DETERMINANTS OF TAX REVENUE IN EAST AFRICAN COUNTRIES: AN APPLICATION OF MULTIVARIATE PANEL DATA COINTEGRATION ANALYSIS.

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DEDICATION

I dedicate my research work to my lovely and dearest wife, Buze Gurmu Raje, who leads me through the valley of darkness with the light of hope and support and my beloved kids Lencho and Birmadu whom I cannot stop loving.

I also dedicate my research work to my ever best friend Mebratu Negera Feyissa who did not left me aside when things go bleak.
APPROVAL

This is to certify that the research report entitled “The determinants of tax revenue in East African Countries: An Application of Multivariate Panel Cointegration Analysis” was done by Kitessa Delessa Terefe under my supervision and is approved for submission.

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DECLARATION

I, [Kitessa Delessa Terefe], declare that this research work entitled [Determinants of Tax Revenue in East African Countries: An Application of Multivariate Panel Data Cointegration Analysis] is my original work and has not been submitted to any other university for the award of any academic degree or Diploma.

Signature ________________________________ Date 20/10/2017

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ABBREVIATIONS AND ACRONYMS

ADF  Augmented Dickey-Fuller
AR   Auto Regressive
CD   Cross-Sectional Dependence
DCs  Developed Countries
DPD  Dynamic Panel Data
ECT  Error Correction Term
FE   Fixed Effect
FDI  Foreign Direct Investment
FGLS Feasible Generalized Least Square
GDP  Gross Domestic Product
GLS  Generalized Least Square
GMM  Generalized Methods of Moments
GNI  Gross National Income
GNP  Gross National Product
IMF  International Monetary Fund
IPS  Im-Pesaran-Shin
LLC  Levin-Lin-Chu
OLS  Ordinary Least Square
OECD Organization for Economic Cooperation and Development
ODA  Official development Assistance
OER  Official Exchange Rate
PCSE Panel Corrected Standard Errors
PVECM Panel Vector Error Correction Model
RE   Random Effect
SSA  Sub-Saharan Africa
WB   World Bank
WDI  World Development Indicator
ABSTRACT

Domestic revenue mobilization has received growing attention in recent years. For the economies of Sub-Saharan African (SSA) countries in general and that of the East Africa countries in particular domestic resource mobilization has crucial national and international dimensions. In most countries, the share of tax revenue collection to GDP is declining and countries rely on foreign aid and other source of capital inflow as a major source of the government budget. Thus, as tax revenue is key for economic development, the study thought to empirically examine the key determinants of tax revenue for East African countries using the recent year data ranging from 1992 to 2015 by employing panel data cointegration approach.

Panel unit root test of stationarity using the LLC, IPS and ADF test of stationarity shows that all variables are cointegrated of order one, I(1) except the variable inflation which is stationary at level. The model estimation was made by using the FGLS and the dynamic panel data GMM model. The long run estimated equation from the FGLS results indicates that per capita GDP, foreign aid, trade openness, share of agriculture, share of industry and share of services have positive contribution for tax revenue of east African countries over the study period. On other hand, urbanization, official exchange rate and rate of inflation have negative impact of the tax revenue to GDP ratio. From the short run panel vector error correction model one period lagged tax revenue and urbanization has negative impact on the current period tax revenue while two period lagged urbanization and official exchange rate has positive impact.

Thus, the result of the study calls for an indication that tax revenue increases under stable macroeconomic environment. Hence, East African countries should therefore better pursue economic policies that at least reveal low inflation rate and favorable trade policies. Moreover, the countries are required to set prudent macroeconomic policy environment which create economic integrations among different sectors, mobilizes domestic resource and improve external trade policies to make each country’s growth sustainable on the basis of domestic resource mobilizations. The cumulative effects lead to improved tax revenue collection of the region.
CHAPTER ONE: INTRODUCTION

This chapter presents the background to the study, the statement of the problem, objectives of the study, significance of the study, scope and limitations of the study and lastly the organization of the study.

1.1 Background of the Study

Sustainable economic development, a base for improvement of welfare and living standards of societies, basically depends on the real capital formation which is supposed to be generated from availability and mobilization of domestic resources at large. Efficient mobilization and channeling of resources to productive activities call for the development of efficient financial system where the link between saving and investment promising. Government expenditure a key for such development basically comes from different sources among others tax revenue, printing notes, internal and foreign borrowings, income from investment activities, aid and grants, disposal of assets and non-tax revenue are the major ones. Each of the financing options has their own pros and cons but though government uses various methods of raising and mobilizing resources the role of tax as an importance and sustainable source of government revenue is far reaching.

In less developing countries, like those of the advanced countries, resources are needed by government for wide multiplicity of expenditures ranging from public administration and defense to provision of social services and infrastructural developments. Such increase in public expenditure and notably public investment are pillars of the economy usually considered as indispensable aspects of the development process. Such substantial expenditure cost usually requires adequate tax collection to be covered at least partly (Ehtisham & Nicholas, 1989).

Tax revenue is the specified amount of money the citizen of the country legally pays for the government of the country on the enforceable ways to support the economic and social developments of the country. In many developing countries taxation go in a parallel and proportionate way with the economic growth and they are the lifeblood for government to secure finance used to provide social services and undertake different public investments on long term basis (Joyce, 2014); (Garner, 1999) and (OECD . , 2008)
Taxation is an important instrument for fiscal policy which can be used for mobilizing resources for capital formation in the public sector (Saibu & Olasunbo, 2013). In less developing countries there is high mismatch and imbalance between the ever increasing demand for government expenditure and the limited scope of tax revenue raised to finance such development scenarios. (David, 2000).

1.2 Statement of the Problem

Revenue mobilization in developing countries is a subject of great concern and received a number of attentions in recent years due to a rapid and unmatched increase in public expenditure. The need to raise tax revenue is fundamental for developing countries to lower dependence on foreign aid, solve macroeconomic problems, limit the recourse of borrowing and achieve robust economic growth. Reflecting this, increasing tax to GDP ratio is an explicit aim of policy in developing countries (Nouriel, 1994); (Zulal, 2005) and (Saibu & Olasunbo, 2013). Regardless of copious tax reforms intended to increase tax to GDP ratio, to advance the socioeconomic conditions through increasing public goods by government, the Sub-Saharan African (SSA) countries in general and East African countries in particular remain among the poorest in the world with lowest revenue collections allied to large fiscal deficits triggering fiscal imbalances. Such persistent and broadening budget deficits forces the government to run unsustainable budget deficits, negative trade balance and decline in exports of goods and services incapable to achieve macroeconomic goals as the tax system is the victim of numerous economic crises (Kayaga, 2007). Moreover, failure to collect sufficient revenue and low capacity of tax administration exposed East African countries to suffer from tiny proportion of tax revenues further deteriorating the financial situations of the countries and baring them to external shocks. And, this remains a crucial problem in the taxing system of the countries (Bersley & Persson, 2014); (IMF, 2015) and (Langford & Ohlenburg, 2016).

Therefore, as tax revenue collection is not optimal subject to a number of factors it is essential to explore forces working behind it. To this point, the study thought to empirically examine the key determinants of tax revenue for nine East African countries using the broader data ranging from 1992 to 2015 by employing a technique of multivariate panel cointegration approach which gives large number of data points, increases degree of freedom reduces collinearity among explanatory variables and allows to control for omitted variables.
1.3 Objective of the Study

The main objective of the study is to empirically assess the determinants of tax revenue for East African countries. The specific objectives of the paper were to:

(i) Empirically examine the impact of sectoral composition of the economy on tax revenue
(ii) Estimate the effect of trade openness on tax revenue
(iii) Empirically assess the effect of macroeconomic stability on tax revenue

1.4 Hypothesis of the Study

✓ H0: Sectoral economic performances do not affect tax revenue
✓ H0: Trade openness does not affect tax revenue
✓ H0: Macroeconomic stability does not affect tax revenue posits

1.5 Significant of the Study

The study adds value to the existing literature by extending the works of others and helps in filling the knowledge gaps in the area of the determinants of tax revenue for East African Countries. The empirical result of the study could be used to design a clear growth enhancing policy on the potential of the economy to generate sufficient amount of tax revenue used for different development objectives. The study brings together comprehensive evidence on the determinants of tax revenue in East African Countries. It provides an informed basis for concerned policy makers, government officials and the tax revenue authorities to take action with the right ways of intervention on tax policy in addition to filling the gap about what is currently known about determinants of tax revenue in the region. Further, the study also stimulates further research in the area of taxation.

1.6 Scope of the Study

The study is limited to the period 1992 to 2015 to capture the responsiveness of tax revenue to changes in its determinants. Furthermore, the study area is limited to East African countries.
1.7 Organization of the Study

The study is organized into five main chapters with first chapter constituting sections including the general introduction. The remaining parts are arranged as follows. Chapter two highlights relevant literatures including theoretical and empirical reviews and the observed research gaps. Chapter three presents the model specification and methodology adopted for the study, touching on issues such as specification of the model, description of variables, sources of the data and methodology used in estimation of the model. The fourth chapter deals with estimation and discussion of results based on the estimated model. Finally, chapter five concludes and provides policy recommendations and also shows some direction for further research.
CHAPTER TWO: REVIEW OF LITERATURE

The purpose of this chapter is to review the related literature on the area of the determinants of tax revenue. This establishes a framework which guides the study. The section constitutes areas discussed under theoretical and empirical literature. The first part deals with theoretical literature and second part reviews empirical study related to the study area. At last the observed gaps of the previous works of the same area is explored and filled by the study.

2.1 Theoretical Literature

The issue of tax revenue in less developing countries has been an area of debate to many scholars and researchers for many years. This is because of the divergence between theoretical and empirical arguments as there is no robust evidence to say that macro level factors retard or promotes tax revenue of the region due to country specific factors. Thus, the subsequent section provides a review of the existing literatures.

2.1.1 Taxation and Economic Development

It is quite evident that developing country governments oblige sustainable sources of finance for economic development. And this is new perspective on development financing approach. In the past, attention was given for development assistance where foreign grants and public sector loans were used foremost sources of finance. Nevertheless, subject to a lot of circumstances the finance sources from such sources is declining from time to time. For example, the share of Official Development Assistance (ODA) to developing countries decreased from 0.50% of donors’ Gross National Product (GNP) to 0.35% in 1985. ODA further declined to 0.25% of donors’ GNP by 1996 (Todaro, 2000). Even though donors renewed their commitments to substantial amount of ODA they failed to fulfill their commitments and due to its volatile nature ODA is not dependable and sustainable source of finance (United Nations, 2010 ; (Weeks, 2010).

The perspectives on tax and economic development hinges from the structural link and well-built connection between the two which takes into account the structural characteristics and types of taxes to be imposed, and nature of the economy as a key issue. The standard economic approach to taxation and development explicitly focuses on how the dynamic change in economy puts influence on the tax system and tax revenue collection. The economic structure where share of
informal sector (not accountable for tax payment) declines from time to time enhances the growth of transparent firms which in turn facilitates taxation. Thus, taxation and formal finance linkage mainly requires focus on the specific economic channels through which the economic structure supports growth in share of taxation (Kleven, Claus, & Saez, 2009), (Tanzi V., 1987). According to (Barro & Sala-i-Martin, 1992) a well-designed and efficient tax system minimizes efficiency loss and in turn leads to tax revenue with the aim of spending on public investments and make the economy dynamic.

In general, the standard economic approach states that the connection between taxation and development\(^1\) gives clear emphasis that the amount of revenue collected is hampered by narrow tax base and there is a bidirectional relation between them.

**Figure 1 : The standard Approach (Timothy & Tosten, 2013)**

It should be clear that the economic development of the country does not automatically translate into revenue take as the political decision of the state manifested by the political institution is required as key administration to boost tax revenue share of GDP. Thus, apart from the economic factors the political factors also play key roles in line with the old slogan, “no taxation without representation”.

**Figure 2: Extended Approach (Timothy & Tosten, 2013)**

The general objective of taxation both for developing and developed nations are almost the same though some intermediate objectives differ. Taxation is a mechanism of raising resources to finance the government’s development expenditure. The perceived responsibility of government also differs from developed to developing countries. For example, in less developing countries

\(^1\) Some other scholars also pointed the incoherence between tax and development. For example using the Netherlands data (Francis, 1979) clearly reasoned out the effect of Dutch tax policy on the taxation of multinationals in developing countries.
where there is prevalent market failure, wide spread inequality and etc. there is high degree of government intervention using corrective taxes and regulatory instruments. But, the main problem here is the more the government intervenes the economy the more the government inefficiency occurs in different forms like corruption, rent seeking and other related inefficiencies. Thus, because of such severity there is an argument that the proportion of government intervention in less developing economy should be less compared to the developed economy (Robin & Nicholas, 1993).

In dealing with the role tax plays in once economy different scholars begin with the basic rationale of why government intervene the economy. According to them “market failure” is the main reason, key departure from welfare economists, for the government to intervene. Market failures including externality, missing markets and asymmetric information, Poverty and income distribution deals with whether there is efficient outcome or not, deprivation, attractive or unattractive distribution, Right to education, health, nutrition and housing deals with states responsibility to assure the equality of opportunity and provision of basic services without the individuals participation in the economy, Paternalism is situation where the state might overriding an individual preferences and Future generations is a situation where private individual action do not take into account the welfare of future generations. Thus, these arguments point reason for government action particularly the expenditure on infrastructure, social security, education, health, and environment and role of the government in keeping the economy competitive. Financing of the expenditure might take different forms but as the emphasis of the theme is, taxation, tax revenue is taken into account. Hence with the notion of the “Ricardian equivalence” principle is that tax brings an equivalent effect on the economy as the future borrowing or vice versa (Barro, 1974) and (Bernheim, 1987). Here, tax supports the economic development of the countries as it is source of finance for the stated expenditures.

The analysis and level of expenditure in less developing explain that the over proportion of taxation as share of GDP where greater share goes to direct tax is higher in industrial countries than developing countries. On the contrary, developing countries generate substantial share of their revenue from the non-tax revenue than tax revenue (Tanzi V., 1987). This further shows that even though the demand for public investment is still tremendously high, the finance required from tax revenue lags behind.
It is plausible that better tax system lead to increase in economic growth. But, in less developing countries because of low income levels the tax level is also low. This suggests that in order to levy more tax the country is supposed to be more developed. Since tax is assumed as cost of production by firms, higher taxes dampens growth. Despite the fact that development without tax is not viable, tax should come from growth. A more similar issue is that the willingness to tax (the demand side) is more encouraging than the capacity to tax (the level of GDP) or the ability to tax (the level of financial development). It is when people expect that they get more benefit from the increased delivery of public services that they are more likely to support to raise tax revenue. Thus, the interest of people being taxed as so crucial in imposing tax. That is why the revenue from income taxes are buoyant (more income tax with economic development were that tax more closely represent the citizens ability to pay and the revenue would be more income elastic) (Richard, 2010).

In line with taxation and development, for less developing countries, the key to successful tax reform is focus on taxation as a policy instrument. Here in the context of policy attention is given two important issues. The first is tax administration matters a lot. The best tax policy ineffectively administered amounts to nothing. On the contrary, the revenue administration yields its own policy product. The second important point is that tax is all about politics just as politics also to a degree about taxation. Thus, the building of social capital is considered both administration and political aspect of taxation should be deemed (Ibid).

As shortage of resources hinder the development prospects of once economy, the policy of less developed countries is growth-oriented. This follows from the argument that it is only when there is income first that we can maintain equitable distribution of income and when there is productive capacity built priorly that we assure full and rational implementation of productive capacity. Consequently, the goal of fiscal policy in general and tax policy in particular is to guarantee a preferred rate of economic growth (Suphan, 1973).

In the nutshell, a well performing revenue system is a prediction for strong and sustained economic development. Prominent public expenditures such as physical, social and other infrastructure which are key inputs in maintaining business to flourish or expand are all funded through tax revenue. The more the revenue system is improved the more the society state
interconnection and the more accountable and stable government which further led to high employment and economic growth.

There is a general consensus that provision of public goods plays a key role in economic development given that there is safety and security where there is high probability for people to invest as no one is interested to scarify the real resource today when tomorrow’s return from such investment is uncertain. Access to health and education services, transport, communication and energy infrastructures all contribute towards productivity and innovation which further enhances economic development on sustainable basis. Thus, these basic public goods inherent to build stronger economic development purposes are majorly financed by tax revenue (Michael, 2015) and (Cotterlli, 2011).

2.1.2 Determinants of Tax revenue

The clear examination that less developing countries still need resource for development entail that the endeavor towards increasing tax revenue should increase. Here attention is given to the tax to GDP ratio across countries is evaluating the tax revenue potential of the countries on one hand and the key determinants of tax revenue on the other hand. And, a number of studies have examined that the level of taxation (here tax revenue-GDP ratio or Tax/GDP) was relatively low in developing countries (DCs) (Saeid, 2008).

In Sub-Saharan Africa (SSA) countries there is mixed trend on tax efforts. Some countries collect more than what is expected while other countries collect less. For example, according to Organization for Economic Cooperation and Development (OECD, 2010) almost half of the African countries collected more than what is expected showing that domestic resource mobilization is more hampered by GDP growth and broader developments than the tax revenue system of a given country.

According to (Mwakalobo, 2009):

“The amount of government revenue collected depends on the taxation potential of the individual countries, the taxation targets set by the authorities, and the ability of governments to collect revenue. However, the success of exploiting the revenue potential and attaining the taxation targets depends on a number of other factors. These include the macroeconomic environment, economic
structure and the level of development as well as the administrative capacity and the willingness to pay taxes (Teera & Hudson, 2004). These factors may interact in different ways at different times and in different countries, thus the disparities in government revenue collection among countries.”

Different literatures propose various determinants of tax revenue depending on different factors taken into account. Among which economic development, Share of export and import as GDP, foreign aid, Agricultural share in GDP, Per capita income and etc. (Gupta A., 2007).

Per capita income a proxy for overall economic development is expected to have positive effect on the tax revenue performance of the country. Increase in demand for public goods assumed to associate economic development entails increase in public expenditure (Tanzi V., 1987). Such increase in demand is met by increase in the taxpaying capacity. Structural factors indicating accelerated development are key determinants of tax revenue. These are shift from agricultural sector to industrial sector; increase in per capita income, increase in demand of consumers towards manufactured goods, increase in urbanization and etc will all likely lead to greater income and higher tax capacity (Bornhorst, Gupta, & Thornton, 2009).

Institutional qualities like legitimate and responsive state that maintains rule of law and keep corruption under control has positive impact on the revenue tax collection. According to (Chand & Moene, 1997) fiscal corruption is a main factor working behind poor revenue performances in less developing countries. Measures to fight corruption will lead to increase in revenue performances (Gupta A., 2007). Thus, the stronger the institutions the more opportunity for tax revenue to increase.

Persistent budget deficits and accumulated debt that causes macroeconomic instabilities lead to increase in tax revenue to neutralize the effect. The degree of external indebtedness of a country may affect revenue performance in such a way that to generate the necessary foreign exchange to service the debt, a country may choose to reduce imports. In such a scenario, import taxes will be lower. Alternatively, the country may choose to increase import tariffs or other taxes with a view to generate a primary budget surplus to service the debt. Thus, debt burden leads to high collection of tax.

Foreign aid is another important determinant of tax revenue even though there is no clear explanation regarding the relationship between the two. For example using data for eleven
African found that aid has negative impact on tax revenue but other scholars like (Khan & Hoshino, 1992) found positive impact while (Ouattara, 2006) found significant relationship. Further studies on aid fungibility by (McGillivray & Morrisey, 2000) obtained that the recipient countries use aid for non-productive purposes in place of the donors’ objectives. When it is financing other expenditures it will lead to decrease tax revenue supposed to collect (Aniket & Yiagadeesen, 2012).

Tax base, takes into accounts all items or activities subject to tax, is also another important determinants of tax revenue. As tax revenue is the application of tax rate to a tax base; more socially acceptable increase in tax revenue goes with increase in tax base. For a given level of income the increase in tax revenue due to broaden tax base is more momentous that the increase in tax for a given level of income.

Openness, the degree of international trade, measured as share of export and import to GDP also influences revenue performance. Open economies will lead to increase in fiscal impact of government. Thus, according to (Rodrik, 1998) there is strong positive relation between trade liberalization and tax revenue though (Keen & Alejandro, 2004) argued that the relationship is ambiguous as it works through tariff and exemption in tariff leads to loss is tariff revenue (Gupta, 2007).

Inflation rate, representing the increase in overall price level on sustainable basis, is measured by Consumer Price Index (CPI). Higher inflation rate leads to increase in cost of production like wage paid for workers and as a result production will decline. Such tendency of decrease in production arising from increase in cost of production decreases the amount of output produced on one hand and adversely affects the tax generating potential of the economy (Mwakalobo, 2009).

Urbanization, measured by a percentage of population living in urban areas, has key social, economic and political implications. Urbanization brings new demand for public services and governments’ ability to collect tax is closely related with it (Al-Hakami, 2008).

Population density is another factor determining the tax revenue. With increase in population pressure demand for public goods proportionally increase further leading to increase in public expenditure. Thus, higher population density leads to high tax revenue to meet the increase in demand for goods and services (Teera & Hudson, 2004) as cited in (Mwakalobo, 2009).
2.2 Empirical Literatures

In the empirical literature a number of variables have been taken into account as a key determinant factor of tax revenue. Based on the scholarly findings of different researchers and the research objectives variables like per capita GDP, degree of trade openness, monetization of the economy, ratio of aid to GDP, ratio of overall debt to GDP, FDI, Inflation, urbanization, institutional factors like political instability and corruption are taken as a potential determinant factors.

The empirical literatures are basically summarized in two parts. The first part dealing with the less developing and SSA countries and the second part is for East African countries\(^2\).

According to (Ahmed & Mohammed, Determinants of tax buoyancy: Empirical evidence from developing countries, 2010), of the determinants of tax buoyancy examined for 25 developing countries, growth in import and manufacturing sector has positive impact on growth of tax collection. The effect of agriculture is insignificant while service sector has positive and significant impact. Again, monetary growth and increase in budget deficit has positive impact on tax collection while growth in grants has negative effects on tax collection.

For SSA countries study made by (Stotsky & WoldeMariam, 1997), using the panel of 43 SSA countries, during the period sample period of 1990-95 measured the determinants of tax to GDP ratio. Accordingly, the share of agriculture and mining to GDP has both negative and significant effect on the tax share while the share of exports and imports to GDP has both positive and significant influences. But, per capita income is not significant in determining the tax share during the period.

Using the panel of 22 SSA countries, (Agbeyegbe, Stotsky, & WoldeMariam, 2004) analyzed tax revenue, trade liberalizations and exchange rate relationships. Consequently, trade liberalization, agricultural share, Industrial share, government consumption and terms of trade has positive effect on tax revenue while inflation rate has negative effect.

Using the time series data from 1970 to 2000 (Teera J., 2003) examined the determinants of tax revenue in Uganda. The empirical result shows that agricultural ratio, population density and tax evasion affect all kinds of taxes. Foreign aid has positive and significant impact while openness

\(^2\) Burundi, Tanzania, Kenya, Ethiopia, Rwanda, Zimbabwe, Zambia, Uganda, Madagascar, Mozambique, South Sudan and Sudan
and tax evasion has negative and significant impact. Astonishingly per capita GDP has negative impact during the period. 

(Tesfaye, 2015) analyzed the determinants of tax revenue in Ethiopia from 1999-2014. Consequently during the stated period the result from the regression model shows that the share of industry as a percentage of GDP and per capita income has positive and significant impact. According to the researcher’s argument as the manufacturing enterprises hold financial records their activities than those in agricultural sectors the industry share has positive impact on the tax revenue. In the same way, as increase in per capita income is an indication for economic development and improvement in standards of living, the government’s ability to collect and the citizen’s ability to pay tax increases with increase in per capita income. Foreign direct investment has negative and significant impact on tax revenue for the same period because of the fact that the impact of investment on tax revenue is not immediate.

The study made by (Gaalya, Bbaale, & Hisali, 2017) on East African Community (EAC) countries, using the panel data covering the period 1994-2012, examined the effect of trade openness on revenue performance (for different categories of tax). The empirical outcome from the panel cointegration regression result shows that the average tariff rate measuring trade openness has positive impact on total tax, indirect tax and trade tax while the squared average tariff has negative impact confirming the “the Laffer effect” scenario for the three categories of taxes.\(^3\)

(Nnyanzi, Babyenda, & Bbale, 2016)\(^4\) examined regional integration and tax revenue for East African Community(EAC). Using the annual data ranging from 1980 to 2014, they estimated the tax model using the generalized method of moments (GMM). The empirical result of the study shows that regional integration has significant impact on the tax revenue of EAC subject to the existence of institutional quality. Further, the result clearly presented that the nexus between tax

\(^3\) The three categories of taxes are total tax, direct and indirect tax. See (Gaalya, Bbaale, & Hisali, 2017)

\(^4\) The authors further stressed that the nexus between regional economic integration and tax revenue largely depends on institutional quality which largely affects the way to promote revenue. Increased and sustained source of tax revenue in the member states of the EAC seeks an economic integration targeting on reduction of the shadow economy, revision of the tax system, harmonization the domestic taxes, design and effective implementation of laws and procedures relating to tax matters to curb the problem of distortions and smuggling and capital account liberalizations.
revenue and regional integration depends on a number of compelling factors among which corruption, regulatory quality and accountability has positive impact while government effectiveness, rule of law and political stability has negative impact.

(Beni & Adam, 2009) studied the economic reform in three East African Countries namely Tanzania, Uganda and Kenya with special emphasis on the impact on government revenue and public investment using annual data from 1970 to 2005. The research employed the dynamic time series analysis to address both the long run and short run impacts of economic reforms on government revenue, tax performance and public investment. Empirical results from the long run cointegration analysis and the short run vector error correction model shows that trade reform has negative impact on the government revenue in Uganda where as it does not have significant impact on the tax revenue of both Tanzania and Kenya. In spite of decline in tax GDP ratio in Tanzania the econometric result shows that tax reform has positive impact on government revenue. For Uganda, trade reform has negative impact while it is inconclusive for Kenya.5

2.3 Summary of Literature

The chapter made the summary of brief literature reviews on the area of determinants of tax revenue in different sub-Saharan countries in general and in specific countries included in the sample for the present research. The reviewed literature shows that even though it differs from country to country there are various determinants of tax revenue that are indeed taken into account.

The empirical studies made so far on the subject matter is not complete. In many cases what is observed is inconsistency in results where one cannot conclude the effect of one variable on tax revenue. On top of that there is no previous study done on determinants of tax revenue for East African countries included in the sample all together though some studies are there for East African communities. Thus, taking this rationale into account and the literature gap on the noted concern it can justify good reason for conducting this study.

5 The author further confirms that the impact of the impact of economic reforms on government revenue, tax performance and public investment spending is not the same in the three countries. This is partly due to the fact that Tanzania, Kenya and Uganda differ significantly in their economic structure, level of development, macroeconomic environment, institutional framework, and fiscal structure and policies.
CHAPTER THREE
MODEL SPECIFICATION AND METHODOLOGY

The chapter presents the appropriate econometric model designed to capture the determinants of tax revenue in East African countries with clear methodology to be applied so that it meets the research hypothesis and research objectives of the study. Accordingly, it constitutes three major parts. The first section of the chapter specifies an appropriate model used to analyze the determinants of tax revenue for East African Countries. In doing so after the conceivable model is specified, brief description of variables with their hypothesized sign is clarified. Subsequently, the second part presents the sources of data on variables used in construction of the model. Finally the chapter winds up by explaining the estimation methods used for the study at hand.

3.1 Model Specification

The conceptual framework of the model follows the explicit production function where set of explanatory variables, here the tax revenue determinants, are taken into account as potential factors explaining the specified dependent variable, tax revenue as a ratio of GDP. Thus, to investigate the dynamic relationship between the dependent and explanatory variables the conceptual framework based on the empirical literature is summarized as follows:

Figure 3: The diagrammatic illustration of set of variables

Source: Own Conceptual illustrations, 2017
Thus, the econometric model specification with panel data type starts with:

\[
\left( \frac{T}{Y} \right)_{it} = f(X_{it}) = \beta_0 + \beta_{it}X_{it} + \mu_i + \varepsilon_{it} - - - [1]
\]

Here it is assumed that \( \left( \frac{T}{Y} \right)_{it} \), the ratio of tax revenue to GDP for country \( i \) at time \( t \), is explained by a set of vector of explanatory variables \( X \) that are taken in two dimensions, temporal and individual, \( X_{it} \), where \( i \) is for individual dimension and \( t \) is for time dimension. With \( X_{it} \) the set of explanatory variables measured on individuals at different dates, \( \mu_i \) refers to the individual effects, and \( \varepsilon_{it} \) error terms.

Assuming the multiplicative augments among explanatory variables, the function is summarized as:

\[
\left( \frac{T}{Y} \right) = f(GDPPC, AID, URB, OPEN, OER, AGR, IND, SERV, INF, \varepsilon) - - - [2]
\]

The specific outfitted model in an estimable econometric form is given as:

\[
\ln \left( \frac{T}{Y} \right)_{it} = \beta_0 + \beta_1 \ln GDPPC_{it} + \beta_2 AID_{it} + \beta_3 \ln URB_{it} + \beta_4 \ln OPEN_{it} + \beta_5 \ln OER_{it} + \beta_6 AGR_{it} + \beta_7 IND_{it} + \beta_8 SERV_{it} + \beta_9 INF_{it} + \varepsilon_{it} - - - [3]
\]

Where:

\( T/Y \) here after represented as \( TR \) is the ratio of tax revenue of GDP; \( GDPPC \) is GDP per capita in constant US$; \( AID \) is net official development assistance (ODA) received (% of GNI); \( URB \) is percentage of urban population; \( OPEN \) is trade openness measured as sum of export plus import as a percentage of GDP; \( OER \) is the official exchange rate; \( AGR \) is the share of agriculture value added (% of GDP), \( IND \) is the share of industry value added (% of GDP), \( SERV \) is the share of service value added (% of GDP) and \( INF \) is Inflation, GDP deflator (annual %).

### 3.2. Explanation of Variables

**GDP per Capita (GDPPC):** Sustained increase in GDP will lead to increase in GDP per capita used to measure the relative economic performance of one country in relation to another. It is a tool for making comparison in standards of living between countries and over a period of time. Thus, higher income leads to increased GDP per capita which further leads to higher tax GDP
ratio. As a result it is expected that there is a positive relationship between GDP per capita and tax revenue \( (\beta_1 > 0) \).

**Foreign Aid (AID):** For the economies of the less developing countries like SSA where there is clear resource gap due to low tax revenue collection the inflow of resources in the form of foreign aid is inevitable. But, the effect of foreign aid depends on the cumulative effects of the concessional loans and grants. Loans have positive effect on taxation because of the obligation to repay them back while grants have negative effects as the recipient countries can easily divert it to a nonproductive economic activity (aid fungibility). Thus, the overall effect of foreign aid on domestic resource mobilization will be negative if the negative effect from the grants outweighs the positive effect from loans and vice versa. Hence the expected sign for \( \beta_2 \) is conditional and inconclusive here.

**Urbanization (URB):** Increase in urbanization leads to increase in demand for provision of goods and services accompanied by increase in public expenditure. This in turn entails increase in tax revenue to cover the spending. Thus, a positive relationship is expected between urbanization and tax revenue \( (\beta_3 > 0) \).

**Openness (OPEN):** measured as the ratio of the sum of exports and imports of goods and services over GDP, as named, measures the degree of openness of countries to international trade. Greater trade openness may be beneficial in two ways: exporters experience a decrease in the costs, while imported goods and services increase. This increase in the traded goods widens the tax base and makes the government more likely to move from cross-border taxation to internal taxation. On top of that based on the implicit assumption that trade creates jobs, expands markets, facilitates competition; disseminates knowledge and raises income in less developing countries including the economy of East African countries trade as a principal engine for growth. Thus, a positive relationship is expected between Openness and tax revenue \( (\beta_4 > 0) \).

**Official Exchange Rate (OER):** According to (Tanzi V. , 1989) there is inverse relationship between official exchange rate and tax revenue. Currency appreciation has the direct effect of destroying of import and export of goods and services measured in domestic currency units which further deteriorate international trade tax. Overvaluation also has indirect effects by reducing the incentive to produce goods for export, encouraging capital flight and currency substitution, weakening the balance of payments, encouraging black markets, and encouraging
trade restrictions. Hence, negative relationship is expected between official exchange rate and tax revenue ($\beta_5 < 0$).

**Share of Agriculture Value Added (AGR):** According to some authors agriculture is always dubbed as “the hardest sector to tax” as it is characterized by voluminous informal sector and underground economies dominated by a large number of subsistence farmers. Inefficiency in tax administration puts pressure on fiscal authorities so that the probability of escaping from paying tax is common for the sector and it exacerbates loss in tax revenue. This leads us to conclude that negative relationship is expected (Matsuyama, 1992). The divergent view is that there is a *revenue generation effect*, in that higher agricultural productivity raises agricultural output, which increases tax revenues and public spending on infrastructures (Jing, Been-Lon, & Mei, 2006). Hence the expected sign for $\beta_6$ is questionable.

**Share of Industry Value Added (IND):** The sector pillar for economic development of the nation. Industry is viewed as leading sector to economic development. Helps to have economies of scale where production and employment will increase rapidly. This will bring economic growth and capital formation. Industrial development helps in the rapid growth of national and per capita income. A country cannot produce goods and services of high quality in order to attain decent living standard without the progress of industrial sector. And so the cumulative effect is increase in tax revenue. Consequently, positive relationship is expected between shares of industry value added and tax revenue ($\beta_7 > 0$).

**Share of Services Value Added (SERV):** Nowadays service sector is emerged as the dominant and vibrant sector of the economy and its share in GDP been rising time to time. On top of this the sector is contributing to the growth in employment, international trade and foreign direct investment. The economy moves towards an increasingly services-dominant economy. Therefore, negative relationship is expected between shares of service value added and tax revenue ($\beta_8 > 0$).

**Inflation (INF):** Measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. This is all about how government revenue responds for increase in price level over a period of time. Its effect commonly known as the *Oliveira-Tanzi effect* stipulates that inflation impacts negatively the tax revenue due to lags in

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6 The *Oliveira-Tanzi effect* is an economic situation involving a period of high inflation in a country which results in a decline in the volume of tax collection and a deterioration of real tax proceeds being collected by the
the tax collection. In fact, inflation causes the real value of the collected taxes to decrease between the time of implementation and the time that the tax is effectively levied. Hence, negative relationship is expected between inflation and tax revenue ($\beta_9 > 0$).

Table 1: Summary of variables, their hypothesized sign and explanations

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition of Variables</th>
<th>Source/ Sign</th>
<th>Hypothesized Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax revenue</td>
<td>Tax revenue (% of GDP)</td>
<td>WDI</td>
<td>Dependent variable</td>
</tr>
<tr>
<td>Per capita GDP</td>
<td>Gross domestic product divided by midyear population.</td>
<td>WDI</td>
<td>+</td>
</tr>
<tr>
<td>Foreign Aid</td>
<td>Net ODA received (% of GNI).</td>
<td>WDI</td>
<td>?</td>
</tr>
<tr>
<td>Urbanization</td>
<td>People living in urban areas defined as % of total population</td>
<td>WDI</td>
<td>+</td>
</tr>
<tr>
<td>Trade Openness</td>
<td>Openness measured as the sum of exports and imports of goods and services a ratio of GDP</td>
<td>WDI</td>
<td>+</td>
</tr>
<tr>
<td>Official Exchange Rate</td>
<td>Official exchange rate (LCU per US$, period average) calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).</td>
<td>WDI</td>
<td>-</td>
</tr>
<tr>
<td>Share of Agriculture as % of GDP</td>
<td>Agriculture, value added (% of GDP)</td>
<td>WDI</td>
<td>?</td>
</tr>
<tr>
<td>Share of Industry as % of GDP</td>
<td>Industry, value added (% of GDP).</td>
<td>WDI</td>
<td>+</td>
</tr>
<tr>
<td>Share of Services as % of GDP</td>
<td>Is Services, etc., value added (% of GDP).</td>
<td>WDI</td>
<td>+</td>
</tr>
<tr>
<td>Inflation</td>
<td>Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole.</td>
<td>IMF(^8)</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: WDI and IMF, 2017

7 Extracted from World Bank data bank
8 Extracted from the World Economic Outlook data base of IMF
3.3. Sources of Data

As the achievement of any econometric analysis eventually depends on the availability and accuracy of data, it is, therefore, indispensable to discuss about the source and nature of data. The study used a sufficient length of secondary data ranging from 1992 to 2015 collected from different sources. Two data sources were used in this study. The first was collected from the World Development Indicator (WDI) and the second additional source was the International monetary Fund (IMF). There is no missing observations for all years included in the sample. The computation is done using STATA software version 13 and Eviews 7 for balanced panel data observations.

3.4 Method of Data Analysis and Estimation Techniques

3.4.1 Panel Unit Root Tests

A variety of procedures have been developed for the analysis of unit roots in a panel context. The emphasis is to combine information from the time–series dimension with that obtained from the cross–sectional dimension. Panel based unit root tests have higher power than the individual based time series.

Among many panel unit root test, the most common tests used in practice are (Levin, Lin, & Chu, 2002), (Im, Pesaran, & Shin, 2003) and Fisher type tests using Augmented Dickey Fuller (Maddala & Wu, 1999).

Here the unit root tests classification is based on the basis of the Autoregressive (AR) process across cross section or series. Thus, considering the AR (1) process for panel data:

\[ y_{it} = \rho_i y_{i,t-1} + \delta_i x_{it} + \epsilon_{it} \]

where \( i = 1,2,\ldots,N \) cross-section units or series, that are observed over periods \( t=1,2,\ldots,T_i \).

The \( X_{it} \) represent the exogenous variables in the model, including any fixed effects or individual trends, \( \rho_i \) are the autoregressive coefficients, and the errors \( \epsilon_{it} \) are assumed to be mutually independent idiosyncratic disturbance. If, \( |\rho_i| < 1 \), \( y_i \) is said to be weakly (trend-) stationary. On the other hand, if \( |\rho_i| = 1 \), \( y_i \) contains a unit root.

For the purpose of the unit root testing, there are two key assumptions about \( \rho_i \). The first assumption that persistent parameters are common across cross-sections so that \( \rho_i = \rho \) for all \( i \).
LLC employ this assumption. Alternatively, one can allow $\rho_l$ to vary freely across cross-sections. IPS and Fisher ADF are tests of this form.

**3.4.1.1. The Levin-Lin Chu Test**

One type of unit root tests developed for panel data by Levin and Lin. Their test is based on analysis of the equation:

$$\Delta y_{it} = \alpha_i + \delta_{it} + \theta_l + \rho_i y_{i,t-1} + \varepsilon_{it} \quad i = 1, 2, \ldots N, t = 1, 2, \ldots T.$$  \[5\]

This model allows for two-way fixed effects ($\alpha$ and $\theta$) and unit-specific time trends. The unit-specific fixed effects are an important source of heterogeneity, since the coefficient of the lagged dependent variable is restricted to be homogeneous across all units of the panel. The test involves the null hypothesis $H_0: \rho_l = 0$ for all $i$ against the alternative $H_A: \rho_l = \rho < 0$ for all $i$, with auxiliary assumptions under the null also being required about the coefficients relating to the deterministic components. The test follows the following hypothesis:

$H_0$: each time series contains a unit root

$H_1$: each time series is stationary

**3.4.1.2. The Im-Pesaran-Shin Test**

The (Im, Pesaran, & Shin, 2003) test extends the LLC framework to allow for heterogeneity in the value of $\rho_l$ under the alternative hypothesis. They allow for individual unit root processes so that $\rho_l$ may vary across sections. The test is characterized by the combining of individual unit root tests to derive a panel specific result. Given the same equation:

$$\Delta y_{it} = \alpha_i + \delta_{it} + \theta_l + \rho_i y_{i,t-1} + \varepsilon_{it} -- -- -[6]$$

The null and alternative hypotheses are defined as:

$H_0: \rho_l = 0 \forall i$

$H_A: \rho_l < 0, i = 1, 2, \ldots, N; \rho_l = 0, i = N_1 + 1, N_1 + 2, \ldots N$

Thus under the null hypothesis, all series in the panel are nonstationary processes; under the alternative, a fraction of the series in the panel are assumed to be stationary. This is in contrast to the LLC test, which presumes that all series are stationary under the alternative hypothesis. The errors are assumed to be serially autocorrelated, with different serial correlation properties and differing variances across units.
3.4.1.3 The Augmented Dickey Fuller Test

ADF Fisher type test combines the p-values from the unit root for each cross-section $i$ from $N$ independent unit root tests, as developed by (Maddala & Wu, 1999).

The formula of the test is as follows:

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

The test is asymptotically chi-square distributed with $2N$ degrees of freedom($T_i \to \infty$ for finite $N$). Based on the p-values of individual unit root tests, Fisher's test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Main benefit of this test is that unlike the IPS test Fisher's test does not require a balanced panel.

The following table summarizes the basic characteristics of the panel unit root tests.

**Table 2: Summary of Panel Unit Root Tests**

<table>
<thead>
<tr>
<th>Test</th>
<th>Null ($H_0$)</th>
<th>Alternative ($H_a$)</th>
<th>Possible Deterministic Component</th>
<th>Autocorrelation Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLC</td>
<td>Unit root</td>
<td>No unit root</td>
<td>None, F, T</td>
<td>Lags</td>
</tr>
<tr>
<td>IPS</td>
<td>Unit root</td>
<td>Some cross-sections without unit root</td>
<td>None, F, T</td>
<td>Lags</td>
</tr>
<tr>
<td>Fisher-ADF</td>
<td>Unit root</td>
<td>Some cross-sections without unit root</td>
<td>None, F, T</td>
<td>Lags</td>
</tr>
</tbody>
</table>

Notes: None=no exogenous variable; F=fixed effect and T= individual effect and individual trend.

Source: Summary compilation, 2017

3.4.2 Panel Cointegration Test

3.4.2.1 Pedroni Panel Cointegration Test

Panel cointegration is the test for the existence of a long-run relationship among tax revenue as a ratio of GDP and the independent variables using panel cointegration tests suggested by (Pedroni, 1999, 2004). The test applies seven panel cointegrations (Pedroni P., 1999) by to determine the appropriateness of the tests to be applied to estimated residuals from a cointegration regression.

The procedures proposed by Pedroni make use of estimated residual from the hypothesized long-run regression of the following form:
\[ y_{it} = \alpha_i + \beta_{1i}x_{1it} + \beta_{2i}x_{2it} + \cdots + \beta_{mi}x_{mit} + e_{it} \quad [7] \]

For \( t = 1, \ldots, T; i = 1, \ldots, N; m = 1, \ldots, M \), where \( T \) is the number of observations over time, \( N \) number of cross-sectional units in the panel, and \( M \) number of regressors. In this set up, \( \alpha_i \) is the member specific intercept or fixed effects parameter which varies across individual cross-sectional units. The same is true of the slope coefficients and member specific time effects, \( \delta_{it} \).

### 3.4.2.2 Kao Panel Cointegration Test

Kao (1999) proposes the Dickey Fuller and Augmented Dickey-Fuller (ADF). If \( \hat{e}_{it} \) is the estimated residual from the following regression equation:

\[ y_{it} = \alpha_i + \beta x_{it} + e_{it} \quad [8] \]

The Kao DF test is applied to the estimated residuals:

\[ \hat{e}_{it} = y\hat{e}_{i,t-1} + \hat{\sigma}_{it} \quad [9] \]

The null hypothesis of no cointegration, \( H_0: \gamma = 1 \), is tested against the alternative of cointegration for all \( i = 1 \ldots n \).

### 3.4.3 Panel Vector Error Correction Model (PVECM)

The PVECM for tax revenue model (\( lnT_R_{it} \)) on the cross-sectional unit at time \( t \) is given as:

\[ \Delta lnT_R_{it} = \mu_i \Delta X_{it-1} + \varphi_1 (lnT_R_{it-1} - \beta_i X_{it-1}) + u_{it} \quad [10] \]

Where \( \Delta \) represents the first difference, \( \mu_i, \varphi_1 \) and \( \beta_i \) are unknown parameters, \( X_{it-1} \) is vector of explanatory variables and \( u_{it} \) is the white noise error term.

Test for cointegration using the PVECM framework tests the null hypothesis of \( (H_0: \varphi_1 = 0) \) against the alternative hypothesis of \( (H_1: \varphi_1 \neq 0) \) (Kremers, Ericson, & Dolado, 1992).

### 3.4.4 Panel Data Models

Panel data are repeated measurements at different points in time on the same individual unit, firm, state, or country. Regression can then capture both variation over units, similar to regression on cross-sectional data, and variation over time.

Panel data model errors are likely correlated. Regardless of the assumption made, some correction to the default ordinary least square (OLS) standard errors is usually necessary and efficiency gains using generalized least squares (GLS) may be possible. They also permit the estimation of dynamic models where lagged dependent variables may be regressors.
The static linear model in panel data setting starts with identifying the two basic models, the fixed and random effects model, and therefore discusses the choice between the two.

### 3.4.4.1 The Fixed Effects Model

The fixed effect regression is a method of controlling for omitted variables in panel data when the omitted variables vary across entities but do not change over a time. They can be used when we have more than two observations \((T > 2)\).

Econometrically, the setup starts from the following equation:

\[
y_{it} = \alpha + \beta x_{it} + u_{it} - - - - - [11]
\]

where \(y_{it}\) is the dependent variable, \(\alpha\) is the intercept term, \(\beta\) is a \(k \times 1\) vector of parameters to be estimated on the explanatory variables, and \(x_{it}\) is a \(1 \times k\) vector of observations on the explanatory variables, \(t = 1, \ldots, T\); \(i = 1, \ldots, N\).

The fixed effects models allow the intercept in the regression model to differ cross-sectionally but not over time, while all of the slope estimates are fixed both cross-sectionally and over time.

To see how the fixed effects model works, we can take equation (3.4) above, and decompose the disturbance term, \(u_{it}\), into an individual specific effect, \(\mu_i\), and the ‘remainder disturbance, \(v_{it}\), that varies over time and entities (capturing everything that is left unexplained about \(y_{it}\)).

\[
u_{it} = \mu_i + v_{it} - - - - - [12]
\]

Thus equation (3.11) can be rewritten by substituting in for \(u_{it}\) from (3.12) to obtain

\[
y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it} - - - - - [13]
\]

Where \(\mu_i\) as encapsulating all of the variables that affects \(y_{it}\) cross-sectionally but do not vary over time.

The fixed effect regression model is given as:

\[
\ln\left(\frac{T}{Y}\right)_{it} = \beta_0 + \beta_1 \ln GDP_{PC_{it}} + \beta_2 \ln AID_{it} + \beta_3 \ln URB_{it} + \beta_4 \ln OPEN_{it} + \beta_5 \ln OER_{it} + \beta_6 \ln AGR_{it} + \beta_7 \ln IND_{it} + \beta_8 \ln SERV_{it} + \beta_9 \ln INF_{it} + \mu_i + v_{it} - - - - [-14]
\]
3.4.4.2. The Random Effects Model

An alternative to the fixed effects model described above is the random effects model, which is sometimes also known as the error components model. As with fixed effects, the random effects approach proposes different intercept terms for each entity and again these intercepts are constant over time, with the relationships between the explanatory and explained variables assumed to be the same both cross-sectionally and temporally. However, the difference is that under the random effects model, the intercepts for each cross-sectional unit are assumed to arise from a common intercept \( \alpha \) (which is the same for all cross-sectional units and over time), plus a random variable \( \varepsilon_i \) that varies cross-sectionally but is constant over time. \( \varepsilon_i \) measures the random deviation of each entity’s intercept term from the ‘global’ intercept term \( \alpha \).

The random effects panel model as
\[
y_{it} = \alpha + \beta x_{it} + \omega_{it}, \quad \omega_{it} = \varepsilon_{it} + v_{it} - - - - - [15]
\]

where \( x_{it} \) is still a \( 1 \times k \) vector of explanatory variables, but unlike the fixed effects model, there are no dummy variables to capture the heterogeneity (variation) in the cross-sectional dimension. Instead, this occurs via the \( \varepsilon_i \) terms. Note that this framework requires the assumptions that the new cross-sectional error term, \( \omega_{it} \), has zero mean, is independent of the individual observation error term \( \varepsilon_{it} \), has constant variance, \( \sigma_i^2 \), and is independent of the explanatory variables \( \{x_i t\} \).

3.4.4.3 The Hausman Test

It is also called Hausman test for endogeneity or Hausman specification test. This test is used to detect the endogenous regressors in the panel regression model. As endogenous variables have values determined by other variables having them in the panel regression model will cause one of the Ordinary Least Square Assumption (OLS) to fail. The OLS classical assumption states that there is no correlation between the predictor variables and the error term \( \text{Cov}(X_{it}, \varepsilon_{it}) = 0 \).

Thus, Hausman test is used to figure out whether the predictor variables are endogenous or not. If there is no correlation between the regressors and effects, then FE and RE are both consistent, but FE is inefficient. But, if there is correlation, FE is consistent and RE is in consistent. The decision rule for the Hausman test is straight forward: the null hypothesis of no correlation is
rejected if the p-value is small (less than 0.05) which means there is no difference between the estimators (Hausman, 1978).

The Hausman test is carried out as follows:

\[ H_0: \hat{\beta}_{RE} - \hat{\beta}_{FE} = 0 \text{ against } H_1: \hat{\beta}_{RE} - \hat{\beta}_{FE} \neq 0 \]

The Hausman test is designed to detect violation of the RE modeling assumption that the explanatory variables are orthogonal to the unit effects. If there is no correlation between the independent variables(s) and the unit effects, then the estimates of \( \beta \) in FE model (\( \hat{\beta}_{FE} \)) should be similar to the estimates of \( \beta \) in RE model(\( \hat{\beta}_{RE} \)). The Hausman test statistic \( H \) is a measure of the difference between the two estimates:

\[ H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [\text{Var}(\hat{\beta}_{FE}) - \text{Var}(\hat{\beta}_{RE})^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE})] \]

Thus, running Hausman tests to test the validity of random effects approach relative to a fixed effects approach with rejection of the null hypothesis is an indication of no matter how better the random effects estimator was in principle, the data told us to estimate a fixed effects estimator.

The limitation of Hausman test is that it usually tests whether FE is preferred to RE or vice versa not in terms of what is actually going on in the data (Kelvyn & Andrew, 2014).

Hence, when there is cross-correlation between error terms for a given cross-sectional units at different points in time the Feasible Generalized Least Square (FGLS) is used to get consistent and efficient estimators in place of FE and RE models.

3.4.4.4. Feasible Generalized Least Square (FGLS)

The FGLS is a technique for estimating the unknown parameters in a linear regression model. FGLS can be used to perform linear regression when there is a certain degree of correlation between the residuals in a regression model. When there is high autocorrelation and heteroskedasticity problem in the model as fixed effects or random effect model may result in inefficient estimates; the FGLS estimation technique is appropriate to come up with efficient estimates. Hence, the model interpretation for the report follows FGLS estimation method.

With the presence of autocorrelation and heteroskedasticity problems the FGLS estimator is more efficient and powerful than OLS. It allows estimation in the presence of autoregressive of order one (AR(1)) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels.
3.4.5 The dynamic Panel data (GMM) model

There might be cases where the dependent variable is explained by its own lag. Thus, in order not to lose the dynamic information the autoregressive one (AR (1)) is incorporated. Thus, the dynamic model based on the previously specified model is set as follows:

\[
\ln(T/Y)_{it} = \varphi_0 + \varphi_1 \ln GDPPC_{it} + \varphi_2 AID_{it} + \varphi_3 \ln URB_{it} + \varphi_4 \ln OPEN_{it} + \varphi_5 \ln OER_{it} + \varphi_6 AGR_{it} + \varphi_7 \ln IND_{it} + \varphi_8 \ln SERV_{it} + \varphi_9 \ln INF_{it} + \varepsilon_{it}
\]

Where \( i \) denotes East African countries used in the sample and \( t \) denotes the time dimension.

Where \( \ln(T/Y) \) the natural log of tax to GDP ratio is, \( \ln(T/Y)_{it-1} \) is the rate of tax to GDP ratio growth, \( \ln(T/Y)_{it-1} \) is the initial level of log of tax to GDP ratio, \( x_{it} \) is vector of explanatory variables, \( u_{it} \) is an unobserved country specific and time invariant effect, \( \varepsilon_{it} \) is the error term. \( \delta_t \) refers to the specific intercept terms to capture changes common to all countries.

Equation (18) can be rewritten as:

\[
\ln(T/Y)_{it} = \delta_t + \gamma \ln(T/Y)_{it-1} + \beta_i x_{it} + u_{it} + \varepsilon_{it}
\]

This is the same as:

\[
\ln(T/Y)_{it} = \delta_t + (\gamma + 1) \ln(T/Y)_{it-1} + \beta_i x_{it} + u_{it} + \varepsilon_{it}
\]

Thus, the dynamic panel data model used here with the realization of current tax to GDP ratio is influenced by past ones is set as:

\[
\ln TR_{it} = \delta_t + (\gamma + 1) \ln TR_{it-1} + \beta_1 \ln GDPPC_{it} + \beta_2 AID_{it} + \beta_3 \ln URB_{it} + \beta_4 \ln OPEN_{it} + \beta_5 \ln OER_{it} + \beta_6 AGR_{it} + \beta_7 \ln IND_{it} + \beta_8 \ln SERV_{it} + \beta_9 \ln INF_{it} + u_{it} + \varepsilon_{it}
\]
CHAPTER FOUR
ESTIMATION AND DISCUSSION OF RESULTS

Based on the specified econometric model to estimate the determinants of tax revenue for East African countries and different estimation techniques used here with; this chapter thoroughly explicate the estimation and discussion of results.

The section starts with brief description of summary of variables used for the study at hand and explanation of correlation matrix among variables. Subsequently the econometric test including test for panel unit root, panel cointegration and panel vector error correction model followed by long run estimation results including Pooled OLS, Fixed Effects (FE), Random Effects (RE), Feasible Generalized Least Square (FGLS) and the Generalized Methods of Moments (GMM) of dynamic panel data that are presented to assess the long run relationship among the variables entered as the determinants of tax revenue to GDP ratio.

4.1 Descriptive Statistics

4.1.1 Summary Statistics

Table 3 below summarizes the descriptive statistics of the variables used in the study to analyze determinants of tax revenue in East African countries. The summary statistics was done for nine East African countries \((n = 9)\) for the period of 1992 - 2015 \((T = 24\ years)\) and 216 observations \((N = n * T = 9 * 24 = 216)\).

As it can be seen from below, the overall average annual growth in tax revenue to GDP ratio is about 2.912% with the overall annual minimum growth of 2.192% in Uganda (2009) and overall maximum growth of 4.046% in Seychelles (1992). The variation in growth of tax revenue as a share of GDP within the East African countries varies from the overall average growth by about 0.402% showing that there is no significant difference.

Compared to other variables included here as determinates of tax revenue; the average share of sectoral economic performances accounts for largest contribution. On average the share of agriculture value added as a % of GDP accounts for overall amount of 20.68% with largest overall share of 65.97% in Ethiopia (1992) and with smallest overall share of 2.35% in Seychelles (2012). The difference in overall contribution of this sector varies from the overall average contribution by about 14.24%. Similarly the overall average contribution of industry
value added as a % of GDP amounts to 20.05% with the maximum overall contribution of 48.97% in Zambia (1992) and minimum contribution of 6.30% in Ethiopia (1992) (Moreover, the overall average share of service sector value added as a % of GDP estimated to 51.38% with maximum contribution of about 104% in Seychelles (1993) and minimum contribution of 24.01% in Zambia (1993). Thus, over the study under consideration, 1992-2015, the overall share of service was maximum (51.38%) followed by the share of agriculture (29.68%). The lowest sectoral share goes to the industrial sector (20.05%).

Table 3: Summary of descriptive statistics (1992-2015)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std.Dev</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnTR</td>
<td>2.911692</td>
<td>0.4019864</td>
<td>2.191598</td>
<td>4.045749</td>
<td>N = 216</td>
</tr>
<tr>
<td></td>
<td>overall</td>
<td>overall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>between</td>
<td>between</td>
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<td></td>
<td>within</td>
<td>within</td>
<td></td>
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</tr>
<tr>
<td>lnGDPPC</td>
<td>6.478885</td>
<td>1.114734</td>
<td>5.08657</td>
<td>9.513568</td>
<td>N = 216</td>
</tr>
<tr>
<td></td>
<td>overall</td>
<td>overall</td>
<td></td>
<td></td>
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<tr>
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<tr>
<td></td>
<td>within</td>
<td>within</td>
<td></td>
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</tr>
<tr>
<td>AID</td>
<td>13.35963</td>
<td>10.69667</td>
<td>0.4992877</td>
<td>67.73533</td>
<td>N = 216</td>
</tr>
<tr>
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<td>overall</td>
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<td></td>
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<td>within</td>
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<tr>
<td>lnURB</td>
<td>3.247303</td>
<td>0.480575</td>
<td>1.89266</td>
<td>3.986889</td>
<td>N = 216</td>
</tr>
<tr>
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<td>overall</td>
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<td></td>
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</tr>
<tr>
<td>lnOPEN</td>
<td>3.313509</td>
<td>0.5039178</td>
<td>1.494733</td>
<td>4.723056</td>
<td>N = 216</td>
</tr>
<tr>
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<td></td>
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<td>within</td>
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</tr>
<tr>
<td>lnOER</td>
<td>4.484798</td>
<td>2.493869</td>
<td>-1.75909</td>
<td>8.083528</td>
<td>N = 216</td>
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<td></td>
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<td>within</td>
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</tr>
<tr>
<td>AGR</td>
<td>29.68163</td>
<td>14.23664</td>
<td>2.350568</td>
<td>65.97296</td>
<td>N = 216</td>
</tr>
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</tr>
<tr>
<td>IND</td>
<td>20.04651</td>
<td>7.132779</td>
<td>6.298477</td>
<td>48.96779</td>
<td>N = 216</td>
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<td>within</td>
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<tr>
<td>SERV</td>
<td>51.37961</td>
<td>13.87897</td>
<td>24.00501</td>
<td>104.3466</td>
<td>N = 216</td>
</tr>
<tr>
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<td></td>
<td>within</td>
<td>within</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>13.70688</td>
<td>18.14033</td>
<td>-5.755335</td>
<td>165.534</td>
<td>N = 216</td>
</tr>
<tr>
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</tbody>
</table>

Source: Own calculation, 2017
The average overall growth in per capita GDP which measures the given country’s development activity was about 6.48 units with maximum overall per capita GDP growth of 9.51 units in Seychelles (2015) and minimum overall per capita GDP growth of 5.09 units in Mozambique (1992).

Trade openness, which is calculated as the sum of export and import of goods and services as a ratio of GDP, is another important determinant of tax revenue. On average the overall growth in trade openness over the period under consideration was about 3.31% for East African countries. Over the given period the maximum overall growth in trade openness was recorded in Seychelles (2009) and the minimum overall growth in trade openness belongs to Ethiopia (1993).

Foreign including both concessional loans and grants is also an important determinant of tax revenue. Such financial inflow from developed countries to the recipient countries based on the ideology of filling resource gap. Thus, when it is used efficiently it supplements the low tax revenue of the region. On average the overall amount of foreign aid received by east African countries was about 13.35% of the GNI with maximum overall amount of 67.74% of GNI for Mozambique (1992) and minimum of 0.50% of GNI for Seychelles (2015).

Urbanization, measuring the % of population living in urban areas, is also an important determinant of tax revenue. It has both demand and supply side effects. With demand side effects growth in urbanization leads to increase in demand for provision of public goods and services. On the supply side, growth in urbanization leads to increase in number of people living in urban areas leading to increase in tax revenue. On average for East African countries the overall growth in urbanization was 3.25% with maximum overall urbanization growth of 3.99% for Seychelles (2015) and minimum overall growth of about 1.89% in Burundi (1992).

Official exchange rate, the rate at which one countries local currency is exchanged for another United States dollar currency, is also potential variable influencing tax revenue of the region. Domestic currency devaluation leads to increase in export of goods and services so that revenue as a share of GDP also increases. Over the period of time the average overall exchange rate growth is about 4.48%. The maximum overall growth was about 8.08% in Uganda (2015) and the minimum was -1.76% in Zambia (1992).

Macroeconomic condition is also another decisive factor posing influence on tax revenue of the region. Macroeconomic stability of any economy is explained by the degree as to which the fiscal and monetary policies are able to manage the performance of the economy on one hand
and lead to achieve macroeconomic goals set by the policy makers. One of the indicators of such stability is change in prices over the period of time named as inflation. Abnormal increase in price of goods and services negatively affects the welfare of the society at large. It discourages the demand for goods and services which further leads to decrease in investment activities and production economy. The average overall rate of inflation is about 13.71% with maximum overall rate of inflation of 165.53% in Zambia (1992) and minimum overall rate of inflation of -5.76% in Ethiopia (2001).

4.1.2 Pairwise Correlation Analysis

Table 4\textsuperscript{9} below presents the correlation matrix between the tax revenue as a ratio of GDP and its determinants for East African countries over the period of 1992-2015. The correlation between GDP per capita and tax revenue is positive and the correlation coefficient ($\rho_{\ln(TR), \ln(GDPPC)}$) is equal to 0.543. As this value is greater than 0.5 and statistically significant ($p_{-value} = 0.000$ is less than 1%), there is strong and significant positive relationship between GDP per capita and tax revenue. Similarly, the there is a positive association between the net aid received as percentage of GNI and tax revenue with the correlation coefficient of 0.038. Again there is a positive correlation between shares of industry (value added) as a percentage of GDP and tax revenue with correlation coefficient of 0.101.

Moreover, inflation and urbanization and has negative correlation with tax revenue with correlation coefficient of -0.103, -0.014 and -0.389 with significant impact respectively whereas official exchange rate has negative correlation with tax revenue with no significant impact. Furthermore trade openness and shares of service (value added) as a percentage of GDP has positive correlation with tax revenue with correlation coefficient of 0.550 and 0.542 respectively with significant impact as shown with p-values.

\textsuperscript{9} Description of the correlation matrix is for first column only as the interest is on assessing the impacts of variables on tax revenue.
Table 4: Pairwise Correction Matrix

<table>
<thead>
<tr>
<th></th>
<th>lnTR</th>
<th>GDPPC</th>
<th>AID</th>
<th>URB</th>
<th>OPEN</th>
<th>lnOER</th>
<th>AGR</th>
<th>IND</th>
<th>SERV</th>
<th>INF</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnTR</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>GDPPC</td>
<td>0.543** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AID</td>
<td>0.038 (0.577)</td>
<td>-0.509** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URB</td>
<td>-0.014 (0.8392)</td>
<td>0.670** (0.000)</td>
<td>-0.515** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>OPEN</td>
<td>0.550** (0.000)</td>
<td>0.522** (0.000)</td>
<td>-0.195** (0.004)</td>
<td>0.437** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OER</td>
<td>-0.389** (0.000)</td>
<td>-0.379** (0.000)</td>
<td>-0.025 (0.715)</td>
<td>-0.204** (0.000)</td>
<td>-0.320** (0.000)</td>
<td>1.000</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>AGR</td>
<td>-0.389** (0.000)</td>
<td>-0.639** (0.000)</td>
<td>0.338** (0.000)</td>
<td>-0.622** (0.000)</td>
<td>-0.688** (0.000)</td>
<td>0.351** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IND</td>
<td>0.101 (0.138)</td>
<td>0.427** (0.000)</td>
<td>-0.008 (0.904)</td>
<td>0.203** (0.003)</td>
<td>0.303** (0.000)</td>
<td>-0.348** (0.000)</td>
<td>-0.596** (0.000)</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERV</td>
<td>0.542** (0.000)</td>
<td>0.628** (0.000)</td>
<td>-0.414** (0.000)</td>
<td>0.643** (0.000)</td>
<td>0.538** (0.000)</td>
<td>-0.273** (0.000)</td>
<td>-0.662** (0.000)</td>
<td>0.211** (0.002)</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>-0.103 (0.133)</td>
<td>-0.082 (0.232)</td>
<td>0.362** (0.000)</td>
<td>-0.073 (0.286)</td>
<td>-0.032 (0.642)</td>
<td>-0.226** (0.001)</td>
<td>0.059 (0.385)</td>
<td>0.273** (0.000)</td>
<td>-0.246** (0.000)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Notes: ** indicates the statistical significance at 5 % (** p < 0.05) and values in parenthesis shows p-values.

Source: Own calculation, 2017

4.2 Econometric Analysis

4.2.1 Panel Unit Root Tests

For the variables used in study plausible regression results which is supposed to be interpreted is done confidently if and only if the test for unit root is clearly established and so that the order of integration can be set.

Here three types of formal panel unit root tests are conducted to examine that whether the data series is stationary or has unit root. These tests are the Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IPS) and the individual root-Fisher-Augmented Dickey Fuller (ADF) tests. The null hypothesis states that the data has panel unit root while the alternative hypothesis states that the series is stationary. The panel unit root tests are used to detect the problem of spurious regression in analyzing the determinants of tax revenue for the economy of East African countries. The Panel unit root test results are presented in table below 5

5 All the panel unit root tests were conducted using Eviews 7
As shown in table 5 above, both the LLC and IPS panel unit root tests show that \( \text{lnTR} \) is nonstationary at level as the null hypothesis of unit root is not rejected at conventional level of significance. However, when the first difference of \( \text{lnTR} \) (i.e., \( \Delta \text{lnTR} \)) is taken it is stationary for LLC, IPS and ADF tests at 1% level of significance.

Further the test shows that except for variable \( \text{INF} \) all other explanatory variables (\( \text{lnGDPPC}, \text{AID}, \text{lnURB}, \text{lnOPEN}, \text{lnOER}, \text{AGR}, \text{IND} \) and \( \text{SERV} \)) are all nonstationary. Thus, we do not reject the null hypothesis of unit root for almost all variables in levels. Yet, when the first differences are used, the null hypothesis of unit root (non-stationarity) is strongly rejected at the \( p<0.01 \) statistical level. The study concluded that the variables were stationary first difference.

According to these tests, all variables are integrated of the same order (i.e they are all integrated of order one, I(1)) except inflation which is I(0). This implies that the variables are stationary at first difference and integrated of I(1).

Thus, it can be concluded that the results of panel unit root tests (LLC, IPS and ADF tests) reported in Table 5 support the hypothesis of a unit root in all variables across countries, as well
as the hypothesis of zero order integration in first differences. At most of the 1 percent significance level, we found that all tests statistics significantly confirm that all series strongly reject the unit root null. Given the results of LLC, IPS, and ADF tests, it is possible to apply panel cointegration method in order to test for the existence of the stable long-run relation among the variables.

4.2.2 Panel Cointegration Tests

The finding that many macro time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. Section 4.2.1 shows that the test of panel unit root tests show that all the variables are nonstationary at level except inflation (INF). The econometric analysis makes sense with nonstationary variables only when their linear combination results in a stationary series. The test of cointegration in this section tests for existence of such a relationship among the nonstationary variables considered in this study.

4.2.2.1 Pedroni (Engle-Granger based) Cointegration Tests

The Pedroni cointegration test is based on an examination of the residuals of a spurious regression performed using I(1) variables. If the variables are cointegrated then the residuals should be I(0). On the other hand if the variables are not cointegrated then the residuals will be I(1). (Pedironi P., 1999,2004) and (Kao, 199) extend the Engle-Granger framework to tests involving panel data.

The cointegration examination according to (Pedironi P., 2004) has seven test statistics and tests the null of no cointegration. The panel tests are founded on the within-dimension form, which comprises four statistics, respectively panel v, panel rho, panel PP, and panel ADF that pool the autoregressive coefficients across dissimilar states for the unit root checks on the estimated residuals. The group tests are established on the between dimension form which cover three statistics: group rho, group PP, and group ADF, that are set on means of the individual
autoregressive coefficients related with the unit root checks of the residuals for each state in the panel.

As such, panel PP-statistic, panel ADF statistic, group PP-statistic and group ADF statistic support that there is cointegration relationship.

**Table 6: Panel Pedironi Cointegration test results**

<table>
<thead>
<tr>
<th>Pedroni Residual Cointegration Test</th>
<th>Individual Intercept</th>
<th>Deterministic intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within-dimension</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cointegration Test</td>
<td>Statistic</td>
<td>Weighted Statistic</td>
</tr>
<tr>
<td>(lnTR lnGDPPC AID lnURB lnOER SERV INF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel v-Statistic</td>
<td>-0.909</td>
<td>-2.719</td>
</tr>
<tr>
<td>Panel rho-Statistic</td>
<td>1.827</td>
<td>1.865</td>
</tr>
<tr>
<td>Panel PP-Statistic</td>
<td>-2.547***</td>
<td>-1.983*</td>
</tr>
<tr>
<td>Panel ADF-Statistic</td>
<td>-2.990**</td>
<td>-3.057***</td>
</tr>
<tr>
<td><strong>Between-dimension</strong></td>
<td></td>
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<tr>
<td>Group rho-Statistic</td>
<td>3.210</td>
<td>4.194</td>
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<tr>
<td>Group PP-Statistic</td>
<td>-5.328***</td>
<td>-4.162***</td>
</tr>
<tr>
<td>Group ADF-Statistic</td>
<td>-3.22***</td>
<td>-3.339***</td>
</tr>
<tr>
<td>Null Hypothesis</td>
<td>No Cointegration</td>
<td>There is Cointegration</td>
</tr>
<tr>
<td>Trend Assumption</td>
<td>No deterministic trend</td>
<td>Deterministic intercept and trend</td>
</tr>
</tbody>
</table>

Notes: ***, ** and * indicates statistical significances at *p<0.1, **p<0.05, ***p<0.01.

*Source: Own calculation, 2017.*

From the above Panel Pedironi Cointegration test results, it can be seen that only 3 of the 7 statistics fail to reject the null hypothesis of no cointegration and accept the alternative hypothesis meaning that the variables are cointegrated. The majority, 4 out of 7, rejects the null of no cointegration. Those three statistics are the panel v, panel rho and the group rho statistics. Thus, since all the other statistics conclude in favour of cointegration, and this, combined with the fact that the according to Pedroni (1997) the panel ADF and the group ADF statistics are more reliable, we conclude that there is a cointegrating relationship among our variables. And this works both for deterministic trend specifications, that is, individual intercept on one hand and individual intercept and individual trend on the other hand as specified above.

---

The results calculated using Eviews 7
The cointegration test further assures that the regression performed using the I(1) variables is not spurious. When the variables are cointegrated the residuals are cointegrated of I(0). Thus, the result shows that the cointegrating equation does not result in non-stationary error term as majority of the p-values are significant at conventional levels (that is the null of no cointegration is rejected).

4.2.2.2 Kao (Engle-Granger based) Cointegration Tests

Kao panel cointegration tests are also used to examine the presence of cointegration relationship among the variables incorporated in the tax revenue model. The ADF test statistic rejects the null hypothesis of no cointegration at 1 percent level of significance as the probability is less than 1% (P_value = 0.0002). This implies that there exists a long-run relationship among variables included in the model which means that they are cointegrated.

Table 7: Kao Cointegration test results

<table>
<thead>
<tr>
<th>Kao Residual Cointegration Test12</th>
<th>Individual Intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF (t-statistic)</td>
<td>Prob</td>
</tr>
<tr>
<td>Residual variance</td>
<td>0.0136</td>
</tr>
<tr>
<td>HAC variance</td>
<td>0.007</td>
</tr>
<tr>
<td>Null Hypothesis:</td>
<td>No cointegration</td>
</tr>
<tr>
<td>Trend Assumption:</td>
<td>No deterministic trend</td>
</tr>
</tbody>
</table>

Notes: ***, ** and * indicates statistical significances at ***p<0.01.

Source: Own Computation using Eviews 7, 2017

4.2.3 Panel Vector Error Correction Model (VECM)

Once the long run relationship is confirmed from the panel cointegration test the next step is running the panel VECM. The change in the variables represent variation in the short run, while the coefficients obtained from the error correction term (ECT) represents the speed of adjustment towards the long run relationship. It should be noted that the existence of long run relationship among the variables is not a guarantee to say that the change in explanatory variables have significant impact on dependent variable.

In Panel Vector Error Correction Model (PVECM) all exogenous variables considered in the long run equation entered into the right hand side of the model by differencing them with appropriate lag length. The intuition behind doing this is because of the fact that there is high

12 Results calculated using Eviews 7
degree of correlation between current and lagged values of a variable, which causes the problem of multicollinearity. In addition, ECT, which is derived from the long run coefficients, enters in to the model by lagging one year, called the lagged error term as the dynamic shocks cannot adjust automatically.

In PVECM all insignificant explanatory variables are continuously dropped until a parsimonious model with fewer explanatory variables but acceptable in terms of significance, economic interpretation and diagnostic validity is obtained after step-by-step elimination of insignificant variables from the estimates.\(^\text{13}\)

The panel VECM for determinants of tax revenue in East African countries with appropriate lag length is derived as follows:

\[
\begin{align*}
D\text{ln}(T/Y)_{it} &= \beta_0 + \beta_1 D\text{ln}(T/Y)_{it}(-1) + \beta_2 D\text{ln}(T/Y)_{it}(-2) + \beta_3 D\text{ln}\text{GDPPC}_{it}(-1) \\
&+ \beta_4 D\text{ln}\text{GDPPC}_{it}(-2) + \beta_5 \text{DAID}_{it}(-1) + \beta_6 \text{DAID}_{it}(-2) \\
&+ \beta_7 D\text{lnURB}_{it}(-1) + \beta_8 D\text{lnURB}_{it}(-2) + \beta_9 D\text{lnOPEN}_{it}(-1) \\
&+ \beta_{10} D\text{lnOPEN}_{it}(-2) + \beta_{11} D\text{lnOER}_{it}(-1) + \beta_{12} D\text{lnOER}_{it}(-2) \\
&+ \beta_{13} D\text{AGR}_{it}(-1) + \beta_{14} D\text{AGR}_{it}(-2) + \beta_{15} D\text{IND}_{it}(-1) + \beta_{16} D\text{IND}_{it}(-2) \\
&+ \beta_{17} D\text{SERV}_{it}(-1) + \beta_{18} D\text{SERV}_{it}(-2) + \beta_{19} D\text{INF}_{it}(-1) + \beta_{20} D\text{INF}_{it}(-2) \\
&+ \beta_{20} (\text{ln}(T/R/Y)_{it}(-1) - \beta_i x_{it}(-1)) + \epsilon_{it}
\end{align*}
\]

Where \((\text{ln}(T/Y)_{it}(-1) - \beta_i x_{it}(-1))\) represents error correction term (ECT) generated from the long run panel cointegrating equation.

The long run panel cointegration equation result here by captured by ECT\(^\text{14}\) is given as:

\[
\begin{align*}
\text{ECT}_{t-1} &= (\text{ln}(T/Y)_{it}(-1) - 0.31 \text{lnGDPPC}_{it}(-1) - 0.039 \text{AID}_{it}(-1) + 0.148 \text{lnURB}_{it}(-1) \\
&+ 0.231 \text{lnOPEN}_{it}(-1) + 0.048 \text{lnOER}_{it}(-1) - 0.054 \text{AGR}_{it}(-1) \\
&- 0.017 \text{IND}_{it}(-1) - 0.039 \text{SERV}_{it}(-1) + 0.053 \text{INF}_{it}(-1) + 2.93)
\end{align*}
\]

\(^{13}\) Table 8. Panel Vector Error Correction Model: Long run casualty confirms this statement where all insignificant variables are dropped and we are left with few variables.

\(^{14}\) Where [ ] represents the t-statistics
Thus, estimable PVECM is given as:

$$D\ln TR_{it} = \beta_0 + \beta_1 D\ln TR_{it(-1)} + \beta_2 D\ln TR_{it(-2)} + \beta_3 D\ln GDPPC_{it(-1)}$$
$$+ \beta_4 D\ln GDPPC_{it(-2)} + \beta_5 D\ln AID_{it(-1)} + \beta_6 D\ln AID_{it(-2)}$$
$$+ \beta_7 D\ln URB_{it(-1)} + \beta_8 D\ln URB_{it(-2)} + \beta_9 D\ln OPEN_{it(-1)}$$
$$+ \beta_{10} D\ln OPEN_{it(-2)} + \beta_{11} D\ln OER_{it(-1)} + \beta_{12} D\ln OER_{it(-2)}$$
$$+ \beta_{13} DAGR_{it(-1)} + \beta_{14} DAGR_{it(-2)} + \beta_{15} DIND_{it(-1)} + \beta_{16} DIND_{it(-2)}$$
$$+ \beta_{17} DSERV_{it(-1)} + \beta_{18} DSERV_{it(-2)} + \beta_{19} DINF_{it(-1)} + \beta_{20} DINF_{it(-2)}$$
$$+ \beta_{21} ECT_{t-1}$$

The results for PVECM model divulge that the short run changes in growth of tax to GDP ratio is affected negatively and significantly by one period lagged changes in tax revenue. Economically it makes sense that the current tax revenue depends on previous period tax revenue. On the other hand, urbanization lagged by one period had a negative and significant impact while it has positive and significant impact when lagged by two periods. This implies that the growth impact of urbanization is observed over the period of time and it has long gestation periods like other productive investment activities. The official exchange rate lagged by two periods has negative and significant impact showing that it did not contribute towards enhancing tax revenue of the region over the given period. Moreover from the short-run analysis the coefficients of the error correction term (ECT) were used to explain the tendencies for the variable to return to equilibrium. The findings reveal that the long run causality determined by the ECT has the right sign (i.e. negative) and significant (p-value =0.0916 lower than 10% significance level) showing that there is long run casualty running from independent variables to dependent variable. The appropriate sign of ECT further confirms the existence of cointegrating relationships between tax revenue and its determinants for East African countries for the period under considerations.

The PVECM model determines the required period to correct any chock or disequilibrium (speed of adjustment) among the variables. Hence, the result from table 8 below shows that the speed of adjustment from the short run towards the long run equilibrium is about 4.12% for tax revenue equation.
Table 8: Panel Vector Error Correction Model: Long run causality

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECT(-1)</td>
<td>-0.0412</td>
<td>0.0244</td>
<td>-1.688</td>
<td>0.0916*</td>
</tr>
<tr>
<td>DlnTR(-1)</td>
<td>-0.1663</td>
<td>0.0819</td>
<td>-2.0297</td>
<td>0.0425**</td>
</tr>
<tr>
<td>DlnURB(-1)</td>
<td>-8.3711</td>
<td>3.3624</td>
<td>-2.5091</td>
<td>0.0122**</td>
</tr>
<tr>
<td>DlnURB(-2)</td>
<td>8.1761</td>
<td>3.3624</td>
<td>2.4317</td>
<td>0.0151**</td>
</tr>
<tr>
<td>DlnOER(-2)</td>
<td>0.1575</td>
<td>0.0842</td>
<td>1.8715</td>
<td>0.0615*</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.154851</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj.R-squared</td>
<td>0.048575</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Statistics</td>
<td>1.45062</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>138.3278</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akaike AIC</td>
<td>-1.23098</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schwarz SC</td>
<td>-0.853636</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin Watson Stat</td>
<td>1.962740</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: **, and * indicates statistical significances at 5% (**p<0.05) and 10% (*p<0.1) respectively.
Source: Own calculation, 2017.

The estimated PVECM can be set as:
\[ D{\text{ln}}TR = -0.0412ECT(-1) - 0.1663D{\text{ln}}TR(-1) - 8.3711D{\text{ln}}URB(-1) + 8.176D{\text{ln}}URB(-2) + 0.158D{\text{ln}}OER(-2) \]

The PVECM short run causality is determined with the test for the joint significance of the lagged explanatory variables using Wald test. As can be seen from the following table the null hypothesis for the Wald test states that the coefficients for DlnTR (-1), DlnURB (-1), DlnURB(-2) and DlnOER(-2) are jointly equal to zero \( C(2)=C(8)=C(9)=C(13)=0 \). This is done to check their influence on current tax to GDP ratio. Accordingly, the PVECM of short run causality shows that the null hypothesis is rejected as the overall test (see from P_value below) shows that the coefficients are statistically significant and they are different from zero. This indicates that there is short run causality running from independent variables to dependent variable. The computed \( \chi^2 (16.81338) \) with \( P\text{-value}<0.01 \) the coefficients are statistically significant.

Accordingly the results from PVECM using ECT and Wald test confirms that there is both long run and short run causality running from the set of independent variables to the dependent variable. The regression result for short run causality is given below.
Table 9: Panel Vector Error Correction Model: Short run causality

<table>
<thead>
<tr>
<th>Wald Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Statistic</td>
</tr>
<tr>
<td>Value</td>
</tr>
<tr>
<td>df</td>
</tr>
<tr>
<td>Probability</td>
</tr>
<tr>
<td>Chi-square</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>0.0021***</td>
</tr>
</tbody>
</table>

Null Hypothesis: C(2)=C(8)=C(9)=C(13)=0

Null Hypothesis Summary:

<table>
<thead>
<tr>
<th>Normalized Restriction (= 0)</th>
<th>Value</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(2)</td>
<td>-0.166297</td>
<td>0.081930</td>
</tr>
<tr>
<td>C(8)</td>
<td>-8.371098</td>
<td>3.336244</td>
</tr>
<tr>
<td>C(9)</td>
<td>8.176185</td>
<td>3.362391</td>
</tr>
<tr>
<td>C(13)</td>
<td>0.157501</td>
<td>0.084160</td>
</tr>
</tbody>
</table>

Restrictions are linear in coefficients.

Notes: *** indicates statistical significances at 1 %( **p<0.01)
Source: Own calculation, 2017

4.2.4 Panel Estimation Results of the Regression Model

This section gives the long run regression of different estimation techniques considering tax revenue to GDP ratio as dependent while others are treated as set of explanatory variables. The long run empirical result from the table below shows that the model is estimated using four different estimation techniques. These are the Pooled OLS method (model one), the fixed effect regression model (model two), random effect regression model (model three) and the dynamic panel data generalized methods of moments model (model four). This helps to compare and contrast different estimation techniques as well as the robustness of the results.

---

15 Where C(2), C(8), C(9) and C(13) are the coefficients of DlnTR(-1), DlnURB(-1), DlnURB(-2) and DlnOER(-2) respectively.
Table 10: The long run estimates of tax revenue determinants (1992-2015)

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Model 1 Pooled OLS</th>
<th>Model 2 FE</th>
<th>Model 3 RE</th>
<th>Model 4 FGLS</th>
<th>Model 5 GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnGDPPC</td>
<td>0.299***</td>
<td>0.0483</td>
<td>0.299***</td>
<td>0.299***</td>
<td>0.119</td>
</tr>
<tr>
<td></td>
<td>(0.0272)</td>
<td>(0.0866)</td>
<td>(0.0273)</td>
<td>(0.0267)</td>
<td>(0.0807)</td>
</tr>
<tr>
<td>AID</td>
<td>0.0106***</td>
<td>0.00523**</td>
<td>0.0106***</td>
<td>0.0106***</td>
<td>0.00494**</td>
</tr>
<tr>
<td></td>
<td>(0.00254)</td>
<td>(0.00179)</td>
<td>(0.00163)</td>
<td>(0.00159)</td>
<td>(0.00155)</td>
</tr>
<tr>
<td>lnURB</td>
<td>-0.467***</td>
<td>0.0686</td>
<td>-0.467***</td>
<td>-0.467***</td>
<td>0.0984</td>
</tr>
<tr>
<td></td>
<td>(0.0649)</td>
<td>(0.114)</td>
<td>(0.0385)</td>
<td>(0.0376)</td>
<td>(0.110)</td>
</tr>
<tr>
<td>lnOPEN</td>
<td>0.243***</td>
<td>0.338***</td>
<td>0.243***</td>
<td>0.243***</td>
<td>0.236***</td>
</tr>
<tr>
<td></td>
<td>(0.0271)</td>
<td>(0.0500)</td>
<td>(0.0472)</td>
<td>(0.0461)</td>
<td>(0.0613)</td>
</tr>
<tr>
<td>lnOER</td>
<td>-0.0226*</td>
<td>-0.00203</td>
<td>-0.0226**</td>
<td>-0.0226**</td>
<td>-0.0820*</td>
</tr>
<tr>
<td></td>
<td>(0.009224)</td>
<td>(0.0347)</td>
<td>(0.00571)</td>
<td>(0.00557)</td>
<td>(0.0375)</td>
</tr>
<tr>
<td>AGR</td>
<td>0.0309***</td>
<td>0.0257***</td>
<td>0.0309***</td>
<td>0.0309***</td>
<td>0.00928*</td>
</tr>
<tr>
<td></td>
<td>(0.00416)</td>
<td>(0.00426)</td>
<td>(0.00376)</td>
<td>(0.00368)</td>
<td>(0.00396)</td>
</tr>
<tr>
<td>IND</td>
<td>0.0112*</td>
<td>0.0142***</td>
<td>0.0112**</td>
<td>0.0112**</td>
<td>0.00385</td>
</tr>
<tr>
<td></td>
<td>(0.00470)</td>
<td>(0.00348)</td>
<td>(0.00380)</td>
<td>(0.00371)</td>
<td>(0.00300)</td>
</tr>
<tr>
<td>SERV</td>
<td>0.0276***</td>
<td>0.0219***</td>
<td>0.0276***</td>
<td>0.0276***</td>
<td>0.00757</td>
</tr>
<tr>
<td></td>
<td>(0.00278)</td>
<td>(0.00356)</td>
<td>(0.00299)</td>
<td>(0.00292)</td>
<td>(0.00462)</td>
</tr>
<tr>
<td>INF</td>
<td>-0.00187</td>
<td>-0.000788</td>
<td>-0.00187*</td>
<td>-0.00187*</td>
<td>-0.00353***</td>
</tr>
<tr>
<td></td>
<td>(0.00114)</td>
<td>(0.000792)</td>
<td>(0.000823)</td>
<td>(0.000804)</td>
<td>(0.000937)</td>
</tr>
<tr>
<td>L.lnTR</td>
<td>-0.888</td>
<td>-0.968</td>
<td>-0.888*</td>
<td>-0.888*</td>
<td>-1.061</td>
</tr>
<tr>
<td></td>
<td>(0.521)</td>
<td>(0.946)</td>
<td>(0.415)</td>
<td>(0.406)</td>
<td>(0.831)</td>
</tr>
<tr>
<td>No of Observations</td>
<td>216</td>
<td>216</td>
<td>216</td>
<td>216</td>
<td>207</td>
</tr>
<tr>
<td>No of Countries</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.807</td>
<td>0.344</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj.R-sq</td>
<td>0.1802</td>
<td>0.287</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>412.7</td>
<td>11.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob&gt;F</td>
<td>0.000***</td>
<td>0.000***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald chi2(9)</td>
<td>863.34</td>
<td>905.25</td>
<td>264.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob&gt;chi2</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ***, ** and * indicates statistical significances at 1% (***(p<0.01), 5% (**p<0.05) and 10% (*p<0.1) respectively. Standard errors in parentheses. Where Pooled OLS = Pooled Ordinary Least Square, FE= Fixed Effects, RE= Random Effects, FGLS= Feasible Generalized Square and GMM = Generalized Methods of Moments

Source: Own Calculation, 2017

The F statistic value (412.7) with (P_value < 0.01) is high and significant for model 1 (Pooled OLS); therefore the overall model is acceptable. As per the regression results the coefficient of determination (R²) of 80.7% implies that 80.7% of variations in tax revenue is explained by its determinants. For Pooled OLS model all variables are statistically significant apart from
inflation. The sign of per capita GDP, foreign aid, openness, share of agriculture, share of industry and share of industry. All are significant at 1% except share of industry which is significant at 5%. Thus, all contribute positively towards tax enhancement of East African countries. On the contrary growth in urbanization and official exchange rate affect the tax revenue negatively over the period under review. The effect of inflation is insignificant.

The first and second column shows the long run model estimation done using the Fixed Effect (FE) and Random Effect (RE) approaches. The FE model is applied under a vital assumption that the unobserved cross-country heterogeneity is correlated with the regressors included in the models while in the RE estimation is done with the assumption of correlation between the unobserved heterogeneity and included regressors is relaxed.

Similarly the F statistic value (11.53) with \(P\text{\_value} < 0.01\) is high and significant for model 2 (Fixed Effect Model); therefore the overall model is acceptable. As per the regression results the coefficient of determination \(R^2\) of 34.4% implies that 34.4% of variations in tax revenue is explained by its determinants. Thus, compared to model 1 higher variation in dependent variable is explained by model 2. For Fixed Effects model foreign aid, openness, share of agriculture, share of industry and share of services have significant positive on the tax revenue of East Africa countries. They are all significant at 1%. However per capita GDP, urbanization, official exchange rate and inflation have insignificant impact over the study period.

The Wald Chi2 (863.34) with \(P\text{\_value} < 0.01\) is also high and statistically significant for model 3 (Random Effect model). Thus, the overall model is acceptable. Per capita GDP, foreign aid, share of agriculture, share of industry and share of services have positive and significant contribution for tax revenue of East African countries. All of them are statistically significant at 1% except the share of industry which is significant at 5%. On the other side inflation, official exchange rate and growth in urbanization contributes negatively towards tax revenue of the region. Growth in official exchange rate and urbanization is significant at 1% while inflation is weakly significant at 10%.

One of the merits of the use of RE over FE model is that it allows for the inclusion of time-invariant variables which may be relevant in explaining the determinants of tax revenue in East African countries. But in situation where the unobserved heterogeneity is correlated with the regressors of the model, the FE model produces consistent and efficient estimates while the RE
model does not. On the other hand, if the null hypothesis of no correlation between the unobserved heterogeneity and regressors is accepted, the RE model produces estimates that are both consistent and efficient. In this situation, the FE model estimates are consistent but inefficient. Here Hausman test (see appendix D) is used to differentiate between the two approaches (i.e FE or RE model in panel data) produces efficient and consistent estimates.

Accordingly the null of no correlation is rejected based on the Hausman test in favour of the fixed effect models. The diagnosis tests result from the FE regression model shows that there is autocorrelation problem \( \text{Cov}(U_t, Xb) = 0.2852 \neq 0 \) in the model (see the appendix). This violates the Classical Linear Regression Model (CLRM) assumption of no correlation between vector of explanatory variables and the error term \( \text{Cov}(X_{it}, \varepsilon_{it}) = 0 \).

Therefore, even though the Hausman test selects fixed effects model over the random effect model as there is autocorrelation problem it may result in inefficient estimates. With the presence of autocorrelation and heteroskedasticity problems using the Feasible Generalized Least Square (FGLS) estimation technique is appropriate to come up with efficient estimates. As one can see the regression results for FGLS it controls both for autocorrelation and heteroskedasticity problems and works under the assumption of no autocorrelation and homoscedasticity (see appendix E). On the other way instead of allowing for serial correlation in error term, the econometric model specification could also capture the performance of tax revenue performance by including the lagged value of the dependent variable which is creates problem. Such problem of serial correlation is solved by using the dynamic panel data model called the generalized methods of moments (GMM). Thus, estimation and interpretation of the model follows FGLS and GMM techniques.

Results from the dynamic panel methods shows that The Wald Chi2 (264.87) with \( P_{-value} < 0.01 \) is also high and statistically significant for model 5 (the GMM model). Thus, the overall model is acceptable. Foreign aid, trade openness, share of agriculture and one period lagged tax revenue have positive and significant contribution for tax revenue of East African countries. Trade openness and lagged tax revenue are statistically significant at 1% while foreign aid is significant at 5%. Lastly share of agriculture to GDP is statistically significant at 10%. On the contrary official exchange rate and inflation has negative significant impact during the period. Inflation is statistically significant at 1% while official exchange rate is significant at 10%.
Per capita GDP (GDPPC) has positive and significant impact on tax-GDP ratio. The FGLS regression result shows that GDPPC is statistically significant at 1% growth in GDPPC leads to 0.299% increase in growth of tax to GDP ratio. Sustained increase in GDP leads to increase in GDP per capita used to measure the relative economic performances. It is a tool for making comparison in standards of living between countries and over a period of time. Thus, higher income leads to increased GDP per capita which further leads to higher tax GDP ratio. This result disagrees with (Teera J., 2003) and agrees (Workineh, 2016) and (Oyetunji, 2008)

Foreign Aid (AID) has positive and significant impact on tax revenue both for FGLS and GMM model at 1% and 5% percent of level of significance respectively. This concurs with the argument that for the economies of less developing countries where vicious circle of poverty is availing the rationale for foreign aid is very straight forward. The gap model theories asserts that foreign aid inflow fill the saving gap, foreign exchange gap and the revenue gap models. Thus, it is conceivable to see that it has positive impact on the tax revenue of East African countries. This further proof that there is a complementarity role between foreign aid and tax revenue in place on being substitutable (Gaalya S., 2015); (Morrissey & Clist, 2010).

Urbanization (URB) measuring the proportion of population dwelling in urban areas in an important determinant of tax revenue. The FGLS estimation result from above table shows that urbanization growth has negative and significant impact on tax revenue of the region over the period under consideration. As described priorly under section 4.1 it is only when the supply forces surpasses the demand forces the positive impact is observed. Here in less developing countries including East Africa higher population in cities are associated with lower incomes because of high cost of living which further leads to low tax revenue collection. The finding is consistent with (Addison & Levin, 2006); (Becker, Glaeser, & Murphy, 1999) and inconsistent with (Nnyanzi, Babyenda, & Bbale, 2016). In urban economy, though better off, offered limited opportunities for revenue generation. In less developing countries including East African countries the formal economies accountable for tax revenue collection comprises of small, micro and medium enterprises which had been devastated and begin to re-emerge now. That, there is low potential to tax revenue collection with adverse population pressures due to urbanization.

Openness (OPEN) has positive and significant impact on tax revenue to GDP ratio. As openness is the sum of export and import of goods and services the revenue obtained is tax of exports and imports also. The indication is that taxes on imports and exports do not have lots of
administrative complications so that they can be easily collected and managed. The more the countries follows open economies trade among countries increases which has the repercussion effect of increasing in tax revenue from such trade interactions. For FLGS model 1% increase in growth of trade openness leads to about 0.243% increase in tax revenue to GDP ratio of the region while for GMM model 1% increase in growth of trade openness brings about 0.236% of growth in tax revenue to GDP ratio other things remain fixed. The FGLS model has more persistent impact then GMM model as it leads to higher increments for a given increase in trade openness. The result is consistent with (Addison & Levin, 2006); (Gaalya S. , 2015).

Official exchange rate (OER) has negative and significant impact of the tax revenue of the region. Exchange rate appreciation will lead to decrease in export of goods and services. Such decrement in export has dual effects. One is decrease in production of exportable goods in the future and the other is decrease in income tax form exportable goods. Thus, the cumulative effect is that exchange rate appreciation leads to decrease in tax revenue of the region. The OER is statistically significant at 1% and 10% for FGLS and GMM models respectively (Gaalya S. , 2015). Holding other things constant, for FGLS model a 1% growth in OER leads to 0.0226% decrease in growth of tax revenue as a ratio of GDP where as for GMM model a 1% growth in OER leads to 0.236% decrease in growth of tax revenue.

The sectoral economic activities are other key factors influencing the revenue performances of the region. The FGLS regression result shows holding other factors constant 1% increase in share of agriculture value added as a % of GDP leads 3.09% increase in tax revenue as a ratio of GDP. In the same way the regression results GMM dynamic model shows that a 1% increase in share of agriculture leads to about 0.928% increase in tax revenue other things remaining constant. Thus over the period 1992-2015 agriculture contributes positively in supporting the tax revenue collection of East African countries. This shows agriculture is still backbone of the economy of less developing countries including the countries included in the study sample. Thus, as the contribution of the sector in imperative, modernization and transformation of the sector should key policy intervention. The finding is in contrary to (Gupta A. , 2007); (Stotsky & Woldemariam, 1997) & (Teera J. , 2003). Again the results from FGLS shows that share of industry have positive and significant impact on the tax revenue of the region even though it is significant for GMM model. A 1% increase in share of industry leads about 1.12% increase in tax revenue to GDP ratio holding other things fixed. This concurs with (Teera J. , 2003) ;
Moreover the FGLS regression result shows that share of service has positive and significant impact on tax revenue of East African countries. A 1% increase in share of service sector leads about 2.76% increase in tax revenue to GDP ratio holding other factors remaining constant.

Inflation rate (INF) measuring the over trend and movement in price of goods and services (a measure of macroeconomic stability of the region) has negative and significant impact on tax revenue both for FGLS and GMM model at 5% and 1% percent of level of significance respectively. Both GLS and GMM estimation results conforms this. According to the FGLS model a 1% increase in overall price of goods and services leads to about 0.187 % decrease in tax revenue over the period under considerations hold other factors remaining constant. Like-minded for the GMM model 1% increase in overall price of goods and services leads to about 0.353 % decrease in tax revenue over the period under considerations hold other factors remaining fixed. This consistent with the findings of (Ghura, 1998).

The GMM result confirms that lagged tax revenue is a strong and significant predictor of current revenue performance showing that higher tax revenue is the previous period leads higher tax revenue collection in the current period. This is the superiority of the model in taking into account the lag of the dependent variable as explanatory variable. A 1% increase in lagged tax revenue leads to 0.586% increase in tax revenue as a ratio of GDP holding other factors remaining constant. The finding is agrees with (Nnyanzi, Babyenda, & Bbale, 2016).
CHAPTER FIVE

CONCLUSION AND POLICY IMPLICATIONS

The chapter presents summary of conclusion, policy implication and further research where the study intended to examine determinants of tax revenue in East African countries. The first part goes through a brief summary of conclusion of the study. The second one points out a sort of policy implications forwarded based on the conclusion of the study. Finally some issue of further research is stated.

5.1 Conclusion

Domestic revenue mobilization has received growing attention in recent years. For the economies of Sub-Saharan African (SSA) countries in general and that of the East Africa countries in particular domestic resource mobilization has crucial national and international dimensions. In most countries, the share of tax revenue collection to GDP is declining and countries rely on foreign aid and other source of capital inflow as a major source of the government budget. Even though rising tax enables the government to acquire assets not liable, the tax revenue collection is not effective as it should be attributable to many factors. Thus, as tax revenue is key for economic development, the study thought to empirically examine the key determinants of tax revenue in East African countries using the recent year data ranging from 1992 to 2015 by employing panel data cointegration approach.

To achieve the objective of this study the econometric model capturing both dependent and set of independent variables is framed. Accordingly a panel econometric form encompassing the tax revenue as % of GDP (dependent variable) and other potential explanatory variables were set. Nevertheless, before we proceed for the panel cointegration test, all variables were tested for panel unit root test of stationarity using the LLC, IPS and ADF test of stationarity. The test for unit root shows that almost all variables are cointegrated of order one, I(1) except the variable inflation which is stationary at level. The panel cointegration test is used check for the long run relationship among variables entered the tax revenue model and the panel vector error correction model is used to assess the short run relationship among variables and the dynamic linkage with the long run equilibrium path and adjustments. Further, the test for existence of cointegration
was done using the Pedironi and Kao test cointegration test for residuals. The results from the two tests show that there is cointegration among variable entering the tax revenue model.

The model estimation was made by using the FGLS and the dynamic panel data GMM model.

As matter of fact, the estimation of the result shows that there is divergence between the hypothesized sign and econometric results of variables. But, the results are still supported by existing literatures. The long run estimated equation from the FGLS results indicates that per capita GDP, foreign aid, trade openness, share of agriculture, share of industry and share of services have positive contribution for tax revenue of east African countries over the study period. On other hand, urbanization, official exchange rate and rate of inflation have negative impact of the tax revenue to GDP ratio. From the short run panel vector error correction model one period lagged tax revenue and urbanization has negative impact on the current period tax revenue while two period lagged urbanization and official exchange rate has positive impact.

5.2 Policy Implication

In the context of recommendation based on the empirical conclusion the following policy implication are drawn by the researcher:

It has been seen that the sectoral economic composition (share of agriculture, share of industry and share of share of services value added) contributes positively for tax revenue performance of East African Countries. This shows that these variables remain as the key factor that can foster tax revenue of the region. Thus, East African countries should continuously take measures to improve the performance of each economic sector and for successful transformation of the economy. Introduction of new technologies, allowing innovation in production, policy incentives that supports sustainable resource use and the like should be practiced in an inclusive manner so that welfare of the general society will be improved and tax revenue collection too. Thus, a need to design policies and strategies to strengthen these sectors as they are the pillars for spur of development and gear of tax revenue potentials is vital agenda.

The East African economy is characterized by the prevailing resource gaps. The regression results from FGLS and GMM show that foreign aid is used to finance this resource gap and keep on augmenting tax revenue of the region. But, as the issue financial sustainability by external
fund is a key question. Thus, there has to be attainable policies working towards enhancing tax revenue of the region via internal domestic resource mobilizations.

Empirical evidence obtained from this study is an indication that tax revenue will increase under stable macroeconomic environment. Hence, East African countries should therefore better pursue economic policies that at least reveal low inflation rate and favorable trade policies.

The overall result shows that the countries are required to set prudent macroeconomic policy environment which create economic integrations among different sectors, mobilizes domestic resource and improve external trade policies to make each country’s growth sustainable on the basis of domestic resource mobilizations. The cumulative effects lead to improved tax revenue collection of the region.

5.3 Further Research

As the research report do not incorporate all the determinants of tax revenue at a time, it is advisable if the study can further go and put emphasis other determinants of tax revenue posing challenges on tax revenue of the region. Some of the factors include corruption, bribery, fragile human resource, extent of shadow economy and the likes. Thus, this deserves further study.

Further, the tax revenue model developed for this study is in the aggregate form. It would be more advisable if the model is in disaggregated in forms: (i) direct taxes, (ii) indirect taxes, (iii) VAT, (iv) Tax from natural resource and (v) Tax from non-natural resource and see how the fiscal policy works. By doing this, the one can analyze the determinants on the disaggregated tax revenue types for East African countries. Yet again this warrants further study.
REFERENCES


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Jeff, K. a. (1994). Where in world is population growth bad?


Tanzi, V. (1989). The impact of macroeconomic policies on the level of taxation and the fiscal balance in developing countries. IMF staff papers, 36, 633-56.


List of Appendices

Appendix A: List of East African Countries included in the sample

- Burundi
- Ethiopia
- Kenya
- Madagascar
- Mozambique
- Seychelles
- Tanzania
- Zambia
- Uganda

Appendix B: Definition of variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition of Variables</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR</td>
<td>Tax revenue (% of GDP)</td>
<td>WDI(^{16})</td>
</tr>
<tr>
<td>GDPPC</td>
<td>Gross domestic product divided by midyear population.</td>
<td>WDI</td>
</tr>
<tr>
<td>AID</td>
<td>Net ODA received (% of GNI).</td>
<td>WDI</td>
</tr>
<tr>
<td>URB</td>
<td>People living in urban areas defined as % of total population</td>
<td>WDI</td>
</tr>
<tr>
<td>OPEN</td>
<td>Openness measured as the sum of exports and imports of goods and services a ratio of GDP</td>
<td>WDI</td>
</tr>
<tr>
<td>OER</td>
<td>Official exchange rate (LCU per US$, period average) calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).</td>
<td>WDI</td>
</tr>
<tr>
<td>AGR</td>
<td>Agriculture, value added (% of GDP)</td>
<td>WDI</td>
</tr>
<tr>
<td>IND</td>
<td>Industry, value added (% of GDP).</td>
<td>WDI</td>
</tr>
<tr>
<td>SERV</td>
<td>Is Services, etc., value added (% of GDP).</td>
<td>WDI</td>
</tr>
<tr>
<td>INF</td>
<td>Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole.</td>
<td>IMF(^{17})</td>
</tr>
</tbody>
</table>

Notes: IMF= International Monetary Fund, WDI=World Development Indicator

Appendix C: Trends of Tax Revenue for East African Countries

16 Extracted from World Bank data bank

17 Extracted from the World Economic Outlook data base
Appendix D: Growth rate of Tax revenue as a share of GDP over the period 1992-2015 for East African Countries

Appendix E: Summary of basic Summary Regression Results

Appendix F: Pooled OLS

```
.xtreg lnTR lnGDP, i(country) t(1992 2015) e(robust)
```

Regression with Driscoll-Kraay standard errors

|                      | Coef.  | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|----------------------|--------|-----------|-------|-------|----------------------|
| lnGDP                | .2991245 | .0271884 | 11.00 | 0.000 | .242881 to .3553679  |
| AID                  | .0105026 | .0025403 | 4.17  | 0.000 | .0059276 to .015076  |
| lnURB                | -1.4673258 | .0649035 | -2.20 | 0.000 | -2.01589 to -1.318766 |
| lnOPEN               | .2429886 | .027095  | 8.97  | 0.000 | .1869382 to .299039  |
| lnOER                | -0.0226171 | .0092449 | -2.45 | 0.022 | -0.0417416 to -0.0034927 |
| AGR                  | .030923  | .0041511 | 7.43  | 0.000 | .0223151 to .0395309 |
| IND                  | .0111748 | .0046995 | 2.38  | 0.026 | .001453 to .0208965  |
| SERV                 | .0275969 | .0027785 | 9.93  | 0.000 | .021849 to .0333448  |
| INF                  | -0.0018678 | .0011404 | -1.64 | 0.115 | -0.004227 to .0004913 |
| _cons                | -0.6860204 | .5206620 | -1.31 | 0.102 | -1.965094 to .1890520 |
Appendix G: Fixed Effect Regression Results

```
. xtregr lnTR lnGDPPC AID lnURB lnOPEN lnOER AGR IND SERV INF,re
```

Fixed-effects (within) regression
Number of obs = 216
Group variable: country1
Number of groups = 9

R-sq: within = 0.8438
between = 0.5851
overall = 0.5241

|                | Coef.  | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|----------------|--------|-----------|-------|-----|----------------------|
| lnGDPPC       | .048307| .0865844  | 0.56  | 0.578| -.122439             | .219053  |
| AID           | .0052281| .0017979  | 2.92  | 0.004| .0016995             | .0087507 |
| lnURB         | .0609911| .1133788  | 0.60  | 0.547| -.1353683            | .2563274 |
| lnOER         | .0020492| .034917     | -0.06 | 0.953| -.0704668            | .0664866 |
| AGR           | .0257301| .0042593  | 6.04  | 0.000| .0173306             | .0341295 |
| IND           | .0122232| .0034799  | 4.09  | 0.000| .0073597             | .0180106 |
| SERV          | .0218669| .0035557  | 6.15  | 0.000| .014850              | .0288788 |
| INF           | -.0009787| .0007922  | -0.99 | 0.311| -.0023456            | .0003774 |
| _cons         | -.5676447| .9468458  | -1.02 | 0.308| -.2804294            | .0987195 |

\[\sigma_u\]  
\[\sigma_e\]  
\[\rho\] (fraction of variance due to \(u_i\))

F test that all \(u_i=0\): \(F(9, 198) = 10.24\) \(\text{Prob} > F = 0.0000\)

Appendix H: Random Effects Regression Results

```
. xtregr lnTR lnGDPPC AID lnURB lnOPEN lnOER AGR IND SERV INF.re
```

Random-effects GLS regression
Number of obs = 216
Group variable: country1
Number of groups = 9

R-sq: within = 0.2371
between = 0.9907
overall = 0.8074

|                | Coef.  | Std. Err. | z     | P>|z| | [95% Conf. Interval] |
|----------------|--------|-----------|-------|-----|----------------------|
| lnGDPPC       | .2911245| .027397   | 10.94 | 0.000| .2455449             | .357204  |
| AID           | .0105826| .001627   | 6.50  | 0.000| .0073337             | .0137715 |
| lnURB         | -.4573289| .039491   | -12.14 | 0.000| -.5427668            | -.371849 |
| lnOPEN        | .2429886| .0472167  | 5.15  | 0.000| .1504456             | .3355316 |
| lnOER         | -.0225171| .0097087  | -2.30 | 0.000| -.0318959            | -.0131383 |
| AGR           | .0309232| .0027699  | 11.37 | 0.000| .0254550             | .0364001 |
| IND           | .0111748| .0037991  | 2.94  | 0.003| .0037315             | .0186209 |
| SERV          | .0275969| .0029946  | 9.22  | 0.000| .0212757             | .0339662 |
| INF           | -.0016678| .0006229  | -2.72 | 0.006| -.0034806            | -.000255 |
| _cons         | -.8880204| .4152831  | -2.14 | 0.032| -.701966             | -.740805  |

\[\sigma_u\]  
\[\sigma_e\]  
\[\rho\] (fraction of variance due to \(u_i\))

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Appendix I: Hausman Test for Fixed versus Random Effect Model

Note: the rank of the differenced variance matrix (8) does not equal the number of coefficients being tested (9); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

`hausman FE RE, sigmamore`

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)</td>
<td>(B)</td>
<td>(b-B)</td>
<td>sqrt(diag(V_b-V_B))</td>
<td></td>
</tr>
<tr>
<td>lnGDPPC</td>
<td>.049307</td>
<td>.2991246</td>
<td>- .2508175</td>
<td>.0971644</td>
</tr>
<tr>
<td>AID</td>
<td>.052251</td>
<td>.0105626</td>
<td>- .0416875</td>
<td>.0013025</td>
</tr>
<tr>
<td>lnURB</td>
<td>.0681712</td>
<td>-.4673288</td>
<td>.5359169</td>
<td>1.266876</td>
</tr>
<tr>
<td>lnOPEN</td>
<td>.3384711</td>
<td>.2429686</td>
<td>.0954625</td>
<td>.0342751</td>
</tr>
<tr>
<td>lnOER</td>
<td>-.0020381</td>
<td>-.0226171</td>
<td>.020584</td>
<td>.0400499</td>
</tr>
<tr>
<td>AGR</td>
<td>.0257301</td>
<td>0.030923</td>
<td>.0051929</td>
<td>.0032304</td>
</tr>
<tr>
<td>IND</td>
<td>.0142222</td>
<td>0.011748</td>
<td>.002474</td>
<td>.0014226</td>
</tr>
<tr>
<td>SERV</td>
<td>.0218659</td>
<td>.0275696</td>
<td>-.00573</td>
<td>.002866</td>
</tr>
<tr>
<td>INF</td>
<td>-.0007878</td>
<td>0.001878</td>
<td>.00108</td>
<td>.0004187</td>
</tr>
</tbody>
</table>

b = consistent under H0 and Ha; obtained from xtreg  
B = inconsistent under H0, efficient under Ha; obtained from xtreg

Test: H0: difference in coefficients not systematic  
\[ \text{chi}^2(9) = (b-B)'[(V_b-V_B)^{-1}] (b-B) = 60.30 \]  
Prob > chi2 = 0.0000

Appendix J: Feasible Generalized Least Square (FGLS)

```
. xtreg lnTR lnGDPPC AID lnURB lnOPEN lnOER AGR IND SERV INF  
```

Cross-sectional time-series FGLS regression

| Coefficients: | generalized least squares |
| Panels: | homoskedastic |
| Correlation: | no autocorrelation |

Estimated covariances = 1  Number of obs = 216  
Estimated autocorrelations = 0  Number of groups = 9  
Estimated coefficients = 10  Time periods = 24  
Log likelihood = -68.72644  Prob > chi2 = 0.0000

| lnTR | Coef. | Std. Err. | z | P>|z| | [95% Conf. Interval] |
|------|-------|-----------|---|------|------------------|
| lnGDPPC | .2991245 | .0266667 | 11.20 | 0.000 | .2467999 | .351449 |
| AID | 0.0105626 | .0018999 | 6.66 | 0.000 | .0074604 | .0136966 |
| lnURB | -.4673288 | .0375894 | -12.43 | 0.000 | -.5406997 | -.3936519 |
| lnOPEN | .2429686 | .0461109 | 5.27 | 0.000 | .1526133 | .3333654 |
| lnOER | -.0020381 | .005575 | -0.406 | 0.000 | -.0075458 | -.0015904 |
| AGR | .0257301 | .0306799 | 8.41 | 0.000 | .0237166 | .0277522 |
| IND | .0142222 | .0037191 | 3.01 | 0.000 | .006903 | .0164465 |
| SERV | .0218659 | .0029245 | 7.44 | 0.000 | .0219685 | .0318288 |
| INF | -.0007878 | .0008036 | -2.32 | 0.020 | -.0016429 | -.0002920 |
| _cons | -.8888024 | .4055561 | -2.19 | 0.029 | -1.682896 | -.083145 |

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Appendix K: Linear Regressions with Panel Corrected Standard Errors (PCSE)

Linear regression, correlated panels corrected standard errors (PCSEs)

<table>
<thead>
<tr>
<th>Group variable:</th>
<th>country1</th>
<th>Number of obs = 216</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time variable:</td>
<td>Year</td>
<td>Number of groups = 9</td>
</tr>
<tr>
<td>Panels:</td>
<td>correlated (balanced)</td>
<td>Obs per group: min = 24</td>
</tr>
<tr>
<td>Autocorrelation:</td>
<td>no autocorrelation</td>
<td>avg = 24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>max = 24</td>
</tr>
<tr>
<td>Estimated covariances = 45</td>
<td>R-squared = 0.8074</td>
<td></td>
</tr>
<tr>
<td>Estimated autocorrelations = 0</td>
<td>Wald chi2(9) = 941.46</td>
<td></td>
</tr>
<tr>
<td>Estimated coefficients = 10</td>
<td>Prob &gt; chi2 = 0.0000</td>
<td></td>
</tr>
</tbody>
</table>

| lnTR       | Panel-corrected Coef. | Std. Err. | z   | P>|z| | [95% Conf. Interval] |
|------------|------------------------|-----------|-----|-------|----------------------|
| lnGDPFC    | .2991245               | .0311143  | 9.61| 0.000 | .2381415             | .3601074 |
| AID        | .0105826               | .0016666  | 6.27| 0.000 | .007277              | .0138882 |
| lnURB      | -.4673258              | .0610665  | -7.65| 0.000 | -.5870141            | -.3476376 |
| lnOPEN     | .2429886               | .0539705  | 4.50| 0.000 | .1372084             | .3487638 |
| ln0ER      | -.0226171              | .0083283  | -4.24| 0.000 | -.0303604            | -.0121738 |
| AGR        | .030923                | .00411    | 7.52| 0.000 | .0228675             | .0389785 |
| IND        | .0111748               | .004294   | 2.60| 0.009 | .0027588             | .0195908 |
| SERV       | .0275969               | .0031672  | 8.71| 0.000 | .0213893             | .0338045 |
| INF        | -.0018678              | .0008922  | -2.09| 0.035 | -.0036164            | -.0001192 |
| _cons      | -.8880204              | .4797743  | -1.85| 0.061 | -1.828361            | .05232    |
Appendix L: Generalized Methods of Moments (GMM) regression

Dynamic panel-data estimation
Group variable: country1
Time variable: Year

Number of instruments = 163
Wald chi2(10) = 264.87
Prob > chi2 = 0.0000

One-step results

| lnTR | Coef.   | Std. Err. | z     | P>|z| | [95% Conf. Interval] |
|------|---------|-----------|-------|-----|---------------------|
| lnTR | .5862055 | .0586914  | 9.99  | 0.000 | .4711723 to .7012386 |
| L1   | .1190248 | .0807066  | 1.47  | 0.140 | -.0391573 to .2772069 |
| lnGDPFC | .0049397 | .0015461  | 3.19  | 0.001 | .0019093 to .00797   |
| AID  | .0983874 | .1103911  | 0.89  | 0.372 | -.117834 to .3146088 |
| lnURB| .235553  | .061308   | 3.84  | 0.000 | .1153916 to .3557145 |
| lnOPEN| -.0819944| .0374866  | -2.19 | 0.029 | -.1554668 to -.008522 |
| AGR  | .0092754 | .003956   | 2.34  | 0.019 | .0015218 to .017029  |
| IND  | .0038522 | .0030033  | 1.28  | 0.200 | -.0020342 to .0097386 |
| SERV | .0075725 | .0046164  | 1.64  | 0.101 | -.0014755 to .0166205 |
| INF  | -.0035291| .0009368  | -3.77 | 0.000 | -.0053652 to -.0016931 |
| _cons| -1.060551| .8313619  | -1.28 | 0.202 | -.2.689991 to .5688879 |

Instruments for differenced equation
GMM-type: L(2/).lnTR

Instruments for level equation
Standard: _cons

Appendix M: Testing for cross-sectional dependence/ contemporaneous correlation

Note: Cross-sectional dependence (CD) is an issue of macro panels with long time series (over 20-30 years) than in micro panels. CD test is used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in tests results (also called contemporaneous correlation). The null hypothesis is that residuals are not correlated

```
.xtcsd, pesaran abs

Pesaran's test of cross sectional independence = -1.372, Pr = 0.1700
Average absolute value of the off-diagonal elements = 0.266
```

No cross-sectional dependence
Appendix N: Cointegration graphics showing long run relationships among variables