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SCHOOL OF GRADUATE STUDIES

CAUSALITY ANALYSIS OF TERMS OF TRADE AND ECONOMIC GROWTH OF FIVE EAST AFRICAN COUNTRIES: VECTOR AUTOREGRESSIVE APPROACH

BY

YEKIN AHMED

JULY 2011

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CAUSALITY ANAYSIS OF TERMS OF TRADE ANDECONOMIC GROWTH OF FIVE EAST AFRICAN COUNTRIES: *VECTOR AUTO REGRESSIVE APPROACH*

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YEKIN AHMED

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

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By

Yekin Ahmed Ali

Approved by the Board of Examiners:

Advisor	**Signature**
Examiner	**Signature**
Examiner	**Signature**

DECLARATION

I, the undersigned, declare that this thesis is my original work and has never been presented for a degree in any other university and that all sources of materials used for this thesis have been duly acknowledged. The advisor's and examiners' comments have been duly taken in to account.

Declared By:

Name: _____

Signature: _____

Date: _____

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Name: _____

Signature: _____

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Place and Date of Submission: _____

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ABSTRACT

This thesis analyses causal linkages between terms of trade and economic growth in five East African countries using annual data for the time period 1980-2009. It also analyses the impacts of openness and financial development on economic growth and terms of trade. To achieve these objectives: unit root (ADF and PP tests), co integration (Johansen's procedure), and Granger-causality (Wald coefficient restriction test, χ^2 and F- statistics) are carried out. The results of the unit root tests show that the series of the interest are stationary in first differences. Co-integration and causality between terms of trade and economic growth are tested and compared using two types of bi-variate vector autoregressive models: models without exogenous variables VAR (p), and models with exogenous variables VARX (p, b). The results of co-integration tests on both types of bi-variate models show that two Granger-causality alternative models (VAR in first difference and Error Correction Models) fit for this study. In both types of models, Granger-causality (unidirectional or bidirectional causations) between terms of trade and economic growth are tested using Chi – square and F – statistics from Wald coefficient restriction test: terms of trade causes GDP and GDP causes TOT hypotheses are accepted in all countries investigated more for VARX (p, b) than for VAR(p). Openness, in this study, is found to result in negative growth in Ethiopia, Burundi and Rwanda and in positive growth in Sudan and Kenya; and also found to deteriorate terms of trade of Ethiopia and Rwanda while it has no impact on terms of trade of other countries. The economic growth impact of financial development is positive for Burundi and Kenya whereas, it is negative for Rwanda and insignificant for Ethiopia and Sudan. The terms of trade impact of financial development is positive for Burundi and Kenya, negative for Rwanda and null For Ethiopia and Sudan. This study lends support to export friendly outward and inward oriented policies whose long term impacts are yet to be observed.

INTRODUCTION

1.1 Back ground of the study

The proliferation of trade is in the interest of many countries around the world as a source of economic growth. The argument in favor of free trade is that openness promotes the efficient allocation of resources through comparative advantage, allows the dissemination of knowledge and technological progress, and encourages competition in domestic and international markets (Roberto C.el, 2005). Integrations of economies through trade make domestic economies sensitive to external swings of prices. Concisely, the terms of trade (export price relative to import price), which is the main transmission channel of external prices to the domestic economy, holds a strategic role in influencing the economic stability, where the impacts may impede growth and economic development of the country (Paradesh, 2006).

If a country's export prices rise relative to import prices, its terms of trade are said to have moved in a favorable direction, since, in effect, it now receives more imports for each unit of goods exported. The terms of trade, which depend on the world supply of and demand for the goods involved, indicate how the gains from international trade will be distributed among trading countries. An abrupt change in a country's terms of trade (e.g., a drastic fall in the price of its main export) can cause serious problems in its balance of payments. This change has acted adversely on developing countries; for example, African terms of trade deteriorated by over 30% between 1980 and 1989(ECA, 2004).

In recent years, East African countries have been enjoying the benefits associated with openness to the world market (e.g., increases in international demand for commodities and international oil and metal prices). Upward trends in growth as well as an improvement of the institutional environment and the governance of economies have also been registered. After almost two

decades of stagnation and decline, real GDP in East Africa countries such as Ethiopia, Sudan, Burundi, Kenya and Rwanda is now growing at an average rate of more than 7 percent a year and real per capita incomes are rising in all countries.

1.2 Statement of the problem

The 1980s and 1990s were decades of slow or negative growth in per capita GDP, worsening balance of payments, debt and financial crises, and declining competitiveness for most African countries particularly for countries of East Africa. Since the early years of this Millennium, however, new directions have been taken to reduce poverty and improve economic conditions in East African's countries and in 2007 Ethiopia's growth rate was about 11 percent, Sudan, Kenya and Rwanda each registered 7 percent growth rate and Burundi's growth rate was 4 percent. Admittedly, this rate is an improvement on past performances, due to the increase in global market prices of primary commodities including oil, higher growth in the agricultural sector and increase of international support to the continent, particularly in the form of aid. However, the rate remains low and growth in these countries is very fragile failing to reach the levels required to achieve the Millennium Development Goals (MDGs) and reduce poverty by half by 2015.

Progresses in the areas of education and health are still insufficient to achieve MDGs; maternal and infant mortality rates are yet alarming due to progression of epidemics such as HIV – AIDs and malaria. These countries also remain in a fragile situation with respect to food availability and security. On international trade front, these economies have been subjected to terms of trade shocks owing to fluctuations of international commodity prices, rise in import prices including oil (excluding Sudan as oil exporter after 2000).

For example, the decline in terms of trade in the 1980's translated into an average loss of 0.7 percent growth for African countries (Hadass Y. el. 2001). Another study by UNCTAD showed that coffee and sugar producers would have earned an additional $19 billion and $1.4 billion respectively, while West African cotton growers would have earned an additional $1 billion between 1999 and 2002 if prices had maintained their 1998 level and the decrease in primary commodity prices cost Africa six percent in annual average for investment coefficient and 50 percent of per capita income.

In spite of the improvements in recent years, African countries were unable to fully utilize the various trade preference schemes granted by developed countries due to the low diversification of trade structures and supply-side constraints; slow regional integration, poor infrastructure and poor financial domestic markets, etc.(ECA,2006). The fiscal and monetary policies in almost all the five countries have been striving to achieve low inflation and stable exchange rates, despite; this target has been challenged by fast domestic currency depreciation in countries such as Ethiopia.

So as to improve this fragile economic conditions and human welfare one strategy needed to be taken by many African countries is trade expansion through the encouragement of trade liberalization with other countries (Anderson, 2004).The economic argument for trade liberalization is that it help accelerate growth by promoting the competitiveness of domestic producers and speeding up these countries' integration into the global economy.

Given the importance of external trade and financial development in the national economies of the East African countries and the pivotal role of terms of trade movements in allocating gains from trade among trading parties, a detailed study of the empirical linkages between terms of trade, economic growth, openness and financial deeping is motivated to be investigated for

countries of Ethiopia, Sudan, Burundi, Kenya and Rwanda to see how openness as policy variable and financial development as institutional variable impact the GDP and TOT of respective countries.

1.3 Objectives of the study

The major objective of this thesis is to empirically examine the bi- directional impacts of terms of trade and economic growth on each other of five East African countries for the time period 1980-2009. Specifically, the objectives of this thesis are to:

1. Test for a causal linkage between terms of trade and economic growth , and
2. Test for impacts of openness and financial development on economic growth and terms of trade

1.4 Scope of the study

The thesis makes use of GDP, labor force, gross fixed capital formation, TOT, openness, and domestic credits provided for investment time series data to empirically test the growth impact of terms of trade and test the direction of causation between GDP and TOT of five East African countries for the time period spanning the years 1980-2009. It also examines what impacts do commercial policy as measured by total external trade of a country and the amount of domestic credits provided for investors as a proxy for financial deepening in an economy possess on GDP and TOT. The countries included in the study are: Ethiopia, Sudan, Burundi, Kenya and Burundi.

1.5 Hypothesis

This study intends to test the following hypotheses:

1. Terms of trade has positive impact on economic growth.
2. There is a bidirectional relationship between economic growth and terms of trade in the short run, long run and / or overall.
3. Openness and financial development have positive impacts on economic growth and terms of trade

1.6 Limitation of the study

The choice of countries to be investigated, methodology to be used and time period covered in this study depends on the availability of the data sources. The implication for this is that these are countries for which the required data on the variables of interest exist and the methodology is the best that fit this ground reality .As a result ,the analysis that can be made of this study will be confined geographically to the countries investigated and timely to the time period covered.

1.7 Outline of the thesis

The thesis is divided into five chapters: chapter one contains introduction, problem statement, objectives that leads to the study, the scope, hypothesis and limitation; the second chapter contains theoretical and empirical literature; Chapter three provides the methodology needed to carry out the study, including the selected economic theory and the econometric methods to be followed (unit root tests, co-integration test, and Granger-causality test) and data sources. Econometric results and descriptive analysis are presented in chapter four. The last chapter provides conclusions and policy implications drawn from the finding of the study.

LITERATURE REVIEW

2.1 Theoretical Literature

The changes to real incomes from terms of trade movements can be seen as difference between real GDP and real gross domestic income (RGDI). GDP in current prices represents the current value of both production and income in both open and closed economies ,whereas, RGDI measures the purchasing power of the total income generated by domestic production. Real GDP and real income, though equivalent in a closed economy, are not necessarily equivalent in an open economy. The difference between real GDP and real gross domestic income in the open economy arises from the deflation of the trade balance. Real GDP is computed by deflating the current value of the components of GDP by their respective implicit price deflators, *P*,

$$\text{RGDP}_t = {}^{C\,t}/_{Pt\,c} + {}^{It}/_{PtI} + {}^{Gt}/_{PGt} + {}^{Xt}/_{PtX} - {}^{Mt}/_{PtM} \qquad (2.1.1)$$

While Kehoe and Ruhl (2007) and, Reinsdorf (2009) computed real income as:

$$\text{RGDI}_t = {}^{C\,t}/_{Pt\,c} + {}^{It}/_{PtI} + {}^{Gt}/_{PGt} + {}^{(Xt-Mt)}/_{PtM} \qquad (2.1.2)$$

Where C_t , I_t , G_t, X_t , M_t are respectively consumption, investment , government, export and import at time period t and P_{tc} , P_{tI} , P_{tG} , P_{tX} and P_{tM} are their respective price levels.

For terms of trade improvement the amount by which RGDI exceeds RGDP and for terms of trade deterioration the amount by which the later exceeds the former respectively is the gain and the loss to economy due to terms of trade movement.

For countries in which either the terms of trade has been stable or trade is not an important factor in output, such as United States, real GDP and real GDI are similar (Kehoe and Ruhl , 2007).

For countries such as East Africa whose terms of trade has been unstable, real GDI offers an alternative way of viewing economic performance; RDI will grow(slow) significantly faster than RGDP in response to appreciation(depreciation) of terms of trade.

Although the changes to real incomes from terms of trade movements can be seen from deviation of the two above, the total economy-wide impacts of terms of trade movements are hard to quantify. Changes in the terms of trade can have different macroeconomic impacts depending on the composition of the relative price movements. If a fall (rise) in the terms of trade is due to a decrease (increase) in export prices, then this will initially impact on exporters before indirectly affecting households. However, if a fall (rise) in the terms of trade is a result of an increase (decrease) in import prices (for example, oil prices), this is likely to affect households and businesses more directly and the macroeconomic shock will be different (Grimes, 2006).

Movements in relative prices often trigger a production and resources shift away from one sector of the economy to another. The currency appreciation associated with an improvement in the terms of trade lowers the relative price of imported physical capital, particularly machinery and equipment, and encourages the substitution of capital for labor, which should contribute to higher labor productivity over time, other things being equal. This can lead to significant shifts

in production and employment toward sectors of the economy generating higher income, resulting in a loss of jobs in some industries and growth in others (Duguay, 2006).

While the effect of the reallocation of resources on real income is always positive, its effect on aggregate output is less clear. In the short run, the adjustment process can be expected to exert a transitory drag on productivity growth. For instance, workers with skills tied to a particular industry may require retraining in order to become fully functional in areas of the economy that are expanding. For one thing, the rise in price of non-tradables can be expected to lower productivity in this sector, as higher-cost—that is, less-productive—activities become more profitable. On the other hand, the reallocation of capital and labor away from the production of tradables goods toward the production of commodities should raise overall labor productivity, since labor productivity levels are higher in the more capital-intensive non tradable sector (Duguay, 2006). Thus, the impact on economic growth as resources shift from one sector to another is difficult to interpret, as they are likely to be coupled with productivity changes and therefore the sole impact of a relative price change is hard to quantify.

The dominant sets of theories predict a positive correlation between terms of trade and income growth. An increase in export prices relative to import prices allows a larger volume of imports to be purchased with a given volume of exports. The implied increase in the real purchasing power of domestic production is equivalent to a transfer of income from the rest of the world and can have large impacts on consumption, savings and investment. The terms of trade can also be thought of as a rate of return on investment and therefore a secular improvement in the terms of trade leads to an increase in investment and hence economic growth. Kehoe and Ruhl (2007) examine data for the United States and Mexico over the period 1970-2007 and see that sharp deteriorations in the terms of trade are accompanied by drops in real GDP and that most of these

drops in real GDP are driven by drops in TFP, not drops in factor inputs. According to Singer's (1950) observation an increases in the terms of trade can provide surpluses for long-term capital accumulation. One possibility is that if the terms of trade improves, the balance of payments constraint eases and the government grants more import licenses, so that investment increases because more capital equipment can be imported. Alternatively, improvements in the terms of trade raise domestic incomes and demand, inducing producers to invest in additional capacity (Bleaney and Greenaway, 2001).

Harberger (1950) and Laursen and Metzler (1950) were some of the first to model the impact of a terms of trade shock on an economy. They suggested that a deterioration in the terms of trade will reduce a country's real income (or increase real expenditure for a given income level) consequently decreasing savings and investment, through consumption smoothing behavior. This later became known as the Haberger-Laursen-Metzler effect (HLM). Obstfeld (1982) and later Kent and Cashin (2003) extended this idea and showed that the duration or persistence of terms of trade shocks are important when determining the effect on an economy. A longer or more persistent shock may result in lower investment and potentially higher saving in anticipation of lower future output. Angyridis and Mansoorian(2008) recover the HLM and assert that when representative agent has Marshallian preferences, with which the rate of time preference is a decreasing function of savings; higher savings reduce the rate of time preference and increase lifetime utility. Terms of trade deterioration reduces the permanent income of the representative agent and reduces savings, leading to a current account deficit.

The Harberger-Laursen-Metzler literature is interpreted as implicitly involving welfare judgments as proxied by measures such as expenditures and current account balance. Schubert and Turnovsky (2006) and Turnovsky (1991, 1993) seek to assess the welfare costs explicitly, by

evaluating the effect of terms of trade changes(anticipated and unanticipated) on the consumer's intertemporal utility as the economy transitions to its equilibrium path. Schubert and Turnovsky (2006) suggest deterioration in the terms of trade has two effects. First, a substitution effect induces consumers to switch their consumption from foreign to the relatively cheaper domestic good. The second effect is the associated income or wealth effect which also depends on the initial state of economy either as debtor or creditor, as a result of which decreases or increases consumption of imported goods. The wealth effect of terms of trade on growth suggests that the country that improves its terms of trade will save more, accumulate more capital, and eventually grow faster (Backus, Kydland, and Prescott, 1994). The consumers in the country that improves its terms of trade can buy more foreign (and domestic) goods. Since the propensity to consume out of wealth is assumed to be smaller than one, the increased wealth is partially directed towards future consumption, i.e. larger savings and more capital accumulation. The effect of the deterioration in the terms of trade is thus unambiguously positive for the domestic good but positive or negative for the foreign good, depending on whether or not the intertemporal elasticity of substitution exceeds unity. In the case of unitary intertemporal elasticity of substitution (log utility, $\gamma = 0$), the income and substitution effects are precisely offsetting and the consumption of the imported good is unchanged.

Schubert and Turnovsky (2006) and Turnovsky (1991, 1993) analyzed the impact of terms of trade changes on a small open economy based on the stochastic optimizing model. In this model terms of trade shocks have no dynamic effects case, the only response is that consumption fully adjusts instantaneously, with the current account remaining unchanged. The current account response to a terms of trade shock is shown to depend critically on a country's credit status i.e., whether it is a debtor or creditor. However, the major short coming of the model is that terms of

trade affect economy only through consumers' goods neglecting the direct impacts on production of terms of trade of productive inputs which are very important for countries such as East Africa.

Other theories predict a negative long run correlation between the terms of trade and growth, but for different reasons. One of the advocates of this theory was Hans Singer, who claimed that even if the terms of trade of primary products improved in short run, over the long run a positive terms of trade in primary-product-producing countries will reinforce comparative advantage, suck resources into the export sector from other activities, and cause de-industrialization (Singer 1950: p. 482). Fifty years later, the words we might use to describe this effect would be "industrialization crowding out or "Dutch disease." Thus, while an improving terms of trade would have augmented incomes in the short run, a good thing; it would also have suppressed industrialization in the long run, a bad thing. To the extent that industrialization is the prime carrier of capital-deepening and technological change, then Hans Singer was right to assert that positive external price shocks for primary producers will lower growth rates in the long run (Blattma el,2003).

Other economists have suggested the same result, but along different channels. Some have argued that resources are a "curse" to development, such that while an improvement in the terms of trade facing primary product exporters would increase the value of the resource base being exploited, poor growth would result. The notable explanation of natural resource curse theory was offered by Jeffrey Sachs and Andrew Warner (1995, 2001) who use the crowding-out logic, whereby primary production crowds out growth-enhancing alternative activities. They note that manufactures production and investment in human capital are the crowded out activities in many resource-rich economies and suggest that countries with great natural wealth tend to grow more

slowly than resource-poor countries: natural resources, and any terms of trade boom that raises their value, are therefore a curse to development.

As an alternative to the crowding-out theory, Anne Krueger (1974) famously argued that rent-seeking was a growth-suppressing tendency of resource-owning elites in poor countries. More concretely, Aaron Tornell and Andres Velasco (1992) have suggested that resource abundant poor countries have undeveloped property rights such that terms of trade booms get translated into capital flight so that gains (in particular rents) are transferred to rich countries for safekeeping. Hence terms of trade booms translate into capital flight. No one theory of the natural resource curse is universally accepted, however.

2.2 Empirical Literature

Mendoza (1997) examines the impact of terms of trade on economic growth in 40 industrial and developing countries (9 industrial countries and 31 developing countries) using cross-sectional and time series data for the period 1971–1991.One of the objectives of his study was to test the hypothesis established on the relationships between consumption growth and terms of trade by a model of a small open economy, that extends the savings-under-uncertainty framework of Phelps (1962) and Levhad and Srinivasan (1969). This is: The time-series hypothesis that consumption growth rates and rates of change of terms of trade are positively related over time within each country. The regression equation of the particular interest here is:

$$Consumption\ growth_{it} = \alpha + \beta\ (rate\ of\ change\ of\ TOT)_{it} + \varepsilon_{it} \qquad (2.2.1)$$

However, panel regressions of such estimation produce low R^2 or adjusted R^2 statistics. Note, however, that Easterly et al. (1993), Fischer (1993), and Barro and Sala-i-Martin (1995) find that the terms of trade is robust determinants of economic growth even in the presence of variables

that measure country characteristics and economic policies. Moreover, when these authors address simultaneity problems and apply instrumental variable methods, they find that treating the terms of trade as a truly exogenous variable does not alter the outcome of panel regressions significantly. Thus, the author provides this strong evidence to support the view that the contribution of the terms of trade to explain growth can be examined in a simple bivariate framework.

Consumption growth is deflated at both import and consumer prices and applied to data organized as geographical sub-samples: Industrial countries, Asia, Africa, Midle East and West Hemisphere; export base: commodity exporters and non commodity exporters and decade sub samples: 1971-1980 and 1981-1991. Box-Jenkins methods and Augmented Dickey-Fuller tests are employed on the data expressed as logarithmic first differences, to test the validity of the assumptions that consumption growth and the rates of change in terms of trade in each of the 40 countries are white-noise processes or stationary. (i.e., that consumption growth rates and rates of change in terms of trade are log-normal stationary processes, that the marginal propensity to save with respect to wealth is a time-invariant positive fraction, and that this marginal propensity to save varies with structural parameters and with the mean and variance of the terms of trade, linear technology and iso elastic preferences).

The general panel models: total, fixed-effects, and random-effects models show that terms of trade is a statistically significant explanatory variable of consumption growth for both types of consumption measures, whereas , the between-means models are the only ones that reject the hypothesis that the terms of trade explain growth. This is consistent with the finding of Fischer (1993) that the role of terms of trade is more significant in pooled regressions than in-between-

means regressions, and with the conjecture of de Gregorio (1992) that the terms of trade are irrelevant for explaining growth, which he derived from between-means estimation.

The time series regressions for both consumption deflators report terms of trade as believed to be a key factor in explaining growth and business cycles in industrial countries while the result is mixed and the coefficient is even negative for some developing countries. For some G-7 countries, the model explains more than 75% of the annual changes in per capita consumption growth at either consumer or import prices.

The results for panel models organized by geography show Pooled, fixed-effects, and random-effects models using data at import prices detect strong positive growth effects of terms of trade in the Western Hemisphere but not in Asia, Africa and the Middle East, while the data at consumer prices suggest the opposite. In both cases, the results for industrial countries show a significant effect of terms of trade on consumption growth. It is even the case that the hypotheses that the savings rate and the growth effects of terms of trade are similar across industrial countries cannot be rejected. Between-means models continue to perform poorly regardless of the manner in which the data are organized, and of whether consumption is measured at consumer or import prices.

The results for data organized according to export base indicate that regardless of the deflator used to measure consumption, the terms of trade are a significant determinant of growth for both commodity-based and non-commodity based exporters. Thus, the model is more robust to the ordering according to export base than to the ordering according to geography. As before, the model performs generally better when applied to industrial countries, or to diversified exporters, than when applied to developing countries or commodity exporters.

The results of the panel models for two sub-samples, 1971-1980 and 1981-1991, using data organized according to export-based and both consumer and import price deflators indicate that growth effects of terms of trade were generally stronger in the 1980s than in the 1970s, as previously argued by Easterly et al. (1993). Surprisingly, when the data are broken down into two sub-samples, the models for commodity-based exporters fail to detect a statistically significant link between the terms of trade and growth.

Bleaney and Greenaway (1999 and2001) examine the impact of terms of trade on investment and economic growth in 14 sub-Saharan African countries using cross-sectional data for the period 1980–1995. In their 2001 work, they modified the former equations as:

$$I_{it} = B_{it} + \beta_1 ln\, y_{it} + \beta_2 TOT_{it} + \beta_3 SDTOT_{it} + \beta_4 RER_{it} + \beta_5 SDRER_t + \beta_6 I_{it-1} + \beta_7 I_{it-2} + \varepsilon_{it} \quad (2.2.2a)$$

$$GRY_{it} = B_{it} + \beta_1 ln\, y_{it-1} + \beta_2 TOT_{it} + \beta_3 SDTOT_{it} + \beta_4 RER_{it} + \beta_5 SDRER_t + \beta_6 I_{it} + \varepsilon_{it} \quad (2.2.2b)$$

For country i , year t , country dummy, B_{it} , $investment,\ I_{it}$,growth of GDP, GRY_{it} terms of trade, TOT , standard deviation of terms of trade, SDTOT, real exchange rate, RER, standard deviation of real exchange rate, SDRER.

This later work is also estimated by instrumental variable and OLS method. Using fixed and random effects models of panel regressions they report the significance of positive terms of trade effects in investment and growth equations : when the terms of trade are more favorable, the

incentive to invest in the export sector is greater and is consistent with the interpretation of balance of payments constraints as a limiting factor in developing countries' growth (ŽEsfahani, 1991).The other explanatory variables are reported to have significant expected sign of impact on economic growth.

Blattman et al. (2003) analyze more than half a century of pre-World War II data, 1870–1938, for 35 countries (19 core and 16 periphery).Their objective is to test for asymmetric impacts of terms of trade in the periphery and in the core. The hypotheses are: secular terms of trade growth had a positive impact on growth, but it was *much* weaker in the periphery than in the core.

They run general regression model as follows:

$$GRy_{it} = \beta_0 + \beta_1 ln\, y_{\,it} + \beta_2 GRTOT_{it} + \beta_2 SDTOT_{it} + \beta_4 X_{it} + \beta_5 Y_t + \beta_6 Z_i$$

$$+ \ \beta_7 GRTOT_{it} * X_{it} + \beta_8 SDTOT_{it} * \mathrm{X/GDP} + \varepsilon_{\,it} \qquad (2.2.3)$$

for country *i* and decade *t*. *GRy* is the 10-year average growth rate in GDP per capita in percentage units, *GRTOT* represents the 10-year average growth in the terms of trade (also in percentage units), *SDTOT* is the standard deviation of the terms of trade over the 10-yearinterval, and *lny* is the natural log of GDP per capita in the first year of the decade. Other control variables, represented above by the *X* vector, include the share of primary product exports in total exports, which we will refer to by PP/X, and the export share in GDP, denoted X/GDP. Time and country fixed effects represented by Y and Z above respectively are included in order to control for unobserved characteristics in countries and decades. They did impose country fixed effects to capture *all* of growth fundamentals such as primary school enrollment rate, land labor ratio and openness since they are not the motivation here. In this regression TOT and SDTOT are interacted with the variables in X vector. The other independent variables (ln GDP per capita,

PP/X, X/GDP, % Kids in School) are taken from the first year of that decade, in an effort to avoid problems of causality and endogeneity.

The result is reported for subsamples dived as: core and periphery. The result of time and fixed effects estimate show that positive growth effects of TOT was much strong for the core implying that those countries specializing in primary product exports received smaller beneficial effects from terms of trade gains than did those specializing in manufactured exports (and especially so *within* the periphery). The impact of ToT was negative when interacted with PP/X. Thus, those countries specializing in primary product exports received smaller beneficial effects from terms of trade gains than did those specializing in manufactured exports (and especially so *within* the periphery). And also to account for country structural attributes that would generate different responses to the same terms of trade movement, marginal impact and to reflect both structural elements as well as the actual terms of trade experience of each region, actual impacts are estimated which show that for the same movement in terms of trade both in the core and periphery over the period 1870-1938 economic growth in is periphery is less by 0.2percentage. And also a decline in terms of trade experienced by the periphery represented a significant drag on economic growth during those seven decades.

Hadass and Williamson (2003) examine the relationship between terms of trade and economic growth using time series data for the period 1870–1940. They used the following regression:

$$\Delta \ln Y_{i,t-\tau} = \delta + \beta \ln Y_{i,t-\tau} + W_{i,t-\tau} + \eta_i + \xi_t + \varepsilon_{it} \qquad (2.2.4)$$

where $Y_{i,t}$, is the per capita GDP in country i , $W_{i,t}$ is a row vector of determinants of economic growth(labor ,capital, TOT ,Land- labor ratio ,etc), η_i is a country-specific effect, ξ_t is a period specific constant, and $\varepsilon_{i,t}$, is an error term. The variables in $W_{i,t}$ and the individual effect η_i are

proxies for this long-run level on which the country is converging, and the time dummy, ξ_t, is expected to capture global shocks affecting aggregate production function across the board.

They estimated two equations: (i) where wage is regressed on its lagged value as instrument and terms of trade and land labor ratio, (ii) where real GDP per capita is regressed on its lagged value as instrument and the same variables as the former. Furthermore, they use dummy variables in growth regressions to capture differences between the periphery) and the center and the terms of trade effect is explored in the conditional growth model by itself (a larger sample) and also interacted with the export-GDP ratio, the latter added to capture the size of the sector (a smaller sample).

The result from these estimates indicates positive short run impact for both, whereas the long run shows the differential center verses the periphery impacts of terms of trade which they interprets as: for the periphery, the short-run gain from an improving terms of trade was overwhelmed by a long-run loss attributed to deindustrialization; it reinforced primary product comparative advantage in the periphery - penalizing the sector which carried growth or "resource curse": caused capital flight and rent seeking in the primary producers, both of which diminished long run growth potential. And for the center, the short-run gain reinforced industrial comparative advantage in the center - favoring the sector which carried growth. Besides, they attempt to test the direction of causation between terms of trade and growth where they report the causation running from terms of trade to economic growth and not the opposite way.

Grimes (2006) examine the impact of terms of trade on economic growth in New Zealand using time series data for the period 1960-2004. Specifically they estimate(test) whether the annual rate of GDP growth (March years) is affected (a) by the level of the terms of trade at the start of the relevant March year, and (b) by the volatility (10 year moving quarterly standard deviation) of

the terms of trade to the relevant year. In measuring the level of the terms of trade, it makes very little difference whether to use the raw series or the natural logarithm (ln) of the series; so choose the logarithmic form to aid interpretation of the results. Brueush –Goldfrsey test is employed on residuals to test for any sign of mis specification of the equation to be estimated and adopted the following estimate from among the alternatives:

$$\Delta \ln (\text{GDP})_t = \beta_0 + \beta_1 \ln (\text{TOT})_1 + \beta_2 (RMP10)_t + \varepsilon_t \qquad (2.2.5)$$

where Δln(GDP)t is the annual growth rate in GDP between year t-1 and year t, ln(TOT)t is the logarithm of the terms of trade at the start of year t, $RMP10$t is the 10 year moving standard deviation (up to year t) of real import price index ε_t is an i.i.d. error term with standard properties. Here lags of both dependant and independent variables are found not statistically significant from zero and therefore, no sign of dynamic mis-specification here. The results from the estimate show annual GDP growth over 45 years can be explained by the level of terms of trade and the relationship is robust across four economic regimes.

Urban (2007) examines theoretically and empirically the medium and long run relationship between terms of trade and income in industrialized countries by employing co integration analysis based on the data from Japan and U.S covering the years 1971 to 1997 . The study offers two theoretical channels, which relate the terms of trade to income growth in a stochastic and dynamic general equilibrium model. The first one is home market effect, which predicts that countries with a faster economic growth will have real appreciation of their terms of trade whereas, the second is the productivity shock effect, that predicts countries with a faster economic growth will have real depreciation of their terms of trade. The productivity-shock

model implies a negative long-run relation of relative income growth and terms of trade, while the home market effect model implies a positive long-run relation.

Shuxiao, and Ying (2004) adopt the methods of Co-integration and Granger Causality Test to test the relationship between terms of trade and economic growth in China using time series data for the time period 1980-2004. In order to avoid appearing "false regression", make the tendency for co-integrated relationship linear, and eliminate the heteroskedasticity in the time series, they make a change by taking logarithm of original data on GDP and terms of trade as follows:

$LNGDP = Log(GDP)$ (Natural logarithm of real GDP fixed price 2000=100)

$LNNBTT = Log(NBTT)$ (Natural logarithm of net barter terms of trade fixed price 2000=100)

They use ADF test to test LNGDP time series and LNNBTT time series of unit root test before testing the existence of stable and long-term relationship between LNNBTT and LNGDP, by Engle-Granger two-step test method which was used by Engle and Granger in 1987 to check out whether there is the co-integrated relationship. These are: (i) get the equation with OLS to LNNBTT and LNGDP by regression analysis,(ii) then make unit root test on residual series of this equation, and get the results. Some of the economic variables show their significant correlation, but it doesn't mean that they are all meaningful. Therefore, there is the need to distinguish and test the established model, so that one can judge whether they accord with the original presupposition and economic significance. The requirements for Granger Causality Test are that there must exists dynamic equilibrium of long-term and stable relationship between the two variables. For the last test they report that GDP is the Granger Cause of NBTT, and LNNBTT is not the Granger cause for LNGDP. This is to say that China's economic growth has

the remarkable influence on the terms of trade, whereas the effect terms of trade has on economic growth clear.

Cakari(2009) investigates the impact of terms of trade on economic growth of 18 emerging market economies using dynamic panel data model for the period 1990-2004.He employed Generalized Method of Moment to deal with country specific and endogeneity of repressors and run the following two regressions: the first one to investigate the importance of determinants of growth in endogenous growth model and in the second regression each variables of the model is interacted with terms of trade to see the complimentary effect of the explanatory variables on economic growth.

$$Growth_{it} = \alpha(Growth)_{it-1} + \beta_1 edu_{it} + \beta_2 fin_{it} + \beta_3 gov_{it} + \beta_4 inf_{it} + \beta_5 inv_{it} + \beta_6 TOT_{it} + V_{it} \quad (2.2.6a)$$

$$Growth_{it} = \alpha + \beta_i(cv)_{it} + \beta_i(Z)_{it} * TOT_{it} + V_{it} \quad (2.2.6b)$$

The term *cv* represents the explanatory variables as presented in equation (2.2.6a) and *(z)it* is a subset of the variables in *cv* and includes the educational enrolment, financial depth, government expenditure, and inflation rate. The estimate of (2.2.6a) prove positive significant effect of terms of trade and the estimate of (2.2.6b) report financial depth, inflation and terms of trade are not statistically significant which means they do not have any impact on economic growth whereas, the complimentary on economic growth impact of terms of trade, government expenditure, investment and education is significant .

Wong (2010) used Johansen (1988) co integration and the generalized forecast error variance decomposition methods to examine the impact of terms of trade and terms of trade volatility on

economic growth in Japan and Korea using time series data for the period 1960-2006 and 1971-2006 respectively. The equation used to investigate terms of trade impact is;

$$LnY_t = \beta_0 + \beta_1 LngK_t + \beta_2 LngL_t + \beta_3 LnToT_t + \beta_4 LnFID_t\ \varepsilon_t \quad (2.2.7)$$

Where Ln is the natural logarithm, *Yt* is real GDP per capita, *Kt* is capital, *Lt* is labour, TOT*t* is terms of trade, FID*t* is financial development and the coefficients of capital, labour, terms of trade, and financial development are expected to be positive (Harrison 1996; Blattman et al. 2003, 2004, 2007; Ang and Mckibbin 2007). The stationarity of the data is examined by The Dickey and Fuller (1979) (DF) and Phillips and Perron (1988) (PP) unit root test statistics.Johansen (1988) cointegration method is used to examine the long-run relationship between terms of trade and realGDPper capita. The cointegration method is able to test the existence of more than one cointegrating vector in a system (Johansen 1988). The generalised forecast error variance decomposition and generalised impulse response function (Koop et al. 1996; Pesaran and Shin 1998) are used to examine the relationship of variables in a system.

Statistical significance of the coefficient of explanatory variable is tested by likelihood ratio test statistic and proved that the explanatory variables are generally important to be included in the estimation mostly at 1,5, and 10 percent level. For Japan, all explanatory variables are found to have the expected signs, except the financial development. Real GDP per capita and terms of trade are jointly determined. And For Korea, all explanatory variables are found to have the expected signs, except labor and financial development. Real GDP per capita and terms of trade are jointly determined.

In general the finding that an increase in terms of trade will lead to an increase in economic growth is consistent with the findings of Blattman et al. (2003,2004), and Hadass and

Williamson (2003), amongst others. Nonetheless, the impact of terms of trade on economic growth is found to be higher in a relatively small open economy than a relatively large closed economy.

METHODOLOGY AND MODEL SPECIFICATION

3.1 Theoretical Model Specification

The international trade theory (Neoclassical Trade Theory) is based on the principle of comparative advantage of David Ricardo, which states that a country has a comparative advantage in producing a good if the opportunity cost of producing that good, in terms of another good, is lower in that country than it is in other countries. In the H-O-S model, trade can take place due to comparative advantage which is explained through differences in relative factor endowments-factor abundance such that a country will produce and export the good whose production makes intensive use of the relatively abundant factors of production before trade. This country should limit the production and increase the imports of the good whose production makes intensive use of the expensive factor of production before trade (Appleyard et al., 2001). A country will gain from trade whenever its terms of trade (TOT) is different from its own relative prices in autarky. A country with different terms trade of has the advantage of expanding the production of the factor abundant good, exporting the good more acceptable in other countries, and importing the good that is relatively more expensive to produce at home. Countries can achieve better results by specializing themselves in the productive activities in which they are relatively more efficient. The central idea is that the higher specialization and the expansion of the markets, through free trade, would increase efficiency and provide economy of scale gains.

Thus, given that the East African countries possess an abundant endowment of low qualification labor force, the specialization of the economy in the production of primary products for export combined with the import of manufactured products from the developed countries became a widespread strategy in the region. The basic idea is that the technical

progress generated in the developed countries would reach these countries, through reduction of the prices of industrialized goods. Moreover, the lower incorporation of technology in the production of primary products and the increasing demand from the developed countries would contribute to the rise of the prices of these products (Souza, 1997, p. 199). As a result of Neoclassical Trade Theory's predictions, the terms of trade improvement had been occurred and would have catalyzed the development of the Sub Sahara African countries in general and these East African countries in particular. Nevertheless, owing to its adequacy in explaining what governs movement of goods across countries, it fails to predict deterioration in terms of trade of primary commodities exporting countries and factors that determine movement in terms of trade. Besides the contributions to GDP of capital, labor and terms of trade, it is important to look for the role of commercial policy as embodying technological transfer and financial institutions for mobilizing domestic resources.

Trade liberalization: eliminates distortions and leads to a better allocation of the resources; tends to facilitate the acquisition of inputs, intermediary products and new technologies; will increase the supply of foreign capital and may raise the domestic welfare; and, if the country was already rich , it allows the countries to explore increasing returns to scale in the R&D sector and will raise terms of trade simply through the expansion of the market (Harrison, A, 1996).

Financial systems: facilitate the trading, hedging, diversifying, and pooling of risk; allocate resources; monitor managers and exert corporation control; mobilize saving; and facilitate the exchange of goods and services (Wong, 2010). The increased availability of financial instruments and institutions reduces transaction and information costs in an economy.

In contrast with the examples in which terms of trade affects economic growth, we can also think of a reverse causal relation between these variables. The India economist Jagdish Bhagwati connects the terms of trade with economic growth and put forward the proposition of "immiserizing growth". Johnson (1955) claims that deteriorating terms of trade are just a consequence of a country's faster output expansion. When countries produce different homogenous products, many international trade theories predict that output expansion due to technological progress or factor accumulation worsens a country's terms of trade. This result is clearly observed in the Ricardian model by Dornbusch,Fischer and Samuelson (1977), its adaptation by Krugman (1985), a Heckscher-Ohlin model with complete specialization, or whenever the Armington's assumption is used to distinguish goods by country of origin(Debaere el.2003). The intuition for declining terms of trade is straightforward. To sell additional output on world markets, all else equal, a country slides down the world demand for its products and lowers its export price. Alternatively, if more output means more income and higher import demand, import prices will rise.

However, Krugman (1989) and Debaere and Lee have argued that output increases do not necessarily lead to decreasing terms of trade if they take the form of more production and exports of new varieties (or higher-quality goods). In this case an increase in a country's aggregate supply (with unobserved increasing product variety) will be accompanied by rising demand for the country's goods and an improvement in its terms of trade. This is consistent with new trade theory that predicts intra-industry trade (in product varieties) especially among industrialized countries and also with Feenstra (1994) who expect higher quality production in richer countries.

And also, because, there exist some mechanisms through which commercial opening can generate dynamic gains as stated above, therefore, it could affect the terms of trade. A sound financial system also as well is important institutional variable that could affect terms of trade movement.

In this theoretical specification, the impacts of terms of trade, trade openness and financial development on economic growth and the vice versa impacts of economic growth, openness and financial development on terms of trade are examined based on an augmented neoclassical production function with terms of trade, openness and financial development as additional factors of production. Openness and financial deepening are included as policy and institutional variables affecting the two variables as capturing international technology diffusion and domestic financial investment environment respectively. The production function is specified as,

$$Y=F(K, L, TOT, OPP, FID) \quad (3.1)$$

Where Y= aggregate output (real GDP,), K is capital, L is labor force, and TOT is terms of trade, OPEN is openness and FID is financial deepening. Because of their importance in production, economic theory says that capital and labor have positive effects on overall output. Because of their externalities OPEN and FID might have a positive or a negative effect on GDP and TOT. In short run TOT has positive impact on aggregate output but in the long run may have negative impact as well. The impacts of aggregate output on TOT may be positive or negative in each time period signaling that the growth in output is attributed to technological innovation or to growth in factor accumulations respectively.

3.2 Empirical Model Specification

3.2.1 Vector Autoregressive Models

Vector auto regression (VAR) is an econometric model used to capture the evolution and the interdependencies between multiple time series, generalizing the univariate AR models. All the variables in a VAR are treated symmetrically (as ***endogenous***) by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. Based on this feature, Sims (1980) advocates the use of VAR models as a theory-free method to estimate economic relationships, thus being an alternative to the incredible identification restrictions in structural model. The general form of the VARX (p, b)[1] model with deterministic terms and exogenous variables can be specified as below:

$$\boldsymbol{Yt = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots \ldots + \beta_p Y_{t-p} + \Phi D_t + \alpha_0 X_t + \alpha_1 X_{t-1} + \ \ldots \ \ \ldots + \alpha_s X_{t-s} + \varepsilon_t} \quad \textbf{(3.2)}$$

Where **Yt** = an (n×1) vector of time series variables.

β_i = are (n×n) coefficient matrices and

α_i = are (nxm) coefficient matrices

$\boldsymbol{\varepsilon_t}$ = an (n×1) unobservable zero mean white noise vector process (serially uncorrelated or independent) with time invariant covariance matrix Σ.

Dt = an (l × 1) matrix of deterministic components,

X_t = an (m × 1) matrix of exogenous variables, and Φ and α are parameter matrices.

Within VAR frame work Granger Causality analysis is employed to investigate the causal relationship between TOT and economic growth. In a two variable universe, Y is said to cause TOT in the Granger sense if the one-step ahead forecast of TOT improves by taking into account

[1] P and b are lag lengths for endogenous and exogenous variables respectively

the historical values of Y. Bi-variate models without exogenous variables will be developed because of their simplicity and because they are frequently used in applied works related to co-integration, causality and other studies requiring econometric analysis for pair series (Zapata and Rambaldi, 1997).

$$\boldsymbol{LnY_t = b_{10} + \sum_{i=1}^{p} \Phi 1i\, lnY_{t-i} + \sum_{j=1}^{p} b1j\, lnTOT_{t-j} + \varepsilon_{1t}} \quad (3.3a)$$

$$\boldsymbol{lnTOT_t = b_{20} + \sum_{i=1}^{p} \Phi 2i\, lnY_{t-i} + \sum_{j=1}^{p} b2j\, lnTOT_{t-j} + \varepsilon_{2t}} \quad (3.3b)$$

However, in this augmented neoclassical production function capital, labor openness and financial deepening are assumed to be inputs of production. Therefore, VAR models with current exogenous variables will be introduced into the analysis to account for the importance of the variables in the production function as inputs and not as endogenous variables. Developing bi-variate models with exogenous variables will allow for comparing their results to those that will be obtained from bi-variate models without exogenous variables. Bi-variate models with exogenous variables are also introduced to reduce the problems of possible misspecification and multicollinearity in the data (Lopete, 2004). Bi-variate models with exogenous variables with b-lags for each exogenous variable are formulated as:

$$lnY_t = b_{10} + \sum_{i=1}^{p} \Phi 1i lnY_{t-i} + \sum_{j=1}^{p} b1j\, lnTOT_{t-j} + \sum_{n=0}^{b} \lambda 1n\, lnGFCF_{t-i} + \sum_{m=0}^{b} p1m\, LAB_{t-m} + \sum_{k=0}^{b} w1k\, OPP_{t-k} + \sum_{r=0}^{b} u1r\, FID_{t-r} + \varepsilon_{1t}$$

(3.4a)

$$lnTOT_t = b_{10} + \sum_{i=1}^{p} \Phi 2i lnY_{t-i} + \sum_{j=1}^{p} b2j\, lnTOT_{t-j} + \sum_{n=0}^{b} \lambda 2n\, lnGFCF_{t-n} + \sum_{m=0}^{b} p2m\, LAB_{t-m} + \sum_{k=0}^{b} w2k\, OPP_{t-k} + \sum_{r=0}^{b} u2r\, FID_{t-r} + \varepsilon_{2t}$$

(3.4b)

Both types of models are called bi-variate because of the number of dependent variables in the VAR models (GDP and TOT in both cases). If the b_{1j} are jointly significant but areΦ_{21} not, there is unidirectional causality from TOT to GDP. On the other hand, if areΦ_{2i} jointly significant but b_{1j} are not, there is unidirectional causality from GDP to TOT. There is bi-directional causality between the two variables if both sets of coefficients of the lagged independent variables are jointly significant in their respective equations.

The standard OLS regression techniques of VAR models are based on the assumption that both the dependent and independent variables are stationary and that the errors have zero mean and constant variance. Therefore, a common concern in standard regression models is the presence of unit roots in the series since most economic time series normally behave with stochastic trends. The presence of non-stationary variables (unit roots) will lead to spurious regressions[2], where the results obtained are evidence of contemporaneous correlations rather than true causal

[2] A spurious regression has high R_2, t-statistics that is significant, but with no significant economic meaning.

relationship between the variables in the model resulting in invalid statistical test(i.e t and F tests). Hence, before proceeding any further it is imperative to ensure that the underlying data generating process are stationary at respective order of integrations. Two of the widely used unit root tests will be applied to this study: the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. With evidence of unit roots, the series are said to be non stationary at respective integration order, meaning that they must be modeled in consecutive differences (Δyt, Δ(Δyt) , etc) till they achieve stationaritiy. Each type of the test is summarized below.

3.2.2 Augmented Dickey- Fuller Tests

This involves OLS estimate of the following generalized autoregressive model with a drift (intercept) to test for unit roots in the series, because the t- statistics has the standard t-distribution under such case. The error term in this equation is assumed to be independent (White noise)[3] with equal variance.

$$\mathbf{\Delta y}_t = \alpha + \boldsymbol{\gamma y}_{t-1} + \sum_{i=1}^{p-1} \boldsymbol{\beta}\ \mathbf{i}\ \mathbf{\Delta y_{t-1}} + \boldsymbol{\varepsilon}_t \qquad (3.5)$$

Where, p is the number of lags,

$$\boldsymbol{\gamma} = \sum_{\mathbf{j=1}}^{\mathbf{p}} \mathbf{bj} - \mathbf{1}, \boldsymbol{\beta}_i = \sum_{j=i+1}^{p} \boldsymbol{bj}$$

In this equation the parameter of interest is $\boldsymbol{\gamma}$. If this coefficient is not significantly different from zero, the series contains unit roots—I(1) or non-stationary. The null hypothesis that y is generated by unit root process, i.e. $\boldsymbol{\gamma}$= 0 will be tested. Failing to reject these null hypotheses implies that the series in levels are non-stationary and they must be modeled in first

[3] White noise process: a sequence of a variable is said to be white noise if the values in the sequence are serially uncorrelated, have mean zero, and variance σ^2.

differences—I(1), to make them stationary. Rejecting these hypotheses (calculated t-statistics greater than critical values) implies that the series are stationary and they must be modeled in levels (actual data) making them I(0).

Phillips-Perron Tests

Phillips and Perron (1998) provide an alternative test for the unit roots that is robust to a wide variety of stochastic processes for the disturbance term and consider less restriction on the distribution of the disturbance term (Enders, 1995). The Phillips-Perron (PP) test is based on the following equation:

$$y_t = \alpha + \rho y_{t-1} + \varepsilon_t \qquad (3.6)$$

The tests assume that the expected value of the error term is equal to zero, but PP does not require that the error term be serially uncorrelated. Phillips and Perron derive test statistics for the regression coefficients under the null hypothesis that y is generated by unit root process, i.e ρ=1. The critical values of PP tests are similar to those given for DF tests.

3.2.3 Co-integration Test

If individual time series turn out to be non-stationary in their levels (contain stochastic trends), it is possible that stochastic trends are common across series leading to stationary combinations of the levels. For instance, in a bi-variate set up, a linear combination of two variables may be stationary even though each variable follows a random walk process. This is known as co integration [4]. More formally, consider two series, and, both integrated of order one. According to Engle and Granger, if a linear combination, $Z_t = X_t - \delta y_t$ is I(0) then $Y_t$and X_t are said to be

[4] The concept of Co integration was introduced by Granger (1981) and further developed by Engle-Granger (1987) and Johansen (1988), where the latter manages to nest the concept into the vector autoregressive model. Many aspects of the theory have been developed since then, as they arose from economic hypotheses of interest, several of these can be found in Johansen (1996).

cointegrated. Tests for cointegration are carried out by using the Johansen's testing procedure which involves the estimation of a vector error-correction model (VECM) in order to obtain the likelihood ratios (LR). To describe this procedure, consider the following vector auto-regression (VAR) of order p:

$$\boldsymbol{Yt = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots \ldots + \beta_p Y_{t-p} + \varepsilon_t} \quad (3.7)$$

The above VAR can be written alternatively as:

$$\mathbf{\Delta y}_t = \mathbf{\Pi} \boldsymbol{y}_{t-1} + \sum_{i=1}^{p-1} \mathbf{\Gamma\, i\, \Delta y_{t-1}} + \boldsymbol{\varepsilon}_t \quad (3.8)$$

$$\mathbf{\Pi} = \sum_{\mathbf{j=1}}^{\mathbf{p}} \mathbf{Bj} - \mathbf{I_k}, \boldsymbol{\Gamma_i} = -\sum_{\boldsymbol{j=i+1}}^{\boldsymbol{p}} \boldsymbol{Bj}$$

where *yt* = (kx1) vector of variables (β1yt-1, β2yt-2,…βpyt-p), ε*t* is the independent and identically distributed n-dimensional vector with mean zero and variance equal to matrix Σ ε, Π = (αβ') is the number of independent co-integrating vectors, where the elements of α are the adjustment parameters in the error-correction model, and β contains the co integrating vectors. Johansen's procedure relies on the rank of Π and its characteristics roots:

i. If rank (Π) = 0, the matrix is null (no co-integration) and equations in vector y_t are common VAR in first differences.
ii. If Π has full rank (Π = k), the vector process is stationary and the equations in yt are modeled in levels—I(0).
iii. If rank (Π) = 1, there is evidence of a single co-integrating vector.

Johansen drives two test statistics to test co-integrating rank:

Trace test

$$\boldsymbol{\lambda_{trace}(r) = -T\sum_{i=r+1}^{k} ln(1-\lambda_i)} \quad \textbf{, and} \tag{3.9}$$

Maximum eigen value test

$$\boldsymbol{\lambda_{max}(r, r+1) = -T\sum ln(1-\lambda_{r+1})} \tag{3.10}$$

Where λ r+ 1…, λn are the (k - r) smallest estimated Eigen values. In both tests, λ represents the estimated values of the characteristic roots obtained from the estimated Π matrix, and T is the number of observations. The trace test attempts to determine the number of co-integrating vectors between the variables by testing the *null hypothesis* that r = 0 against the alternative that r > 0 or r ≤ 1 (r equals the number of co-integrating vectors). The maximum Eigen value tests the *null hypothesis* that the number of co-integrating vectors is equal to r against the alternative of r+1 co-integrating vectors. If the value of the likelihood ratio is greater than the critical values, the null hypothesis of zero co-integrating vectors is rejected in favor of the alternatives. Overall, evidence of co-integration indicates unidirectional or bidirectional causation between variables (Howard, 2002).

3.2.4 Granger- Causality Tests

In this paper two types of models: bi- variate VAR – D models without exogenous variables and bi – variate ECMs with exogenous variables are developed based on the co integration tests.

3.2.4 .1 VAR in First Difference Models

The VAR – D model applies to the non- stationary series whose linear combinations are not found stationary or zero, that is, the variables are not co integrated.

$$\Delta lnY_t = b_{10} + \sum_{i=1}^{p} \Phi 1i\, \Delta lnY_{t-i} + \sum_{j=1}^{p} b1j\, \Delta TOT_{t-j} + \varepsilon_{1t} \quad (3.11a)$$

$$\Delta lnTOt_t = b_{20} + \sum_{i=1}^{p} \Phi 2i \Delta lnY_{t-j} + \sum_{j=1}^{p} b2j\, \Delta TOT_{t-j} + \varepsilon_{2t} \quad (3.11b)$$

3.2.4 .2 Vector Error Correction Models

The Vector Error correction Model (VECM) applies to series that are I(1) and co-integrated (Engle and Granger, 1987). In such case, VECM should be estimated to account for the variable deviations from equilibrium, a mechanism that brings the economies back to equilibrium. The ECM is used to estimate the significance of the error term in the co integrating vector(s) to see how quickly the series adjust to their long-run equilibrium condition. To correct for disequilibrium in the co-integrating vector(s), the residuals from the equilibrium regressions should be used to estimate the VECM (Engle and Granger, 1987). The following VECMs with exogenous variables will be estimated:

$$\Delta lnY_t = b_{10} + \sum_{i=1}^{p} \Phi 1i \Delta lnY_{t-i} + \sum_{j=1}^{p} b1j\, \Delta TOT_{t-j} + \sum_{n=0}^{b} \lambda 1n\, \Delta lnGFCF_{t-n} + \sum_{m=0}^{b} p1m \Delta\, LAB_{t-m} + \sum_{k=0}^{b} w1k\, \Delta OPP_{t-k} + \sum_{r=0}^{b} u1r\, \Delta FID_{t-r} - \chi \varepsilon_{t-1} + \varepsilon_{1t} \quad \textbf{(3.12a)}$$

$$\Delta lnTOt_t = b_{20} + \sum_{i=1}^{p} \Phi 2i \Delta lnY_{t-i} + \sum_{j=1}^{p} b2j \Delta\, TOT_{t-j} + \sum_{n=0}^{b} \lambda 2n \Delta\, lnGFCF_{t-n} + \sum_{m=0}^{b} p2m\, \Delta LAB_{t-m} + \sum_{k=0}^{b} w2k\, OPP_{t-k} + \sum_{r=0}^{b} u2r\, FID_{t-r} - \delta \varepsilon_{t-1} + \varepsilon_{2t} \quad \textbf{(3.12b)}$$

Where, ε_{t-1} , is the Error Correction Term (ECT) representing lagged residuals from the co-integrating relationships. The ECT represents the disturbance from the equilibrium relationship in co-integrated series; χ and δ are the long-run and; b and $\mathbf{\Phi}$ are short run adjustment parameters respectively. Therefore, as opposed to the conventional Granger causality test, an error-correction model combines the short run dynamics with the long run properties of the data and thus provides a convenient tool for investigating short run as well as long run causal patterns. In the ECMs, the null hypotheses state that, there is no causation: short run and long run, and overall.

From TOT → GDP,

If H0: b11 = b12 =… b1p = χ = 0,

From GDP → TOT,

If H0: φ21 = φ 22 =… φ2p = δ = 0.

3.3 Data Sources

This study is fully based on secondary time series data of the time period 1980-2009 collected for five East African countries namely Ethiopia, Kenya, Sudan, Burundi and Rwanda. The data are obtained from the World Development Indicators and Africa Development Indicators CD-ROM (2010). The variables included in the analysis are gross domestic product, , gross fixed capital formation (gross domestic fixed investment) as a proxy for capital, total labor force, net barter terms of trade, trade share of GDP ,as measure of openness ,and domestic credit share of GDP, as proxy for financial deepening. All variables (except labor force) are deflated to 2000 constant US$ (2000=100); labor is measured in million units

RESULTS AND DISCUSSIONS

4.1 Descriptive Analysis

Six macroeconomic indicators (real GDP, TOT GFCF, LAB, OPP and FID) are used to describe macroeconomic features of East African countries included in this study over the period from 1980 - 2009. These countries can be put from the largest to the smallest economy as Sudan, Kenya, Ethiopia, Rwanda and Burundi.

Over the period 1980 – 2009 Sudan's GDP grew by average growth rate of 2%, Kenya's and Rwanda's GDP grew by 3% each. Burundi's GDP grew by1% and Ethiopia's GDP grew by 4% .The labor force in these East African countries has also increased. For instance, in 2009 Ethiopia's labor force was 20 million more than it was in 1980; Kenya's 11million, Sudan's 6 million , Rwanda's 2.5 million and Burundi's 2 million more than they were in 1981.The amount of real capital investment in all countries has shown increment as well. Sudan's gross fixed capital formation is more by about $24.5 billion than its level thirty years before. Ethiopia's and Kenya's GFCF have increased by about$ 2.5 billion over the same period whereas for Burundi and Rwanda the increment is so meager that it is less than $1 billion. Trade competitiveness as measured by openness (total trade in goods and services divided by real GDP) is considered in this paper as one of macroeconomic performance indicator in these small open economies. The countries can be put in descending level of openness as: Sudan, Kenya, Ethiopia, Rwanda and Burundi. This shows how important the role of trade is in the national economies of these countries and the economies are currently becoming more open than previously they were. Money supply in the form of domestic credits provision to private sectors is continually increasing in these economies: the amount of money available for investors is more by $191 billion in Sudan,$4billion more in Kenya, $3billion more in

Ethiopia,$500million more in Rwanda and $200million more in Burundi than were thirty years ago. The relative price of a country's export good versus import good has been below its level in 1980 for all countries except for Sudan and Rwanda. This clearly reflects the contribution of oil to the national economy of Sudan in general and to its TOT in particular. While for Rwanda different reason holds to explain the appreciation of terms of trade. The detail descriptions of the variables for each country are provided as below.

Table4.1 Descriptive Statistics of six Macroeconomic variables for five East African countries

Country	Variables	Mean	Maximum	Minimum	Std.Deviation
Ethiopia	GDP	7.83E+09	1.66E+10	4.85E+09	3.15E+09
	TOT	114.6993	150.9615	78.10263	17.50258
	GFCF	1.17E+09	3.40E+09	7.04E+08	5.73E+08
	LAB	25707371	39142272	15920961	7071144.
	OPP	1.63E+09	6.31E+09	9.49E+08	1.03E+09
	FID	1.29E+09	3.11E+09	3.68E+08	8.64E+08
Sudan	GDP	1.08E+10	2.26E+10	5.53E+09	5.07E+09
	TOT	116.7580	234.1876	89.19847	39.06047
	GFCF	1.60E+11	3.25E+11	8.08E+10	7.45E+10
	LAB	9396899.	13109649	6573550.	2025684.
	OPP	3.59E+11	7.29E+11	1.81E+11	1.67E+11
	FID	8.01E+10	2.60E+11	1.47E+10	7.39E+10
Burundi	GDP	7.67E+08	9.30E+08	5.59E+08	96130186
	TOT	152.5006	296.2264	85.90399	55.66286
	GFCF	93267217	1.69E+08	36540576	37135402
	LAB	3052108.	4407426.	2047400.	651532.7
	OPP	2.92E+08	5.54E+08	1.51E+08	1.12E+08
	FID	1.35E+08	2.35E+08	49914432	56022149
Kenya	GDP	1.16E+10	1.80E+10	7.08E+09	3.15E+09
	TOT	89.91198	114.0000	70.10000	11.17193
	GFCF	2.17E+09	3.73E+09	1.30E+09	6.18E+08
	LAB	12106425	18651208	6677238.	3744509.
	OPP	7.43E+09	1.13E+10	4.63E+09	1.99E+09
	FID	3.41E+09	5.59E+09	2.09E+09	8.81E+08
Rwanda	GDP	1.79E+09	3.21E+09	7.90E+08	5.46E+08
	TOT	89.73207	169.5014	39.74359	33.01553
	GFCF	3.10E+08	7.33E+08	78814970	1.61E+08
	LAB	3324577.	4945368.	2406787.	809147.6
	OPP	5.96E+08	1.40E+09	3.29E+08	2.58E+08
	FID	1.74E+08	5.00E+08	78023629	1.15E+08

4 .1.1 Ethiopia

In the first two decades Ethiopia's economic activities had been characterized by ups and downs the last short. In 1985 the real GDP registered the maximum negative growth rate followed by two consecutive years of about 10 percent growth. However, its macroeconomic performances since 2003 was different that the country' GDP has been continuously growing year after year by more than 10 percent. This high growth rate has been driven mainly by a boom in services and healthy growth in agriculture, supported by strong service exports and increasing official development assistance (ODA). The economy experienced structural change in 2008 as services surpassed agriculture to become the dominant sector of the economy and it become the fastest expanding sector since 2005. Private consumption is the main driver of domestic demand, growing strongly since 2002(Economic outlook for Africa, 2010).

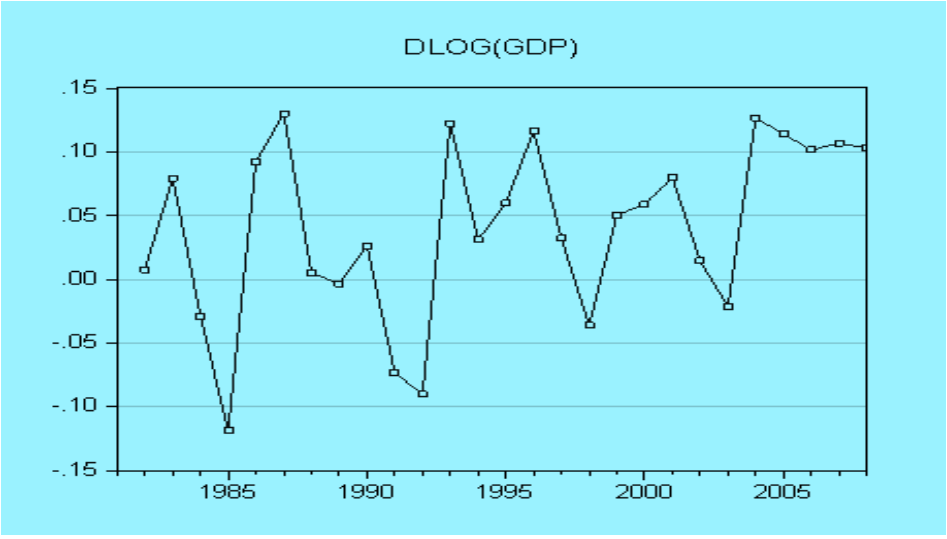

Figure 4.1 Ethiopia's real GDP growth (1980-2009)

Figures 1 through 6 in appendix A represent the trend of six macroeconomic performance indicators for Ethiopia. The trend path for terms of trade has been ups and downs with the minimum figure observed in 1982 and the maximum in 1995 and 1998.The reason for the former can be due to the fact that the earlier year was the time of regime change and in the major parts of the country there was political instability.

The good record of terms of trade in those years can be attributed to international market conditions that favored the export sector and import sectors. It had got worsened for the subsequent five years and had got improved from 2003 to 2007 before the improvement came to halt in 2008.

The amount of capital investment in the country has been growing dramatically in recent years owing mainly to large public investment. The labor force of the country has observed continuous sharp increase over the last three decades. The country's overall trade has been grown dramatically since 2003 after two decades of stagnant growth. The growth path for money supplied for private sectors was characterized by more of ups and less of down turns with the minimum record occurred in 1993. It has been improving recently and the banking system, which is not yet open to foreign competition, dominates the financial sector of the country. According to Economic outlook for Africa's 2010 report Private Banks generally performed better than state-owned banks in terms of resource mobilization.

4.1.2 Sudan

Sudan's economy could not have maintained years of positive growth and there were six years of negative growth episodes before the turn of this century. However, the positive growth could have been maintained ever since. For example, real GDP growth registered more than 10% per year in 2006 and 2007. The boom is mainly the result of increases in oil production, high oil prices and large inflows of foreign direct investment following crude oil export since the last quarter of 1999. Economic outlook for Africa in 2010 reported that the continued growth in private and public investment was the main source of the recent upsurge in Sudan's GDP growth. The oil sector attracted substantial FDI for production and further exploration. Private investment continued to increase in agriculture and services, mainly transport, communication, hotel and restaurants.

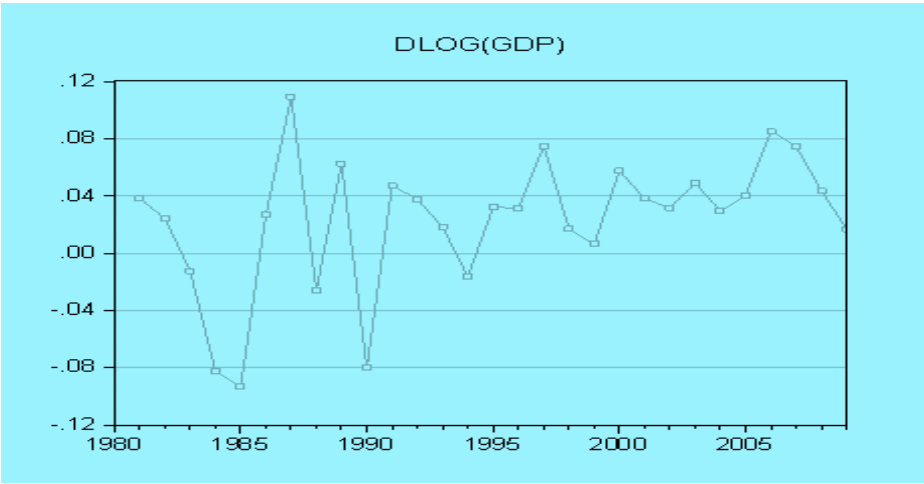

Figure4. 2Sudan's real GDP growth (1980-2009)

The graphical representation of the variables' growth path for Sudan is shown in appendix A figures 7 – 12. Real GDP, gross fixed capital formation, openness and labor force have been trending up in similar fashion over the entire sample periods. Except labor the rest variables have growing fast since early 2000s.Terms of had been constant over the first two decades

and has risen dramatically since 2000. Sudan's exports have witnessed a remarkable structural shift with oil becoming the main export. Cotton, the traditional commodity export, dropped to fourth position in 2008, after oil, edible oil seeds, and meat. Financial development had been swinging ups and downs in the first two decades reaching its minimum level in 1995 and has shown improvements since early 2000s.

4.1.3 Burundi

In 1980s Burundi's economic performance was one of the best in Sub Sahara Africa with yearly average growth of four percent. This progress was interrupted by civil war that broke in 1993 with ensuing regional economic embargo that together destroyed agriculture, the pillars of its economy for ten consecutive years. Private sector development is hindered by an unfavourable business environment. The last episode of negative growth had lasted in 2003 and the economy has witnessed improvements maintaining the growth episodes of positive growth since then. Burundi is the typical developing economy where the primary sector plays a central role in economic growth. Agriculture provides over 94 percent of employment and more than 50 percent of the gross domestic product (GDP) of Burundi. In addition, the agricultural sector supplies 95 percent of the nation's food needs and over 90 percent of its export earnings. Service sector contributes about one third of GDP mainly from transport and communication sub- sectors. Financial and tourism services are underdeveloped. Little industry exists except the processing of agricultural exports and industrial sector contributes the least.

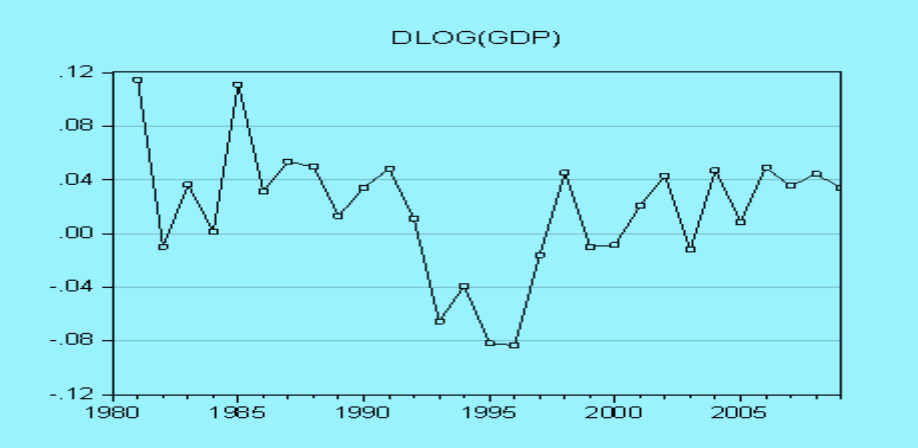

Figure4.3 Burundi's real GDP growth (1980 - 2009)

Economic outlook for Africa in 2010 reports that private sector's contribution to gross capital formation increased considerably more than that of the public sector, owing to the increased share of private enterprise in investment and national production. Public investment continued to make the largest contribution to growth, however. Final consumption and foreign trade made a positive contribution to growth of owing mainly to a proportionally grater rise in exports than imports.

Figures 13 through 18 in appendix A represent the trends in real GDP, TOT, GFCF, LA, OPP and FID respectively for Burundi. Terms of trade has been swinging ups and down over entire sample periods and below the level it was thirty years before. The dependence on agricultural produce for its foreign currency earnings has increased the country's vulnerability to seasonal yields and international commodity prices (global economic ups and down swings), making the country vulnerable to terms of trade shocks.

4.1.4 Kenya

Over the last three decades Kenya has experienced two short episodes when economic growth exceeded five percent and was sustained for at least three consecutive years: 1986-88 and 2004-2007. Like other economies its performance after the turn of the century has been well. For instance, in 2007 the real GDP grew by 7%.

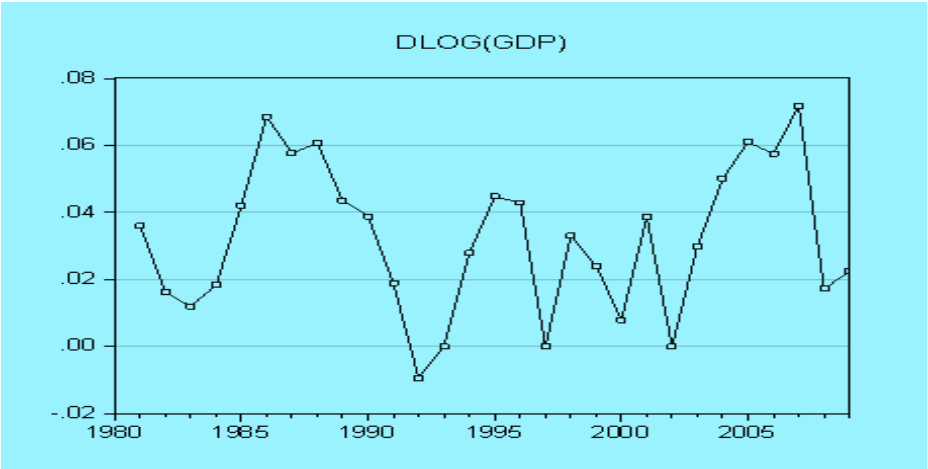

Figure 4.4 Kenya's real GDP growth (1980 - 2009)

Service sector is the largest contributor to Kenya's gross domestic product (GDP), followed by, agriculture and industrial sectors. Kenya's services sector, which contributes about 63 percent of GDP, is dominated by tourism. The tourism sector has exhibited steady growth in most years since independence and by the late 1980s had become the country's principal source of foreign exchange. In the late 1990s, tourism relinquished this position to tea exports, because of a terrorism-related downturn. Kenya is generally perceived as Eastern and Central Africa's hub

for Financial, Communication and Transportation services such that its businesses are well-positioned to take advantage of the free movement of labour and capital.

Agriculture remains the main sector in Kenyan economy and employs almost 75% of working Kenyans, although only 15 percent of Kenya's total land area has sufficient fertility and rainfall to be farmed, and only 7 or 8 percent can be classified as first-class land. In 2006 Kenya's labor force was estimated to include about 12 million workers. The number employed outside small-scale agriculture and pastoralism was about 6 million. Although Kenya is the most industrially developed country in East Africa, manufacturing still accounts for only 14 percent of gross domestic product (GDP).

Figures 19 through24 in appendix A show that real GDP, gross fixed capital formation, labor force, money supply and total trade have all increased over that last three decades while terms of trade has been the variable that fluctuates most and has got worse than its level thirty years before. This was due to the fact that the country's economy in general and the export sector in particular are vulnerable to two adverse shocks. First, the global economic fluctuations will impact Kenya's main export markets and Tourism sector including its import sector as well. Second, the erratic, delay and shorter rainfall will have a negative impact on the agriculture sectors.

4.1.5 Rwanda

Over the last three decades Rwandan economy has witnessed stable growth of more than 5 percent that last short on from 1999- 2002 and 2004 -2009. The minimum and the maximum growth were recorded in 1994 and 1995 respectively. Like other countries its economy has been performing well from 2003 onwards. For instance, from 2005- 2008 real GDP grew by

more than 7 percent. This GDP growth performance has been due to the healthy performance of the service, industrial and agricultural sectors.

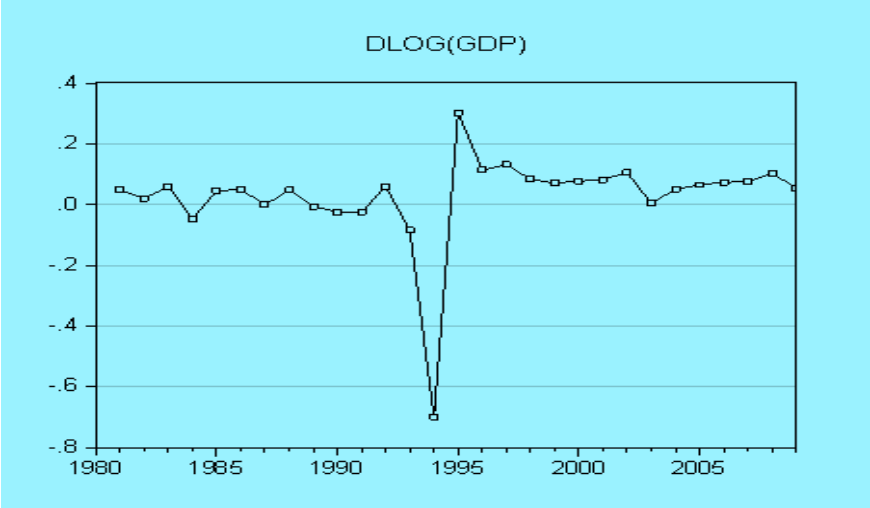

Figure4.5 Rwanda's real GDP growth (1980 - 2009)

According to Economic Outlook for Africa's report growth in the services sector was primarily driven by the information, communication and technologies (ICT) sector and the finance and tourism sectors. Growth in the manufacturing sector has also been supported by the healthy performance of mainly the food, beverages, tobacco and the mining sector and, to a lesser extent, the construction sector. Agriculture remains the backbone and most important sector of the Rwandan economy. It provides the primary subsistence livelihood for 90 per cent of the population of 9.2 million. The country's export items come from the sector. Coffee is the most important export crop in Rwanda, with tea coming a close second followed by Cassiterite and coltan.

Macroeconomic indicators for Rwanda are shown in figures 25 through 30 appendix A. Unlike other countries' its labor force had been falling in the first half of 1990s and as opposed to Burundi, Ethiopia and Kenya as oil importers its terms of trade in 2009 was got better than its

level thirty years before. The reason for this could be that the country might have imported less than its export to the rest of the world in the total value of its external trade.

Correlation analysis is done to examine the relation between the variables (GDP, TOT, GFCF, LAB, OPP and FID). The result shows positive and negative correlation among the variables for all countries (Appendix B, Table 1). At a 5% critical value significant correlation is found between GDP and terms of trade for Ethiopia (which is negative), Sudan and Rwanda (which is positive). For Burundi, negative and for Kenya, positive but not significant correlations between GDP and terms of trade are discovered. At the same critical value strong, positive and significant correlations are found between GDP and the rest five variables for all countries. The significant correlation between terms of trade and GFCF, LAB, OPP and FID is negative for Ethiopia and Burundi while it is positive for Sudan, Kenya and Rwanda. However, it should be noted that strong correlation between the variables does not imply causal impact that is meaning full economically. Therefore, this study will examine the direction of causation between real GDP and terms of trade based on econometric techniques in the section that follows.

4.2 Model Application and Empirical Results

This section presents results and interpretations for econometric models developed in the last chapter: the causality between GDP and TOT is evaluated for both bi-variate VAR models with and without exogenous variables. The econometrics procedure to be used are taken mostly from Enders (1995) such as: (1) test for unit roots and the order of integration, to ensure that all variables included in the study are stationary either in levels or differences, (2) test for co-integration between the series, to look at the possibility of long-run relationships between the

integrated variables and (3) test for causality, to determine the direction of causation between GDP and TOT. Each step is analyzed below.

4.2.1 Unit Root Tests

A univariate unit root tests are carried out on six series to investigate stationarity properties of the underlying data and to determine integrating order of the variables. Following convention log of the variables are used so that spurious regressions are less likely to appear and the problem of hetroskedasticity in the series could be minimized. The variables are differenced once or twice such that the rejection of null hypothesis of unit roots represents stationarity of the variables at respective integrating orders. Table 4. 2.1 shows that GDP, TOT and OPP are stationary at first differences and are integrated of order one (I) for all five countries and the variables: LAB (for Ethiopia, Sudan and Burundi), and GFCF (for Kenya) are differenced twice to make them stationary and are integrated of order two or I (2).

Table 4.2.1 Unit Root Tests for (GDP, TOT GFCF, LAB, OPP and FID)

Variable	Augmented Dickey Fuller Test			Phillis Perron Test		
	Constant (C),Trend	Value of test	Order of integrati	Constant (C),Trend	Value of test statistic	Order of
Ethiopia						
GDP	C,T,1	-5.2578***	I(1)	C,T	-5.5622*	I(1)
TOT	C,T,1	-4.2996**	I(1)	C,T	-9.5590***	I(1)
GFCF	C,T,1	-3.232*	I(1)	C,T	-3.229*	I(1)
LAB	C,T,1	-3.9462**	I(2)	C,T	-5.2335**	I(2)
OPP	C,T,1	-4.1013**	I(1)	C,T	-3.9637**	I(1)
FID	C,T,1	-4.817**	I(1)	C,T	-6.4675***	I(1)
Sudan						
GDP	C,T,1	-5.2878***	I(1)	C,T	-7.5522***	I(1)
TOT	C,T,1	-3.5757*	I(1)	C,T	-3.6944**	I(1)
GFCF	C,T,1	-5.5383***	I(1)	C,T	-5.2300***	I(1)
LAB	C,T,1	-3.3245*	I(2)	C,T	-4.4542*	I(2)
OPP	C,T,1	-4.5401***	I(1)	C,T	-7.5755***	I(1)
FID	C,T,1	-3.3664**	I(1)	C,T	-4.2958**	I(1)
Burundi						
GDP	C,T,1	-3.2390*	I(1)	C,T	-3.7806**	I(1)
TOT	C,T,1	-3.8645**	I(1)	C,T	-5.9687***	I(1)
GFCF	C,T,1	-3.3292*	I(1)	C,T	-6.4219***	I(1)
LAB	C,T,1	-4.8691	I(2)	C,T	-3.23532*	I(2)
OPP	C,T,1	-3.6877**	I(1)	C,T	-4.8083***	I(1)
FID	C,T,1	-3.300*	I(1)	C,T	-6.1730***	I(1)
Kenya						
GDP	C,T,1	-3.2460*	I(1)	C,T	-3.6027*	I(1)
TOT	C,T,1	-3.2999*	I(1)	C,T	-5.8915***	I(1)
GFCF	C,T,1	-4.0268**	I(2)	C,T	-6.1011***	I(2)
LAB	C,T,1	-5.2780***	I(0)	C,T	-8.6253*	I(0)
OPP	C,T,1	-3.5858**	I(0)	C,T	-4.5622*	I(2)
FID	C,T,1	-4.6374***	I(1)	C,T	-6.3237***	I(1)
Rwanda						
GDP	C,T,1	-4.1440**	I(1)	C,T	-5.7147***	I(1)
TOT	C,T,1	-3.9134**	I(1)	C,T	-7.6310***	I(1)
GFCF	C,T,1	-4.8670*	I(1)	C,T	-6.4677***	I(1)
LAB	C,T,1	-5.4956***	I(1)	C,T	-1.3178*	I(2)
OPP	C,T,1	-6.2108***	I(1)	C,T	-8.4176***	I(1)
FID	C,T,1	-3.3679**	I(1)	C,T	-4.6377***	I(1)

*(**)*** denotes @ 10(5) 1 percent significant levels respectively for indicated order of integration. I(1) and I(2) denote respectively stationary at first and second differences.

4.2.2 Johansen's Co- integration Tests

Johansen's co integration tests' first procedure involves choosing the optimum lag length in vector autogressive models. Therefore, for both bi- variate VAR models the optimum lag length is selected using lag length selection criteria. Choosing too few lags invalidate the test and choosing too many lags entails estimation of additional coefficients and results in loss of degree of freedom. There exist optimum lags length selection criteria to choose the lag length (p) of VAR (p) and the lag length (b, p) of VAR (b, p) namely Akaike Information Criteria (AIC), Schwartz Criterion (SC), and Hannan - Quinn Criteria (HQ). In this paper AIC is used on the ground that the criterion gives the minimum value for sample size considered for all countries.

Table4.2.2 Optimum lags for bi- variate models

Country	VAR(p)	VAR (p,b)
Ethiopia	VAR(3)	VAR (2,1)
Sudan	VAR(2)	VAR (3,1)
Burundi	VAR(3)	VAR (3,1)
Kenya	VAR(3)	VAR (3,1)
Rwanda	VAR(3)	VAR (2,1)

In each VAR, p is the number of lags entering the autoregressive process of GDP and TOT and b is the number of lags of each exogenous variable. The optimum number of lags in each autoregressive process (p) estimated for both types of VAR models are used to test for co-integration between real GDP and terms of trade.

Having determined the optimum lag length, the next step is to investigate co integration (long run relationship) between GDP and TOT in both set ups. For VAR (p, b) the variables (DGFC FandDLAB) were included in co integration test since they are of different integrating order with other variables(i.e integrated of order 2). Then Johansen co integration test for at least one co integrating vector between GDP and TOT is carried out on both bi-variate VAR models. The trace and maximum egien value co integration rank tests are applied under the restriction that there is no separate drift in the Error Correction Model (ECM), but a constant that enters only via the ECM. This assumption of the deterministic trend allowed for the determination of the appropriate ECM to be estimated for all co integrating equations in all countries (Lopet, 2004).

4.2.2.1 Co- integration Tests on Bi-variate Models without Exogenous Variables

With no exogenous variables at 5% critical level the trace and maximum eigen value tests show zero co integrating relationship between GDP and TOT in all countries.

Table 4.2.3 Johansen's Co integration tests on VAR models without exogenous variables

Country	H_O: Rank = r	Trace(λ_{trace})	Max Egenvalue	Rank(decision)
Ethiopia	r = 0	19.80	10.53	0
	r =1	9.26	9.26	
Sudan	r = 0	23.48	17.12	0
	r =1	6.35	6.35	
Burundi	r = 0	20.72	10.28	0
	r =1	6.44	6.44	
Kenya	r = 0	13.03	9.55	0
	r =1	3.48	3.48	
Rwanda	r = 0	9.26	6.19	0
	r =1	3.07	3.07	

Note: H_0 for both tests is rank=r; alternative hypotheses: trace: H_1: rank >r; max eigenvalue H_1: rank=r+1. At 5% critical value: Trace: for r=0 is 25.87; for r=1 is 12.51. Max eigen: for r=0 is 19.38, for r=1 is 12.51

4. 2.2.2 Co- integration Tests on Bi-variate Models with Exogenous Variables

The second co integration tests are conducted on VAR models with exogenous variables (GFCF Labor, OPP and FID). At 5% critical level one co integrating vector is found for all countries investigated. According to the Granger representation theorem (Engle-Granger 1987), a system of co integrated variables has an error-correction representation that combines the short run dynamics of the variables with their long run properties as implied by the co integrating relationship.

Table4.2.4 Johansen's Co integration tests on VAR models with exogenous variables

Country	**H_O: Rank = r**	**Trace(λ_{trace})**	**Max Egenvalue(λ_{max})**	**Rank(decision)**
Ethiopia	r = 0	35.59	30.20	1
	r =1	6.95	6.95	
Sudan	r = 0	55.73	46.78	1
	r =1	8.95	8.95	
Burundi	r = 0	39.30	30.20	1
	r =1	9.10	9.10	
Kenya	r = 0	39.43	32.26	1
	r =1	7.17	7.17	
Rwanda	r = 0	20.59	18.28	1
	r =1	2.31	2.3	

Note: H_0 for both tests is rank=r; alternative hypotheses: trace: H_1:rank>r; max eigenvalue H_1: rank=r+1. At 5% critical value: Trace: for r=0 is 20.26; for r=1 is 916. Max eigen: for r=0 is 15.89, for r=1 is 9.16

4.2.2.3 Models Residual Diagnostics

In order to make the results of VAR models in first differences and ECMX be acceptable and ensure that the models satisfy stability conditions n . The autocorrelation and heteroscedasticity tests on the disturbance term of entire VAR - D models for real GDP and terms of trade show no evidence of autocorrelation and heteroscedasticity for all countries investigated (appendices C, tables 2 and 3). And also the result model stability test show that all estimated uni- variate models for all countries are stable (appendix C, table 4).

In VAR models with exogenous variables the lagged independent variables are included so as to solve the problems of multi-co linearity among the variables included in the estimation. Again, the autocorrelation and heteroscedasticity tests on the disturbance term of entire error correction models for real GDP and Terms of trade show no evidence of autocorrelation and heteroscedasticity for all countries investigated (appendices D, tables 5 and 6). And also the null hypotheses of the models's residuals cannot be rejected at any significance levels for all countries examined (appendix D, table 7).

4.2.3 Granger - Causality Tests

The final step in this section is to determine the direction of causations (either unidirectional or bidirectional) between GDP and TOT on both bi-variate VAR models with and without exogenous variables. The joint null hypotheses of Granger- non causality (there is no causation from TOT to GDP and/ or from GDP to TOT) are tested by Wald $\chi 2$ and F- statistics obtained from Wald Coefficients restriction.

3.2.3.1 Granger - Causality Tests in Bi –variate models without exogenous Variables

Based on the results of Johansen's co integration tests (table 4.2.2) the bi-variate VAR (p) models are zero ranked and no co integration is found between GDP and TOT for all countries: Ethiopia, Sudan, Kenya, Burundi and Rwanda. Therefore, one Granger- causality alternative VAR model, VAR (p) in first differences is applied for all.

4.2.3.1.1 Granger - Causality Tests in VAR - D models without exogenous Variables

Bi-directional causality between terms of trade and economic growth is detected for countries of Ethiopia and Sudan. While uni-directional causation running from terms of trade to economic growth and the reverse side causation are found respectively in Rwanda and Burundi. The estimated equations of the Granger – causality tests in VAR-D; on integrated but not co integrated variables for all countries are shown in appendix E.

No evidence of co integrating relationships between TOT and GDP implies that causal impacts if there is any is short run. Thus, under such scenario the joint hypotheses would be there are no short run bi-directional causations between terms of trade and economic growth.

The Chi- square and F- statistics of the joint significance of lagged independent variables from Wald coefficient restrictions test show that the joint null hypothesis of no short run impact of terms of trade on economic growth and the reverse side impact could be rejected at 5% and 10% critical values respectively for Rwanda and Burundi , whereas, with no evidence of co integration the joint null hypotheses of short run Granger – non causality (bi- directional) between GDP and TOT are rejected for Ethiopia and Sudan at 10 % critical value but could not be rejected for Kenya at any significance level. Below is Wald $\chi 2$ and F- statistics table for the

joint null hypothesis of no short run causations in either direction between terms of trade to economic growth for all five countries. Positive terms of trade impact of economic growth and negative economic growth impact of terms of trade are evidenced except for Sudan where the later impact is positive.

Table4.2.5 Granger – causality tests in VAR-D model without exogenous variables (Null hypotheses: terms of trade and economic growth do not impact each other in short run).

Country	Direction of	F- statistic			Chi-square			Conclusion
		Value	Df	Probability	Value	df	Probability	
Ethiopia	TOT to GDP	2.88	(2,22)	0.0770	5.77	2	0.0557	Yes
	GDP to TOT	2.1672	(3,19)	0.0954	6.5017	3	0.0896	Yes
Sudan	TOT to GDP	2.88	(2,22)	0.0770	5.77	2	0.0557	Yes
	GDP to TOT	4.65	(2,23)	0.0200	9.31	2	0.0095	Yes
Burundi	TOT to GDP	0.76	(3,19)	0.5301	2.28	3	0.5161	No
	GDP to TOT	2.93	(2,19)	0.0774	5.87	2	0.0530	Yes
Kenya	TOT to GDP	0.29	(3,19)	0.8316	0.87	3	0.8322	No
	GDP to TOT	1.34	(3,19)	0.2895	4.03	3	0.2577	No
Rwanda	TOT to GDP	3.14	(3,19)	0.0492	9.43	3	0.0240	Yes
	GDP to TOT	0.49	(3,19)	0.6905	1.48	3	0.6862	No

The discussions and the associated interpretations for these results are presented together with the results of error correction models at the end of next section.

4.2.3.2 Granger - Causality Tests in Bi –variate models with exogenous Variables

With inclusion of exogenous variables in VAR models Johansen's co integration tests found evidence of one co integrating relationship between terms of trade and economic growth for all countries. This is instructive that the Ganger – causality should be tested in error correction model with exogenous variables (ECMX) set up. Given the fact that the variables GDP and TOT are stationary in first differences for all and the variables; labor for (Ethiopia, Sudan and Burundi), GFCF for Kenya achieve stationaritiy in second differences the existence of long run relationships will manifest themselves through co integration only in levels for series of integrated of order one or I(1) and those of integrated of order two or I(2) will not be considered here. Therefore, to investigate causation under such case only first difference stationary series are put in estimation at their levels

4.2.3.2.1 Granger – Causality Tests in Error Correction models with exogenous Variables

ECM makes short and long runs distinctions on the parameters, where the coefficients for lagged independent variables and the coefficient for ε_{t-1} are respectively the short-run and long run adjustment parameters. The statistical significance of the respective adjustment coefficients are tested to determine the direction of causations in the short run, long run and overall, whereas, the overall causality is tested by the joint significant of the short run and long run parameters. Therefore, the joint null hypotheses of Granger – non causality represent no bi-directional causations between TOT and GDP in both time periods and overall. The ECMX estimations for all countries are shown in appendix F tables 13 through 17.

The Chi- square and F- statistics both from Wald coefficient restrictions test are used here too, to test the joint significance of lagged explanatory variables for short run, the significance of

ECT for long run; and the joint significance of lagged exogenous variables and ECT for overall causations. As can be seen from the table 4.2.6 below terms of trade does not possess short run impact while, its long run and overall impacts are strong for all except Kenya with weak overall impact.

On the other hand, the reverse side short run impact of economic growth is observed only for the countries of Ethiopia and Sudan. Strong long run impact is detected for all except Ethiopia which is weak. No overall impact is detected for Burundi and Kenya whereas; the impact is strong for Ethiopia and weak for Sudan and Rwanda.

Table 4.2.6 **G**ranger – causality tests in ECMX(Null hypotheses: terms of trade and economic growth do not impact each other in short run, long run and overall).

Country	Direction of	F- statistic			Chi-square			Conclusion
		Value	Df	Probability	Value	df	Probability	
Ethiopia	TOT to GDP							
	SR	2.28	(2, 12)	0.1446	4.56	2	0.1021	No
	LR	7.06	(1, 12)	0.0209	7.06	1	0.0079	Yes
	total	5.85	(3, 12)	0.0106	17.55	3	0.005	Yes
	GDP to TOT							
	SR	4.14	(2, 12)	0.0429	8.28	2	0.0159	Yes
	LR	3.60	(1, 9)	0.0899	3.60	1	0.0575	Yes
	Total	4.77	(3, 9)	0.0294	14.33	3	0.0025	Yes
Sudan	TOT to GDP							
	SR	1.32	(3, 9)	0.3263	3.96	3	0.2648	No
	LR	5.74	(1, 9)	0.0401	5.74	1	0.0165	Yes
	total	2.69	(4, 9)	0.0997	10.78	4	0.0291	Yes
	GDP to TOT							
	SR	2.16	(3, 9)	0.09620	6.49	3	0.0898	Yes
	LR	5.35	(1, 9)	0.0459	5.35	1	0.0206	Yes
	Total	2.13	(4, 9)	0.1591	8.52	4	0.0742	Yes
Burundi	TOT to GDP							
	SR	1.24	(3, 10)	0.3441	3.73	3	0.2910	No
	LR	22.69	(1, 10)	0.0008	22.69	1	0.0000	Yes
	Total	6.57	(4, 10)	0.0073	26.30	4	0.0000	Yes
	GDP to TOT							
	SR	1.87	(3, 7)	0.2226	5.61	3	0.1319	No
	LR	4.44	(1, 7)	0.0730	4.44	1	0.0350	Yes
	Total	1.73	(4, 7)	0.2453	6.95	4	0.1382	No
Kenya	TOT to GDP							
	SR	1.61	(3, 8)	0.2611	4.84	3	0.1836	No
	LR	6.16	(1, 8)	0.0379	6.16	1	0.0130	Yes
	Total	2.06	(4, 8)	0.1777	8.25	4	0.0826	Yes
	GDP to TOT							
	SR	0.05	(3, 9)	0.9836	0.15	3	0.9846	No
	LR	6.08	(1, 9)	0.0358	6.08	1	0.0137	Yes
	Total	1.71	(4, 9)	0.2295	6.87	4	0.1428	No
Rwanda	TOT to GDP							
	SR	1.99	(2, 11)	0.1829	3.98	2	0.1367	No
	LR	12.14	(1, 11)	0.0051	12.14	1	0.0005	Yes
	Total	4.92	(3, 11)	0.0209	14.75	3	0.0020	Yes
	GDP to TOT							
	SR	0.34	(2, 9)	0.7200	0.68	2	0.7112	No
	LR	6.75	(1, 9)	0.0288	6.75	1	0.0093	Yes
	Total	2.51	(3, 9)	0.1244	7.53	3	0.0566	Yes

In ECMX set up also tested is the significance of variables such as GFCF, LAB, OPP and FID in GDP equation and also whether openness and financial deeping as policy and institutional variables respectively impacts terms of trade in TOT equation. In order to avoid the problems of multi-collinarity between these four variables, GDP and TOT, current and lagged values of both exogenous and endogenous variables are used as they were used in co integration and causality tests. Again F and Chi- square Statistics from the same equation estimated for causality test is used to test the joint significance of current and lagged values of respective variables.

In GDP equation of Ethiopia gross fixed capital formation and openness have respectively strong, significant positive and negative impacts while labor and financial development remain insignificant. For Sudan the contributions to GDP of gross fixed capital formation and openness are strong, positive while labor's contribution is strong, negative; financial development is insignificant. Openness and financial development have respectively strong, negative and positive impacts on Burundi's economy whereas; the impacts of the two are strong, positive for Kenya. In both countries labor and gross fixed capital formation are insignificant. Except gross fixed capital formation, the contributions to GDP of Rwanda of the variables labor, openness and financial deepening are strong, negative.

Terms of trade equations for respective countries are also estimated. Based on these estimates, this study could found strong evidence of negative openness impacts of terms of trade only for Ethiopia and Rwanda while, it does not possess any sort of impact on terms of trade of the rest of countries; Financial deepening has positive impacts on terms of trade of Kenya and Burundi, negative impacts on terms of trade of Rwanda while its impact on Ethiopia's and Sudan's terms

of trade is null. (Appendix F tables 13 – 17 for the sign of the coefficients and appendix I for significance of the variables).

The evidence of short run, long run and overall causations between terms of trade and economic growth has sound economic interpretations. In short term perspectives terms of trade improvement means transfer of some fractions of domestic output from the export and/ or the import sector to domestic consumption or capital formation. The change in components of aggregate demand as a result of transfer of income from trading partners will increase aggregate output in short run. And in the long run higher aggregate demand will induce more investment in additional capacity. Besides, it can impact economy through variety of channels: improving terms of trade will enhance foreign currency reserves and help cease balance of payments constraints as the country continues to gain from international trade. A given level of exports can command more import of capital goods that contribute to productive capacity gains through technological diffusion of knowledge. Rising terms of trade will direct investment in the most efficient sectors of economy consistent with country's comparative advantages while specialization in these sectors enhance productivity in the economy leading to higher output growth. However, the negative long run impact of improving terms of trade will result in negative economic growth due to industrialization crowding out effect as countries continue to specialize in primary goods production exports.

The reverse side overall (short run and long run) causations of economic growth on terms of trade are observed less significant and weaker for these countries. This confirms the prediction in empirical literature that smaller economies do not possess impact on their terms of trade. The impact of economic growth is confirmed to raise the price of a country's import good versus export good there by worsening its terms of trade for some countries. This also is in

confirmation of the prediction that economic growth that is driven by factor accumulations will worsen its terms of trade ((more realistic version of Prebisch – Singer thesis (PST)). The implication for this is that a country can circumvent deteriorating terms of trade by diversifying and upgrading its product in international market. This is consistent with the finding of Debaere and Lee (2003) that fast output expansion does not have to lead to worsening terms of trade when it is accompanied by increases in a country's relative per capita GDP or by R&D induced productivity increases. The newer and better products will coincide with an outward shift of the world demand for a country's products.

Openness has significant negative impact on economic growth of Ethiopia, Burundi and Rwanda and significant positive impact on economic growth of Sudan and Kenya. These results could be pointing to the possibility that openness in these three countries, especially in terms of imports, have resulted mainly in non-technology enhancing imports leading probably to the importation of final consumption goods rather than capital and intermediate imports which have embodied technologies that would have led to positive and significant influence on the productivity. In the later two countries it could a bit catalyze a technological spillover that leads to increase factor productivity in growth.

Financial deepening has been found to catalyze increase in economic growth only in Kenya and Burundi. The logic of argument that could be attributed to the results with regard to financial deepening is that the intermediation role of the commercial banks that would have been expected to channel savings to the private sector leading to investments that would raise growth succeeded a bit only in these two countries but failed to materialize in others. The possible explanation could be the fact that the intermediation functions of financial institutions could accelerate economic performance by facilitating migration of resources to the best users.

Moreover, it is possible that investment opportunities in the rest three East African countries are thin and the private sector credit growth has been directed at personal consumption rather than to investments by private firms towards renewing their technologies or investing in research and development.

In this study, the attempt is also made to find out whether the variables: openness and financial development can have any sort of impacts on terms of trade of these economies. From those estimated equations negative, positive and insignificant impacts of both variables are evidenced. The same logic of argument as in the case of economic growth could be attributed to openness and financial deepening impacts of terms of trade. Openness can have impact through domestic demand for foreign goods and trade partners' demand for home goods including technological diffusions. Financial development act as a condition since it facilitates channel of resource from savers to borrowers, help ease liquidity constraints and enable the economies obtain export and import financing to exploit economies of scale.

Thus, this study support the hypotheses of bidirectional causations between terms of trade and economic growth with the expected signs for almost for all countries; the hypothesis of positive causal impacts of openness on GDP is accepted only for Sudan and Kenya whereas, the hypothesis of financial development impacts is accepted with expected signs only for Burundi and Kenya.

CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Conclusions

In the theoretical literature that has evolved since PST, there has been greater focus on the critical role of improvement in terms of trade as a vehicle to accelerate economic growth. Following this development, terms of trade movements, its impacts and causes have been intensely debated. Most economists((Mendoza, Bleaney and Greenway, Blattman,Grimes, Urban, Duguay, Shuxio and Ying, Cakari and Wong ,etc) have argued that improved terms of trade mean greater international purchasing power per unit of exports, implying greater import capacity which eases foreign exchange constraints and leads to augment GDP growth. Also, there is potential for reverse causality, i.e. GDP growth leads to terms of trade improvement or deterioration. These issues are still debatable, and there is little empirical evidence that accepts or rejects the hypothesis of such relationships between economic growth and terms of trade. However, the broad consensus among economists is that there is a close symbiotic relationship between GDP growth and terms of trade.

On the basis of this debate, this study carries out empirical investigation of bi-directional causations hypotheses between GDP and TOT for Ethiopia, Sudan, Burundi, Kenya and Rwanda. Within bi- variate VAR frame work the concept of Granger causality is employed to determine the direction of causation between terms of trade and real GDP, duly taking into account the stationarity properties of the time series data. ADF and PP tests for the existence of unit roots confirm that all series are non-stationary processes that they are integrated of order one (GDP, TOT, OPP and FID) for all countries and order two (LAB for Ethiopia, Sudan and Rwanda; GFCF for Kenya).

Two bi- variate VAR models, one with only endogenous variables and the other with exogenous variables as well, are used to address the question of Granger causality. For the former models Johansen co integration test results show that although the variables are first difference stationary, there is no co integrating relationship between GDP and TOT. In absence of co integration, Granger causality test is carried out in first difference VAR. With inclusion of exogenous variables, co integration tests indicate that there exists a long run equilibrium relationship between real GDP and terms of trade in all countries. The presence of common stochastic trends between real GDP and terms of trade dictated the use of ECM. For each VAR the respective lag length for each country is selected as suggested by AIC.

In VAR – D set up, bi- directional causations between GDP growth and terms of trade are detected in Ethiopia and Sudan while, economic growth impact of terms of trade and the opposite side terms of trade impact of economic growth are accepted respectively for Rwanda and Burundi.

Within ECMX framework, the evidences of long run and overall causal impacts of terms of trade on economic growth are found for all. The short run, long run and overall reverse side impacts of economic growth on terms of trade are accepted for Ethiopia and Sudan. In Burundi and Kenya only long run impact of economic growth on terms of trade is evidenced while, in Rwanda short run impact is rejected. Under the same set up, the study also investigated the impacts of openness and financial development on economic growth and terms of trade as proxies for capturing the impacts of respectively commercial policy and institutional environment on the same variables. Positive, negative and insignificant impacts of openness

and financial development on the two endogenous variables are evidenced for different countries.

When bi- variate VAR models with and without exogenous variables are compared, the use of bi–variate VARX models makes substantial differences in the results obtained owing to the importance of the variables GFCF, LAB, OPP and FID in augmented production functions. The VARX models increase the chances of obtaining results otherwise not found in the common VAR models (i.e., evidence of co-integrating relationship between the variables, more results supporting existence of causations between GDP and TOT in all countries than the VAR models).

Finally, the empirical results of this study assert that the short run, long run and overall causations between terms of trade and economic growth are economically meaning full: improvement in the terms of trade will accelerate the economic growth of these countries with the possibility for slowing down the growth in the long run due to industrialization crowding out effect as the countries continue to specialize in primary goods production exports. The other novel result worth interpretation is that these countries can circumvent deteriorating terms of trade by diversifying and an upgrading its tradeables products. Also the results from this study imply that trade openness and financial development, if properly managed, will help poverty reduction efforts by helping tackle the myriad developmental challenges facing these East African economies through their positive impacts on economic growth.

5.2 Policy Implications

A major policy implications that can be drawn from this study are: first, these countries ought to adopt the strategies for diversified and qualified exports so as to assume more potential power in their export markets; second, adopt strategies that could channel the imports toward inputs for domestic productions to home and foreign markets; third, make environment conducive for financial markets to flourish and help facilitate mobilization of resources for investment so, also as to help attract FDI.

However, given the importance of primary products as lion share of exports of these economies and the agricultural sector not as the prime carrier of capital-deepening and technological change, over the long run a positive terms of trade will reinforce comparative advantage, lock these economies on primary goods production and results in industrialization crowding out or Dutch disease. Besides, movements in terms of trade of primary commodities are world market driven phenomenon such that they are affected more of by the global demand for commodities and the associated world wide price swings of commodities. Thus, policy makers should remain on alert to circumvent the possibilities for this not to happen and therefore, there must be inward looking policies as well that are proactive and reactive of each others.

Finally, caution must be exercised in interpreting these results owing to limitations of the empirical analysis. First, the Granger causality concept is a theoretical in the sense that it is based solely on the statistical properties of the data and not on the structural relationships implied by economic theory. Second, wide-ranging structural transformations as well as changes in trade policy regimes have taken place in all these economies in the last three decades. Such policy shifts bring about structural breaks and, as a result, the estimated

statistical coefficients may become unstable across different policy regimes. Finally, a limitation of these tests emerges from the assumption that GDP growth and terms of trade movements are functions of each other i.e. common in VAR models. Despite the effort to explain terms of trade with variables such as openness and financial development, terms of trade remain exogenous in empirical literature.

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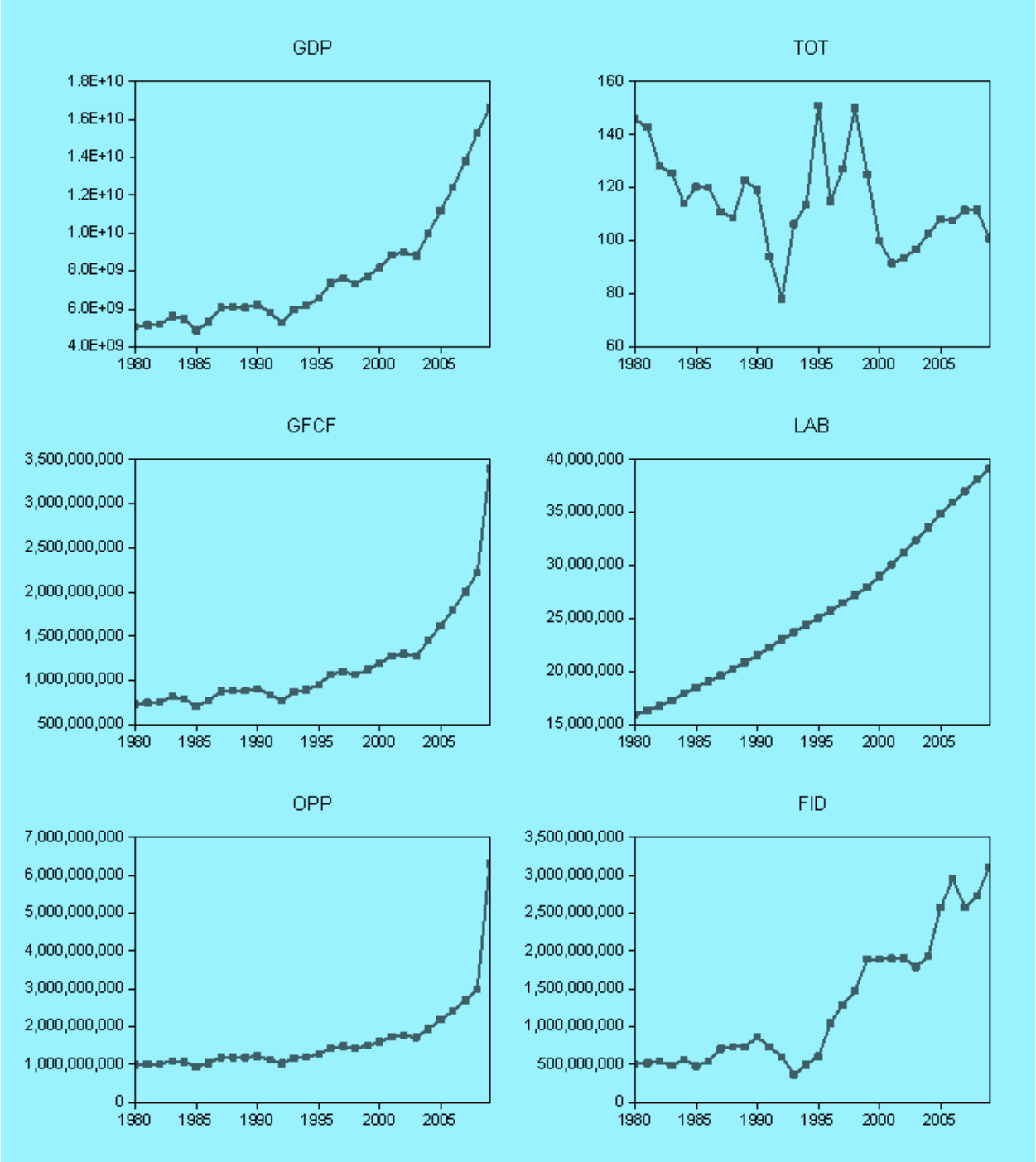
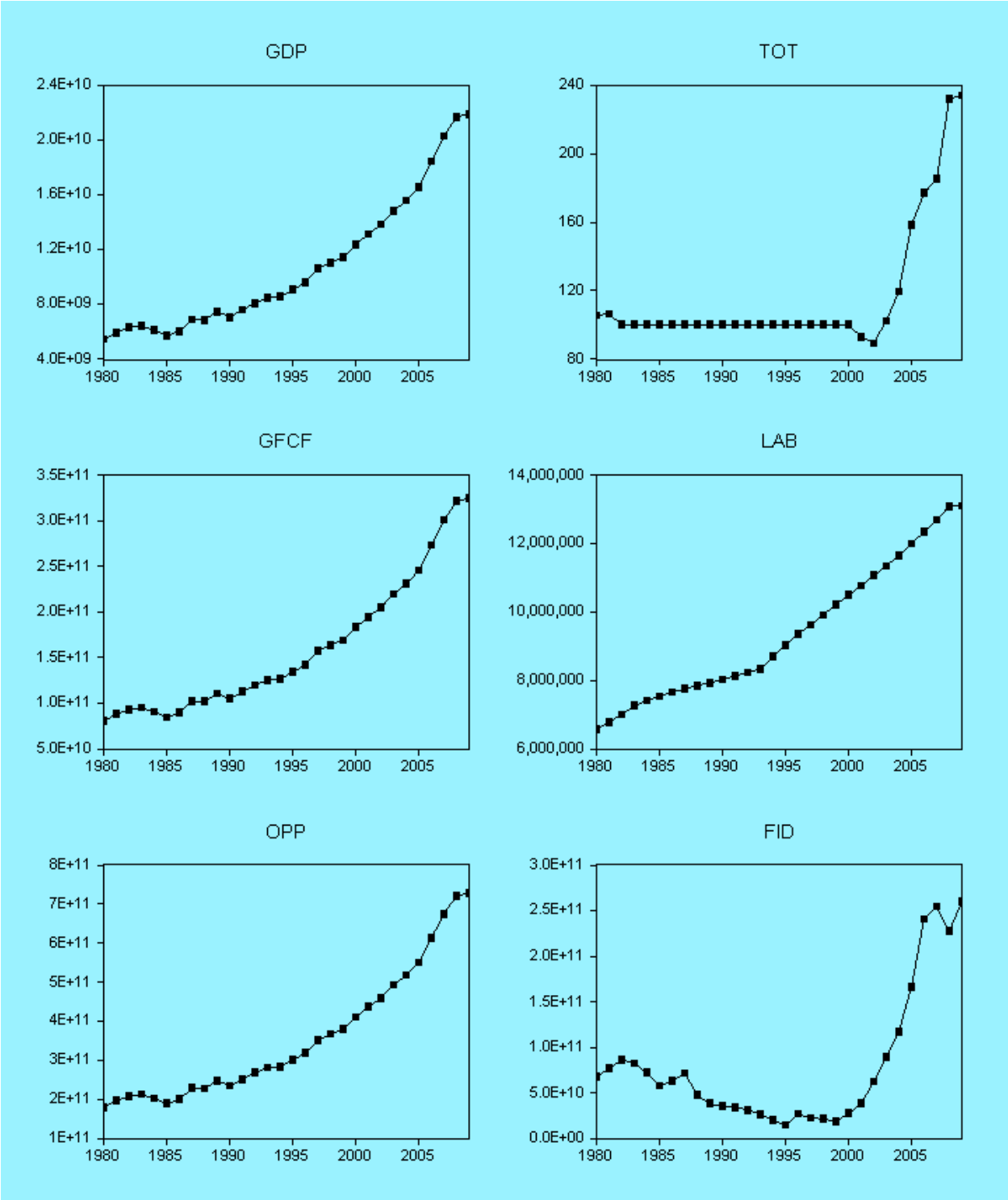
APPENDICES

APPENDIX A: graphical representations of selected variables for five countries of east africa

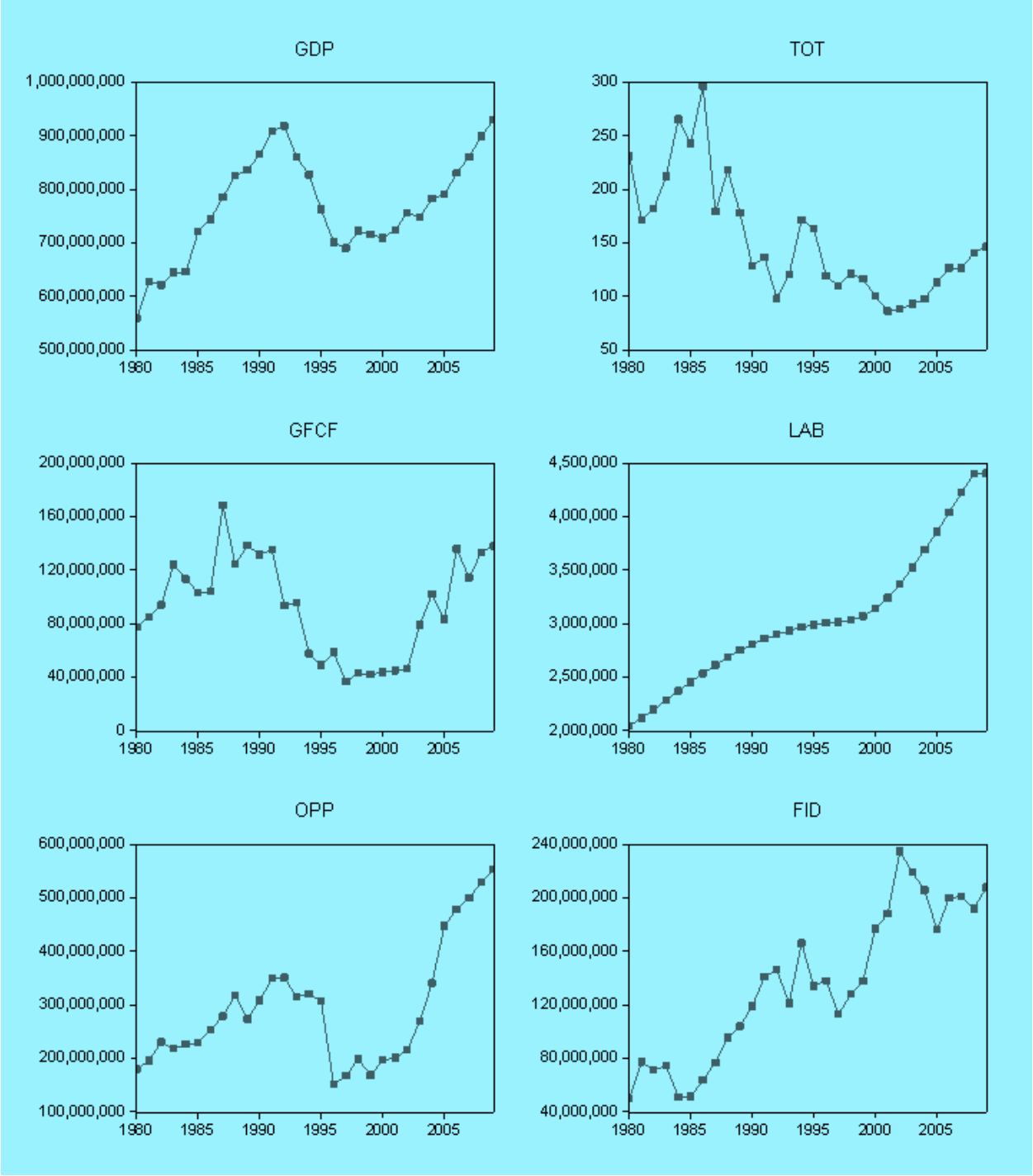
Figures 1-6 Macroeconomic Indicator for Ethiopia (1980-2009)



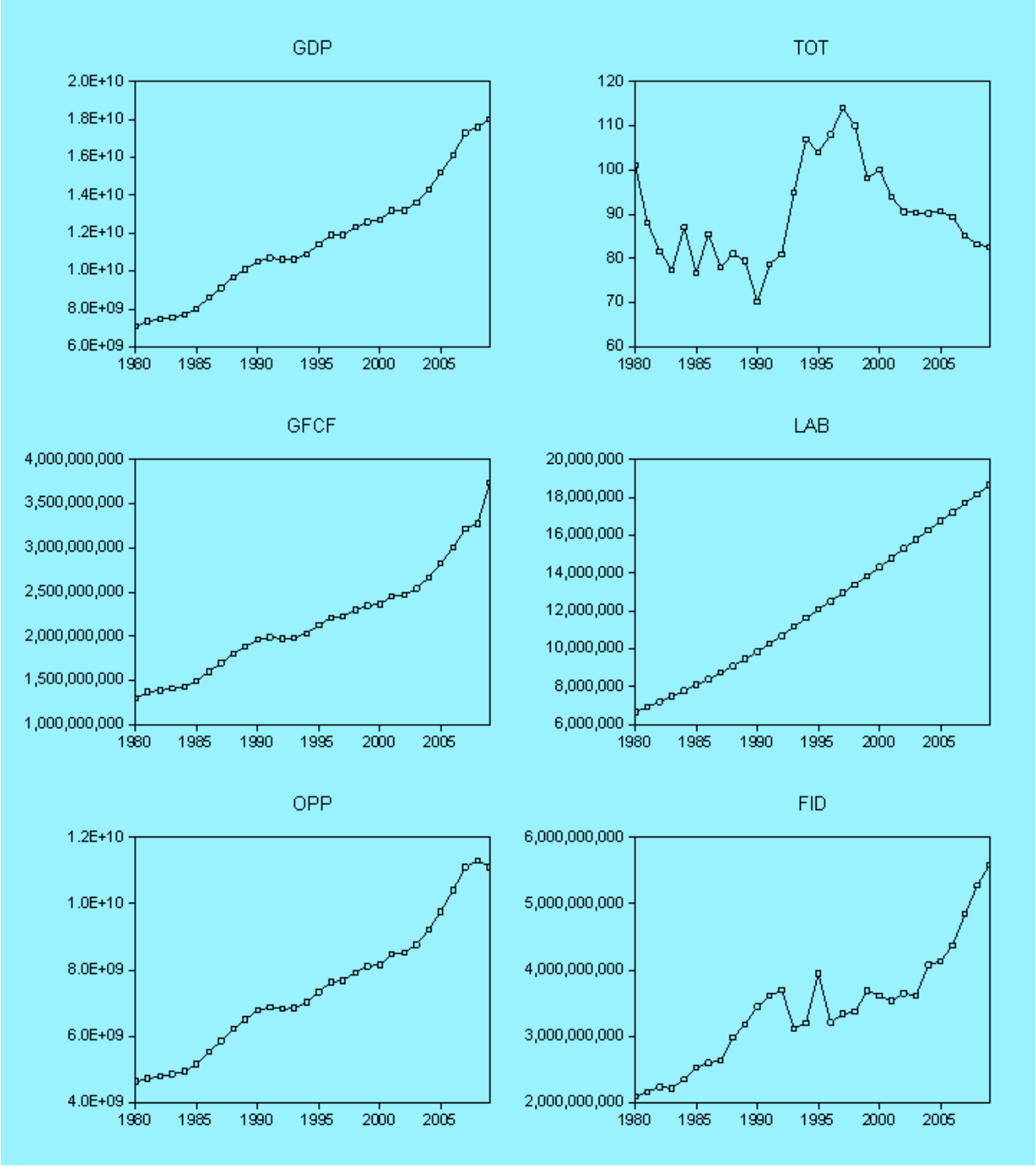
Figures 7 - 12 Macroeconomic Indicators for Sudan (1980- 2009)



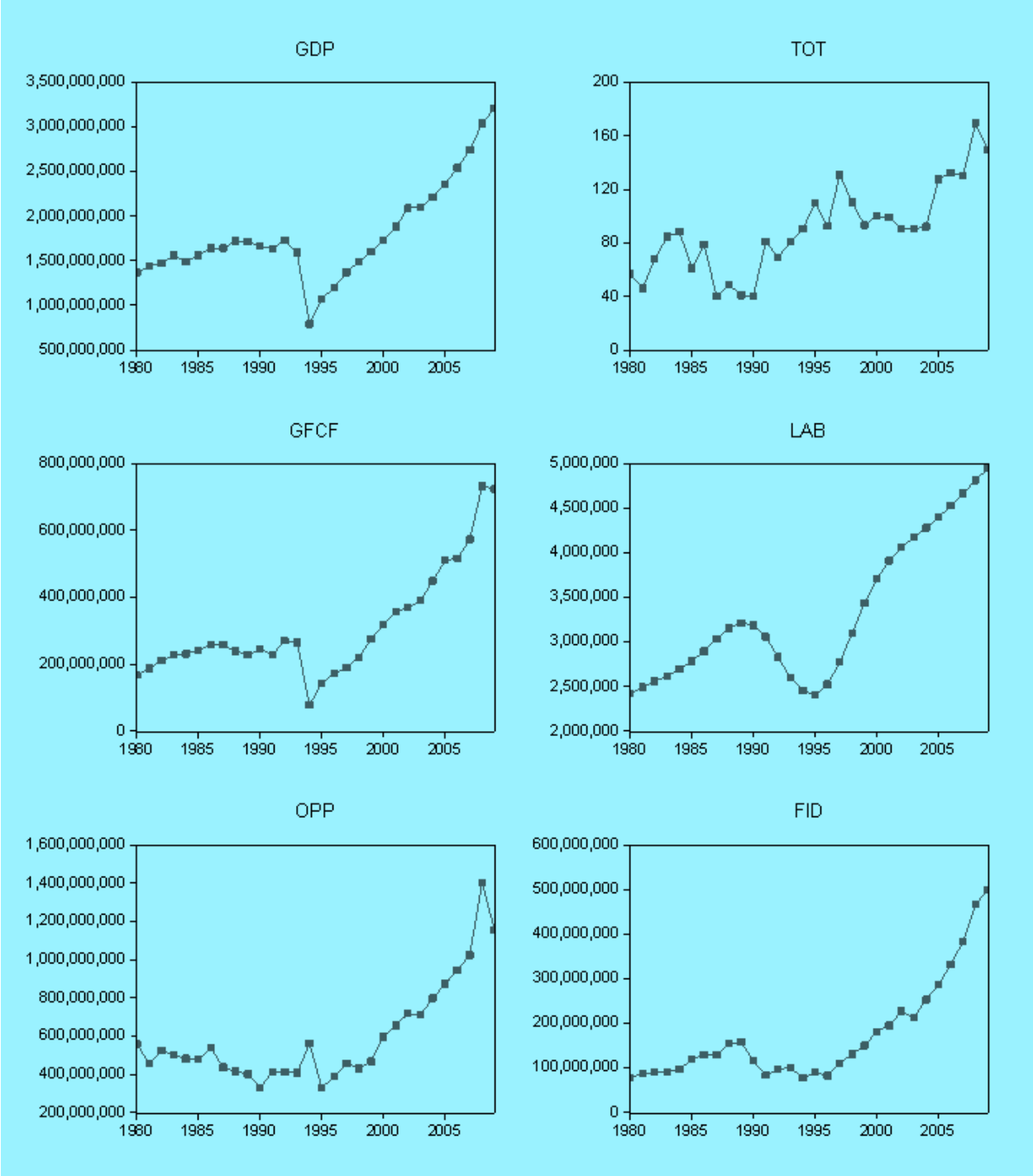
Figures 13- 18 Macroeconomic Indicators for Burundi (1980 – 2009)



Figures 19 – 24 Macroeconomic Indicators for Kenya (1980 – 2009)



Figures 25 – 30 macroeconomic Indicators for Rwanda(1980 – 2009)



APPENDIX B

SPEARMAN'S CORRELATION COEFFICIENTS FOR SIX VARIABLES FOR FIVE SELECTED EAST AFRICAN COU NTRIES

Table.1 Correlation Analysis for log series (GDP,TOT, GFCF.LAB,OPP,FID) , (1980-2009)

Ethiopia		TOT	GFCF	LAB	OPP	FID
	GDP	-041(0.02)	0.99(0.00)	0.95(0.00)	0.99(0.00)	0.92(0.0.00)
	TOT		-0.41(0.02)	-0.5(0.004)	-0.4(0.02)	-0.4(0.02)
Sudan	GDP	0.6(0.002)	0.5(0.002)	0.9(0.00)	0.95(0.002)	0.3(0.07)
	TOT		0.7(0.00)	0.6(0.0002)	0.6(0.0002)	0.5(0.004)
Burundi	GDP	-0.2(0.3)	0.5(0.002)	0.5(0.007)	0.85(0.00)	0.5(0.003)
	TOT		0.5(0.006)	-0.7(0.00)	0.03(0.9)	-0.7(0.00)
Kenya	GDP	o.3(0.1)	0.9(0.00)	0.9(0.00)	0.9(0.00)	0.9(0.00)
	TOT		0.3(0.09)	0.3(0.09)	0.3(0.09)	0.12(0.5)
Rwanda	GDP	0.3(0.07)	0.94(0.00)	0.93(0.00)	0.6(0.0004)	0.9(0.00)
	TOT		0.4(0.02)	0.5(0.008)	0.6(0.001)	0.5(0.006)

The numbers in brackets are p- values

APPENDIX C

MODELS RESIDUAL DIAGNOSTIC TESTS FOR VAR (p)

Table 2 . Breusch – Godfrey Serial Correlation LM Test, Uni - variate Model without exogenous variables

Country	Variable	F- statistic				
		Value	Df	Probability	Obs*R -squared	Prob. Chi-square(2)
Ethiopia	GDP	0.43	F(2,17)	0.65	1.26	0.53
	TOT	0.12	F(2,17)	0.88	0.36	0.83
Sudan	GDP	1.02	F(2,20)	0.37	2.29	0.28
	TOT	0.13	F(2,21)	0.87	0.35	0.83
Kenya	GDP	2.73	F(2,17)	0.79	6.33	0.84
	TOT	0.37	F(2,17)	0.69	1.09	0.57
Burundi	GDP	0.81	F(2,17)	0.45	2.27	0.32
	TOT	1.73	F(2,20)	0.20	0.81	0.13
Rwanda	GDP	1.06	F(2,17)	0.36	2.88	0.23
	TOT	2.83	F(2,17)	0.68	6.49	0.32

Table 3 Hetrosckedasticity Test Breusch – Godfrey , Univariate Model without exogenous variables

Country	Variable		F- statistic		Chi-square			
		Value	Df	Prob.	Obs*R-squared	Prob. Chi-square(4)	Scaled Explained SS	Prob. Chi-square(2)
Ethiopia	GDP	3.61	F(6,19)	0.14	13.86	0.03	3.47	0.74
	TOT	0.81	F(6,19)	0.57	5.29	0.50	1.82	0.93
Sudan	GDP	2.33	F(4,22)	0.18	8.04	0.1	3.35	0.48
	TOT	0.46	F(4,23)	0.75	2.10	0.71	1.85	0.76
Kenya	GDP	0.26	F(6,19)	0.94	2.08	0.91	0.70	0.99
	TOT	1.26	F(6,19)	0.31	7.43	0.28	4.08	0.66
	GDP	0.72	F(6,19)	0.63	4.83	0.56	3.24	0.77
Burundi	TOT	2.51	F(6,19)	0.57	11.51	0.1	4.51	0.60
Rwanda	GDP	1.84	F(6,19)	0.14	9.59	0.14	22.38	0.01
	TOT	0.26	F(6,19)	0.94	1.98	0.92	2.53	0.86

Table 4 Ramsey Reset Stability Test Uni-variate model without exogenous variables

Country	Variable		F- statistic		Chi-square	
		Value	df	Prob.	LR	Prob. Chi-square(1)
Ethiopia	GDP	0.90	F(1,18)	0.35	1.27	0.25
	TOT	2.59	F(1,18)	0.12	3.49	0.61
Sudan	GDP	0.35	F(1,21)	0.55	o.45	0.49
	TOT	0.34	F(1,22)	0.56	0.43	0.51
Kenya	GDP	2.65	F(1,18)	0.12	3.57	0.25
	TOT	0.46	F(1,18)	0.50	0.66	0.41
Burundi	GDP	2.57	F(1,18)	0.12	3.47	0.16
	TOT	0.34	F(1,18)	0.56	0.49	0.48
Rwanda	GDP	2.02	F(1,18)	0.17	2.77	0.1
	TOT	0.41	F(1,18)	0.52	0.58	0.44

APPENDIX D

MODELS RESIDUAL DIAGNOSTIC TESTS FOR VAR (b, p)

Table 5. Breusch – Godfrey Serial Correlation LM Test, Uni - variate Model without exogenous variables

Country	Variable	F- statistic				
		Value	Df	Probability	Obs*R - squared	Prob. Chi-square(2)
Ethiopia	GDP	5.62	F(2,9)	0.26	13.88	0.11
	TOT	0.03	F(2,7)	0.96	0.22	0.89
Sudan	GDP	0.68	F(2,7)	0.53	4.07	0.13
	TOT	0.37	F(2,7)	0.70	2.40	0.30
Burundi	GDP	0.103	F(2,8)	0.90	0.65	0. 72
	TOT	0.51	F(2,7)	0.62	16.85	0.32
Kenya	GDP	1.82	F(2,15)	0.19	5.29	0.10
	TOT	0.08	F(2,7)	0.92	0.57	0.75
Rwanda	GDP	0.27	F(2,9)	0.76	1.44	0.48
	TOT	1.58	F(2,10)	0.25	6.25	0.43

Table 6 Hetrosckedasticity Test Breusch - Godfrey , Uni-variate Model without exogenous variables

Country	Variable		F- statistic		Chi-square			
		Value	Df	Prob.	Obs*R-squared	Prob. Chi-square(13)	Scaled Explained SS	Prob. Chi-square(13)
Ethiopia	GDP	0.63	F(13,11)	0.78	10.68	0.63	0.97	0.9
	TOT	0.74	F(13,9)	0.69	11.93	0.53	2.10	0.99
Sudan	GDP	0.79	F(15,9)	0.66	14.22	0.50	1.44	1.00
	TOT	0.85	F(15,9)	0.61	14.72	0.47	1.57	1.00
Burundi	GDP	1.13	F(15,10)	0.42	16.40	0.35	1.74	1.00
	TOT	1.24	F(15,9)	0.38	16.85	0.32	1.77	1.00
Kenya	GDP	1.20	F(15,9)	0.40	16.38	0.33	1.20	0.10
	TOT	1.08	F(15,9)	0.46	16.11	0.37	1.17	0.10
Rwanda	GDP	0.41	F(13,11)	0.93	8.16	0.83	1.03	1.00
	TOT	0.63	F(13,12)	0.78	10.61	0.64	1.84	0.99

Table 7 Ramsey Reset Stability Test Uni-variate model without exogenous variables

Country	Variable		F- statistic		Chi-square	
		Value	df	Prob.	LR	Prob. Chi-square(1)
Ethiopia	GDP	0.11	F(1,10)	0.74	0.27	0.59
	TOT	0.25	F(1,8)	0.62	.27	0.39
Sudan	GDP	0.90	F(1,8)	0.36	2.69	0.10
	TOT	0.39	F(1,8)	0.54	1.19	0.27
Burundi	GDP	0.07	F(1,9)	0.79	0.21	0.64
	TOT	0.33	F(1,8)	0.57	1.02	0.31
Kenya	GDP	0.04	F(1,8)	0.85	0.11	0.73
	TOT	1.48	F(1,8)	0.25	4.26	0.24
Rwanda	GDP	2.54	F(1,10)	0.15	9.36	0.19
	TOT	1.11	F(1,11)	0.31	2.51	0.12

APPENDIX E

VAR IN DIFFERENCE MODEL ESTIMATIONS

Table 8. VAR – D Estimation for Ethiopia

		Dependent Variables					
		DLOG(GDP)	T- stastistic	P-value	DLoG(TOT)	T- stastistic	P - value
Explanatory Variables	C	-3.16	-3.13	0.005	-0.06	-1.58	0.13
	DLOG(GDP(-1))	0.14	3.17	0.005	0.75	1.78	0.08
	DLOG(GDP(-2))	-0.72	-3.61	0.002	0.88	2.10	0.05
	DLOG(GDP(-3))	0.15	0.84	0.40	-0.57	-1.35	0.19
	DLOG(TOT(-1))	0.21	2.31	0.03	-0.15	-0.74	0.46
	DLOG(TOT(-2))	0.13	1.63	0.12	-0.35	-1.84	0.08
	DLOG(TOT(-3))	0.11	1.40	0.17	-0.36	-1.82	0.08

Table9. VAR – D Estimation for Sudan

		Dependent Variables					
		DLOG(GDP)	T- stastistic	P-value	DLoG(TOT)	T- stastistic	P – value
Explanatory Variables	C	0.02	1.62	0.11	-7.29	-2.87	0.009
	DLOG(GDP(-1))	0.31	1.44	0.16	0.4	0.33	0.73
	DLOG(GDP(-2))	0.01	0.05	0.96	1.18	2.80	0.01
	DLOG(TOT(-1))	-0.07	-2.28	0.032	-0.58	-2.84	0.009
	DLOG(TOT(-2))	0.01	0.50	0.61	-0.16	-0.79	0.43

Table 10. VAR – D Estimation for Burundi

		Dependent Variables					
		DLOG(GDP)	T- stastistic	P-value	DLoG(TOT)	T- stastistic	P - value
Explanatory Variables	C	0.007	0.81	0.42	-0.02	-0.66	0.51
	DLOG(GDP(-1))	0.40	1.86	0.07	0.70	0.68	0.50
	DLOG(GDP(-2))	0.25	1.15	0.26	-2.01	-1.94	0.06
	DLOG(GDP(-3))	-0.05	-0.29	0.7	1.75	1.87	0.07
	DLOG(TOT(-1))	-0.01	-0.36	0.7	-0.03	-0.17	0.86
	DLOG(TOT(-2))	0.006	-0.14	0.88	-0.05	-0.26	0.79
	DLOG(TOT(-3))	0.056	1.39	0.17	-0.01	-0.07	0.9

Table11. VAR – D Estimation for Kenya

		Dependent Variables					
		DLOG(GDP)	T- stastistic	P-value	DLoG(TOT)	T- stastistic	P - value
Explanatoy Variables	C	0.28	0.56	0.57	1.70	1.05	0.30
	DLOG(GDP(-1))	-0.01	-0.50	0.62	-1.18	-1.65	0.11
	DLOG(GDP(-2))	0.36	1.37	0.18	-0.30	-0.40	0.68
	DLOG(GDP(-3))	-0.29	-1.04	0.31	-0.07	-1.02	0.31
	DLOG(TOT(-1))	0.01	0.25	0.80	-0.25	-1.16	0.26
	DLOG(TOT(-2))	0.06	0.91	0.37	0.24	1.13	0.27
	DLOG(TOT(-3))	-0.07	-0.08	0.93	0.09	0.49	0.62

Table 12.VAR – D Estimation for Rwanda

		Dependent Variables					
		DLOG(GDP)	T- stastistic	P-value	DLoG(TOT)	T- stastistic	P - value
Explanatory Variables	C	-0.8	-1.99	0.06	-4.28	-0.96	0.34
	DLOG(GDP(-1))	-0.15	-0.79	0.43	-0.31	-0.98	0.33
	DLOG(GDP(-2))	-0.17	-0.88	0.38	0.5	1.45	0.16
	DLOG(GDP(-3))	-0.05	-0.31	0.75	-0.29	-0.88	0.38
	DLOG(TOT(-1))	0.07	0.62	0.53	-0.40	-1.97	0.06
	DLOG(TOT(-2))	0.20	2.10	0.04	0.08	0.38	0.70
	DLOG(TOT(-3))	-0.2	-2.54	0.01	0.15	0.76	0.4

APPENDIX F

VECTOR ERROR CORRECTION MODEL ESTIMATIONS

Table13. Vector Error Correction model estimation for Ethiopia

		Dependent Variables					
		DLOG(GDP)	T-stastistic	P - value	DLoG(TOT)	T-stastistic	P - value
Explanatory Variables	C	0.01	0.69	0.5	-4.95	-1.8	0.09
	DLOG(GDP(-1))	1.11	1.46	0.17	-23.63	-3.22	0.01
	DLOG(GDP(-2))	-0.02	-1.18	0.26	-22.40	-3.01	0.01
	DLOG(TOT(-1))	0.03	-2.37	0.03	0.66	1.37	0.20
	DLOG(TOT(-2))	0.001	-0.09	0.92	0.11	0.37	0.71
	DLOG(GFCF)	2.08	53.03	0.00	-48.49	-3.13	0.01
	DLOG(GFCF(-1))	-0.32	-0.43	0.67	-23.01	-3.005	0.01
	D(DLOG(LAB))	-0.50	-1.07	0.30	6.61	0.55	0.59
	D(DLOG(LAB(-1)))	-0.26	-0.81	0.43	-8.37	-0.60	0.55
	DLOG(OPP)	-1.09	-44.6	0.00	-25.26	-3.12	0.01
	DLOG(OPP(-1))	-0.75	-1.87	0.08	-20.86	2.88	0.01
	DLOG(FID)	0.02	2.19	0.05	-0.35	-1.09	0.30
	DLOG(FID(-1))	-0.01	-1.26	0.23	0.24	0.98	0.35
	RESUG(-1)	-0.99	-2.15	0.05	0.22	1.89	0.08

Table 14. Vector Error Correction model estimation for Sudan

		Dependent Variables					
		DLOG(GDP)	T-stastistic	P - value	DLOG(TOT)	T-stastistic	P - value
Explanatory Variables	C	-0.04	-2.83	0.02	-8.47	-1.97	0.079
	DLOG(GDP(-1))	-0.83	-1.42	0.18	47.55	-0.85	0.41
	DLOG(GDP(-2))	0.07	2.93	0.01	1.49	0.79	0.44
	DLOG(GDP(-3))	0.04	2.54	0.03	2.63	1.62	0.13
	DLOG(TOT(-1))	-0.004	-1.68	0.12	-1.93	-2.79	0.02
	DLOG(TOT(-2))	0.001	0.39	0.69	0.28	0.83	0.42
	DLOG(TOT(-3))	-0.003	-1.03	0.32	-0.11	-0.37	0.71
	DLOG(GFCF)	0.003	-0.84	0.42	0.47	1.06	0.31
	DLOG(GFCF(-1))	0.018	5.39	0.0004	0.37	2.03	0.07
	D(DLOG(LAB))	-0.720	-8.54	0.00	-5.74	-0.70	0.50
	D(DLOG(LAB(-1)))	-0.45	-3.41	0.0077	2.19	0.20	0.84
	DLOG(OPP)	0.99	50.05	0.0000	0.25	0.09	0.92
	DLOG(OPP(-1))	0.89	1.49	0.16	46.37	0.82	0.43
	DLOG(FID)	0.017	2.85	0.018	0.18	0.35	0.72
	DLOG(FID(-1))	0.011	2.90	0.017	0.20	0.59	0.56
	RESUG(-1)	0.75	2.39	0.04	1.26	2.31	0.05

Table15. Vector Error Correction model estimations for Burundi

		Dependent Variables					
		DLOG(GDP)	T-stastistic	P - value	DLOG(TOT)	T-stastistic	P - value
Explanatory Variables	C	0.01	1.37	0.19	0.02	0.48	0.6449
	DLOG(GDP(-1))	0.31	1.95	0.08	3.96	1.69	0.1343
	DLOG(GDP(-2))	0.16	1.07	0.31	-4.81	-2.27	0.0575
	DLOG(GDP(-3))	-0.10	-0.69	0.50	3.89	1.97	0.0894
	DLOG(TOT(-1))	-0.01	-0.43	0.67	0.12	0.43	0.6746
	DLOG(TOT(-2))	0.01	0.38	0.71	-0.16	-0.57	0.5847
	DLOG(TOT(-3))	0.05	1.90	0.09	0.23	0.87	0.4106
	DLOG(GFCF)	0.0005	0.02	0.98	0.36	1.06	0.3251
	DLOG(GFCF(-1))	0.02	0.91	0.38	0.02	0.01	0.9412
	D(DLOG(LAB))	-0.12	-0.18	0.86	5.66	0.90	0.3941
	D(DLOG(LAB(-1)))	0.24	0.16	0.87	5.53	0.43	0.6733
	DLOG(OPP)	-0.10	-3.44	0.006	-0.03	-0.09	0.9272
	DLOG(OPP(-1))	-0.03	-0.79	0.44	-0.65	-1.22	0.2603
	DLOG(FID)	0.031	0.88	0.39	0.43	0.995	0.3528
	DLOG(FID(-1))	0.08	2.42	0.04	1.26	-2.90	0.0229
	REUG(-1)	1.00	4.76	0.0008	-1.34	-2.11	0.0730

Table16. Vector Error Correction model estimations for Kenya

		Dependent Variables					
		DLOG(GDP)	T-stastistic	P - value	DLOG(TOT)	T-stastistic	P - value
Explanatory Variables	C	-0.001	-0.10	0.92	-4.26	-0.46	0.65
	DLOG(GDP(-1))	-0.62	-2.14	0.06	1.53	0.17	0.86
	DLOG(GDP(-2))	-0.0032	-0.08	0.93	-0.44	-0.03	0.97
	DLOG(GDP(-3))	-0.01	-0.26	0.79	0.27	0.32	0.75
	DLOG(TOT(-1))	0.004	0.37	0.72	0.20	0.63	0.54
	DLOG(TOT(-2))	0.003	0.36	0.72	0.32	1.44	0.18
	DLOG(TOT(-3))	0.01	1.28	0.23	-0.01	-0.06	0.95
	DLOG(GFCF)	0.27	9.51	0.00	0.38	0.60	0.56
	DLOG(GFCF(-1))	0.60	0.68	0.51	-1.49	-0.16	0.87
	D(DLOG(LAB))	-0.59	-0.90	0.39	15.44	0.92	0.37
	D(DLOG(LAB(-1)))	0.61	0.83	0.42	-7.97	-0.51	0.62
	DLOG(OPP)	0.72	18.23	0.00	0.53	0.51	0.62
	DLOG(OPP(-1))	1.47	1.85	0.10	0.63	0.05	0.96
	DLOG(FID)	0.005	0.58	0.57	0.57	2.27	0.05
	DLOG(FID(-1))	0.02	2.07	0.07	0.32	1.56	0.15
	REUG(-1)	-1.07	-2.48	0.04	1.218	2.46	0.04

Table17. Vector Error Correction model estimations for Rwanda

		Dependent Variables					
		Dlog (GDP)	T-stastistic	P - value	Dlog (tot)	T-stastistic	P - value
Explanatory Variables	C	-2.15	-2.62	0.02	0.08	1.85	0.09
	DLOG(GDP(-1))	0.01	0.06	0.95	-0.63	-0.559	0.58
	DLOG(GDP(-2))	0.10	2.62	0.02	-0.19	-0.29	0.77
	DLOG(TOT(-1))	0.07	1.98	0.07	-0.78	-2.74	0.02
	DLOG(TOT(-2))	0.04	1.26	0.23	0.004	0.019	0.98
	DLOG(GFCF)	0.53	14.84	0.00	0.13	0.47	0.64
	DLOG(GFCF(-1))	0.144	1.360	0.20	0.60	0.93	0.37
	D(DLOG(LAB))	0.909	2.30	0.04	0.61	0.33	0.74
	D(DLOG(LAB(-1)))	0.69	1.76	0.10	-2.24	-0.88	0.39
	D(DLOG(OPP))	-0.144	-2.51	0.03	-0.13	-0.27	0.078
	D(DLOG(OPP(-1)))	-0.06	-0.09	0.92	-0.88	-1.50	0.09
	DLOG(FID)	-0.1313	-2.07	0.06	-0.078	-0.18	0.085
	DLOG(FID(-1))	-0.19	-3.073	0.010	-0.69	-1.54	0.15
	RESUG(-1)	-0.88	-3.48	0.005	-1.12	-2.59	0.02

APPENDIX I

SIGNIFICANCE TEST STATISTICS FOR LOG SERIES (GFCF, LAB, OPP AND FID) IN ECMX

Table 18 Significance Test Statistics for exogenous variables in ECMX (The null hypothesis: each variable will not impact GDP and TOT)

	GDP							TOT					
	F - stastics				Chi -square			F - stastics			Chi -square		
	varia	values	df	Prob	values	df	Prob.	values	df	Pro	values	df	Prob.
Ethiopia	GFCF	1510	(2,12)	0.00	3021	2	0.00	5.34	(2,12)	0.02	10.68	2	0.004
	LAB	0.612731	(2,12)	0.55	1.22	2	0.54	0.003	(2,12)	0.99	0.0065	2	0.99
	OPP	1036	(2,12)	0.00	2072	2	0.00	5.35	(2,12)	0.02	10.71	2	0.004
	FID	1.69	(2,12)	0.22	3.39	2	0.18	1.81	(2,12)	0.20	3.62	2	0.16
Sudan	GFCF	3.03	(2,6)	0.09	6.06	2	0.05	0.05	(2,9)	0.95	0.09	2	0.95
	LAB	18.91	(2,6)	0.002	37.85	2	0.00	0.10	(2,9)	0.90	0.20	2	0.90
	OPP	333.4	(2,6)	0.00	666.93	2	0.00	0.91	(2,9)	0.43	1.83	2	0.40
	FID	1.31	(2,6)	0.33	2.63	2	0.26	0.099	(2,9)	0.90	0.19	2	0.90
Burundi	GFCF	0.69	(2,10)	0.52	1.39	2	0.49	0.406	(2,10)	0.67	0.81	2	0.66
	LAB	0.0003	(2,10)	0.99	0.0006	2	0.99	0.25	(2,10)	0.78	0.50	2	0.77
	OPP	6.08	(2,10)	0.01	12.17	2	0.002	4.36	(2,10)	0.04	8.73	2	0.01
	FID	4.08	(2,10)	0.05	8.16	2	0.02	7.24	(2,10)	0.01	14.49	2	0.00
Ken iya	GFCF	55.32	(2,8)	0.00	110.64	2	0.00	1.11	(2,9)	0.37	2.21	2	0.32
	LAB	0.45	(2,8)	0.64	0.914	2	0.63	4.07	(2,9)	0.05	8.15	2	0.02
	OPP	182.77	(2,8)	0.00	365.55	2	0.00	1.27	(2,9)	0.32	2.54	2	0.28
	FID	2.16	(2,8)	0.17	4.33	2	0.01	3.39	(2,9)	0.07	6.78	2	0.03
Rwanda	GFCF	108.42	(2,11)	0.00	216.8	2	0.00	1.38	(2,9)	0.29	2.77	2	0.24
	LAB	2.89	(2,11)	0.09	5.78	2	0.05	0.25	(2,9)	0.78	0.50	2	0.77
	OPP	3.12	(2,11)	0.08	6.25	2	0.04	2.46	(2,9)	0.14	4.92	2	0.08
	FID	7.36	(2,11)	0.009	14.72	2	0.0006	2.48	(2,9)	0.13	4.97	2	0.08