ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS

DETERMINANTS OF AGRICULTURAL PRODUCT EXPORT: EVIDENCE FROM A PANEL DATA ANALYSIS OF EAST AFRICAN COUNTRIES

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Economics (Natural Resource And Environmental-Economic)

By
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This is to certify that the thesis prepared by Amanual Kebede, entitled with **Determinants of Agricultural Product Export: Evidence from a Panel Data Analysis of East African Countries**. Moreover, submitted in partial fulfillment of the requirements for the Degree of Master of Science in Economics (Natural Resource and Environmental-Economic). Complies with the regulations of the University and meets the accepted standards concerning originality and quality.

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Declaration

I hereby declare that this MSc. Thesis entitled "Determinants of agricultural product export: evidence from a panel data analysis of east African country" was carried out by me for the masters of economics under the guidance and supervision of Dr. Mesele W. Araya, Addis Ababa University, College of Business and Economics, Department of Economics. The interpretations put forth are based on my reading and understanding of the original texts and they are not published anywhere in the form of books, articles, and reports. The other books, articles, and websites, which I have made use of are acknowledged at the respective place in the text.

For the present thesis, which I am submitting to the University, no degree, diploma, or distinction has been conferred on me before, either in this or in any other University.

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Abstract

This paper investigates the determinants of agricultural product export in east African countries. Due to the limitation of data availability, only 12 East African countries and 19 years, (2000-2018) macroeconomic data were considered. A secondary data source was used and the necessary data were collected from the World Bank Development Indicator and UNICTAD baseline data. The thesis attempts to explain theoretically and assess empirically climate change and the other factors affecting agricultural export of east African countries. Specifically, the study focuses on analyzing the relative importance of climate change and the two major factors in determining the countries agricultural export performance. A Linear panel data Model was employed for the analysis. The selection test result confirmed that fixed effect to be an appropriate model for the analysis. The estimation result shows that the effect of climate change and real effective exchange rate, on agricultural products from east African countries is negative and significant. Moreover, on the supply side, factors such as real GDP, trade openness, and FDI of exporting country is positively and significantly affects agricultural export. The study also indicates that on the demand side the effect of per capita GDP of the US is positive and significant. Therefore, The study advocates that policy makers of east African country; the government should take a remedial action for climate change problem through allocate sufficient annual budget to combat the problem with a serious supervise and *policymakers should give equal emphasis for demand and supply side determinants of agricultural export, indirectly affects the export potential utilization.*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Trades on agricultural commodities are dominant and still an applicable export type of business in the African economy. The agricultural sectors compose a major part of the entire economy and employees a significant proportion of the labor force. Furthermore, increasing agricultural export is an indeterminate step toward restoring the external balance of payment equilibrium which has been the central part of most economic structural adjustment programs initiated in the 1980s and 1990s (Gbadebo and Odularu, 2007).

Nagruko (2003), also noted that although the success stories of the 'Asian tigers' have made export-led growth mainly focusing on manufactured goods export, which is believed to include many advantages over agricultural export. According to Sekatt and Varoudakis (2000), 50% of the total export is primary and processed agricultural export even when they are imagined to be producers of manufacturing export. In Africa also, this share amounts to 50% of the total export, and part of the remaining share includes minerals, which do not have manufactured commodity advantage. They also advocate that in the short and medium term economic character -including the development of manufactures- will rely on agricultural export, especiallyin Africa. Agricultural product export is the main source of comparative advantage.

According to Nagruko (2003) export in general and primary commodity export in particular affect development through the financing of capital accumulation by lifting two types of constraints: the limitation of international liquidity and the constraint of solvability. In the latter case, export provides opportunities for economies to make extra income and thus extra saving that would not exist otherwise. Thus, emphasis should be given for the agricultural sector in general and exports in particular for the reason that the sector is the basic source of foreign exchange earnings and income as well as employment creation for the majority of the population in, sub-Saharan Africa.

According to Cleaver (1985), agriculture is important in SSA contributing from 20% - 60% of GDP depending on the country; an average of 80% employment, and 50-90percentage of export. Much of the industry, trade, etc. depends on agriculture.

The importance of agriculture in east African countries has not been stressed enough given that it is central to economic growth and most of the economic activities depend on it. Most African countries' export remains and dominated by primary commodities, and the contribution of agriculture in SSA's total exports has turned down sharply in the last 40 years. Only a small number of SSA countries have realized significant diversification of their exports. Despite those trends, agriculture remains the main export-revenue source for many SSA countries and the largest income generator for their population (WB, 2007).

Trade and macroeconomic policies as well are expected to play a critical role in the export sector in particular and hence are major concerns for policymakers. In a developing country, export is dominated by agricultural commodity and until now, it is stagnant. Identifying the determinants of the export sector might help in improving the sector's performance. Owing to this fact, the analysis of the implication of trade and macro policies should be the concern for many less developed countries. In contrast to this, relative to its importance, little attention has been given for such analysis both theoretically and empirically. The topic in both cases has been highly investigated in numerous urbanized countries starting from the works of Schuh's (1974).

In under developing country climate change has a complex challenge. While the challenge of global climate change is comparatively new, the kinds of challenges posed by global climate change for economic development are in some ways familiar. Since its inception, development economics has mainly focused on large-scale phenomena involving multiple impact channels and sophisticated interactions. Additionally, uncertainty and therefore they got to deal with short-term shocks to proceed on a positive long-term development path have often been central considerations. In this way, global climate change shares many characteristics with traditional development issues. Overall, climate change complicates the already formidable task of fomenting end of the day develop ent (C. Arndt, et.al, 2012).

1.2 Statement of the Problem

Agriculture remains the main export revenue source for many African countries and the largest income generator for their population (World Bank, 2007). The region's share of worldwide agricultural export has declined gradually from almost 10% four decades ago to around 3% today. On the import side, the other pattern emerges, as Sub-Saharan Africa is the only developing country region that has seen its share of world agricultural imports increase rather than a decrease (Bacchetta, 2007; World Bank, 2007; and Christiansen, 2004).

Sub-Saharan African country's agricultural sector has developed faster than anywhere else have in the world with a 4.6 percent agriculture GDP growth rate for the last two decades. However, about 20 percent of Africa's populations (256 million people) are facing severe food insecurity. The condition is receiving not as good as because of the negative impacts of global climate change and conflicts. Severe weather events such as droughts and floods have become recurrent and prolonged, leading to the diminished productive capacity of the land and loss of natural capital. Additionally, farmers face several significant climate risks, especially in rain-fed agriculture and rustic production systems. The net effect is that per-capita food production is declining given a fast-growing population, making food smaller quantity available and available to a significant section of the residents. The number of undernourished people in most sub-regions has been on the rise again since 2014 and if this trend continues, the hard-won gains of previous years will be lost.

Climate is constantly changing, and the signal that indicates that the changes are occurring can be evaluated over a range of temporal and spatial scales. We can think about climate to be a combination of complex weather conditions averaged over a significant area of the earth (typically in the region of 100 km2or more). It expressed in terms of both the mean of weather expressed by properties such as temperature, radiation, atmospheric pressure, wind, humidity, rainfall and cloudiness (amongst others) and therefore the distribution, or range of variation, of those properties, usually calculated over 30 years. Because the frequency and magnitude of seemingly unremarkable events change, such as rainstorms, the mean and distribution that characterize a particular climate will start to change. Thus climate, as we define it, influenced by events occurring over periods of hours, through to global processes taking centuries (Nicholas M. 2014)

Natural processes have over the millennia driven changes in climate, and these mechanisms continue to cause change. "Climate change" as a term in common usage over much of the world is now taken to mean anthropogenically driven change in the climate. Such climate change may positively influence agriculture (CO2 fertilization, lengthening of growing seasons, more rainfall) or negative way (more drought, faster growth thus shorter life cycles, and salinization).

Agriculture is moderately dependent on imported inputs, fertilizers, pesticides, equipment. The balance of payment crisis has caused reduced imports of inputs and equipment, perhaps causing a reduction in agricultural production and export of developing countries (Cleaver1985). Moreover, the high susceptibility of most African economies to trade and current account deficit arises from world share, declining terms of trade, excessive export turning volatility and falling export revenues are reasons for the poor export performance of the region in general and SSA's in particular(Ignacio, 2007; and Ackah and Morrrissey,2005).

So far, there has been a divergence of opinions as to what really undermines Africa's exports in global trade. While a school of thought believes that, the trade restrictions hindered Africa's exports to developed countries and some developing countries. Thereby reducing the income level and employment rate, another argued that even if Africa's exports are allowed free access to the developed countries' markets, the continent cannot produce to meet the demand due to Africa's supply constraints (Kareem, 2009).

Many research findings so far undertaken on agricultural product export came about with price competitiveness measures, which tend to be relatively small, which translates into a slow adjustment of export volumes to relative price developments. The cause of poor export performance in agricultural sector, especially in East African countries could have been attributed to poor domestic policies as well as restrictive policies pursued by developed countries related to tariffs and no tariffs. Moreover, the region to increase its agricultural product exports conceived as constrained by its economic level, infrastructure and institutional barriers, its ability to diversify Export, issues related to exchange rate, and contrary agricultural development policies set by developed countries. Thus, this research work was set about doing to examine factors other than price competitiveness on agricultural product export performance of East African counties including climate change.

Identifying and assessing the major constraints that significantly determine the overall agricultural export performance in the region will give some useful guidance to policymakers in designing sound macroeconomic policies to improve the sectors' export performance. Moreover, can be used as a base for a detailed study on individual country agricultural export constraints to take remedial measures and ultimately to achieve overall economic growth.

In this study climate change represented by a proxy variable, that is rainfall. The impact of climate change can occur through three major routes: Drought, Flooding and Timing of water availability. Changes in regional rainfall will ultimately affect water availability and may lead to decreased agricultural production and export from the sector and potentially widespread food shortages. The availability of water is fundamental to agriculture. Some studies like Kandiero and Randa; 2004; Taylor 2007) have found positive supply side effect to agricultural export but others have found not only supply side there is a demand side effect to the sector, for example (Eyayu , 2011), (Harisson, 1999), and (Sasidharan, 2006). There are studies on the determinants of agricultural product export but the existing empirical study not linked with climate change in east African country and timing of the existing studies is the main motivation of the study.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of the study is to examine empirically the determinants of east African countries agricultural export

1.3.2 Specific Objectives

The specific objectives of the research work were set forth of making an effort:

I. To indicate the effect of climate change on east African country agricultural export performance.
II. To examine the relative importance of other major factors that affects east African country agricultural export performance.

1.4 Hypothesis of Study

To test whether pursued policies both in the exporting and importing countries (demand side as well as supply-side factors simultaneously) are in favor of or biased against the export of primary commodities. For the reason, most of the variables except natural factors are affected by their policy choices'. In this study, the following are the major hypotheses that are will be tested: To test empirically the importance of demand and supply-side factors in determining the performance of the sector along with the pursued policies in the exporting countries and trading collaborates. Moreover, to show the effect of climate change precipitation on east African countries export, the expected sign is negative

1.5 Significance of the Study

The study will significant in identifying the factors that affect agricultural export from both the demand side as well as supply-side constraints. The study brings empirical evidence on the implication of policies on the export of primary commodities on which little previous work has been done. As a result, it is assumed to draw a concentration of forthcoming researchers to this area. Besides, it is expected to come up with how east African country's policymakers should bargain to access market opportunities to their farmer's output. It is also expected to give an insight as to how east African countries should integrate to increase their bargaining potential to affect world prices.

1.6 Organization of the Study

The study organized in such a way that, in chapter one a brief introduction is made on the study. In chapter two, a brief review of the literature will be both on theoretical and empirical aspects along with other factors that are found to be related to primary commodity export of East African countries. In chapter three, the model specified so that it could accommodate all the domestic as well as external factors, which are supposed to affect the sector's performance. In the fourth chapter, a brief discussion is made on the estimation procedure, technique as well as results of the estimated model. In the last chapter, a summary provided on the major findings of the study, and plausible policy implications and recommendations are drowning from the analysis.

CHAPTER TWO

LITERATURE REVIEW

In the rest of this chapter, the study have a discussion about the detail of different scholars those who have done on agricultural product export and economic growth part and empirical evidence which explain about primary commodity export contribution on east African countries economy. The presumption at the back of the study was discussed and summarized in theoretical framework.

2.1 Review of Theoretical Literature

This section briefly reviews theories of demand and supply factors that influence agricultural export. Add to this, the section discusses the different approaches conducted in explaining the export determination.

Different scholars have been writing on issues related with the supply side constraints of the agricultural export sector for developing countries (Bond, 1987 and Alemayehu, 2002). Moreover, few scholars dealt with on the demand side constraints (see Sanhadji and Montinegro, 1998) even more scarcely researchers are interested to analyze the simultaneous impact of the demand and the supply side factors on the sectors performance(Goldstein and Khan, 1978 and kinal and Lahiri,1993). The following sections revise the existing options to model export.

Before going through the theoretical model, Dawson (2004) cited a number of theoretical justification which asserts that the export performance is an important determinant of economic growth, and hence the concern for many developing countries where growth is assumed to be their ultimate concern. First, via foreign exchange multiplier, export growth leads to economic growth. Second, foreign exchange from exports can be used to finance imported manufactured goods, capital goods, and technology, which contribute a lot to growth. Third, competition leads to scale economics, advance in technology and growth. Forth, export sector may provide positive externalities such as more efficient management and production technique, which leads to growth. These all related findings indicate that the export sector has a lot to do with the growth process of a country. Analyzing the interaction between the

export sector with the growth process of a country under considerations is paramount as it has been subject to an empirical testing, though it is not the focus of this study.

2.1.1 Theoretical Models of Export Determination

In theory, identifying the determinants of the export performance of imperfectly substitutable goods, where by the characteristics of such goods differ markedly either in quality, type or else in their country of origin, is considered to depict realistic version of export. Accordingly, King (1997) identified two methods of linking the export of imperfect substitute goods. The first being the world trade model where by the attempt encapsulates total world in a single, in a multiple equation model or else complicated world trade that relates to trade flows between parts of countries. The second broad method examines the determinants of exports between a single country and with another country or the rest of the world.

In explaining the link between a country's exports to the rest of the world, the same author identifies four types of models where most researchers apply to see the export performance of a country or region under consideration. The author also provides a comprehensive review of theoretical models which dates back to late 1930's until now. These are the export demand model, export determination models, simultaneous models and two-regime models.

2.1.1.1 Single Equation Export Demand Model

The export demand model is the simplest export model of which its utilization in empirical studies goes back to the late 1930's. Essentially, it is a single equation model that concentrates on the demand side determinants of export whilst treating the supply side by assumption to be perfectly elastic. Basically, this model assumes that the supply side either has an idle productive capacity or else the economy exhibit increasing returns to scale. It is also assumed that the price elasticity of supply of exports tends to be infinity (King, 1997). Either the assumption of increasing returns to scale or the assumption of full productive capacity does not suit the export sector of SSA.

In most developing countries, the inherent constraint for the export sector is associated with supply side factors. In addition, export is found to be highly inelastic for their export. For the reason that the model works under highly restrictive assumptions, it cannot be taken for

granted to model exports of developing countries within this framework. Researchers limit themselves from using singe equation model to explain the export sector for developing countries. All of the empirical studies conducted until now utilize this model to explain export performance of developed countries.

2.1.1.2 Export Determination Models

Export determination models are built with the theoretical assumption of combining export demand and export supply models that would be estimated in a single equation (reduced form) using ordinary least square (OLS). In this model to solve the problem of omitted variable bias that is exhibited in the single equation export demand model, either domestic demand pressure or/and profitability of exporting is augmented (King, 1997).

Accordingly, including domestic demand pressure (mostly abbreviated as DDP) as one potential explanatory variable helps to analyze the implication of domestic activity over export. Whenever DDP increase as a result of an increase in income, it calls for hiring laid-off staff and bring stand by equipment, hiring new workers and increase in employment. The faster this process the greater the likelihood of bottlenecks and delays in export thereby discouraging export. One can also test the ratchet hypothesis which posits the ability of domestic upswing to depress export is greater than the ability of an equivalent downswing to encourage export. The influence of profitability over exports will also be expected to be related to DDP. So, theoretically including DDP as well as profitability indicator in the supply equation of the export determination model is assumed to capture the supply side variables impact on the sectors performance.

However, King (1997) argued that the inclusion of such variables (domestic demand pressure and profitability, which are assumed to represent the supply side) does not necessarily mean the assumption of supply passively follows changes in demand has been relaxed. Rather the model assumes that supply is still implicitly passive. Even in the extreme case, even if profitability is intended to boost the level of exports on its own, export demand is also assumed to be passive to changes in profit. The basic limitation of such type of model is that supply side variables are expected to operate independently with those of the demand side variables, and the vice versa. For example, an improvement in foreign economic activity or in

competitiveness might result in a rise in the volume exported whether there is an accommodating change on the supply side of the model or not by simply taking advantage of the favorable environment. In this model the interaction effect of the demand and the supply side factors are ignored and hence it requires other way of modeling export. In general, export determination model possessing DDP, profit indicator and their interaction effect along with the estimated variables in the single equation model has the following form.

$$x_t = (\alpha_0 + \alpha_1 PR_t)DDP_t + (\alpha_2 + \alpha_3 DDP_t)PR_t$$

In this model PRt, and DDPt represent the profitability and the domestic demand pressure. The model is specified in such a way that it could handle the interaction between these variables too.

2.1.1.3 Simultaneous Equation Models

When we come to the simultaneous equation model, the model focus on the avoidance of simultaneity bias and hence recognize interdependence between current export volumes and prices. In most studies, structural model comprising separate export demand and supply equation is considered. In this regard, Goldstein and Khan (1978) theoretically specified two major variants of the export determination model. The first, the equilibrium model makes simplifying assumption that there are no lags in the system so that the adjustment of export prices and quantities and prices to their respective equilibrium values is instantaneous.

Whereas the disequilibrium model relaxes this assumption and takes into consideration adjustment to the equilibrium may take place with some delay. Since the model leaves room for explicit recognition of supply side as well as demand side bottlenecks, it has been used for modeling export of developing countries. Alemayehu (2002) noted that such type of model has advantage over the others in incorporating the factors that affect the market for export. He also made a distinction between short-run and long-run factors that affect export supply that could be included in the Goldstein and Khan (1978) simultaneous equation model.

In Alemayehu (2002) study, the short-run factors are factors which increase the capacity utilization potential of a country. These factors are also included in Goldstein and Khan (1978) model being represented by the price response variables. Whereas, the long-run factors are those that are assumed to occur through changes in potential output also called capacity

creation variables. Capacity creation variables are indicated by supply inducing factors such as gross capital formation and foreign inflow. Both Goldstein and Khan (1978) and Bond (1987) used to represent it by utilizing vaguely defined supply side shifters. These factors are also going to be considered in the estimation stage.

Mathematically, the simultaneous equation model in Goldstein and Khan (1978) is specified

as follows.

$$logX_t^S = b_0 + b_1 \log(PX/P)_t + b_2 logY_t^*$$

Where X^S is the quantity of export supplied

PX is the price of export

P is domestic price index

Y* is logarithm index of domestic capacity.

Whereas the disequilibrium model, which allows lagged adjustment towards the equilibrium values is specified as follows.

$$\Delta logX_t = \lambda(logX_t^d - logX_{t-1})$$

Where λ is the speed of adjustment and Δ is a first difference operator, which is given by $\Delta logX_t = logX - logX_{t-1}$

In this model export is assumed to adjust to the conditions of excess demand in the rest of the world and exporters are assumed to be price setters. Since the disequilibrium model is more realistic version, the model has been used extensively which allows for exporter to be either price takers or price setters in the world market.

The theoretical foundation for this model is discussed in Thirlwall (2000), where by the export performance is dependent on two factors which are relative prices (the price of countries export relative to foreign price) and world income which determine the demand for countries goods. The basic foundation for the demand side of the export determination model relies on

trade with imperfect substitute goods. Mathematically, export model for imperfect substitute model is specified as:

$$X = \left({P_d}/{P_f E} \right)^{\eta} \times wy^{\varepsilon}$$

Where X is the value of export,
Pd is the domestic price index,
Pf is foreign price index,
E is the official exchange rate,
wy, represents the world income.

η and ε are price and income elasticity of exports, which are assumed to be constant with negative and positive expected sign respectively.

Taking logs of this function will provide

$$lnX = \eta\left(lnP_d - lnP_f - lnE\right) + \varepsilon(lnwy)$$

This model is similar to the static Goldstein and Khan's (1978) simultaneous equation export determination model. Detailed discussion about this model will be provided in the coming chapter for it would be used in the analysis section.

2.1.1.4 Two-Regimes Model

The forth type of export model is two-regime models that are constructed on the assumption that either exporters are not simply a collection of homogeneous firms and/or the environment which they operate may exhibit fundamental change from time-to-time. The exports of SSA countries are primary commodity exports with little product differentiation. In addition, for centuries almost all SSA countries were engaged in trading of non-manufactured and no processed primary commodities. The economies of most of the countries are static both in production and in trade. Thus, the model is not in harmony to explain the export sector of developing countries and nothing is done empirically for its bold assumption.

2.2 Empirical Literature Review

2.2.1. Overview of Importance of Agriculture in East African Countries

Based on the trade theory of comparative advantage, Africa continues to produce and export its raw materials or primary goods, where it is said to have the comparative advantage. But the comparative advantage theory is has been disappointing as African countries have been forced into the role of exporting raw material and other primary commodities with little or no development impact. The majority of Sub-Saharan African countries depend on primary commodities for their foreign exchange earnings. African merchandise exports did not rise significantly for the period 1980 to 2006 particularly when South Africa and Nigeria are not included (Amin et al, 2007).

Capitalizing upon agriculture's potential to drive development in East African countries (EAC) is both critically important and urgent for enhancing aggregate economic growth and improving the welfare of hundreds of millions of extremely poor people. Agriculture employs 62% of the population of ECA (excluding South Africa) and generates 27% of GDP of these countries, with the majority of the poor living in rural areas (FAO, 2006; World Bank; 2006b as cited in Staatz and Dembélé, 2007). More than 215 million people, nearly a third of the population, are malnourished, and almost half live on less than a dollar a day. EAC is the only region of the world where poverty is still strongly a rural phenomenon—and undernourishment have been increasing over the past 20 years and where those living on less than $1/day have become poorer. This weak economic performance is closely linked to slow productivity growth in the agricultural sector, as the agricultural sector is the key determinant of overall economic growth (World Bank, 2005c as cited Staatz and Dembélé, 2007).

The performance of the sector over the last three decades suggests that the sector has not been able to serve its potential role as engine of growth in the sub-region. Rather than stimulating economic growth, the agricultural sector had dragged it down in many African countries (Oyejide et.al, 2000). An in depth checks out agricultural production and exports trends explain this conclusion. Put simply, various indicator of agricultural production and exports exposed downward trends, until fairly recently. Over the past 30-40 years SSA's share in worlds export has been declining and along with it the standard of living of most Africans. This outcome is the

result of combination several factors: the structure of international trade; the composition of international trade; the composition of SSA trade; low productivity as a result of poor governance ;poor trade and economic policies applied by SSA countries over the past 20 years ;poor infrastructure in SSA countries- which is related to the high cost of doing the business in SSA; the decline in demand for key export produced by SSA ;the substantial erosion of market share of SSA countries; market access and constraint; and agricultural policies in developed countries. At the same time, more than any other developing region, SSA remains heavily dependent on export of primary commodities –some of whose price have been steadily decline (Cleaver and Donovan, 1995; Maunduna, 2005).

The dismal trend in the agricultural export of SSA has been attributed to poor domestic policies and capacity constraints (supply side/internal factors)as well as restrictive policies in developed countries (demand side Factor) (Bacchetta,2007; Redding and Venables,2003; Kandiero and Randa, 2004; Love and Turner,2001).

2.2.2 Supply Side Factors Affecting Agricultural Export in East African Countries

Structural rigidity is the factor that affects agricultural export unenthusiastically by decreasing products to provide in to market in supply side of east African country. Macro environment; poor infrastructure; access to inputs (like fertilizer and credit to increase production); access to information about the market price, standards; and structural and quality of institutional arrangements and excessive tax on agriculture are among the major supply side constraints that hinder agricultural export of East African countries (Ackah and Morrissey, 2005).

Supply conditions are fundamental in defining the export potential of the economy and, for a given level of access to international markets. countries with better supply conditions are expected to export more (Kandiero and Randa; 2004; Taylor 2007).Moreover, Fugazza (2004) as cited in Beshir (2010) analyzed the major determinants of export performance in 84 countries by employing an econometric model of bilateral trade flows using gravity techniques. The result shows that, while trade barrier continue to be concern, supply-side conditions have often been the most important constraint on export performance in various regions particularly in Africa, despite generalized deepening of international trade integration.

According to Schiff and Valdes(1992) as cited in Kandiero and Randa (2004) among all developing country regions EAC countries imposed the highest level of taxation (both implicit and explicit) on agriculture ranging from 46-59 percent. The direct tax on agriculture in these countries is similar to the implicit tax resulting from industrial countries protection and macroeconomic policies. Herman (1997) did similar study that focused on individual crops and found significant policy biases against agriculture, which were more excessive for export crops such as coffee than food crops. The removal of subsidies in recent years has caused prices to increase, reducing fertilizer usage among many small farmers. In some EAC countries, the imposition of import control on fertilizer resulted in higher prices of fertilizers have led many farmers to sharply reduce the amount of fertilizer usage in production in an effort to cut costs. The average SSA fertilizer usage is below the global mean (26.6 kg per hectare) (Kandiero and Randa, 2004).

Wang and Winters (1998) as cited in Frazer and Biesebroeck (2007) in summarizing a set of World Bank technical papers, finds that "the evidence suggests that it is African countries' own trade policies and not those of their partners that must be changed in order to promote growth.

Infrastructure and trade facilitation services problems abound in low-income countries and the high costs and deficient service flows from these non-tradable factors of production often cause serious problems for export competitiveness. Trade requires official paperwork, transport, port handling, and customs inspections, and the high costs, excessive documentation and procedures, and time delays involved in these services have been shown to be one of the most serious obstacle to export growth and diversification in many countries (Sachs and Warner, 1995 as cited in Biggs, 2007).

According to Mbekeani (2007) Weak infrastructure is a major impediment to trade, competitiveness and sustainable development in most SSA countries, particularly land-locked and small island countries. Although many countries have benefited greatly from policies aimed at fuller integration into the world economy, lagging countries are found in all regions, though regional aggregates suggest that Sub Saharan Africa has been the least successful. The high transport costs of imports of African countries inflate the prices of capital goods and intermediate inputs, thereby increasing the cost of domestic agricultural and industrial

production. Notably, the high transit costs faced by African exports have become a far more restrictive barrier to trade than tariffs in major markets. Clarke (2005) as cited in Bacchetta (2007) argues that improving the quality of domestic transportation infrastructure and the reliability of transportation services might also improve exports despite the weak support he finds for his assertion in his econometric work.

Limão and Venables (2000) find that the relatively low level of African trade flows "is largely due to poor infrastructure. The researchers also reiterated a significant impact of transport costs on trade, finding that the median landlocked country has only 30 percent of the trade volume of the median coastal economy and that improving the standard of infrastructure of the most badly affected countries stands to have a large expansionary effect on their trade. An empirical study by Babatunde (2009) reveals that being land locked country in SSA can adversely affect the performance of merchandise export.

Kym (1999) as cited in Kandiero and Randa (2004) who argue that poor infrastructure has a negative impact on rural prosperity as it affects fertilizer and other in the put uses, raises producer price elasticity and hinders market integration. Kandiero and Randa (2004) find that a 10 % increase in infrastructure leads to a 2 % increase in agricultural exports share.

The other major factor that affects export supply is real exchange rate. Creating more competitive macroeconomic framework through currency devaluation and establishment of Export Processing Zone by the government of SSA countries will encourage their export. Agbeyegba et al. (2004) argues that overvaluation of exchange rate has a direct effect by suppressing import and export bases measured in domestic currency terms .Overvaluation also have indirect effects by reducing the incentive to produce goods for export, encouraging capital flight and currency substitution ,weakening the balance of payments and encouraging trade restrictions. He concludes that in heavier indebted countries like SSA, the effect of devaluation is largely an empirical question. Fugazzza (2004) empirically analyses the effect of real depreciation on export performance by taking sample SSA countries with in the period 1988-1999 and proves that for all periods on average a 1 percent real exchange rate depreciation could increase export by 6 to 10 percent. In low income, countries undervaluation (overvaluation) of the currency can bolster (undermine) export competitiveness.

Love and Turner (2001) also empirically investigates the impact of real exchange rate policy on export in SSA by using panel data methodology over the period 1975-1995 and real exchange rate as a measure of international competitiveness and concludes that appreciation of real exchange rate has detrimental effect on export performance of the region. According to the literature on SSA, the degree of success of trade policy reform in changing the trade orientation of the country is dependent up on exchange rate reform and consistent macroeconomic policies (Schatz and Tarr, 2000 as cited in Love and Turner, 2001).

A study by Were et al (2002) as cited in Beshir (2010) examine the determinants of Kenya's export volume by disaggregating total export of goods and services in to three categories: traditional agricultural exports(tea and coffee) and other export of goods and services using an error correction model. For each of the three categories of exports, they specified an empirical model along the standard trade models that incorporate real exchange rate (proxy for relative price) and found that supply response for real exchange rate depreciation is significant.

An empirical study by Kandiero and Randa (2004) shows that a 1% depreciation of the real effective exchange rate will lead to about a 2 percent increase in SSA agricultural export shares. A deliberate and a conscious policy decision to depreciate any SSA's currency in an environment of low inflation will make that country's exports, not only agricultural, to be more competitive in the world market.

Institutional quality is another major supply side constraint for agricultural export of the region. The impact of institutional quality on export of primary commodities is likely differing from its effect on manufactured exports. Endowment of natural resources may create natural rents that are usually controlled by administration and generate corrupt competition over their distribution as Ades and di Tella (1999) as cited in Meon and Sekkat,(2006) suggests. In such context, export of primary products may be positively rather than negatively associated with lack of institutional quality. The existence of weak and inefficient institutions could be a limiting factor in the ability of firms to take the advantage of new trading opportunities in low-income developing countries. This is because entrepreneurs are likely to face difficulties moving in to non- traditional exports if there exists ill-defined property rights, have problems in enforcing contracts, lacked access to adequate financing and if they have problems in meeting health and safety standard in foreign markets (Babatunde, 2009; Biggs, 2007). The measure

of institutional quality (risk of expropriation) has a positive and statistically significant effect on export performance, consistent with an important role for the protection of property rights in determining countries ability to export (Redding and Venables,2003). Apart from the direct effect, institutions may also indirectly affect trade through their impact on other variables that determine trade flows like investment and productivity (Méon and Sekkat, 2006).

According to Carmingani and Chowdhury (2007) the key to the SSA specific curse appears to lie in the interaction between institutions and primary commodities (i.e. institutional constraints in the region were found to be the major constraining factors for poor performance of export of primary commodities).

Foreign Direct Investment(FDI) can play a significant role in promoting economic development in low-income countries by serving as a mechanism through which superior technology and managerial know-how are transferred to such countries and to facilitate exporting activities generated by the FDI flows(Oyejide and Ademola,2007).

A study by Staatz and Dembélé (2007) indicates that agriculture's capacity to contribute to growth and poverty alleviation in Africa has been greatly constrained in the past by underinvestment and miss-investment, in both physical and human capital, resulting in a huge cost to Africans in terms of foregone well-being. The underinvestment is reflected in high rates of return to key contributors to agricultural growth such as agricultural research and locally managed irrigation systems .If the motive is to tap export markets by taking advantage of the country's comparative advantage, then FDI may contribute to export growth. Thus, whether FDI contributes to export growth or not depends on the nature of the policy regime.

Helleiner's (2002) as cited in Bacchetta (2007) studies African countries in work also show that FDI has not as yet made a particularly important contribution to African non-traditional export expansion. Oyejide (2007) investigated the critical of African investment codes which place heavy reliance on fiscal and other incentives which may be largely ineffective in attracting FDI and are at the same time quite costly in terms of lost revenue.

Apart from the above supply side factors, the size of importing and exporting countries and degree of openness of the countries determines the export of primary commodities. The size of

the exporting and the importing countries are basic determinants in explaining exports. Generally, countries are expected to trade more as they increase in size. The size of the economy can either be measured by the two variables of population or the GDPs. The GDP of the domestic country is believed to reflect the capacity to supply exporting goods.

Babatunde (2009) empirically evaluates the effect of productive capacity (proxy by GDP of SSA countries) on its export by using both random and fixed effect regression of export supply model. The result reveals that GDP has highly significant positive impact on export volumes and export volumes appear to be lower when manufacturing share in GDP is higher.

According to Kristjánsdóttir (2008) when the export and recipient country variable coefficients are considered specifically, what is noteworthy is that the recipient country coefficients are estimated to be significant. The positive significant coefficient of the recipient country GDP implies increased demand for exports as trading country economic size increases i.e. Exports increase with per capita income of the recipient country. While the export country population is also expected to have positive effects on exports, since the export country is expected to be able to supply more as the population grows in size. His empirical study indicates that1percentage increase in recipient country GDP can be expected to raise exports by about 3.56%, given everything else equal. The study indirectly shows that Africa's marginalization in world trade is primarily due to the continent's lagging performance in terms of output growth.

Traditionally, economists have argued that economies that are more open grow faster. This idea was largely based on the argument that openness improves resource allocation. However, realizing that in models of international trade opening up generates a static improvement in output but does not generate additional growth economists looked for other arguments. Theoretical models and macroeconomic, mainly cross-sectional, empirical evidence so far failed to provide a definite and positive answer to the question of the linkage between trade and growth (Bacchetta, 2007).

According to Rodrik (1997) high levels of trade restrictions have been an important obstacle to exports, and their reduction can be expected to result in significantly improved trade performance in the region. The removal of export restrictions, dismantling

of marketing boards, relaxation of quantitative restrictions on imports, and lowering of import tariffs will sharply increase traditional and non-traditional exports. Country size (as measured by population) and per capita income are two very strong determinants of openness in the economy. The study also indicates that too much focus on "outward orientation" and "openness" can even be counterproductive if it diverts policymakers' attention away from the fundamentals of long-term growth, human resources, physical infrastructure; macroeconomic stability and treats trade rather than per capita income as a yardstick of success.

The estimated coefficient on SSA regarding openness is small (and positive) and statistically in significant. Above all, in many Sub-Saharan countries more open trade policies can be expected to improve incomes in the rural sector, where poverty is concentrated. To what extent this expectation has been borne out in practice and is likely to be borne out in future cases of reform is a question that deserves further study i.e. the effect of openness on exports of LDCs is ambiguous.

Moreover, concentration of SSA countries on few primary and similar commodities negatively affects the export performance of the region and makes the region's export products less competitive in the international market. A study by Morrissey and Mold (2010) indicates that the basic problem is not that Africa trades too little, or that the trade regime is excessively closed– rather that it is trading the wrong kind of products: primary commodities with low value added, low prices and a very low elasticity of demand on world markets. The study also shows that SSA countries have been particularly vulnerable to the problems associated with the 'fallacy of composition' – the idea that if a number of developing countries simultaneously try to increase exports in a similar range of product categories, then they may all end up losing through insufficient foreign demand and depressed international prices.

2.2.3 Demand Side Factors Affecting Agricultural Export in East African Countries

On the demand side anti export biases against the commodities of east African countries in terms of tariff , Non-Tariff and technical barriers determines the degree of market access and hence volume of export in region. Tariffs and other price-based border measures are restrictions that are imposed in order to inhibit the access of certain commodities and also for raising of revenue. They include import duties, export duties, tariff quotas, levies and

charges, and other border duties. While Non-tariff border measures are restrictions involve non-price measures, such as, quantitative restrictions (import quotas, direct prohibitions, domestic content requirements, licensing); contingency measures (antidumping, countervailing, and safeguard measure); technical barriers to trade (TBT) (technical regulations, standards, testing and certification procedures); sanitary and phytosanitary measures (SPS) (for food, animal and plant health and safety) (Kareem,2009).

According to (Biggs, 2007) the world trade system has become more development-friendly in the 1990s, but it is still unwelcoming to the exports of low- income countries. Tariffs and quota arrangements of developed countries especially for agricultural products undermine incentives in low-income countries to move in to higher productivity, nontraditional export.

Paiva (2008) empirically analyses the effect of demand side policies on export of agricultural products of SSA by using the data set that covers bilateral trade in agricultural goods for 152 countries over the periods1990-1993 and 1999-2002. The estimation support claims that protectionism and distortive subsidies to agriculture remain widespread among industrialized nations, which are shown to import fewer and export more agricultural products than expected given other economic, political and geographic determinants of trade. Besides importing fewer agricultural goods than predicted, rich countries tend to import a larger share of agricultural product goods from other rich countries.

The Organization of Economic Cooperation and Development (OECD), which is mainly a collection of countries that are developed, have its share of support in its different sectors. In this aspect the agricultural sector remains the greatest beneficiary of the support. From 1986 to 2005, the annual production support estimate amounted to USD 254 billion for the whole of OECD member countries .This amount is approximately 36 percent of the average annual production for the same period. Out of this production support estimate 70 percent of it is market price support for producers. The average producer support estimate accounted for 42 percent of the total value of production from 1986-1989.It then declined to 36 percent in the 90s and further to 34 percent from 2000-2005. However, the amount of producer support estimates remain more than one third of the value of production implying the support will significantly affect the market price of agricultural products in the world market (Gibbs, 2007).

Tokarik (2005) has assessed the impact of removing agricultural support from OECD using both partial and general equilibrium analysis. In the partial equilibrium analysis the study shows the impact of removing two types of supports; market price support and complete liberalization. As it is expected the removal of support results in the increase in international prices of commodities. Result from the general equilibrium analysis reveals that multilateral liberalization by both the OECD and developing countries would increase the global income by USD 128 billion or 0.4 percent of world GDP.

Despite most-favored nation (MFN) status and in some instances preferential tariffs, many products of trade interest to African countries continue to be subject to tariffs in excess of 100 percent in developed countries. Kandiero and Randa (2004) find that agricultural support to OECD farmers and standards and technical barriers have a statistically significant negative impact on east African agricultural export share. A 10 % reduction on the tariff that the OECD levies on east African agricultural exports will increase SSA exports share by 11 %. This is a very important result as it supports the argument that east African agricultural exports are very sensitive to industrialized countries' tariff rates and any reduction in the tariff rates will significantly increase Africa's exports competitiveness in the foreign markets. Their finding also shows that reduction in agricultural support to OECD farmers by 10 % will increase the African share of exports to those markets by about 6%. Moreover, the researchers find some evidence that a relaxation of standards and technical barriers will lead to an increase in agricultural exports share. Their empirical assessment indicates a 10 % reduction of standards and technical barriers will increase African export share by about 20 %.

Using the World Bank Technical Barriers to Trade database consisting of data of 619 firms from 17 developing countries from five regions described in Wilson and Otsuki (2004) as cited in Ignacio (2007) examine the impact of standards and technical regulations on a firm’s export propensity (measured with overall market share) and market diversification (measured with number of export markets). The variables which most affect adversely a firm’s propensity to export are testing procedures (reduced exports by 9 %), difficulty in getting information (18 %) and greater inspection time (3 %).Another finding implies that varying standards across different markets cause diseconomy of scale and reduce the likelihood of firms entering more than three markets.

Apart from the Non-Tariff Barriers(NTB) imposed by OECD countries, the tariff barriers levied by major trading partners of east African region such as EU, USA, Japan and China on agricultural exports hinders the move towards achieving better export performance and hence economic growth of the region. In the EU, agricultural imports face higher tariffs than non-agricultural products. The simple average MFN applied tariff ratio for agriculture is 15.1% as against the applied 4% for non-agriculture in 2006. Also, non-agricultural goods imports accounted for over 94% of the total imports in EU, leaving agriculture with less than 6%. Similarly, 90% of Japan's imports were non-agricultural commodities with little tariffs imposed, compared to that of agriculture where the tariffs are at peak in the same period. However, United States of America had the lowest tariffs imposed on agricultural products with an average of less than 6%. Despite the seemingly reduction in agricultural products tariffs in the United States, agriculture accounts for a very low percentage of their imports, and this is less than 5%. Further, analysis shows that China imposed about 16% simple average MFN applied tariff rate on agricultural commodities that Africa has comparative advantage in and 9% on non-agricultural goods in 2006(Kareem,2009).

A study undertaken by IMF and WB (2001), shows that tariff peaks and escalation in sensitive products (textiles and clothing, agriculture, food products, wood products, and pulp and paper) disproportionately affect the products exported by developing countries and which inhibit the diversification of exports toward higher value-added products. So, developing countries potentially have a lot to gain from global trade reform. Recent estimates are that developing country income would be some 0.8 percent higher by 2015 than it otherwise would be if all merchandise trade barriers and agricultural subsidies were removed between 2005 and 2010, with about two-thirds of the total gain coming from agricultural trade and subsidy reform (WB, 2007).

The exported commodities from the east African countries fall under different market access programs: Most-Favored Nation (MFN), the Generalized System of Preferences (GSP); GSP for Least Developing Countries (GSP-LDC), and the AGOA program. The GSP program is important because it grants preferences to a wide range of qualifying developing countries around the world- the rule for eligibility is typically set by an income threshold. Romalis, (2003) as cited in Frazer and Biesebroeck (2007) finds that GDP

growth rate and trade volume of countries most affected by the establishment of the GSP increased significantly.

AGOA provides preferential access to U.S. markets for eligible products from designated countries of east African countries as well as improved access to US credit and technical expertise. The program also establishes a high-level dialogue on trade and investment between the U.S .and SSA countries via a U.S.-Sub-Saharan Africa Trade and Economic Forum. The success of the program in promoting export growth in the region depends on how compatible the commodities are under AGOA with the export profiles of countries in the region and how responsive countries are in taking advantage of the opportunities. This in turn depends on the AGOA program incentives and the flexibility in the economic structures in different countries to transmit the incentives to producers of exported commodities (Shapouri and Trueblood, 2003; Frazer and Biesebroeck, 2007).

Gbadebo. O, (2007) as cited in Beshir (2010) modeled Africa's agricultural exports to the United States. In doing so, he used a dynamic econometric model-Vector autoregressive Analysis- that helps to look at both the short-run and long- run effects of income and price changes. The overall result for the estimated demand functions for agricultural commodities covered by the study suggests that there is a statistically significant demand response to income changes in the US. For the combined commodity exports of the region, the trade weighted average income elasticity of export demand by the US is equal to -3.5 and -5.7 in the short-run and in the long – run respectively. The results also demonstrated the in elastic nature of price responses in the US demand for the east African agricultural exports. The relative price (export price per US domestic price) movements affect significantly the trade flow of agricultural commodities, implying that exporter's market share has been influenced by price competitiveness. The short-run relative price elasticity of demand range from -0.4 to -0.6 and the long run elasticity from -1.2 to -7.5. Finally, the author concluded that, trade policy measures in the form of tariff and non-tariff barriers are not very significant in changing the quantity of SSA agricultural exports to US.

All the above reviewed literatures reiterated that the dismal trend of EAC agricultural export over a long period of time is mainly caused by two major important factors: supply side and demand side factors. The studies in common shows that the low GDP per capita growth ;

poor physical infrastructural development and trade facilitation services; overvalued exchange rate; and Africa's dependence over few varieties of primary commodities which are price inelastic predominantly deteriorates the trade performance of African countries. The export of Africa in general and agricultural export of east African countries in particular, according to the studies, lags behind the rest of the world because of these constraining factors. Moreover, the market access condition that has been determined by the trade policy of the major trading partners of Africa erodes the trade performance of the region.

The reviewed literatures theoretically and empirically supports the claim that protectionism and distortive trade policies on agricultural export of East African countries remain widespread among industrialized nations, which are shown to import fewer agricultural products. One can learn from the above studies that the long lasting problem of east African countries agricultural export is related to not only the domestic or supply side factors but also the market access condition and trade policy of the trading partners. Therefore, identifying the most important factors that significantly determines the agricultural export of east African countries to take remedial policy measures requires further investigation. These studies mainly focus on analyzing the relative importance of supply and demand side factors to come up with clear empirical finding indicating the factor, which is crucial in determining the regions' agricultural export performance.

Even if different authors were conducted a research on the factors that affect agricultural commodity export in East African countries none of the empirical works have been done on the effect of climate change on primary commodity export using recent data and econometric panel data analysis in East African countries.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Data Source and Description

3.1.1 Source of Data

For the purpose of analyzing the export sector of the region, secondary data source was used. In line with the variables of interest, the data for different macroeconomic indicators is collected from different sources. The sources include world development indicator, UNCOMTRADE and UNCTAD trade statistics is chosen to get the most recent and highly disaggregated data on current export value of primary commodity. Thus, the data would be compiled from these sources depending on the variable of interest and availability. The data is going to have a panel form (over time across countries).

3.1.2 Explanation of Variables

The dependent Variable, AGRIEXit (million US Dollar) is the total Agricultural Product export of some East African countries for the period 2000-2018.

I. Real GDP of the exporting country (RGDPit): The GDP of the domestic economy is believed to reflect the capacity to supply exporting goods. A high level of GDP indicates a high level of production in exporting country and can be interpreted as a proxy for the range of product varieties available, which increases the availability of exports. We therefore, expect the coefficient of exporting countries GDP to be positive.

II. GDP Per Capita of the importing country (GDPCAPjt): The importer's GDP represents potential demand for imports or the effect of the level of development of importing countries on agricultural export of East African countries. A high level of per capital GDP/income in the importing country suggests high imports. The variable is expected to have a positive sign, referring that higher per capita GDP of major trading partners/importing countries leads to higher import demand which enhances total GDP of exporting country this leads to increase overall agricultural export of East African

countries. Therefore, the coefficient of the exporting country per capita GDP is expected to be positive.

III. Real Effective Exchange Rate (REERit): It is a trade –weighted geometric average of the level of consumer prices in home country relative to that in its trading partners. We use the real effective exchange rate to capture appropriate incentives for exports, which may trigger supply response. The CPI based REER index, for country i, is defined by the IMF as:

$$REER_i = \pi_{j \neq i} \left(\frac{e_i}{e_j} \frac{p_i}{p_j} \right)^{w_{ij}}$$

Where ei= index of nominal exchange rate of country i in US dollar

ej= index of nominal exchange rate of country j in US dollar

pi =index of consumer prices of country i

pj=index of consumer prices of country j

wij= trade weight assigned to partner j by country i

Trade weights reflect relative importance of bilateral trade as well as competition in the third market. The evolution of the real exchange rate determines the competitiveness of a country's commodities in the international market, thus profitability. By nature of its construction, an increase in the REER index represents real appreciation since e is calculated in terms US dollars per unit of local currency. The real appreciation would make Africa's agricultural exports less competitive in the world market and hence decreases total agricultural exports. The decrease in the REER index represents real depreciation which would make Africa's agricultural exports more competitive in the world market and hence, total agricultural export increases. We, therefore, expect the coefficient of REER to be negative.

IV. Openness (TROPENNit): The simple measure of trade policy reform is the ratio of export (X) plus import (M) to GDP, often referred to as measure of openness or trade dependence index but more appropriately considered as a trade volume measure. As a country with a less restrictive trade policy is more open to trade, it could be expected to have a larger trade volume relative to countries with restrictive trade policies. The trade openness of a nation show how much country is participating in the international trade. The more open a country is to the international world, better export promotion policies will be

conducted leading increment of total agricultural export. We therefore, expect the coefficient of openness is to be positive.

V. Foreign Direct Investment (FDIit): experessed as a (% GDP). Following the liberalization processes that began in early 1990s, east African countries opened their markets and have been encouraging foreign investment in abroad range of sectors including agriculture (Kumar and Pradhan, 2002). FDI is supposed to be one of the major determinants of export performance in developing countries since it helps to diversify the export structure. Therefore, the expected sign for the coefficient of FDI is positive implying that increase in flow of FDI enhances the volume of agricultural export.

VI. Export Diversification Index (EXDIVERSit): Conceptually, the definition is derived from the way diversification is measured. We prefer to use the concentration indices to measure the extent to which country's export is diversified. The concentration indices measure whether majority of country's export earnings comes from small range of export products (indication of export concentration) or the source of export earnings are more evenly spread across a given range of export goods (indication of export diversification). Export can grow at the intensive (the growth in the value of existing products) and extensive margin (the increase in the number of export lines). Accordingly, export diversification can be captured along the margins: a more evenly spread of the export basket is an indication of diversification at the intensive margin, while the greater number of export lines indicate diversification at the extensive margin (Cadot et al., 2011). While definition of intensive margin is similar in majority of studies, different authors define extensive margin differently. In our definition, extensive margin is, as in Melitz (2003), new product margin. Besides, the literature argue that diversification of exports on the extensive margin could be achieved along geographic dimension (when a product, either the existing or a new one, is exported to new markets) and along quality dimension (by improving the quality of existing products). Such measures of geographic diversification at the extensive margin can be found in Breton and New farmer (2007), Amurgo-Pacheco and Pierola (2007) and some others. It is not uncommon in empirical studies that export diversification is identified as extensive margin. Diversification on the intensive margin of export growth is not investigated much in the literature. In that sense, our focus on factors that affects diversification at the intensive margin is the novelty

in this literature. Greater diversification of the productive structure would imply, ceteris paribus, more higher value added activities especially for those east African countries dedicated to the export of agricultural commodities, and adds more to the volume of exports. The expectation here is that more diversified economies should expect a stronger export performance. Therefore, the sign of the coefficient is expected to be positive.

VII. Agricultural Inputs (FERTINPUT it): The level of agricultural input, which is proxide by fertilizer consumption per hectare of arable land, in this study, is an important determinant factor for the volume of the agricultural export in Eastern Africa. The higher the fertilizer consumption per hectare of arable land the higher will be the level of agricultural production and hence the total agricultural export. Then we expect the coefficient of this variable, to be positive.

VIII. Landlockdness (LANDL it): The essence of the variable is to capture if being a land locked economy can adversely affect export growth. The dummy variable takes the value of zero if the country is a land locked country one otherwise. The dummy variable reveals being a land locked country adds significantly to the cost of trading internationally or can adversely affect the performance of merchandise export. Therefore, the sign of the variable LANDL is expected to be positive referring that the volume of agricultural export is low if the country is land locked.

IX. Climate Change (RAINFALL it): is the long-term alteration of temperature and typical weather patterns in a place. Climate change could refer to a particular location or the planet as a whole. Climate change may cause weather patterns to be less predictable. These unexpected weather patterns can make it difficult to maintain and grow crops in regions that rely on farming because expected temperature and rainfall levels can no longer be relied on. Climate change has also been connected with other damaging weather events such as more frequent and more intense hurricanes, floods, downpours, and winter storms. The expected sign of climate change negative.

Table 3.1 Detail names of the acronym variables

Acronyms	Detail names of the acronym variables
RGDP	Real GDP of the exporting country
USGDP	GDP Per Capita of the importing country(United States)
REER	Real Effective Exchange Rate
TROPENN	Trade Openness
FDI	Foreign Direct Investment
EXDIVERS	Export Diversification Index
FERTINPUT	Agricultural Inputs (fertilizer consumption per hectare of arable land)
RAINFALL	Climate Change (rainfall)
AGRIEX	Agricultural Product export of some East African countries

3.1.3 Descriptive Analysis

Descriptive statistics are statistics that quantitatively describe or summarize features of a collection of information with the help of measures of central tendency and measures of variability or dispersion. Measures of central tendency include the mean, median and mode, while measures of variability include the standard deviation (or variance), the minimum and maximum values. Thus, the second objective of this seminar would be described using the descriptive analysis.

3.2 Econometric Model and Model Specification

Various methodologies exist as a tool for analyzing the factors that affect the export performance of the region. These approaches include structural and nonstructural econometric models, mathematical programming models, and conceptual models. Structural econometric models can be distinguished from nonstructural models by their explicit effort to capture the effects of intervention, either in terms of parameters or in terms of variables. Nonstructural models on the other hand analyze the statistical properties of the data to answer questions that can be resolved by utilizing the data (Cooley and LeRoy, 1985). The most common non-structural model is vector auto-regressive (VAR) time series model. In contrast, the relationship between the variables of interest is defined based on theoretical foundation of the export of primary commodity as deployed in Goldstein and Khan (1978). Based on this theoretical foundation, structural econometric models are constructed to identify the factors that determine the export performance.

To do so, by selecting a panel of some selected East African countries (preferably, for those having the relevant data on the export of primary commodity export), The model would be augmented with variables which are expected to explain the factors that influence the sector's performance within a panel framework. The time span for the analysis ranges from 2000-2018. Owing to endoginity problem which is created in specifying the model within the dynamic framework and the simultaneous nature of the model, an appropriate estimation procedure is chosen which takes into account these problems.

The method used in this paper coincide with Paiva (2008) and Goldstein and Khan (1978) model. They have used a panel data approach to study determinants of economic growth. Accordingly, in this research paper a linear panel data regression analysis model was used. The choice of the panel data is, because the data used requires panel data techniques and this model has several advantages such as its ability to take in to account the heterogeneity of each country, influence of unobservable features and multi co linearity among the variables assigned. The fixed effect (FE) and random effect (RE) estimators are designed to handle the systematic tendency of $\mu_{it}$to be higher for some countries or individuals than for others (individual effects) and possibly higher for some time periods than for others (time effects). If the unobserved individual heterogeneity and time effect are assumed to be uncorrelated with the included variables, the random effects model yields a consistent and efficient estimator (Greene,2003; Wooldridge, 2005).

3.3 Linear Panel Data Model

To determine the relation between agricultural export of east African countries, supply side macroeconomic variables and other demand side variable, in this study the fixed effects model and the random effects model which are the most common linear panel data analysis models were used. AGRIEX is modeled as a function of eight factors.

The general model of this study was

AGRIEX=f (RGDP, USGDP, REER, TROPENN, FDI, EXDIVERS, FERTINPUT, RAINFALL)

Where RGDP is Real GDP of the exporting country, USGDP is GDP Per Capita of the importing country(United States), REER is Real Effective Exchange Rate, TROPENN is Trade

Openness, FDI is Foreign Direct Investment, EXDIVERS is Export Diversification Index, FERTINPUT is Agricultural Inputs (fertilizer consumption per hectare of arable land), RAINFALL is Climate Change (rainfall), AGRIEX is Agricultural Product export of some East African countries

The fixed effects model is given as:

$$AGRIEX_{it} = \alpha_i + \beta_1 USGDP_{it} + \beta_2 FERTINPIUT_{it} + \beta_3 EXDIVER_{it} + \beta_4 FDI_{it} + \beta_5 REER_{it} + \beta_6 TROPENN_{it} + \beta_7 GDPEX_{it} + \beta_8 RAINFALL_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots (1)$$

In addition, the random effect model is provided as:

$$AGRIEX_{it} = \alpha_i + \beta_1 USGDP_{it} + \beta_2 FERTINPIUT_{it} + \beta_3 EXDIVER_{it} + \beta_4 FDI_{it} + \beta_5 REER_{it} + \beta_6 TROPENN_{it} + \beta_7 GDPEX_{it} + \beta_8 RAINFALL_{it} + \varepsilon_{it} + \mu_i \ldots\ldots\ldots (2)$$

$Wher, \mu_i$ Is random effect of the country i, and for $\mathcal{E}_{it} + \mu_i = \gamma_{it}$ the model is given as:

$$AGRIEX_{it} = \alpha_i + \beta_1 USGDP_{it} + \beta_2 FERTINPIUT_{it} + \beta_3 EXDIVER_{it} + \beta_4 FDI_{it} + \beta_5 REER_{it} + \beta_6 TROPENN_{it} + \beta_7 GDPEX_{it} + \beta_8 RAINFALL_{it} + \gamma_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where γ_{it} is a composite of error term.

Transforming fixed effect model equation (1) into log-linearized form

$$lnagriex_{it} = \alpha_i + \beta_1 lnusgdp_{it} + \beta_2 lnfertinput_{it} + \beta_3 lnexpdiver_{it} + \beta_4 lnfdi_{it} + \beta_5 lnreer_{it} + \beta_6 lntradopnn_{it} + \beta_7 lngdpex_{it} + \beta_8 lnrainfall_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where RGDP, USGDP, REER, TROPENN, FDI, EXDIVERS, FERTINPUT and RAINFALL are, explained in general model specification α_i is intercept, β_t is coefficient of explanatory variable I indicate within individual and t indicates time, ln is log of explanatory variable and ε_{it} is error term.

Summing up, the random effects estimator and fixed effects estimator, both are models designed to handle the specific structure of panel data. That is, unobservable individual heterogeneity is taken in to account by both models. The difference between the two models is whether the individual specific time invariant effects are correlated with the repressors or not. Moreover, given that the random effects model is valid, the fixed effects estimator still produces consistent estimates of the identifiable parameters.

As it often might be unlikely to believe that the individual specific effects are uncorrelated with the relevant covariates, it is appealing to prefer the fixed effect estimator to the random effects estimator.

Determinant of agricultural product export of East African country the study can be expressed using the general form of linear panel regression model as specified bellow:

$agriex_{it=}x'_{it}\beta+\mu_{it}$ i=1, 2,…,N t=1,2,….,T…1)

Where, uit =μit + εit The vector β is a constant vector of parameters; μit denotes the unobservable individual specific effects which are time invariant. It Accounts for any individual specific effects not included in X; i subscript denotes is a scalar the cross-section dimension and t denotes the time series dimension, εit is the usual error component which is assumed to be IID~(0,σ2) (Baltagi, 2005).

AGRIEXit represents Total Agricultural Product Export of East African country i at period t (in million USD).
Xit represents a vector of (logs of) the following explanatory variables:
GDPit= GDP (billion USD) of the exporting a countries at time t,
GDPIMjt= GDP (bil. USD) of major trading partners j (US and China) at time t,
REERit=Real Effective Exchange Rate expressed (% GDP) of a country i at time t,
TROPENNit= Openneness (ratio of Export +Import/GDP) at time t,
FDIit=FDI inflow (%GDP) of country i at time t,
EXDIVRSjt= Export Diversification Index of a country i at time t,
FERTINPUTit=Agricultural Input of a country at time t,
LANDL dummy= land lockedness of country I. It is dummy takes value 0 if the country is land locked 1, otherwise 0
RAINFALLit=Rainfall of a country I at time t.

3.4 Specification Test

Before proceeding to inferential statistics/multiple regression analysis, classical linear regression model (CLRM) assumptions and model selection tests were conducted in order to check whether the data and the model fit with CLRM assumptions. Among those tests Shapiro Wilk test for the

residual were used for testing normal distribution of the error term. Multicollinearity test was also conducted using Pearson correlation matrix for identifying relationship between independent variables. Heteroskedasticity test for varying nature of the error variance and autocorrelation test for correlation between the error variance was also conducted using modified Wald test for heteroskedasticity and Wooldridge test for autocorrelation respectively. Link test was also used for model specification test.

Moreover, in order to choose the suitable econometric model the researcher used the most acceptable specification test. Therefore, in this regard, the specification test helps to determine which of the two models (fixed effect or random effect model) is best fit with our model. Hence, in this paper Hausman test was used.

3.4.1 Hausman Specification Test

The Hausman test (1978) can be used in many econometric problems requiring specification. In the case of this paper, the tested hypothesis provides guidance accepted way of choosing between fixed and random effects.

In this test, Ho=the suite model is random effects model

Hl= the suite model is fixed effects model, are hypothesized.

The result from this test led to either reject the null hypothesis and accept the alternative hypothesis about existing of fixed effects or accept the null hypothesis and reject the alternative hypothesis.

To examine the determinants of Agricultural product export of some East African countries entails employing the panel data. Fixed effects estimation technique is employ as a method of data analysis. Using panel technique over time series analysis is due to its advantage that panel technique has the ability to control the individual heterogeneity and measure the effects that are simply not detectable in pure time series data. Additionally, panel technique allows us to construct and test more complicated models than in time series (Marno, 2004; Baltagi, 2005), and it is considered to be more informative as compared to time series data. Panel technique variables are less collinear than in time series, as such, panel technique has more degree of freedom and it is more efficient than time series data (Marno, 2004).

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

Results from the estimation of the effects of climate change on agricultural product export on east African countries are presented in this chapter. The empirical analysis uses annual data on 12 East Africa countries for 19-year period (2000-2018). There are five sections under this chapter. The first section presents descriptive statistics of variables used in the model whilst the second section reports the outcome of diagnostic tests conducted. Results from the estimated model are present and discussed in the third section. In the fourth section of this study, discuss additional regression by export destination result. The last section concludes the chapter.

4.1 Summary Statistics and Description

The descriptive statistics considered the mean, standard deviation, maximum and minimum values of the dependent and independent variables. The statistics are based on 12 East Africa countries out of the total of 18 countries in the region due to the unavailability of data for some countries in relevant variables. The mean represents the average value of the variables whilst standard deviation indicates how variables are distributed around their mean values. Table 4.1 shows the descriptive statistics of the variables.

The real GDP for 12 east Africa countries used in the empirical analysis averaged 15,627.07 million us dollar between 2000 and 2018 ranging from 595.48 million us dollar for Burundi in 2003 to 87,905.68 million us dollar for Kenya in 2018 with a standard deviation statistics of 17,055.62 million us dollar . This variation among countries in the region may be because of occurrences in domestic and external factors such as continuous deterioration in terms of trade, falling commodity prices, global economic downturn and financial crisis in the international economies.

The real GDP of major exporting partner United States used in the empirical analysis averaged 7,684,122 million us dollars between 2000 and 2018 ranging from 4,453,508 million us dollars to 9,431,125 million us dollars with a standard deviation statistics of 1,639,156 million us dollar.

The level of fertilizer input use per hectare in the region remains high averaging 58.05 tones for the period 2000 to 2018. The minimum level of agricultural input per hectare stood at 0 .0836358 tone for Rwanda in 2010 whilst the maximum value recorded at 835.56 tones for Seychelles 2018, with a standard deviation statistics of 126.48 tones.

Openness is measured by the sum of exports and imports value dividing by Gross domestic product. In addition, the mean value of this variable is 3329.92 million us dollar for the period 2000 to 2018. The minimum and maximum value for this variable are ranging from 38.53 million us dollars for Burundi in 2002 to 11588.91 for Kenya in 2018 respectively. The variation from the mean is 2940.89 million us dollar. In the region, the value of imports always greater than the value exports and this leads to the current account balance deficit in the region.

The summary statistics showed that FDI for the period 2000 to 2018 stood at an average of 612.43 million us dollar with a standard deviation of 944.00 million us dollar. Additionally, in the same period, the minimum and the maximum value ranging from negative -25.64 million us dollar to 6175.13 million us dollar for Mauritius in 2001 and Mozambique in 2013 respectively.

The summary statistics showed that climate change (rainfall) for the period 2000 to 2018 stood at an average of 91.86 ml per hectare with a standard deviation of 30.46 ml. Additionally, in the same period, the minimum and the maximum value ranging from 32.55 ml to 180.6 ml for Zimbabwe in 2015 and Mauritius in 2015 respectively.

As per table 4.1, the average values of export diversification is 129.85 million us dollar a group of countries considered under the study from 2000 to 2018. In the same period, the minimum value of exports diversification recorded is 13 million us dollar for Burundi in 2000 & 2002 whilst the maximum value is recorded at 240 million us dollar for Kenya in 2011, 2014, 2015.

Table 4.1: Summary Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
GDP exporting country	228	15,627	17,056	595.5	87,906
Trade openness	228	3,330	2,941	38.53	11,589
Real effective exchange rate	228	110.4	20.64	65.84	188.7
FDI inflow	228	612.4	944.0	-25.64	6,175
Export diversification	228	129.9	62.99	13	240
Fertilizer input	228	58.05	126.5	0.0836	835.6
Rainfall	228	91.86	30.46	32.55	180.6
Agricultural export	228	6.103	5.554	1.21e-06	25.86
GDP per capita of US	228	7.684e+06	1.639e+06	4.454e+06	9.431e+06

Source: Author's calculations from the WDI, UNCOMTRAD and UNCTAD (2019)

As per table 4.1, the average agricultural export as a percentage of GDP is 6.10 million us dollars from the period 2000 to 2018. The ratio is ranging from a minimum value at 0.01 million us dollar for Seychelles in 2015 to the maximum value at 25.86 million us dollar for Ethiopia in 2003. The standard deviation of the variable is 5.55 million us dollar.

The average value of the real effective exchange rate is 110.39 for the period 2000 to 2018. The minimum and maximum value for this variable is ranging from 65.84 for Seychelles in 2011 to 188.67 for Kenya in 2018 respectively. The variation from the mean is 20.64.

4.2 Hausman Specification Test

To decide between fixed or random affects you can run a Hausman test where the null hypothesis is that the preferred model is random effect vs. the alternative the fixed effects (see Green, 2008, chapter 9). It tests whether the unique errors (ui) are correlated with the regressors, the null hypothesis is they are not.

The specification test devised by Hausman (1978) is used to test for orthogonality of the random effects and the regressors and choose between the random effects and fixed effects model. The test is based on the idea that under the hypothesis of no correlation, both OLS in the fixed effects model and GLS are consistent, but OLS is inefficient, whereas under the alternative,

OLS is consistent, but GLS is not. Therefore, under the null hypothesis, the two estimates should not differ systematically (Greene, 2003). He further explains the Hausman's essential result as follows: "The difference between the efficient estimator and inefficient estimator covariance is must be zero." In this study, the Hausman specification test is used to choose between the fixed effects and the random-effects model. Under the Hausman specification test, the null hypothesis is a difference in coefficients is not systematic while the alternative hypothesis is there is a systematic difference in coefficients. The resulting test statistics of the Hausman specification test (table 4.2) show the p-value is zero implying that we fail to accept the null hypothesis and hence fixed effects are appropriate for this model.

Table 4.2 Hausman model specification test

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lneugdp	4.526538	-2.454366	6.980904	.9663712
lnfertinput	.2899984	-.0734943	.3634928	.
lnexdiver	3.174661	4.432356	-1.257695	.
lnfdi	.4332642	.3772451	.0560191	.
lnreer	-4.504236	1.498809	-6.003045	.8980945
lntropenn	2.214681	-.26359	2.478271	.1678965
lngdpex	4.532801	-1.58969	6.122491	.5933872
lnrainfall	-2.564001	-4.61661	2.05261	.4747802

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

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       49.16
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Source: Author's calculations from the WDI and UNCTADstat(2019) using STATA. Full Hausman test put on view on Appendix 1

4.3 Regression Diagnostics Test Results

To ensure that the data used in the model estimation is appropriate, unit root, normality, multicollinearity, heteroscedasticity, autocorrelation, and cross-section dependency tests are conducted.

4.3.1 Panel Unit Root Test

Testing for unit roots in panel data models is necessary to apply an appropriate estimation technique accordingly. In this study, Levin, Lin, and Chu (LLC) test are used to check the stationarity of the variables in the model. LLC suggested a test for unit root for the panel data model with fixed effects, individual deterministic trends, and heterogeneous serially correlated errors. LLC suggests a more powerful panel unit root test than performing individual unit root tests for each cross-section and the test requires strongly balanced data. The null hypothesis is that each time series contains a unit root against the alternative that each time series is stationary (Baltagi, 2005).The resulting LLC test statistics (Annex 4) show that we reject the null hypothesis of the variables non Stationarity or presence of panel unit root. In this study, the Stationarity of variables such as FDI inflow is not tested due to the absence of strongly balanced data.

4.3.2 Normality Test

The normality assumption plays a crucial role in the validity of inference procedures, specification tests, and forecasting. Non-normal error components in the panel data affect the performance of several tests, like the performance of panel heteroskedasticity tests severely affected Blanchard and Matyas (1996). To check the normality of the disturbance term, this study applied the extended version of the famous Jarque -Bera testes for the panel data model. The test was developed by Galvao et al. (2013) and the test particularly useful for the case where the number of individuals (in our case country), N Less than the number of times (in our case year), T. The tests are constructed based on the moment conditions of within and between residuals. As per (table 4.3), the joint and individual tests for normality in both components of error terms indicated not reject the null hypothesis of normality because the P-value is greater than 5%.

Table 4.3: Normality test

Tests for skewness and kurtosis — Number of obs = 227; Replications = 500

(Replications based on 12 clusters in country1)

	Observed Coef.	Bootstrap Std. Err.	z	P>|z|	Normal-based [95% Conf.	Interval]
Skewness_e	-.8279232	.7378451	-1.12	0.262	-2.274073	.6182267
Kurtosis_e	5.320195	3.222272	1.65	0.099	-.9953427	11.63573
Skewness_u	.0836041	.6967922	0.12	0.904	-1.282084	1.449292
Kurtosis_u	-.8818129	1.251266	-0.70	0.481	-3.334249	1.570623

Joint test for Normality on e: chi2(2) = 3.99 Prob > chi2 = 0.1363

Joint test for Normality on u: chi2(2) = 0.51 Prob > chi2 = 0.7745

Note: standardized coefficients

Source: Author's computation in STATA 14.2

4.3.3 Multicollinearity test

High correlations between explanatory variables may result in multicollinearity problem. If there is multicollinearity in the model, the estimated coefficients possess large standard errors (in relation to the coefficient themselves), which means the coefficients cannot be estimated with great precision or accuracy (Gujarati, 2004). To alleviate this problem one or more of the correlated variables must be dropped from the model (Veerbek, 2000). In this study to check for the presence of Multicollinearity in the model, we have used the variance covariance matrix presented in the (Appendix 3). The result indicates that the correlation coefficient between the explanatory variables is less than 0.8 except the high correlation coefficients between GDP of China with rainfall and real effective exchange rate as a result GDP of trade partner China have high correlation coefficient. Dropping Chinese GDP from the model is used as a remedial measure to correct this multicollinearity problem.

4.3.4 Heteroskedasticity test

The heteroskedasticity assumption states that the variance of the unobservable error (Ui) across observation is constant. If the variance of the error term is not constant is it side to be heteroskedasticity (Wooldridge, 2004). If the presence of heteroskedasticity error terms in the model the regression coefficient, results will consistent estimates but the estimates will

not efficient. The loss of efficiency of the estimates will lead to invalid inference through biased standard error (Gujarati, 2004). In order to check the presence heteroskedasticity in the regression or not, this study used a panel level heteroskedasticity Modified Wald statistic for GroupWise heteroskedasticity in fixed effect model. The null hypothesis of this test was that the error variance was homoskedastic. As shown in table 4.4, the chi-square value was statistically insignificant even at 10 percent level of significance and hence the null hypothesis of constant variance was strictly accepted or did not have the problem of heteroskedasticity.

Table 4.4 hetroskedasticity test

```
. local df=e(N_g)-1

. lrtest hetero homosk,df(216)

Likelihood-ratio test                                 LR chi2(216)=    212.55
(Assumption: homosk nested in hetero)                 Prob > chi2 =    0.5536
```

Source: Author's computation in STATA 14.2

4.3.5 Test for Autocorrelation

The covariance between two consecutive error terms i.e. (Uit,Ujt) we can say that the error term uncorrelated to each other or simply the error terms subject to autocorrelation Verbeek (2000). The classical error component panel data model assumes serially uncorrelated disturbances, where the covariance between error terms over time is zero. If the error terms are correlated with one another, it is said to be they are auto correlated or that they are serially correlated. A number of tests for the presence of autocorrelation in a fixed effects panel data model proposed in the literature. The most common test for autocorrelation includes Durbin-Watson test, Breusch Godfrey test, Wooldridge-Drukker and Baltagi and Li (1995) LM statistic.

In this study used Wooldridge test for autocorrelation in panel data for autocorrelation test in panel data. The null and alternative hypotheses of Wooldridge test for autocorrelation in panel data are no first order autocorrelation and the null hypothesis is not true respectively. The resulting test statistics (table 4.5) shows that the p-value is 0.9576,that is greater than 0.05, so we accept the null hypothesis implying that the data are no first order autocorrelation.

Table 4.5: Autocorrelation test

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      11) =      0.003
           Prob > F =      0.9583
```

Source: Author's computation in STATA 14.2

4.3.6 Cross-Section Dependency Test

Cross-sectional dependence arises because of the presence of common shocks and unobserved components that ultimately become part of the error term. If there is a cross-sectional dependency in the model, the standard fixed effect and random effect estimators are consistent but not efficient, the estimated standard errors are biased Hoyos and Sarafidis(2006). Lagrange multiplier (LM) test, developed by Breusch and Pagan (1980) is widely used in cross-sectional dependency test through the command xttest2 but this test valid for T > N. This study used tests developed by Pesaran (2006) and Friedman(1937), which readily available in the Stata through the Stata command xtcds (Sarafidis et al., 2006). As per table 4.6, Pesaran and Friedman‟s tests do not reject the null hypothesis of cross-sectional independence because of the p-value in both testes more than 0.05. Hence, there is enough evidence suggesting the absence of cross-section dependency in the model.

Table 4.6 cross sectional dependence test

```
. xtcsd,pesaran abs

Pesaran's test of cross sectional independence =    -0.328, Pr = 0.7430
Average absolute value of the off-diagonal elements =     0.271
. xtcsd,friedman

Friedman's test of cross sectional independence =    19.222, Pr = 0.0572
```

Source: Author's computation in STATA 14.2

4.4 Results and Discussion

After analyzing various econometric issues that taken into consideration, the estimation technique results in consistent and unbiased estimates selected. In this study, the fixed effects estimation technique is preferred as the estimation technique yield efficient and consistent results.

As discussed in the literature review, the basic framework for estimating the relation between export performances is affected by demand and supply-side factors. Turning to the actual results in Table 4.7 of all supply-side variables real GDP of exporting countries, export diversification, foreign direct investment and major importing country GDP in our case the United States do have positive and statistically significant coefficients and real effective exchange rate and rainfall have a negative effect and statically significant effect east African country. All interpretations are at a given time for a given countries.

From the estimation, results in table 4.7 The result shows that coefficient of real GDP in exporting country is positive and statistically significant, a 1% increase in exporting country's real GDP will lead to on the average about a 4.5 % increase in total agricultural export supply, other things remaining constant.

As the estimated result indicates the sign of the coefficient of FDI inflow as a percentage of GDP is positive and statistically significant. a 1% increase in FDI, other things remaining constant on the average, leads to a 0.43% increase in total agricultural export. The coefficient of the real effective exchange rate is a negative sign as expected and it is statically significant, 1% real appreciation would make east Africa's agricultural exports less competitive in the world market and hence decreases total agricultural exports by 4.50%. This variable reiterates that depreciating real effective exchange rate does not enhance the competitiveness of the agricultural export of East African countries in the international market. Therefore, the depreciation of the exchange rate is little to do with improving East African country's agricultural export.

Table 4.7: Regression Results under Fixed Effects Estimation Technique

Dependent Variable- Log of Total Agricultural Export, 2000-2018

VARIABLES	(1) Fixed Effects
Ln USGDP	4.527**
	(1.759)
Ln Fertilizer input	0.290
	(0.264)
Ln Export diversification	3.175***
	(1.025)
Ln FDI inflow	0.433**
	(0.188)
Ln Real effective exchange rate	-4.504***
	(1.512)
Ln Trade openness	2.215*
	(1.329)
Ln GDP exporting country	4.533**
	(1.950)
Ln Rainfall	-2.564**
	(1.170)
Constant	-54.25*
	(27.71)
Observations	228
Number of country	12
R-squared	0.599
Country FE	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations from the WDI, UNCOMTRAD, and UNICTAD (2019) using STATA.

As far as the major external/demand side determinants is concerned ,the estimation result indicates that the per capita GDP of US significantly affects agricultural export of the region. The result shows that if a 1% increase in the per capita GDP of US, the major trading partner of east African countries, increases the demand for agricultural products from east African countries by 4.53% (See Table 4.7), other things remaining constant.

The coefficient of Trade openness have expected sign and insignificant result at 5% level of significance but at 10% level of significance the coefficient is statically significant, a 1%

increase in trade openness it leads to increase its agricultural export by 2.21%. The more open a country is to the international world, better export promotion policies conducted leading increment of total agricultural export. Export diversification also have significant and expected sign result 1% increase in export diversification (when a product, either the existing or a new one, is exported to new markets and along quality dimension by improving the quality of existing products or increase in export line), on the average other things remaining constant, leads to increase agricultural export by 3.17%.

In this study, rainfall is a proxy variable that represents climate change. The coefficient of Rainfalls also have significant and expected sign outcome, 1percent change in climate change , other things remaining constant, it leads to on the average agricultural export decline by 2.56 percent.

4.5 Regression Analysis by Export Destination

In this part of the study, estimate exporting country agricultural product by their trade destination. As we know most of African countries, export commodity is agricultural product and those product destinations are with in Africa and abroad. For our purpose, the study selects a foreign country because the largest parts of agricultural row material and agro-processed output supplied to overseas, the study select USA and China for analysis based on recent performance selecting country.

The major export partners of USA (Group1) are Kenya, Mauritius, Malawi, Rwanda, Seychelles and Uganda. On the other side main partners of China (Group 2) are Ethiopia, Burundi, Mozambique, Tanzania, Zimbabwe and Zambia. Based on the above classification we estimate and discuses the result as follows:

Table 4.8 Regression by Export Destination

Dependent variable is value of agricultural product export of Group 1 and Group 2

Independent Variables	Coefficient	p-value	Coefficient	p-value
	Group 1		Group 2	
Lnusgdp	7.18	0.001*	2.4	0.413
Lnfertinput	0.52	0.074***	0.20	0.581
Lnexdiver	0.89	0.568	5.29	0.000*
Lnfdi	0.32	0.134	0.55	0.024**
Lnreer	-1.88	0.376	-2.75	0.164
Lntropenn	-0.49	0.732	-2.30	0.269
Lngdpex	6.94	0.008*	1.62	0.556
Lnrainfall	-4.93	0.002*	-4.25	0.009*
_cons	-89.33	0.004	-0.11	0.998
Number of observation 95			Number of observation 133	
F (8,207) = 8.82			F (8,207) = 9.01	
Prob> F = 0.0000			Prob> F = 0.0000	
R-sq: Within = 0.4625			R-sq: Within = 0.3792	
Between = 0.6298			Between = 0.7088	
Overall = 0.3580			Overall = 0.1208	

*Significant at 1%, ** Significant at 5%, and ***Significant at 10%

Source: Author's calculations from the WDI, UNCOMTRAD and UNCTA Dstat(2019) using STATA. The full regression result put on appendixes6 and 7.

Based on the former overall regression Hausman specification test (Table 4.2) results are used in the study the outcome says the fixed effect is appropriate models. To avoid reiterate the study, earlier post estimation test results are accepted and in this part discuss only outcome of regression result.

The first and second objective of this research was explained based on the result of fixed effect model. Accordingly, from the supply side of Group 1, LnGDPEXPit, LnRAINFALL it, were found to be statistically significant at P<0.01 level and LnFERTINPUT it are statically significant at 10% of level of significance. This result reiterate the importance of the use of agricultural inputs to enhance agricultural productivity and production of high value agricultural products, and hence increase total agricultural export of east African countries. While from the demand side, LnGDPUSA it variables was found to be statistically significant at P<0.01. This implies that a 1 percent increase in LnGDPEXPit and LnGDPUSAit variables, holding constant for other variables, the LnAGREXit to USA changes by 0.94 and 7.18 percent respectively. However, for 1 percent increase in LnRAINFALL it variable, holding constant for other variables, the LnAGREXi decreases by 4.93 percent other tings remains constant.

Turning to the impact of agricultural input use (which in this paper is captured by fertilizer consumption per hectare of arable land). The result suggests that if a 1% increase in the use of agricultural inputs leads to a 0.52% increase in current total agricultural export other things remains constant. This result reiterate the importance of the use of agricultural inputs to enhance agricultural productivity and production of high value agricultural products, and hence increase total agricultural export of east African countries on US major trade partner countries. This positive relationship is also found in (Kandiero and Randa; 2004) but the p-value results shows stasticaly insignificant. Because of the fixed effects, the dummy variable, landlockedness, had to be omitted from the specification.

On the other hand from the supply side of Group 2, LnEXDIVERit and LnRAINFALL it, were found to be statistically significant at 1% level of significance and LnFDIit are statically significant at 5% of level of significance. The result imply that if 1 percent increase in LnEXDIVER it and LnFDI it variable, holding other things remaining constant on the average, the LnAGREX it increases by 0.87 and 0.32 percent respectively. Conversely, 1% increase in LnRANFALL it variable, holding other things remaining constant on the average the variable LnAGREX it decrease by 4.25 percent.

In both overall and two-group regression results, the supply side and demand side have a statically significant effect on agricultural commodity export. The effect of climate change has a negative and significant effect on east African country agricultural commodity export.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Agricultural product exports have a significant contribution to African economy in enhancing the source of foreign currency from the export of semi-processed and raw materials. The major objective of this seminar is to examine the determinants of the East African country's agricultural product export. The central question investigated in this paper is whether the supply side or the external/demand side factors significantly determine the agricultural export performance of East African countries and is climate change has significant effect on agricultural export performance of East African countries. To address this question the study uses the panel data, and due to limitation of data availability, only 12 East African countries and 19 years from 2000-2018 of macroeconomic data were considered. The study uses secondary data collected mainly from WDI (2019), UNCOMTRADE and UNCTAD (2019). Both descriptive and econometric models were employing.

In this study, total agricultural export (in million USD) which is taken as dependent variable and selected supply side factors like , GDP of the exporting country, Real Effective Exchange Rate (REER), Openness to trade (OPENN), Foreign Direct Investment (FDI), Export Diversification Index (DIVER), Land lockedness (LANDLK) and climate change (proxy variable rainfall) were considered. On the other hand from the demand side variables like GDP per capita of the importing country (GDP) of country's trade partners was considered as independent/explanatory variables. Having discussed the various econometric issues that ought to be taken into consideration, the fixed effects model estimation results are preferred as the estimation technique yield consistent and efficient results. After descriptive analysis, all data were transformed in to log before estimation made.

The empirical result obtained in this study indicates that the among the supply side factors, real GDP, FDI and export diversification are found to be statistically significant with their respective expected sign. The significant coefficient of real GDP and FDI shows that high production capacity at a point in time determines the export potential utilization and total supply

of agricultural export for east African countries. Export diversification indicates that greater diversification of the productive structure would imply, ceteris paribus, higher value added activities of a country dedicated to the export of agricultural commodities, and adds more to the volume of exports.

Moreover, the positive and significant coefficient of trade openness indicates the trade openness of a nation show how much country is participating in the international trade. The more open a country is to the international world, better export promotion policies conducted leading increment of total agricultural export. The result also revealed that real effective exchange rate affects agricultural export of east African country positively and have significant coefficient indicates that depreciating the real exchange is great to do with enhancing agricultural export of east African countries. In this study, agricultural input uses have insignificant coefficient.

In this study global climate change represented by a proxy variable, that is rainfall. Arguably, one of the most widespread and potentially devastating impacts of climate change in East Africa alters in the frequency, intensity, and predictability of precipitation. Changes in regional precipitation ultimately affect water availability and may lead to decreased agricultural production and potentially widespread food shortages. The availability of water is fundamental to agriculture. The impact of climate change can occur through three major routes: (1) Drought – a lack of water for a period causing severe physiological stress to plants and animals. (2) Flooding an excess of water for a period causing physiological and direct physical stress to plants and animals; and (3)Timing of water availability – when severe lack or excess of water does not occur but its availability through the year changes to no longer be suitable for current agricultural practices, crops or animals. Climate change has negative effect on export of agricultural products in East African countries.

Regarding the demand side factors per capita GDP of US, the major trading partner of east African countries, positively and significantly affects the agricultural export of the region. This is in line with our expectation that the potential demand of trading partners have positive effect on agricultural export of east African countries.

Lastly, the empirical investigation in this study reiterates that both the supply and demand side factors are equally important in determining the total agricultural export of east African countries. This study also finds that the contribution of climate change to the poor performance of east African country's agricultural export is to be significant.

5.2 Policy Implications

The strong relationship between better export performance and economic growth suggests that countries should identify the important factors that directly and indirectly determine their export performance. In this study, the two major determinants of agricultural export are investigated, supply capacity and demand side factors.

The finding indicates that policymakers should give equal emphasis for demand and supply side determinants of agricultural export, indirectly affects the export potential utilization of east African countries. The positive and significant coefficients of the production capacity, denoted by real GDP, suggests that macroeconomic policy reforms aimed at improving the growth of real GDP enhances the total export supply of east African countries to the rest of the world.

The finding also suggests that governments and policy makers in east African countries should undertake policy reforms on agricultural input utilize like fertilizer to create favorable situation with the intention of improve export-oriented agricultural product to have a comparative advantage from the rest of the world.

Climate change is real and happening now. Moreover, the significant coefficient of climate change (proxy by rainfall) reveals that lowering export performance of the region. The empirical result indicates climate change is a momentous factor that affects adversely agricultural export of east African country. The study advocates that policy maker of east African countries; the government should take a remedial action for climate change problem through set sufficient annual budget to combat the problem with a serious supervise.

Turning to the demand side factors the empirical result reveals that the income elasticity of demand for east African agricultural products is high in market of major trading partners such as US. This shows that east African countries should take this advantage by producing price responsive and internationally competitive agricultural products.

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Appendix's

Appendix 1: Hausman Specification Test

Fixed effect

```
. ***hausman test***
. xtreg lnagriex lnusagdp lnfertinput lnexdiver lnfdi lnreer lntropenn lngdpex
> lnrainfall landl ,fe
note: landl omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       227
Group variable: country1                        Number of groups   =        12

R-sq:  within  = 0.3212                         Obs per group: min =        18
       between = 0.5999                                        avg =      18.9
       overall = 0.2515                                        max =        19

                                                F(8,207)           =     12.24
corr(u_i, Xb)  = -0.8947                        Prob > F           =    0.0000
```

lnagriex	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnusagdp	4.526538	1.759383	2.57	0.011	1.057931	7.995145
lnfertinput	.2899984	.2643607	1.10	0.274	-.2311861	.811183
lnexdiver	3.174661	1.024674	3.10	0.002	1.154526	5.194795
lnfdi	.4332642	.1876308	2.31	0.022	.0633519	.8031764
lnreer	-4.504236	1.511701	-2.98	0.003	-7.48454	-1.523932
lntropenn	2.214681	1.329221	1.67	0.097	-.4058655	4.835228
lngdpex	4.532801	1.950466	2.32	0.021	.6874757	8.378127
lnrainfall	-2.564001	1.169924	-2.19	0.030	-4.870495	-.2575061
landl	0	(omitted)				
_cons	-54.24533	27.71372	-1.96	0.052	-108.8827	.3919959
sigma_u	9.4930492					
sigma_e	2.6809678					
rho	.92613385	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(11, 207) =    26.03                 Prob > F = 0.0000

. estimates store fixed
```

Appendix 2 Random effect model

```
. xtreg lnagriex lnusagdp lnfertinput lnexdiver lnfdi lnreer lntropenn lngdpex
> lnrainfall landl ,re

Random-effects GLS regression                   Number of obs      =       227
Group variable: country1                        Number of groups   =        12

R-sq:  within  = 0.2293                         Obs per group: min =        18
       between = 0.3140                                        avg =      18.9
       overall = 0.2872                                        max =        19

                                                Wald chi2(9)       =     67.61
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

lnagriex	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnusagdp	-2.454366	1.470223	-1.67	0.095	-5.335951	.4272178
lnfertinput	-.0734943	.2678909	-0.27	0.784	-.5985508	.4515622
lnexdiver	4.432356	1.070133	4.14	0.000	2.334933	6.529779
lnfdi	.3772451	.1960107	1.92	0.054	-.0069288	.761419
lnreer	1.498809	1.216004	1.23	0.218	-.884515	3.882133
lntropenn	-.26359	1.318575	-0.20	0.842	-2.847949	2.320769
lngdpex	-1.58969	1.858013	-0.86	0.392	-5.231328	2.051948
lnrainfall	-4.61661	1.069255	-4.32	0.000	-6.712312	-2.520909
landl	4.662123	1.784289	2.61	0.009	1.164981	8.159265
_cons	50.43251	23.68657	2.13	0.033	4.007694	96.85733
sigma_u	2.6551799					
sigma_e	2.6809678					
rho	.49516744	(fraction of variance due to u_i)				

```
. estimates store random
```

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnusagdp	4.526538	-2.454366	6.980904	.9663712
lnfertinput	.2899984	-.0734943	.3634928	.
lnexdiver	3.174661	4.432356	-1.257695	.
lnfdi	.4332642	.3772451	.0560191	.
lnreer	-4.504236	1.498809	-6.003045	.8980945
lntropenn	2.214681	-.26359	2.478271	.1678965
lngdpex	4.532801	-1.58969	6.122491	.5933872
lnrainfall	-2.564001	-4.61661	2.05261	.4747802

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

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       49.16
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

ANNEX 3: Correlation Coefficient Test

```
. corr lnagriex  lnfertinput lnfdi lnreer lntropenn  lngdpex lnrainfall landl lnusagdp lngdpchina
(obs=227)
```

	lnagriex	lnfert~t	lnfdi	lnreer	lntrop~n	lngdpex	lnrain~l	landl	lnusagdp	lngdpc~a
lnagriex	1.0000									
lnfertinput	-0.2505	1.0000								
lnfdi	0.1378	0.1353	1.0000							
lnreer	0.4259	0.0114	0.6784	1.0000						
lntropenn	-0.5519	0.1104	-0.1849	-0.4656	1.0000					
lngdpex	0.2206	-0.1145	0.0317	0.4440	-0.1607	1.0000				
lnrainfall	0.1818	0.3714	0.7926	0.8535	-0.2986	0.1698	1.0000			
landl	0.3284	0.1497	0.0037	-0.0213	-0.3059	0.0531	0.0308	1.0000		
lnusagdp	-0.1927	0.1525	0.3587	0.3586	0.0209	-0.0185	0.4011	-0.0079	1.0000	
lngdpchina	0.2669	0.2658	0.6781	0.8351	-0.3586	0.1387	0.9146	-0.0853	0.3173	1.0000

Annex 4: Panel Unit Root Test

```
. ***to tast unit root/ stationarity test
. xtunitroot llc lnrainfall

Levin-Lin-Chu unit-root test for lnrainfall
----------------------------------------------

Ho: Panels contain unit roots                  Number of panels  =     12
Ha: Panels are stationary                      Number of periods =     19

AR parameter: Common                           Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -5.8325
 Adjusted t*          -4.2477        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lnagriex, noconstant demean

Levin-Lin-Chu unit-root test for lnagriex
----------------------------------------------

Ho: Panels contain unit roots                  Number of panels  =     12
Ha: Panels are stationary                      Number of periods =     19

AR parameter: Common                           Asymptotics: root(N)/T -> 0
Panel means:  Not included
Time trend:   Not included                     Cross-sectional means removed

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -3.8457        0.0001
 Adjusted t*          -3.6773        0.0001
------------------------------------------------------------------------------
```

```
. xtunitroot llc lnfertinput,trend

Levin-Lin-Chu unit-root test for lnfertinput
---------------------------------------------
Ho: Panels contain unit roots               Number of panels  =     12
Ha: Panels are stationary                   Number of periods =     19

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -10.2643
 Adjusted t*         -4.5594        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lneugdp

Levin-Lin-Chu unit-root test for lneugdp
-----------------------------------------
Ho: Panels contain unit roots               Number of panels  =     12
Ha: Panels are stationary                   Number of periods =     19

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -11.0664
 Adjusted t*         -8.3757        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lnreer

Levin-Lin-Chu unit-root test for lnreer
---------------------------------------

Ho: Panels contain unit roots                Number of panels  =     12
Ha: Panels are stationary                    Number of periods =     19

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -4.3474
 Adjusted t*          -3.4287        0.0003
------------------------------------------------------------------------------
```

```
. xtunitroot llc lngdpex,trend

Levin-Lin-Chu unit-root test for lngdpex
----------------------------------------

Ho: Panels contain unit roots                Number of panels  =     12
Ha: Panels are stationary                    Number of periods =     19

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -9.8310
 Adjusted t*          -4.8791        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lntropenn

Levin-Lin-Chu unit-root test for lntropenn
---------------------------------------------
Ho: Panels contain unit roots               Number of panels  =     12
Ha: Panels are stationary                   Number of periods =     19

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -9.7280
 Adjusted t*          -4.7262        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lnexdiver

Levin-Lin-Chu unit-root test for lnexdiver
---------------------------------------------
Ho: Panels contain unit roots               Number of panels  =     12
Ha: Panels are stationary                   Number of periods =     19

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -7.3625
 Adjusted t*          -4.3723        0.0000
------------------------------------------------------------------------------
```

Annex 5: Summary of Data

```
. xtsum agriex usgdp fertinput exdiver fdi reer tropenn gdpex rainfall
```

Variable		Mean	Std. Dev.	Min	Max	Observations
agriex	overall	6.102866	5.553955	1.21e-06	25.86385	N = 228
	between		4.79464	.007549	14.7849	n = 12
	within		3.111387	-6.865882	18.92907	T = 19
usgdp	overall	1.50e+07	3025775	1.03e+07	2.07e+07	N = 228
	between		0	1.50e+07	1.50e+07	n = 12
	within		3025775	1.03e+07	2.07e+07	T = 19
fertin~t	overall	58.04953	126.4767	.0836358	835.5778	N = 228
	between		95.86682	1.762292	273.2264	n = 12
	within		86.80245	-179.6317	644.9461	T = 19
exdiver	overall	129.8509	62.98594	13	240	N = 228
	between		59.61733	29.84211	225.4211	n = 12
	within		26.35973	55.11404	212.2719	T = 19
fdi	overall	612.4344	944.0032	-25.64428	6175.125	N = 228
	between		587.1245	4.47401	2022.325	n = 12
	within		757.4701	-1302.038	4765.234	T = 19
reer	overall	110.3928	20.64424	65.84245	188.6653	N = 228
	between		11.28697	85.94505	127.4764	n = 12
	within		17.57528	75.79826	174.3157	T = 19
tropenn	overall	3329.916	2940.887	38.527	11588.91	N = 228
	between		2331.276	143.9486	7645.843	n = 12
	within		1909.168	-1766.853	8776.949	T = 19
gdpex	overall	15627.07	17055.62	595.4813	87905.68	N = 228
	between		13211.91	1074.635	41105.85	n = 12
	within		11409.68	-11013.99	62549.21	T = 19
rainfall	overall	91.86178	30.45896	32.55288	180.5993	N = 228
	between		29.21534	51.24173	147.372	n = 12
	within		11.91191	53.07148	131.2934	T = 19

Appendix 6-Fixed Effect Regression for Group 1

```
. *fe regrassion dependent variable is log agricultural export to usa destination (Group 1)*
. xtreg lnagriexusa lnusgdp lnfertinput lnexdiver lnfdi lnreer lntropenn lngdpex lnrainfall  ,fe

Fixed-effects (within) regression               Number of obs      =        95
Group variable: country1                        Number of groups   =         5

R-sq:                                           Obs per group:
     within  = 0.4625                                         min =        19
     between = 0.6298                                         avg =      19.0
     overall = 0.3580                                         max =        19

                                                F(8,82)            =      8.82
corr(u_i, Xb)  = -0.8917                        Prob > F           =    0.0000
```

lnagriexusa	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnusgdp	7.179128	2.182895	3.29	0.001	2.836655	11.5216
lnfertinput	.5189271	.2864037	1.81	0.074	-.0508212	1.088675
lnexdiver	.8865759	1.544859	0.57	0.568	-2.186641	3.959793
lnfdi	.3229173	.2135545	1.51	0.134	-.1019108	.7477453
lnreer	-1.880015	2.110004	-0.89	0.376	-6.077485	2.317455
lntropenn	-.4880924	1.417643	-0.34	0.732	-3.308235	2.332051
lngdpex	6.935431	2.55553	2.71	0.008	1.851668	12.0192
lnrainfall	-4.93314	1.581081	-3.12	0.002	-8.078415	-1.787866
_cons	-89.32822	30.43616	-2.93	0.004	-149.8754	-28.78101
sigma_u	9.7234087					
sigma_e	1.7008771					
rho	.9703094	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(4, 82) = 21.09                     Prob > F = 0.0000
```

Appendix 7-Fixed Effect Regression for Group 2

```
. *fe regrassion dependent variable is log agricultural export to china destination (Group 2)*
. xtreg lnagriexchina lnusgdp lnfertinput lnexdiver lnfdi lnreer lntropenn lngdpex lnrainfall  ,fe

Fixed-effects (within) regression               Number of obs     =       133
Group variable: country1                        Number of groups  =         7

R-sq:                                           Obs per group:
     within  = 0.3792                                         min =        19
     between = 0.7088                                         avg =      19.0
     overall = 0.1208                                         max =        19

                                                F(8,118)          =      9.01
corr(u_i, Xb)  = -0.8096                        Prob > F          =    0.0000

------------------------------------------------------------------------------
lnagriexch~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnusgdp |   2.398248    2.91702     0.82   0.413    -3.378246    8.174742
  lnfertinput |    .201318   .3638617     0.55   0.581    -.5192272    .9218631
    lnexdiver |   5.29594   1.363086     3.89   0.000     2.596658    7.995222
        lnfdi |    .552094   .2406037     2.29   0.024     .0756332    1.028555
       lnreer |  -2.748253   1.961082    -1.40   0.164     -6.63173    1.135223
    lntropenn |  -2.304087   2.075823    -1.11   0.269    -6.414781    1.806607
      lngdpex |   1.616457   2.737143     0.59   0.556    -3.803831    7.036745
   lnrainfall |   -4.24726    1.59935    -2.66   0.009    -7.414409   -1.080111
        _cons |  -.1069262   45.69543    -0.00   0.998    -90.59632    90.38247
-------------+----------------------------------------------------------------
      sigma_u |  7.6071809
      sigma_e |   2.773569
          rho |  .88266529   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(6, 118) = 16.81                     Prob > F = 0.0000
```

Appendix 8: List of Countries in the Sample

Burundi	Rwanda	Malawi	Uganda
Ethiopia	Seychelles	Mauritius	Zambia
Kenya	Tanzania	Mozambique	Zimbabwe