosis	3.44	1	0.0638
Total	34.90	33	0.3780

```
. estat sbcusum

Cumulative sum test for parameter stability

Sample: 5 - 28                                  Number of obs =         24
Ho: No structural break
```

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	0.4546	1.1430	0.9479	0.850

Appendix 4

OPTIMAL LAGS SELECTION ON ARDL MODEL CONTAINING DEPENDENT VARIABLE (EXTERNAL DEBT) AND INDEPENDENT VARIABLE (TRADE BALANCE)

```
. varsoc lndt lntb

   Selection-order criteria
   Sample:  1995 - 2018                              Number of obs      =        24
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-60.4019				.621574	5.20016	5.2262	5.29833
1	-8.53949	103.72	4	0.000	.011545	1.21162	1.28976*	1.50614*
2	-4.30202	8.4749	4	0.076	.01143	1.19183	1.32206	1.68269
3	-.708127	7.1878	4	0.126	.012092	1.22568	1.40799	1.91288
4	4.48337	10.383*	4	0.034	.011419*	1.12639*	1.36079	2.00993

```
   Endogenous:  lndt lntb
    Exogenous:  _cons

. ardl lndt lntb, lags(. .) bic maxlags(. .) matcrit(lagcombs)

ARDL(1,0) regression

Sample:     1995 -     2018                   Number of obs     =         24
                                               F(   2,     21)   =      48.97
                                               Prob > F          =     0.0000
                                               R-squared         =     0.8234
                                               Adj R-squared     =     0.8066
Log likelihood = -3.7003225                    Root MSE          =     0.3018
```

lndt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lndt						
L1.	.915274	.1014358	9.02	0.000	.7043266	1.126221
lntb	-.0984964	.0545091	-1.81	0.085	-.2118542	.0148614
_cons	-.1705956	2.337707	-0.07	0.943	-5.032123	4.690932

Appendix 5

EC ESTIMATION FROM ARDL (1 0) MODEL CONTAINING DEPENDENT VARIABLE (EXTERNAL DEBT) AND INDEPENDENT VARIABLE (TRADE BALANCE).

```
. ardl lndt lntb, lags(1 0) ec

ARDL(1,0) regression

Sample:     1992 -     2018                 Number of obs     =         27
                                            R-squared         =     0.1162
                                            Adj R-squared     =     0.0425
Log likelihood = -2.9554952                 Root MSE          =     0.2863
```

D.lndt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ADJ						
lndt L1.	-.0710871	.0947731	-0.75	0.460	-.2666892	.1245149
LR						
lntb	-1.126928	1.525489	-0.74	0.467	-4.275384	2.021527
SR						
_cons	-.0672909	2.214251	-0.03	0.976	-4.637281	4.502699

```
. estat btest

note: estat btest has been superseded by estat ectest
      as the prime procedure to test for a levels relationship.
      (click to run)

Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship              F =  1.578
                                        t = -0.750

Critical Values (0.1-0.01), F-statistic, Case 3
```

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_1	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.84

```
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3
```

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_1	-2.57	-2.91	-2.86	-3.22	-3.13	-3.50	-3.43	-3.82

```
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors
```

Appendix 6

POST ESTIMATION TEST ON ARDL (1 0) AND EC MODEL CONTAINING DEPENDENT VARIABLE (EXTERNAL DEBT) AND INDEPENDENT VARIABLE (TRADE BALANCE).

```
. estat dwatson

Durbin-Watson d-statistic(  3,    27) =  1.719933

. estat bgodfrey, lags(1)

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.668	1	0.4136

H0: no serial correlation

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(5)      =      3.04
         Prob > chi2  =    0.6943

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	3.04	5	0.6943
Skewness	1.79	2	0.4090
Kurtosis	1.53	1	0.2158
Total	6.36	8	0.6073

```
. estat sbcusum

Cumulative sum test for parameter stability

Sample: 2 - 28                                  Number of obs =         27
Ho: No structural break
```

Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	0.4041	1.1430	0.9479	0.850

Appendix 7

GREGORY – HANSEN TEST RESULT FOR EXTERNAL DEBT AND TRADE BALANCE WITH CHANGE IN LEVEL, TREND AND REGIME

```
. ghansen lndt lntb, break(level) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Level                          Number of obs    =        28
Lags  =  0  chosen by Bayesian criterion        Maximum Lags     =         2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%           5%          10%
------------------------------------------------------------------------------
   ADF       -3.17          21       2011      -5.13        -4.61       -4.34
   Zt        -3.60          21       2011      -5.13        -4.61       -4.34
   Za       -18.15          21       2011     -50.07       -40.48      -36.19
------------------------------------------------------------------------------

. ghansen lndt lntb, break(trend) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Level and Trend                Number of obs    =        28
Lags  =  0  chosen by Bayesian criterion        Maximum Lags     =         2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%           5%          10%
------------------------------------------------------------------------------
   ADF       -3.19          21       2011      -5.45        -4.99       -4.72
   Zt        -3.60          21       2011      -5.45        -4.99       -4.72
   Za       -18.13          21       2011     -57.28       -47.96      -43.22
------------------------------------------------------------------------------

. ghansen lndt lntb, break(regime) lagmethod(bic)

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Regime                         Number of obs    =        28
Lags  =  0  chosen by Bayesian criterion        Maximum Lags     =         2

             Test       Breakpoint   Date        Asymptotic Critical Values
            Statistic                          1%           5%          10%
------------------------------------------------------------------------------
   ADF       -4.51          18       2008      -5.47        -4.95       -4.68
   Zt        -4.70          18       2008      -5.47        -4.95       -4.68
   Za       -25.62          18       2008     -57.17       -47.04      -41.85
------------------------------------------------------------------------------
```