

**Addis Ababa University  
School of Graduate Studies**

**DETERMINANTS OF PRIMARY COMMODITY  
EXPORT IN  
SUB-SAHARAN AFRICA  
(A PANEL STUDY)**

**By  
Ibrahim Worku Hassen**

**Addis Ababa  
August, 2007**

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**A Master's Thesis Submitted to the School of Graduate Studies  
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**Addis Ababa  
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# Declaration

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been dully acknowledged.

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## **Abstract**

The paper examines the implication of demand and supply side factors on SSA primary commodity export performance. A Sample of 21 countries is selected for the period 1995 to 2005, thus forming a panel data. The simultaneous equation disequilibrium version of Goldstein and Khan (1978) model is used for the analysis. In addition to the usual price and quantity variables, the model is augmented with policy actions of both exporting and importing countries. This model is estimated using both difference generalized method of moments (DGMM) and system generalized method of moments (SGMM). In addition, the study tests whether the small country assumption holds true using Brownes' (1982) specification of the model.

Using the first model, we found that the policy choices and actions of the importing countries are major constraints of the export sector. Although the supply side factors are found to be weak, when compared with the demand side factors, income and road are found to be significant in explaining the sectors performance. Taking the small country assumption into consideration, all the domestic factors are significant in explaining the export performance. In general, the results of the study indicate that the export sector is inelastic for both the external and internal factors. So we can infer that, the export of primary commodity is constrained by both the domestic and external factors. Consequently, there is a need to switch to other export earning mechanism and/or to provide enough attention in alleviating the constraints.

# CHAPTER ONE

## 1. Introduction

### 1.1 Background

It is pertinent to note that trade in agricultural commodities still dominates the export scene of African economies. The agricultural sector constitutes a significant part of the whole economy and employs a considerable proportion of the labor force. Furthermore, increasing agricultural export is an indeterminate step toward restoring external balance of payment equilibrium which has been the central part of most economic structural adjustment programs initiated in 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 are believed to include many advantages over agricultural export. Sekatt and Varoudakis (2000) mentioned that 50% of the total export is primary and processed agricultural export even when they are supposed 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. This suggests that in the short and medium term the economic dynamics -including the development of manufactures- will rely on agricultural export, especially in Africa, where comparative advantage lie with primary commodity export.

Nagruko (2003) also asserted that export in general and agricultural export in particular impact on development through financing of capital accumulation by lifting two types of constraints: the constraint of international liquidity and the constraint of solvability. In the later 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 earning and income as well as employment creation for the majority of the population in, sub Saharan Africa.

Trade and macroeconomic policies as well are expected to play critical role on the export sector in particular and hence are major concerns for policy makers. For decades the export sector has been stagnant and it was highly dominated by primary agricultural products for many of the less developed countries. 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 issue in both cases has been highly investigated in many developed countries starting from the works of Schuh's (1974). This paper tries to identify the link between trade and macro policy along with other factors in affecting the export performance of primary commodity export.

## 1.2 Statement of the Problem

As it was indicated earlier the share of agricultural export from Sub Saharan African (SSA) countries in the world market has significantly declined in the last two decades. The share has not only declined in its volume but also in its value. That is, as a result of distorted agricultural market, developed countries provide protection to the agriculture sector both in terms of subsidies and tariff walls depresses primary commodity export share of SSA. These policies in extreme case go to a rising tariff rate along with the export of processed agriculture export technically referred as tariff escalation.

Despite the constraints, primary commodity export has a significant importance for SSA economy. Analyzing the constraints could help improve its performance. The constraints in general are described as domestic environment and external environment. With the exception of the natural ones', these factors are also affected by policies pursued by the home country as well as their trading partners. Domestic policies includes exchange rate, macroeconomic policy, and trade orientation are the one responsible for the sectors performance. These policies are expected to affect domestic prices, capacity to produce and the domestic demand pressure. These factors are intern expected to create incentive or disincentive to engage in the international market. From the external environment (demand side pressure) their income elasticity for imports of primary commodity export are also expected to affect the sectors performance. In this regard, partners' income elasticity also determines whether or not SSA countries' together could improve their export performance without competing each other to the same market that would eventually depress their export price. Their response towards

imports of primary commodity is also expected to be affected by domestic demand pressure as well as domestic prices.

After recognizing the interdependence of these factors, there is a need to analyze the extent to which these factors are constraining the export sector so as to achieve sustainable export earning there by augmenting the growth process of the region. Thus, the study empirically analyzes how these factors are interacting in determining the export performance of the region along with the policy environment of both exporting countries' and their trading partners'. Previous studies mostly focus on addressing the problems of the sector either in the supply side or on the demand side. In this study, explicit recognition is made to avoid the problem of omitted variable bias that is created by considering only one side of the market in the analysis rather determinant factors on both sides are analyzed simultaneously.

### **1.3 Objective of the Study**

In general the objective of this study is to empirically analyze how trade and macroeconomic policies that are undertaken by SSA countries and constraints imposed by their "trading partner" result in dismal performance of agricultural export in the region.

The specific objectives of the study are:

1. to empirically investigate the relationship between export performance along with policy action from both demand and supply side constraints through the real exchange rate. Thus, identifying the sensitivity of the export market, particularly on primary commodity, to the factors which affect the sectors performance is one specific task of the study.

2. to identify the response of primary commodity export to exchange rate as well as domestic policies of importing countries.
3. to come up with plausible policy prescription and recommendation that would maximize the export performance of the region.

## 1.4 Hypothesis of the 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 going to be tested:

- 1) to test empirically the importance of demand and supply side factors in determining the sectors performance along with the pursued policies in the exporting countries and trading partners.
- 2) to test whether the export performance of all SSA countries' together could be improved i.e. to check whether the fallacy of composition could hold in primary commodity export sector of (which is one of the unsettled empirically testable hypothesis).
- 3) by following the theoretical justification, to test whether SSA countries are price setters or not (i.e. to see the relevance of the assumption of small country assumption in modeling the export sector) is conducted in the regression analysis.

## **1.5 Methodology and Data Source**

To analyze the policy implication on the export sector of the region dynamic structural econometric model will be used. The data is going to have a panel form (over time-across countries). Panel data method of analysis will be employed as it improves estimates by adding more information when the size of the sample increases in terms of time dimension and country specific characteristics.

### **1.5.1 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 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 SSA countries (preferably, for those having the relevant data on the export of primary commodity export), Goldstein and Khan (1978)

disequilibrium model will be used for its explicit recognition of delayed adjustment of the export towards the equilibrium than the static model. 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 1995-2005. Owing to endogeneity 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.

### **1.5.2 Data Source**

For the purpose of analyzing the export sector of the region, secondary data source will be used. In line with the variables of interest, the data for different macro economic indicators is collected from different sources. The sources include IMF CD-ROM, WB CD-ROM, and UNCTAD-CD-Rom. UNCOMTRADE trade statistics is chosen to get the most recent and highly disaggregated data on current export value of primary commodity. Other sources which are used to supplement the data include FAO database, and also Global Development Network<sup>1</sup>. Thus, the data would be compiled from these sources depending on the variable of interest and availability.

## **1.6 Significance of the Study**

The study is significant in identifying the factors that affect the agricultural export both from demand side as well as supply side constraints. The study brings empirical evidence on the implication of policies on the export primary commodities on which little previous work has

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<sup>1</sup> With the exception of IMF CD-ROM, WB CD-ROM, UNCTAD CD-Rom, UNCOMTRADE, other sources are used in case there is missing value and to check the consistency of the data.

been done. Thus, it is assumed to draw attention of forthcoming researchers to this area. In addition, it is expected to come up with how SSA policy makers should bargain in order to access market opportunities to their farmers output. It is also expected to give an insight as to how SSA countries should integrate to increase their bargaining potential to affect world price

## **1.7 Scope and Limitation of the Study**

The study will basically focus on the implication of domestic and external factors along with policy choices particularly on the export of primary commodity export. In doing so, the study does not explicitly recognize the influence of international institutions that are expected to distort border prices and hence the real returns from the export sector. In addition, the study does not incorporate the role of domestic institutions as well as SSA governments' commitment that could partly explain for the dismal agricultural export performance in SSA is not considered. Natural factors and country specific characteristics and differences are not explicitly modeled in this analysis rather such factors are supposed to be captured by the very nature of panel data framework.

## **1.8 Organization of the Study**

The study is organized in such a way that, in chapter one a brief introduction is made on the study. In chapter two, a brief review of literature is made both on theoretical and empirical aspects along with other factors which are found to be related with primary commodity export of SSA. In chapter three, the model is 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 forth

chapter a brief discussion is made on the estimation procedure, technique as well as results of the estimated model. In the last chapter a brief summary is provided on the major findings of the study and plausible policy implications and recommendation are drawn from the analysis.

# CHAPTER TWO

## 2. Review of Literature

### 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 Montenegro, 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 par amount 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 single equation model to explain the export sector for developing countries. All of the empirical studies conducted till 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.

$$x_t = (a_0 + a_1 PR_t) DDP_t + (a_2 + a_3 DDP_t) PR_t$$

In this model  $PR_t$ , and  $DDP_t$  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.

Where as 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. Where as, 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.

$$\log X_t^s = b_0 + b_1 \log(PX/P)_t + b_2 \log Y_t^*$$

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.

Where as the disequilibrium model which allows lagged adjustment to wards the equilibrium values is specified as follows.

$$\Delta \log X_t = \lambda (\log X_t^d - \log X_{t-1})$$

Where  $\lambda$  is the speed of adjustment and

$\Delta$  is a first difference operator, which is given by  $\Delta \log X_t = \log X_t - \log X_{t-1}$ .

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:

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

Where X is the value of export,

$p_d$  is the domestic price index,

$p_f$  is foreign price index,

E is the official exchange rate,

$wy$ , represents the world income.

$\eta$  and  $\mathcal{E}$  are price and income elasticities of exports, which are assumed to be constant with negative and positive expected sign respectively.

Taking logs of this function will provide

$$\ln X = \eta(\ln P_d - \ln P_f - \ln E) + \mathcal{E}(\ln wy)$$

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 fourth 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 non-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.

From the above four theoretical models simultaneous equation model is particularly suitable to explain exports of less developed countries. This study would be adopted in modeling primary commodity export of SSA in this study. Detailed explanation on this model will also be given in the next chapter.

## 2.2 Linking Export with Domestic and External Environment

Love and Turner (2001) noted that the growth of the export sector would ultimately be affected by the country's trade orientation which in turn is determined by the domestic market and external market conditions and other opportunities. In addition, domestic supply factors which influence international competitiveness are strongly affected by the policy regime. The same author argues that since it is difficult to isolate the effect of trade policy from domestic policy, one needs to use a well-established and fairly comprehensive measure of international competitiveness which is the real effective exchange rate (REER).

In their study to relate trade policy and domestic policy regime, they chose the variable REER which is a trade weighted relative price index along with the popular measure of trade orientation that is the black market premium (BMP). REER is also considered to be the variable that relates macro policy and the exchange rate policy with trade policy. Thus, REER helps us to see the effect of trade policy (the extent of countries openness), exchange rate policy (whether countries exchange rate is over or under valued along with its implication for export and import) and as well as the domestic policy environment.

Love and Turner (2001) also argue that countries REER, when measured based on consumer price index clearly depicts whether policy action is in favor of or against of primary commodity export. Whereas when it is measured based on relative labor cost, it gives an insight about the role of policies on manufactured goods. Thus, we choose REER which is measured based on consumer price index (demand side index) to see the implication of policy actions of DCs (importing countries) on SSA export.

Shatz and Tarr (2000) by reviewing different literature noted that the degree of the success of trade policy reform in changing trade orientation of a country is dependent upon the exchange rate reform as well as consistent macro economic policies. We choose exchange rate as indicator of trade orientation for LDCs along with other capacity indicators and important variables to model export.

In relation with the issues raised above, the domestic factors that affect agriculture are macroeconomic policies which basically constitute fiscal, monetary as well as exchange rate policies that tie the domestic economy with the external world. The external factors which are explained above relate to market access that fall with in the category of trade policy or else are affected by trade negotiations and actions taken by DCs, will be analyzed in accordance with their implication on export of primary goods.

### **2.3 Some Stylized facts on Sub-Saharan Africa Export.**

One major issue in the theory of trade policy is creating a more liberalized trade between the north and south where by the north is the dominant being supported by the World Bank (WB) and International Monetary Fund (IMF). Many trade negotiations have been taking place on unilateral, bilateral, multilateral and even on regional level. But the benefit that accrued to less developed countries (LDCs) is almost insignificant vis-à-vis developed countries (DCs). In developing countries, especially Sub-Saharan African (SSA) countries, pattern of exportable goods is dominated by primary agricultural products and for export of processed and semi-processed agricultural products there is limited access to the international markets. Moreover the countries are facing decline in the prices of primary goods in the international market.

However, LDCs basic focus was only to solve problems related to supply side bottleneck without paying much attention to the demand side problems or in some cases taking the demand side for granted.

The export sector of SSA is highly affected not only by domestic policies but also by international policies including the performance of the world economy and other exogenous factors like institutions, governments' commitment, natural resource and intensity and prevalence of poverty. Since the export sector is affected by multiplicity of causes, there has to be a rigorous analysis concerning this sector along with agriculture, where agriculture is the base for the regions' export. Despite the significance of the sector, little work has been done in this area. Accordingly, the study tries to review all the relevant literature conducted to explain demand as well as supply side. In this regard, a brief review of the empirical literature will be reviewed.

## **2.4 Empirical Literature Review**

Agricultural sector is the primary source of employment for SSA countries accounting 70% of the total employment in the region in the late 1990s (Dlagado, 1999). In the year 2000 agricultural value added as a share of gross national product (GDP) was 17%, service sector 53% and manufacturing sector 14%. With its share, the sector's performance in the region has declined significantly in the last decades. Moreover, the share of global agricultural trade value of Sub-Saharan countries has dwindled from 8.4% in 1965 to 2% in 2001 (Kandiero and Randa, 2004).

The cause of poor performance in the agricultural sector has been attributed to poor domestic policies as well as restrictive policies of developed countries. Yeats et al. (1997) argue that African countries' domestic policies led to the decline in the region's share of global export where as Hoekma et al. (2001) points the restrictive market access policies in developed countries are the source of SSA's marginalization from the world market. In addition, in 1980s policies such as exchange rate appreciation and anti-agricultural policies also contributed to the deterioration of the agricultural export performance (Schiff and Valdes, 1992). On the other hand, domestic conditions including the persistence of state trading enterprise, high transportation costs, low productivity, among others, have adversely impacted the agricultural sector (Kandiero and Randa, 2004).

Likewise, macroeconomic environment and policies of the countries, inefficient access to inputs (like fertilizer, credit) to bolster production, access to information about markets, standard and quality of the goods availability in the developed countries markets, and the structure and institutional arrangements in African countries, especially the rural areas are also additional contributors (Kydd and Valdes, 1998).

In literatures, export performance is assumed to be dependent upon domestic supply factors and external demand. Domestic supply factors which influence international competitiveness are strongly affected by policy trends which are to be seen in terms of relative movements in domestic and international prices (Love and Tuner, 2001, Goldstein and Khan, 1978).

In theory, to identify the determinants of export performance of developing country is expected to be affected by certain variable like relative prices, exchange rate, macroeconomic policies and developments, marketing strategies, weather condition, geographical location as well as resource endowment as discussed in Bond (1987). Most of the variables except resource endowment and location are affected by domestic policies. The same author argues that in many developing countries the maintenance of overvalued exchange rate has led to a real appreciation of domestic currency because of the relatively high rates of domestic inflation have not been fully offset by a fall in nominal exchange rate. This would in turn be reflected by the export sector. For most African countries productions of primary commodities fall sharply and manufactured exports were uncompetitive. So as to achieve a favorable growth and foreign exchange earning, management of exchange rate in lined with the export sector is an important constituent.

Exchange rate and favorable terms of trade are also factors that affect the incentive to produce agricultural export. The exchange rate policies adopted by SSA countries reflect the competitiveness of the economy in developed countries market. Real exchange rate misalignment especially is damaging the economic performance because it decreases the profitability of production for the export of tradable goods. In this way, RER misalignment leads to reduction in economic efficiency and misallocation of resources. In addition, by increasing uncertainty, raising the risk of macroeconomic collapse, and foreign investment it contributes to capital flight. These negative effects of misalignment on growth and export performance have been shown by Edwards (1988), Cottaine et. al (1990), Ghura and Grennes (1993). and Elbadawi and Soto (1996) by doing rigorous analysis on RER and its impact on

the performance of agriculture as well as non-traditional export sector for different groups of developing countries.

Kinal and Lahiri (1993) estimated a simultaneous equation error component models to model 31 developing country exports by transforming their data using the so called 'Fuller-Batesse' transformation method to obtain generalized method of moments estimate. They found that very little of the short-run adjustment in external imbalance is achieved by exchange rate policies. They asserted that most of the burden to improve external balance relies on the aggregate demand management.

Senhadji and Montenegro (1998) also noted that exports play a role in the growth process by generating scarce foreign exchange necessary to finance imports of energy and investment goods both of which are crucial to capital formation and hence developing countries should trace with developed countries.

Riedel (1988) argue that LDCs face a downward sloping demand function. So as to expand their export they need to engage in price competition through real devaluation. In contrast, Faini et. al. (1992) pointed out that a country can independently expand export but all countries together cannot. The central element of this controversy lies in the size of income and price elasticity of DCs export demand which determines the success of entering in to price competition. In most literature, this controversy is referred as the fallacy of composition. The author concluded that the higher the income elasticity the more powerful exports will be as an engine of growth, growing export earning as well.

Alemayehu (2002), quoting the works of Binswanger (1992), identified the factors that affect the supply of primary commodity export. These includes cost and accessibility of consumer goods, farm subsidies and taxes, research and extension, the existence of road and infrastructure as well as the availability of services such as marketing and credit. The author explained that these factors are operating jointly in determining the sector performance. Besides, infrastructure, literacy rate, agro-climatic zone, human capital also influence the supply of primary commodity.

Alemayehu (2002) noted that different factors as emphasized by different authors are basically complementary and hence these should explicitly be considered within any estimation. The lag structure will depend on the nature of the commodity under consideration. For instance longer lag should be used for beverages than for annual crops.

Besides their theoretical contribution, previous studies also in general indicated that exports are found to be inelastic to world income. The export sector of SSA is also found to be highly affected by the supply side factors.

In this study, export of primary commodity export would be analyzed considering the interaction between demand and supply factors in to consideration. Previous studies provide less attention for demand side constraint. This study also augments policy actions in the classical Goldstein and Khan (1978) model. The study explicitly models primary commodity export using disequilibrium simultaneous equation model, where by estimation is made using a panel data analysis for its advantage over cross-sectional or time series studies, where past studies rely on.

Bautista and Valdes (1993) also explained the relevance of undertaking such kind of analysis. The link between macroeconomic policies and agricultural export go beyond the sectors contribution to foreign exchange earning. Trade and macroeconomic policies exert their influence on the entire structure of relative prices, essentially through the real exchange rate mechanism. The central premise is that in view of high degree of tradability of agricultural output, the real exchange rate is perhaps the variable that has the greatest influence on the structure of price incentive for agriculture. The theory of real exchange rate determination is particularly relevant in empirical assessment of sector specific and economy wide policies as well as agricultural incentives. In this regard, Temesgen (2004) analyzed the impact of exchange rate and trade policies on Ethiopian agricultural export production incentive taking the case of coffee export.

Therefore, this study also on the way tries to identify two basic empirical research questions that are raised in the literature review portion. One is whether the fallacy of composition holds true or not by looking income elasticity of demand for importing countries. The second is that most models utilize the simultaneous equation model assuming exporters to be price setters. In this study, estimation will be conducted by taking exporters both as a price taker and as a price setter in the world market and to see their implication, if there is any.

## **CHAPTER THREE**

### **3. Data Description and Methodology**

#### **3.1 Data Source Type and Sampling Procedure**

##### **3.1.1 Data Description**

The study utilizes secondary data collected from different sources depending on availability of data and interest of the study. The sources include trade value of the selected commodities (primary commodities of the sample countries under consideration) is obtained from UNcomtrade Statistic on line web site. These commodities are exports of primary commodity classified under standard international trade statistic revision three (SITC R3). Other variables like exchange rate, CPI indices, income (GDP), and other development indicators are collected from WDI on line data base. Data sets for financial indicators like free market price indices, export unit value indices are collected from UNCTAD (2004) CD-ROM. UNCTAD also classifies countries based on the following characteristics of the countries. GDF is also used to collect data on Gross Domestic Investment of the countries under consideration.

##### **3.1.2 Sampling Procedures**

In line with the objective of this study, sample countries are chosen in such a way that it exhibits randomness and unbiasedness. In the first stage all SSA countries are taken to be the intent of the study. From these countries those which do not report their export value for the commodities under consideration (primary commodities, i.e. food and tropical beverages) are dropped. In the next stage, some with highly insignificant export earning from commodities under SO3 classification are also excluded. Countries like Nigeria, Senegal and Botswana base

their export earning on export of oil and minerals. As a result their policies would be expected to favor the sector that is dominant in the export earning. These countries have insignificant export earning for exports of primary commodities under consideration. These countries are also dropped from the sample. So as to increase the variation as well as the number of countries which are highly dependent on the traditional export sector, all the remaining major primary commodity exporters for the period under investigation are included. In total, the study considers 21 SSA countries<sup>2</sup>.

### 3.2 Model Specification

In modeling the agricultural export of an economy, many authors followed the works of Goldstein and Khan (1987). The model is defined in such a way that it could be suitable for explaining both the static as well as dynamics of the export sector. The study follows the disequilibrium version of Goldstein and Khan Specification.

To model the determinants of the export performance of a country, there is a need to identify both the demand and the supply factors in a simultaneous equation in order to explicitly recognize their interdependence, as well. The static simultaneous equation following Goldstein and Khan (1978) is specified as follows.

$$\log X_t^d = a_0 + a_1 \log(PX/PXW)_t + a_2 \log YW_t \dots\dots\dots(3.1)$$

Where  $X_t$  is the quantity of exports demanded

PX is the price of exports

PXW is the weighted average of the export prices of the country's trading partners

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<sup>2</sup> The sample countries are attached at the Appendix 1.

YW is the weighted average of the real incomes of country's trading partners

Since the model is specified in logarithm form, the coefficients represent elasticities where by  $a_1$  is expected to be negative and  $a_2$  is positive. In contrast to the usual income effect, an increase in world income might be associated with faster growth in the production than in the consumption of imported agricultural good,  $a_2$  would have negative expected coefficient. The supply function is specified in similar fashion as follows:

$$\log X_t^s = b_0 + b_1 \log(PX/P)_t + b_2 \log Y_t^* \dots\dots\dots (3.2)$$

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 to produce.

In the above model both  $b_1$  and  $b_2$  are assumed to be positive. In here export is assumed to increase whenever there is favorable price, and as well, there is increasing trend in the production capacity, *ceteris paribus*. After rearranging the supply equation, the following supply equation is generated.

$$\log PX_t = b'_0 + b'_1 \log X_t^s + b'_2 \log Y_t^* + b'_3 \log p_t \dots\dots\dots (3.3)$$

where  $b'_0 = -\frac{b_0}{b_1}$  ;  $b'_1 = \frac{1}{b_1}$  ;  $b'_2 = -\frac{b_2}{b_1}$

The equilibrium model cannot depict the export performance of countries in real world. In the static or equilibrium model, adjustment of export quantities and prices to their respective values is expected to occur instantaneously. The reduced form of the model that is specified by

combining the demand and the supply equations would be utilized in the estimation stage. The model implies that all adjustment is expected to occur instantaneously. A more realistic model is specified by the same author, (Goldstein and Khan, 1978) where by adjustment to the equilibrium value occurs with some delay. The theoretical model of the disequilibrium model (stated in the previous chapter) is specified as follows:

$$\Delta \log X_t = \lambda(\log X_t^d - \log X_{t-1}) \dots\dots\dots (3.4)$$

where  $\lambda$  is the speed of adjustment and

$\Delta$  is a first difference operator. Where  $\Delta \log X_t = \log X_t - \log X_{t-1}$

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. Most studies followed this model to estimate elasticities of export. Goldstein and Khan (1978) make a note of that this might give inferior result for small countries. Only Browne (1982) and Riedel (1988) were in a position to estimate the parameters of interest taking the small country assumption under consideration. According to Browne (1982) the model is specified as follows:

$$px_t - px_{t-1} = \lambda'(x_t^d - x_t), \dots\dots\dots (3.5)$$

$$x_t - x_{t-1} = \gamma'(x_t^s - x_{t-1}^s) \dots\dots\dots (3.6)$$

Where  $\lambda'$  and  $\gamma'$  represent the speed of adjustment towards the equilibrium. The small case letters in the model are used to represent logarithms of the upper case used in the previous specification.

The model implies that export price fluctuations were determined by the demand side of the market. Within this framework, it makes a note of that the volume exported adjusts towards the exporters' desired level and also export price fluctuations are determined by the demand side of the market. In this study, the specification of the remaining variables which are assumed to potentially affect the export sector would be augmented in the disequilibrium model of Goldstein and Khan (1987). In the analysis part, emphasis will also be given to the model specified by considering whether the small country assumption is valid or not following Browne (1982).

The reduced form of the simultaneous equation model is specified as follows:

$$x_t = \gamma\alpha_0 + \gamma\alpha_1(px_t - pf_t) + \gamma\alpha_2yf_t + (1 - \alpha)x_{t-1} \dots \dots \dots (3.7)$$

$$px_t = \frac{\lambda\beta_0}{(1+\lambda\beta_1)} + \frac{\lambda\beta_1}{(1+\lambda\beta_1)}pd_t - \frac{\lambda\beta_2}{(1+\lambda\beta_1)}ddp_t - \frac{\lambda\beta_3}{1+\lambda\beta_1}y_t + \frac{\lambda}{1+\lambda\beta_1}x_t + \frac{1}{1+\lambda\beta_1}px_{t-1} \dots (3.8)$$

In this model the small case letters represent that logarithm of the upper case letters,  $x_t$ ,  $y_t$ ,  $pf_t$ ,  $px_t$ ,  $pd_t$ ,  $ddp_t$ ,  $y_t$  are export value, world income, foreign price, export value index or export price, domestic price, domestic demand pressure and income of trading partner respectively.

By considering the demand and the supply side factors that are expected to affect the export sector, the augmented function would be specified based on Alemayehu (2002). In his model, he specified the long run and the short run factors as capacity creation and capacity utilization factors in determining the supply side of the regions export. His model is specified in the following way.

$$\begin{aligned}
 x_t^s = a_0 + & \left[ \frac{a_1 \left( \frac{ep_s}{p_d} \right) + a_2 \left( \frac{ep_s}{p_d} \right)_{t-1}}{\longrightarrow} \right] + a_3 \left[ \frac{\left( \frac{ep_s}{p_d} \right)_{t-i} - k^{-1} \sum_{i=1}^k \left( \frac{ep_s}{p_d} \right)_{t-i}}{\longrightarrow} \right] \\
 & \text{Capacity utilization} \qquad \qquad \qquad \text{Expected profit} \\
 & + \left[ \frac{a_4 (\Delta K)_{t-i} + a_5 FF_{t-i}}{\longrightarrow} \right] \dots \dots \dots (3.9) \\
 & \qquad \qquad \qquad \text{Capital formation}
 \end{aligned}$$

In the above model, x is the export supply, e is the exchange rate, p<sub>s</sub> is the export price, p<sub>d</sub> is the domestic price, FF is foreign in flow, K is capital formation indicator and t is the time period.

Where the first term represents capacity utilization and the second term refers to the expected profit function which is expected to reflect capital formation indicator. Since the expected profit is calculated from past prices, its effect would be captured from under the capacity utilization indicator. Therefore the coefficient of capital formation would be interpreted as both profit as well as price instability indicator Alemayehu (2002).

The disequilibrium model that takes into account both the capacity utilization indicator as well as capital formation indicator for the supply side includes price (both domestic as well as foreign) and exchange rate, and domestic credit, capital inflow and government investment respectively. The dynamic supply side model which takes into account these effects all together, having a panel framework, is specified as:

$$x_{ijt} = \beta_0 + \beta_1 px_{it} + \beta_2 px_{t-i} + \beta_3 gdp_{it} + \beta_4 rer_{it} + \beta_5 gdi_{it} + \beta_6 gca_{it} + \beta_7 fdi_{it} + \beta_8 fertl_{it} + \beta_9 road_{it} + \beta_{10} debtser + \beta_{10} x_{ijt-1} \dots (3.10)$$

$X_{it}$  represents the export unit value of country i's export to country j at time t. where country j is partner of the exporter.

$P$  in the model represents the ratio of the export price to the domestic price multiplied by the exchange rate so as to reflect the real value of the commodity in the international market.

$gdp$  represents the GDP of the country under consideration, the sign of its coefficient might be positive or negative as discussed in the theoretical literature.

$rer$  is indicator of under/ over valuation of domestic currency in relation to international currency, in this study US dollar, it will be substituted by REER for importing countries since the data is available for the partners.

$gcap$  represents gross capital formation of the exporting country

$fdi$  refers to the flow of foreign direct investment of the exporting country

$fertl$  is fertilizer consumption of the exporting country

Instead of domestic credit, in this study it is assumed that for most farmers who are engaged in the production of primary commodity are expected to use the fund for different activities. Henceforth, instead of domestic credit, fertilizer consumption is chosen. Most farmers obtain fertilizer on credit basis which is going to be used directly in the production of agricultural output. And hence, fertilizer is taken to be one potential explanatory variable.

*road* represents kilometer of total road. It is included for the reason that it indicates the infrastructure facility under consideration. The availability of road creates marketing opportunities in the international market.

*debtser* is debt service of the exporting country. Since it affects the balance of payment, the impact would be transmitted to the export sector by depressing the fiscal balance and hence public investment on infrastructure.

The lagged dependent variable is included as it is the basic variable in Goldstein and Khan (1978) which shows that there is a simple stock adjustment towards the equilibrium than the simple static model where adjustment towards the equilibrium assumed to occurs instantaneously.

In addition to the usual specification of the capacity utilization and capital formation variables, factors related to marketing opportunities as well as policy choice indicators are included. There is also a need to explicitly recognize policy actions in modeling the export sector. Why? Because it is at the discretion of governments to make their policy choices either in favor or biased against the sector that would ultimately generate the most for the economy. Following

the discussion concerning these issues, finally the model would be specified being augmented with these factors.

Policy variables that affect the export sector include the choice of exchange rate. Most of SSA countries are accused of maintaining overvalued exchange rate along with import substitution strategy. Possessing highly protected economy is also considered to be one of the factors that contribute for the dismal performance of the export sector.

The demand for the export of SSA basically is specified as:

$$\log X_t^d = a_0 + a_1 \log(PX/PXW)_t + a_2 \log YW_t \dots \dots (3.11)$$

The model implies that export demand is assumed to be responsive only to prices and income of the importing countries. In addition to these factors, export demand is highly sensitive to the pursued policies of the importing countries. The demand for export is highly affected by the actions of developed countries too, i.e., their exchange rate policy, income elasticity for imports of primary commodities of the trading partners and the degree of openness (trade policy) impact will be reflected through REER<sup>3</sup>. To elaborate this concept very well, whether their marginal income is going to be spent on imports of primary commodity from SSA or manufactured goods or else it is going to be spent on investment or other domestic activity depends on the choice of importers'. Since REER is indexed with consumer price index, REER is also expected to reflect the choice of customers on their spending. Add to this, if the income is going to be spent on consumption of domestically produced goods, it leads to less sensitivity to imports thereby forcing the fallacy of composition to hold.

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<sup>3</sup> REER is used instead of official exchange rate to avoid possible multicollinearity

Though most studies opt to analyze related policy issues that affect the developed countries protectiveness to imports descriptively, it is also possible to capture their protective action through real effective exchange rate (Love and Turner, 2001). Real effective exchange rate is assumed to capture distortions in the domestic market<sup>4</sup>, the impact of proxies of trade policy as well as the trade orientation. Real effective exchange rate which is calculated base upon consumer price index, instead of labor cost that is particularly applicable with issues related to manufacturing sector, is preferable indicator of economy wide measures. Trade orientation of importing countries could also be explained using REER. Thus, REER is used as an indicator of monetary, trade, and exchange rate policy (Love and Turner, 2001). Any change in the trade orientation of the country under consideration manifests itself on REER. In this study, REER is included on the demand side of the simultaneous equation model to see how policy actions of DCs (trading partners) are affecting the export performance of LDCs as it is justified in the literature review. In line with this idea the model is specified as

$$\log X_{it}^d = a_0 + a_1 \log(PX/PXW)_{it} + a_2 \log YW_{it} + a_3 \log REER_{it} \dots (3.12)$$

The last equation for the supply side model (equation 3.10), *inter alia*, the demand side model (equation 3.12) would simultaneously be estimated to see the implication of both demand and supply side factors that are expected to affect the export performance. Thus this model would be used to see the impact of policies along with other factors in the estimation stage. To do so certain estimation issues are considered before estimating the model.

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<sup>4</sup> Domestic distortions that could be created due to subsidies or price support,

# CHAPTER FOUR

## 4 Estimation Techniques and Econometric Analysis

### 4.1 Estimation Technique

In order to see the effects of the variables that are discussed in the previous section on the export determination model, the disequilibrium model of Goldstein and Khan (1978) is chosen for the reasons discussed above. When the model is specified in its disequilibrium form, basically it suffers from two types of problem in estimation. First, since the model is specified in a simultaneous equation form due to the interaction effect between export demand and export supply being explicitly recognized, it creates the problem of simultaneity bias. The second problem is generated from the inclusion of lagged dependent variable in the static equilibrium model. This will create the problem of endogeneity. Due to these basic problems estimating the model using the classical ordinary least square (OLS)<sup>5</sup> will be inconsistent and inefficient. The specification of the model in simultaneous form calls for the use of either two stage least square (2SLS) or instrumental variable (IV<sup>6</sup>) method to get estimates which are more efficient than the classical OLS. Add to this, some of the variables are also possible suspect of being correlated with the dependent variable thereby creating endogeneity.

The analysis is conducted using panel data for its explicit advantage. Panel data models have advantage over cross sectional and time series studies in the following aspects. In a cross section study the time span will be limited to one where as in time series study the cross

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<sup>5</sup> Why OLS is inconsistent and inefficient? See appendix

<sup>6</sup>Econometric justification why it is not best estimate is provided in the appendix.

sectional unit of analysis will be limited to one. Panel data model make more information available allowing to expand the time span as well as the cross sectional unit of analysis. The model, thus, provides more degree of freedom and hence more efficiency would be attained than the others. Panel set up also allows one to control for unobserved individual heterogeneity (country specific effects). Panel data enables one to study the dynamics of adjustment (see also Baltagi, 2005). More importantly panel data models provide more variation within the unit of analysis and/or between different size and characteristics of the cross sectional unit of analysis.

In general, dynamic panel data model, which is similar to the disequilibrium model that will be used in the analysis, has the following specification.

$$y_{it} = \alpha y_{i,t-1} + x'_{it} \beta + \varepsilon_{it} \dots\dots\dots(4.1)$$

where,

$$\varepsilon_{it} = \mu_i + v_{it}$$

$$E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0$$

In this model, current value of the dependent variables is affected by past history which is pretty much identical to the disequilibrium model adopted in this study. In the above model we also have error terms  $\mu_i$  and  $v_{it}$  representing fixed effect and idiosyncratic shocks respectively.  $y_{i,t-1}$ , represent the predetermined values of the dependent variable. The inclusion of this variable creates endogeneity problem and hence classical OLS would be inconsistent and inefficient. This is basically due to the correlation between the error term and

the predetermined value. As a result, the error term violates an assumption necessary for consistency of OLS. If long period of time used in the analysis, the impact of the lagged value is expected to vanish (Baltagi, 2005 and Wooldridge, 2003).

According to Arellano-Bond (1991), problem of endogeneity induced in the model by the predetermined variables could be handled by transforming the data taking the first difference of the lagged variable as instruments. By doing so, one can remove the impact of all fixed effect errors in the model. On the way the problem of endogeneity created by all lagged variables (predetermined values) will be taken care of. The second option is to instrument all the predetermined variables, as to Bond and Blundell (1998), with variables that are expected to be uncorrelated with all fixed effects. This method is referred as system generalized method of moments (here after system GMM). At first, system GMM<sup>7</sup> assumes that all the exogenous variables that are included in the model as possible explanatory variables are assumed to instrument themselves, where as for all endogenous variables and predetermined values are instrumented with differences of the lagged values.

Roodman (2006) argues that, for random walk-like variables, past changes may indeed be more predictive of current levels than past levels are of current changes, as a result instruments generated from past changes that are utilized in system GMM. It provides system GMM instruments to be better representations for all endogenous variables, predetermined values as well. Representing lagged values, i.e. predetermined values, with best instrument gives estimates for these variables to capture all past time shocks to these variables. Therefore,

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<sup>7</sup> Derivation of efficient system GMM starting from simple OLS is provided in the appendix following Baltagi (2005), and Wooldridge (2003).

system GMM is best estimator for simultaneous equation models which is endowed with an inherent problem of endogeneity of variables and the inclusion of lagged values as possible explanatory variables of a given model. In addition, the effect of all lagged variables to current shocks would also be captured.

Since instruments for all endogenous variables and predetermined variables are generated from changes of the lagged values, we need to test whether the error terms are serially correlated or not. If they did so, again estimates from lagged dependent variables would be inconsistent. Arellano and Bover (1995) developed a method of testing the occurrence of autocorrelation in the idiosyncratic disturbance term, i.e.  $V_{it}$ . If instruments are found to be serially correlated, all lagged variables would become endogenous.

The test statistics is given by

$$\frac{1}{N} \sum \hat{\varepsilon}_i \hat{\varepsilon}_i \dots\dots\dots (4.2)$$

where  $\hat{\varepsilon}_i$  is by under the null of no serial correlation is assumed. The ratio of this test statistics by the variance metrics of the estimated coefficient will provide the Arellano and Bond (1991) Z test of  $l^*$ -order serial correlation.  $l^*$  is the lag length, and N is number of groups.

In estimating a model using two-step system GMM, the standard errors are not robust and are found to be biased downward resulting in high p-value. This might lead to system GMM estimates' to be accepted, when in fact it should not. Windmeijer (2005) devised a method of generating standard errors which are corrected for the downward bias of the reported errors. The author found that errors that are superior to robust one-step standard errors. Henceforth, it

is mandatory for one to report two-step efficient GMM coefficients with lower bias and standard errors (Roodman, 2006). Therefore, the study estimates the model coefficients based on two-step system GMM procedure which are corrected for upward bias of the standards errors by utilizing Windmeijer (2005) procedure. Furthermore, comparison would be made between estimates for the robust and non-robust ones.

In addition to testing for autocorrelation and correction for the standard errors, there is a need to test for over identification. To test for over identification in a panel data a researcher basically needs to relay on Hansan (Sargen) test statistics. The test statistics for the null of over identification is given by the following equation.

$$\left( \frac{1}{N} Z' \hat{E} \right)' \text{Var} \left[ \frac{1}{N} Z' \hat{E} \right]^{-1} \frac{1}{N} Z' \hat{E} = \frac{1}{N} (Z' \hat{E})' A_{EGMM} Z' \hat{E} \sim \chi^2_{p-k-1} \dots (4.3)$$

where p refers to the number of columns in the matrix of instruments (Z)

$\hat{E}$  denotes the residuals from two-step estimates k is number of  $\beta$  coefficients.  $A_{EGMM}$  is an efficient and consistent estimator of  $\beta$  which is generated from the weighted moment of the inverse proportion of variance covariance matrix of instruments (Z) (Baltagi, 2005).

According to Baltagi (2005), the consistency of two-step estimates of GMM relies on the moment restriction defined as  $E(\Delta v_{it} \Delta v_{i,t-1}) = 0$ . That is the consistency of the estimators relies on whether the idiosyncratic error terms are serially correlated or not. If these errors are found to be correlated with each other the instruments which are generated from the difference of the lagged variables would not be valid. Henceforth, the upcoming estimates are expected to satisfy these tests.

## 4.2 Model Estimation

In order to see the implication of both demand and supply factors on the performance of primary commodity export, estimation is conducted using the disequilibrium Goldstein and Khan (1978) model for the reasons specified in the theoretical discussion. The model is also augmented with other factors which are expected to affect the regions export performance. Owing to its simultaneity nature, instrumental variable estimation technique will be used for explicit recognition of the interaction effect of demand and supply side factors.

Due to the inclusion of lagged dependent variable, estimating the model using the classical OLS or else simultaneous equation model, which employs instrumental variable technique, would provide a naive estimate. Disregarding these options, at first we estimate the model using difference GMM of Arellano and Bond (1991). To start with, simple estimation will be conducted and step by step the final estimation would be presented in order to show the efficiency gain as well as the significance of the estimated parameters. Accordingly, the result for the first step estimation is tabulated below.

**Table 1:** Estimate of the dynamic Goldstein-khan model using first difference estimation technique.

Dynamic panel-data estimation, one-step difference GMM

Dependent variable lrexxval				
regressors	Coef.	Std. Err.	z	P> z
lrexxval L1	-0.0935322	0.107321	-0.87	0.383
lexuvssa	-0.3468712	0.5668629	-0.61	0.541
lexuvssa L1.	-0.6625705	0.5756814	-1.15	0.250
lexpdomcpi	-1.66838	0.5881342	-2.84	0.005
limgdpco	1.684488	1.239531	1.36	0.174
lexgdinvcop	0.3734942	0.3766659	0.99	0.321
lpwavafb	0.7391592	0.5069198	1.46	0.145
lexoexr	0.3663148	0.446189	0.82	0.412
limreer	2.422864	0.9361116	2.59	0.010
lexgdpco	-0.4058793	1.098303	-0.37	0.712
lgcapcu	0.906706	0.455274	1.99	0.046
lexroad	-0.4308484	0.2099821	-2.05	0.040

  

Arellano-Bond test for AR(1) in first differences: z = -2.64 Pr > z = 0.008				
Arellano-Bond test for AR(2) in first differences: z = -0.23 Pr > z = 0.818				
Sargan test of overid. restrictions: chi2(41) = 104.23 Prob > chi2 = 0.000				
Warning: Sargan/Hansen tests are weak when instruments are many.				
Group variable: exid		Number of obs	=	831
Time variable : year		Number of groups	=	138
Number of instruments = 53		Obs per group: min	=	1
Wald chi2(12) = 48.71		avg	=	6.02
Prob > chi2 = 0.000		max	=	9

The result indicates that the model crushes almost in all aspects. The coefficients are found to be diametrically opposing with the expected sign. In addition, the estimated results are found to be insignificant in all aspects. Since the results are insignificant and contrary to their expected sign, there is a need to resort to other estimation technique.

Since estimates from the first differencing of the lagged dependent variable cannot explain the export performance, we resort to estimate the model using system GMM. The model is estimated using two step system GMM method as the starting point and the result is given below.

**Table 2:** Two-step estimate of the dynamic Goldstein-khan model using first difference estimation technique.

Dynamic panel-data estimation, two-step system GMM

Dependent variable lrexxval				
regressors	Coef.	Std. Err.	z	P> z
lrexxval L1.	0.8432344	0.0397088	21.24	0.000
lexuvssa	0.2010923	0.2475778	0.81	0.417
lexuvssa L1.	-0.6873408	0.3342075	-2.06	0.040
lexpdomcpi	-0.1235065	0.15533	-0.80	0.427
limgdpc	0.0633471	0.0431376	1.47	0.142
lexgdinvcop	-0.267547	0.1260664	-2.12	0.034
lpwavafb	0.5581112	0.2442447	2.29	0.022
lexoexr	0.06477	0.0121656	5.32	0.000
limreer	0.2208566	0.3449318	0.64	0.522
lexgdpc	0.377126	0.1515701	2.49	0.013
lgcapcu	0.1653903	0.1248152	1.33	0.185
lexroad	-0.0335925	0.0423975	-0.79	0.428
_cons	-6.592421	2.814877	-2.34	0.019

Arellano-Bond test for AR(1) in first differences: z = -4.08 Pr > z = 0.000

Arellano-Bond test for AR(2) in first differences: z = 2.07 Pr > z = 0.038

Hansen test of overid. restrictions: chi2(57) = 72.94 Prob > chi2 = 0.076

A\*<sup>8</sup>

<sup>8</sup> The other test statistics are not included in the table for the reason that no different figure is obtained from the previous estimates, i.e. table1.

The signs for the result obtained from the two step estimates are found to be consistent with the theoretical restriction. In addition, most of the variables are found to be significant in explaining the determinants of the export performance. The test for over identification restriction cannot be rejected. Add to this, the coefficients are generated from uncorrected standard error. The results from this estimation procedure are unreliable and hence could not be used for interpretation purpose.

In both of the above regression, the problem of potential endogeneity that would occur with the inclusion of some variables is not considered. In differenced GMM, the model does not give a sufficient room for the inclusion of endogenous variable. Where as, inherent in the Goldstein and Khan (1978), the demand-supply model exhibit simultaneity between export values and prices. In addition, we need to consider that policy choices made in the domestic economy as well as the external economy affects the export performance of a country on both the demand and supply side factors. Bond (1987) identified that the export performance of a county under consideration is affected by policy choices of the domestic environment as well as the external world. Alemayehu (2002) also noted that models which are constructed are expected to be complimentary in identifying the supply constraints of SSA export.

In line with the above idea, the model would be estimated by considering the problem of endogeneity using system GMM. The potential variables which are expected to be endogenous are price of export (in the reduced form model represent the supply of export), and policy variables, i.e. the policy choice index of the importing country represented by REER and the RER of the exporting countries' as well. Since we don't have REER which is constructed based on consumer price indices for the exporting countries, we disaggregated policy indicator

variables into two. One is the RER in which case it is expected to capture the exchange rate policy. It indicates whether the pursued policy of exchange rate is overvalued or not and hence enables us to assess its implication for primary commodity export. Besides, this variable is expected to show whether the exchange rate which is adopted by the exporting country is pro to exporting primary commodity export or not. Where as, other variables like the domestic demand pressure, infrastructure, investment activity, flow of foreign direct investment, domestic marketing opportunities are represented by their respective variables.

Taking all the above factors in to consideration, the model is estimated using system GMM. The resulting estimation is tabulated below.

**Table 3:** Two-step estimate of the dynamic Goldstein-khan model using system GMM estimation technique.

Dependent variable lrexxval				
Explanatory variables	Coef.	Std. Err.	z	P> z
lrexxval L1.	0.7073494	0.0042709	165.62	0.000
lexuvssa	0.1107027	0.0519078	2.13	0.033
lexuvssa L1.	-0.610949	0.0409809	-14.91	0.000
lexpdomcpi	-0.3046415	0.0296998	-10.26	0.000
limgdpc	0.1193246	0.0154778	7.71	0.000
lexgdinvcop	-0.9176565	0.0202306	-45.36	0.000
lpwavafb	0.7470786	0.051795	14.42	0.000
lexoexr	0.1140187	0.0035097	32.49	0.000
limreer	0.0457841	0.0973891	0.47	0.638
lexgdpc	1.0958	0.0273895	40.01	0.000
lgcapcu	0.3189916	0.0275139	11.59	0.000
lexroad	-0.0638077	0.0113571	-5.62	0.000
_cons	-11.24627	0.7744511	-14.52	0.000

Arellano-Bond test for AR(1) in first differences: z = -4.07 Pr > z = 0.000  
 Arellano-Bond test for AR(2) in first differences: z = 2.07 Pr > z = 0.039  
 Hansen test of overid. restrictions: chi2(217) = 134.53 Prob > chi2 = 1.000

The results of the model indicate that almost all of the variables are found to be significant. Before going to interpret the result, the coefficients as well as the standard errors should be generated from the robust standard error which is adjusted using Windmeijer (2005).

**Table 4:** Two-step estimate of the dynamic Goldstein-khan model (Computed after Windmeijer finite-sample correction).

Dynamic panel-data estimation, two-step system GMM

Dependent variable		Lrexxval		
regressors	Coef.	Std. Err.	z	P> z
lrexxval L1.	0.707349	0.0441836	16.01	0.000
lexuvssa	0.1107027	0.4420921	0.25	0.802
lexuvssa L1.	-0.610949	0.6770251	-0.90	0.367
lexpdomcpi	-0.3046415	0.2163165	-1.41	0.159
limgdpco	0.1193246	0.0792196	1.51	0.132
lexgdinvcop	-0.9176565	0.2595757	-3.54	0.000
lpwavafb	0.7470786	0.4182841	1.79	0.074
lexoexr	0.1140187	0.028694	3.97	0.000
limreer	0.0457841	0.7976571	0.06	0.954
lexgdpc	1.09580	0.2838819	3.86	0.000
lgcapcu	0.3189916	0.2536932	1.26	0.209
lexroad	-0.0638077	0.0833352	-0.77	0.444
_cons	-11.24627	5.37519	-2.09	0.036

Arellano-Bond test for AR(1) in first differences: z = -4.01 Pr > z = 0.000

Arellano-Bond test for AR(2) in first differences: z = 2.06 Pr > z = 0.039

Hansen test of overid. restrictions: chi2(217) = 134.53 Prob > chi2 = 1.000

Instead of reporting only the p-value, and the coefficient of estimates, we choose to report the whole regression result to show the difference in standard error which is computed with and without Windmeijer (2005) finite error correction procedure. The regression result in table 4 indicates that the standard errors as well as the coefficient of estimates are biased up ward.

### **4.3 Discussion on the Regression Result**

As discussed in the literature review, the basic framework for estimating the relation between export performances is affected by demand and supply side factors. Based on the previous discussion on the model specification the model is estimated using system GMM. The model is estimated for 21 SSA primary commodity exporters. The time span chosen for the analysis is 11 years (starting from 1995 to 2005). But for most of the countries the data for 2005 is not reported in SITC revision 3. In addition only for the selected few countries is full for 1995. On average the reported data forms a balanced panel for only 7 years. Mostly, system GMM estimators are supposed to be inefficient for longer time-span of analysis. The reason behind such proposition is that when the time span is long enough the growth rate (change) in the lagged variable which occurred in the economic environment is expected to vanish (Baltagi, 2005). Since the export sector of most SSA countries has been highly stagnant for the decades, it guaranties the estimates to be reliable. In addition, any shock that occurred in the medium past cannot fully be neutralized particularly in the export of primary commodity export. With this argument we will interpret the findings of the regression result.

The regression result which is obtained from system GMM is different from the difference GMM. In the difference GMM the estimates did not meet the expected sign as well as the

level of significance. Where as estimates from system GMM, which is not based on robust standard error, become highly significant for all the variables. As disused in the estimation procedure the coefficients are biased. The estimates from the robust (Windmeijer corrected) two step system GMM are found to be significant in explaining the export performance of the regions. With the exception of the income of the exporting countries', the coefficients for other variables are found to be inelastic. The rise in the income of the exporting country leads to a rise in the export of primary commodity. The possible explanation for this result would be a rise in income is expected to increase the countries production capacity, *ceteris Paribus*. It also indicates that the countries' production capacity is found to outsmart the domestic demand pressure, which would have been a possible explanation for negative coefficient.

The price elasticity of the supply of export is found to be positive. Whenever the value which they receive in return for what they are exporting is positive, export sector would positively respond to such opportunity. Or else favorable return becomes attractive for exporters to engage in trade with the rest of the world. The coefficient of adjustment is also found to be positive, which is also consistent with the theoretical restriction.

A rise in the domestic price permits exporters to shift their market target from the world market to home market. The result is found to be negative implying, when compared with the export opportunity, the domestic pressure is pulling potentially exportable commodities to be sold in the domestic market. Although inelastic, favorable price in the world market leads to a rise in export.

The coefficients for domestic investment as well as road (modeled here to capture the impact of infrastructure) are found to be insignificant in explaining the export performance of the regions export, at least for non-oil, non-mineral and non-manufactured primary commodity export. The coefficient for gross capital formation is also found to be insignificant.

Interesting enough, the coefficient for real exchange rate of the exporting countries is found to be significant. This variable is also found to be endogenous. The model automatically breaks down when this variable is considered to be exogenous. Exchange rate affects both the value as well as the volume to be exported thereby creating problem of endogeneity. The coefficient is found to be inelastic but positive. This implies that the exchange rate adopted in the exporting country is not an obstacle for the growth of the value of export. This also implies that most SSA countries are effectively devaluing their currency, at least to favors primary commodity export in the model under consideration. Management of the exchange rate to favor the export sector is not found to be that much supportive. The coefficient for the real effective exchange rate of the importing country also becomes insignificant. In accordance with the objective of the study, there is a need to see the implication of the most important variables of the model. To do so, in this study estimation is conducted by dropping some of the variables which are highly insignificant and with little importance. Without any loss of generality, we safely found a significant result for the coefficient of REER of the importing country as well as for the other variables. The resulting estimation is given as follows.

**Table 5:** Two step estimate of the dynamic Goldstein-khan model using first difference estimation technique (Computed after Windmeijer finite-sample correction). Dynamic panel-data estimation, two-step system GMM

Dependent variable lrexxval				
regressors	Coef.	Corrected Std. Err.	t	P> t
Lrexxval L1.	0.689646	0.0465025	14.83	0.000
lexuvssa	0.3158994	0.485785	0.65	0.517
lexuvssa L1.	-0.7194842	0.6928011	-1.04	0.301
lexpdomcpi	-0.4533525	0.201962	-2.24	0.026
limgdpco	0.0258293	0.0619897	0.42	0.678
lexgdinvcop	-0.612972	0.2289933	-2.68	0.008
lpwavafb	0.5720558	0.4199193	1.36	0.175
lexoexr	0.1435717	0.0302243	4.75	0.000
limreer	-1.584891	0.4577476	-3.46	0.001
lexgdpco	1.08677	0.2618684	4.15	0.000

  

Arellano-Bond test for AR(1) in first differences: z = -3.98 Pr > z = 0.000 Arellano-Bond test for AR(2) in first differences: z = 2.03 Pr > z = 0.043 Hansen test of overid. restrictions: chi2(218) = 143.12 Prob > chi2 = 1.000 F(10, 148) = 6998.32(0.000) Wald chi2(10) = 69983.16(0.000)				
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The test statistics of the above regression result indicate that, the Wald test for joint significance of the variables is rejected. By implication, the variables that are included in the model explain the dependent variable well. The Sargen / Hansen/ test for overall identification, which tests the consistency of the lagged values as instruments, also used in

constructing the moment generating function of system GMM and it is found to be highly significant. Owing to this, moment restrictions are found to be valid. The last but not the least concerning to the test statistics, is Arellano-Bond test of autocorrelation. The null hypothesis of the non-occurrence of first order as well as second order autocorrelation is accepted. It implies that variables in the model are not found to be serial correlated. One can assert that first differences of the lagged variables would also be uncorrelated. It supports that the instruments would also be serially uncorrelated. And hence, the instruments as well are tested to be exogenous making them fit the model under consideration.

The final disequilibrium model Goldstein-Khans' export determination function of will have the following form.

$$\begin{aligned}
 lrexxval = & .689644l.lrexxval + .3158994lexuvssa - .719484l.lexuvssa - .4533525lexpdomcpi \\
 & (14.83) \quad (0.65) \quad (-1.04) \quad (-2.24) \\
 & + .0258293limgdpc0 + .612972lexgdinvcop + .572055lpwavavfb + .1435717lexoexr - \\
 & (0.42) \quad (-2.68) \quad (1.36) \quad (4.75) \\
 & 1.584891limreer + 1.08677lexgdpc0^9 \\
 & (-3.46) \quad (4.15)
 \end{aligned}$$

In this model, the values within the bracket represent Windmeijer corrected standard errors.

From the variables which represent the demand side factors, we found that real effective exchange rate of the importing countries is found to be negatively related to the value of export. In addition, it is also found to be highly elastic. The importing country policy, which is domestic demand pressure, as well as their exchange rate policy is found to be biased against the imports of primary commodities from SSA. Importing countries policies are highly

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<sup>9</sup> Description of variables is provided in the appendix.

protective and blocked imports of primary commodities of SSAs' export. Their residents, as well, are not in favor of consuming goods originated from SSA. Moreover, REER also indicates that exchange rate policies adopted in the importing countries are also biased from the importing country.

**Table 6:** Two-step estimate of the dynamic Goldstein-khan model using two-step system GMM estimation technique. (Computed after Windmeijer finite-sample correction).

Dynamic panel-data estimation

Dependent variable lexuvssa				
regressors	Coef.	Corrected Std. Err.	t	P> t
lrexval	0.001774	0.0033051	0.54	0.592
lrexval L1	-0.0070455	0.0031093	-2.27	0.025
lexuvssa L1.	0.8580876	0.0283543	30.26	0.000
lexpdomcpi	0.1067226	0.0179515	5.95	0.000
limgdpco	0.0034519	0.0039711	0.87	0.386
lexgdinvcop	0.1286311	0.0194778	6.60	0.000
lpwavafb	0.0516739	0.0249653	2.07	0.040
lexoexr	-0.0052071	0.0019576	-2.66	0.009
limreer	0.0118603	0.0338214	0.35	0.726
lexgdpco	-0.1228695	0.0209821	-5.86	0.000

  

Arellano-Bond test for AR(1) in first differences: z = 1.98 Pr > z = 0.048	
Arellano-Bond test for AR(2) in first differences: z = -9.21 Pr > z = 0.000	
Hansen test of overid. restrictions: chi2(169) = 145.41 Prob > chi2 = 0.905	
F(10, 148)	= 217412.94
Prob > F	= 0.000

In the above regression, with the exception of importing country income and REER, significant result is found for most of the variables to explain the determinants of export. In the previous model the quantity exported is expected to adjust to the conditions of excess demand and export price is assumed to adjust to conditions of excess supply. Where as in this model export price fluctuations were determined by the demand side of the market and volume exported adjusted towards the exporters desired level. In this specification exporters are normally regarded as being price takers. Thus, the model is estimated by taking Browne's (1982) small country assumption into consideration. The parameters obtained from this model when compared with the previous estimation are found to be relatively small. In fact, the expectation from the theoretical explanation is supposed to be relatively higher. The possible explanation for this is that, at least in the short-run exporters are found to be price setters. Even in the traditional models of perfectly competitive markets, firms are assumed to be price setters in the short-run. Thus, the results are found to explain the conditions of the export marketing of the short-run.

# CHAPTER FIVE

## 5 Conclusions and Policy Recommendation

### 5.1 Conclusions

As discussed in the previous chapters, the export sector is found to be the most important source of foreign exchange earning for most of SSA countries. The sector's performance is affected by different factors which could be categorized as the domestic and the external environment. Among these factors policies pursued both at home and in the external world also play significant roll on primary commodity export. In this study, analysis is made to identify the implication of different factors on the export of primary commodities.

In view of the fact that both demand and supply factors contribute for the sector's performance. So, analysis is made by considering interdependence of these factors. Given their interdependence, a simultaneous equation dynamic econometric model is chosen. The model is also made to capture the lagged adjustment towards the equilibrium. The problem of endogeniety in a simultaneous equation model requires the model to be estimated using instrumental variable or two-stage least square (2SLS). The existence of lagged variable in the model also limits the utilization of IV or 2SLS. Thus, the study resorts its estimation procedure to generalized method of moments (GMM). The model is estimated using both system GMM and difference GMM. Robust estimate is found for system GMM using robust Windmeijer (2005) finite correction mechanism.

The estimated results show that, primary commodity export is found to be inelastic for most of the factors. Domestic factors like exchange rate, income, domestic investment, though inelastic, are found to be positively related with primary commodity export. Where as domestic price and road (infrastructure) do have a negative effect on the export sector. In addition, domestic capacity is found to have a strong force than the domestic demand pressure. This is reflected through positive result on the income elasticity of the exporting country.

When we look at the demand side factors, primary commodity export is found to be income inelastic. We can conclude that the fallacy of composition holds true, at least for the commodities under consideration. As stated in the literature review, SSA countries cannot significantly improve their export earning for the reason that they are competing each other for the residual world market. Had the income elasticity for export been high enough, all countries would have benefited from their export earning. Contrast to this, the opportunity to benefit from the export market is insignificant. The export market is unreliable as a mechanism of generating foreign exchange.

The coefficient for developed countries REER is also found to be elastic and negative for imports from SSA. Possible generalization is that importing country's environment is unfavorable to absorb primary commodity export from SSA. Furthermore, their policies are also found to be biased against imports of consumption goods which exhibits that their economy tends to be more closed. In general, the conclusion from the panel study is that primary commodity export is highly constrained by both domestic and external economy.

## 5.2 Policy Recommendation

The policy implication that could be inferred from the findings of the study is summarized as follows.

Since both the demands as well as the supply side factors are found to be highly inelastic for the export of primary commodity, there is scarce opportunity to benefit from the export of primary commodity. As a result, countries should shift from exporting highly inelastic primary commodities to other sources, if indeed they aim at improving their export earning. Bond (1987), for example, argued that East Asian Tigers, when they face high level of protection on agricultural export, shifted to the export of manufactured export where little restriction is imposed by the importing countries.

Trade as well as exchange rate policies pursued by importing countries are found to be obstacle for SSA countries to enjoy the benefits export of primary commodities. The policies adopted by the importing countries are beyond the control of SSA countries. What exporters can do is engage into negotiations to let the importing countries open their economies. Funny enough, in most trade negotiations exporting countries are expected to liberalize their market.

Income elasticity of import is also found to be insignificant, which is an empirical evidence for the fallacy of composition to hold true, at least for the export of primary commodities. Since all countries together cannot benefit from the export of primary commodity, they need to diversify their basket of export items or else should engage in the export of goods which are income elastic.

When we come to the domestic factors, rather than Goldstein-Khan model, Browne's model, which takes the small country assumption into consideration, came up with significant result. Even though most of the variables for the domestic factors are found to be significant, the coefficients are found to be inelastic. It implies that the domestic capacity indicators are weakly tied to the export sector. Thus, countries need to expand their domestic investment towards the export sector. In order to achieve better export earning and become competent in the world market construction of road, resource flow both in the form of domestic as well as foreign investment should be tied to the export sector.

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## **Appendix 1**

Countries in the sample

- 1 BENIN
- 2 BRUNDI
- 3 BURKINA FASO
- 4 CAMEROON
- 5 COTE D'IVOIRE
- 6 ETHIOPIA
- 7 GABON
- 8 GAMBIA
- 9 GHANA
- 10 KENYA
- 11 MADAGASCAR
- 12 MALAWI
- 13 MALI
- 14 MAURITIUS
- 15 MOZAMBIQUE
- 16 RWANDA
- 17 SOUTH AFRICA
- 18 SUDAN
- 19 TOGO
- 20 UGANDA
- 21 ZIMBZBWE

## Appendix 2

### How difference GMM and system GMM estimator operates

Given an estimable econometric equation having a characteristic of dynamics (lagged values of the explanatory variable as possible explanatory variable) as well as simultaneity, Baltagi (2005) and Wooldridge (2005) identified the problem with the classical estimation procedure. The authors revised different estimation procedures to tackle these problems. In addition, the authors also indicated how system GMM provides an efficient estimate over the others.

General dynamic econometric model has the following specification

$$y_{it} = \delta y_{i,t-1} + x'_{it} \beta + \mu_{it} \quad i=1, \dots, N, \quad N \rightarrow \infty$$
$$t=1, \dots, T, \quad T \text{ is fixed}$$

$\delta$  is scalar,

$x'_{it} \rightarrow 1 \times k$  the transpose of vector of explanatory variables are

$\beta \rightarrow k \times 1$  are vector of parameters to be estimated

$\mu_{it} \rightarrow$  which is assumed to follows one way error component model. This error term could be subdivided in to country, firm or generally unit of analysis and time varying error term as follows

$$\mu_{it} = \mu_i + v_{it}$$

$\mu_i \sim iid(0, \delta_\mu^2)$  and  $v_{it} \sim iid(0, \delta_v^2)$  are country specific and time as well as cross sectional unit varying (idiosyncratic) error terms having a normal distribution.

$y_{it}$  is a function of  $\mu_i$  and  $y_{i,t-1}$  will also be a function of  $\mu_i$

Thus,  $y_{i,t-1}$  would be correlated with  $\mu_i$   $y_{i,t-1}$

Fixed effect (FE) estimate which wipes out the within transformation  $\mu_i$ , but  $(y_{i,t-1} - \bar{y}_{i,-1})$  where  $\bar{y}_{i,-1} = \sum \frac{y_{i,t-1}}{T-1}$  will still be correlated with  $(v_{it} - \bar{v}_i)$ . This is because  $y_{i,t-1}$  is found to be correlated with  $\bar{v}_i$ . The average error ( $\bar{v}_i$ ) is correlated with  $v_{i,t-1}$ . Thus,  $v_{i,t-1}$  would certainly be correlated  $y_{i,t-1}$ .

Random effect (RE) estimates, which utilize the generalized least square residual (GLS) technique, are still found to be correlated since  $(y_{i,t-1} - \theta \bar{y}_{i,t-1})$  is correlated with  $(\mu_{it} - \theta \bar{\mu}_{i,-1})$ .

Anderson and Hsiao (1981) came up with relatively better option of handling the problem of endogeneity by simply differencing the original equation and hence the error term ( $\mu_i$ ) vanishes and then using  $\Delta(y_{i,t-2}) = (y_{i,t-2} - y_{i,t-3})$  or simply  $y_{i,t-2}$  as instrument for  $\Delta(y_{i,t-1}) = (y_{i,t-1} - y_{i,t-2})$ . These instruments will not be correlated with  $\Delta v_{it} = v_{i,t} - v_{i,t-1}$  as long as  $v_{it}$  are not correlated with themselves. The resulting estimates are found to be inefficient since it did not utilize the required moment condition in generating the estimates. In addition, when differencing procedure is conducted, it is not conducted over the residuals ( $\Delta v_{it}$ ). Add to this, the estimates are susceptible for the occurrence of serial correlation.

Arellano and Bond (1991) suggested a relatively better instrument for the lagged dependent variable so that the model to be estimated using instrumental variable method (IV). He

proposed a generalized method of moments (GMM) using  $\Delta y_{i,t-2}$  as an instrument than  $y_{i,t-2}$  (which Anderson-Hsiao used as an instrument).

In order to get a consistent estimator for  $\delta$ , Arellano (1991) first differenced the original equation to remove the individual effects which creates noise in the estimates i.e. at  $t=2$ , we will have the following expression,

$$(y_{i,t-1} - y_{i,t-2}) = \delta(y_{i,t-1} - y_{i,t-2}) + (v_{it} - v_{i,t-1})$$

In this case,  $y_{i1}$  will be a valid instrument for the reason that it is correlated with  $(y_{i,2} - y_{i,1})$  but not with  $(v_{i,1} - v_{i,2})$  given the condition that  $v_{it}$  are not serially correlated. At  $t=3$ , i.e. at the second stage differencing (period 2) we will have

$$(y_{i,4} - y_{i,3}) = \delta(y_{i,3} - y_{i,2}) + (v_{i,4} - v_{i,3})$$

In this stage, the possible instruments would be  $y_{i,2}$  and  $y_{i,1}$  for  $(y_{i,3} - y_{i,2})$ , since  $y_{i,2}$  and  $y_{i,1}$  are not correlated with  $(v_{i,4} - v_{i,3})$ . When the time span expands, a set of possible instruments will be generated. The set will contain  $(y_{i,1}, y_{i,2}, y_{i,3}, \dots, y_{i,T-2})$  as possible instruments to take care of predetermined values until time T.

Such an IV procedure still does not account for the differenced error terms  $(v_{i,t} - v_{i,t-1})$ .

In order to account for the differenced error term, two-step estimation procedure is conducted in the following way.

The variance of the error term is given by

$$E(\Delta v_i \Delta v_i') = \delta_v^2 (I_N \otimes G)$$

where  $\Delta v_i' = (v_{i,1} - v_{i,2}, \dots, v_{i,T} - v_{i,T-1})$  and

$$G = \begin{bmatrix} 2 & -1 & 0 & \dots \\ -1 & 2 & -1 & \\ 0 & -1 & 2 & -1 \\ \vdots & & & \ddots \\ & & & & \ddots & -1 & 0 \\ & & & & -1 & 2 & -1 \\ & & & & 0 & -1 & 2 \end{bmatrix} \quad w_i = \begin{bmatrix} (y_{i,t}) & & & & & & 0 \\ & (y_{i,1}, y_{i,2}) & & & & & \\ & & \ddots & & & & \\ 0 & & & & & & (y_{i1}, \dots, y_{iT-2}) \end{bmatrix}$$

$w_i$  is the matrix of instruments, which could also be represented as  $w = [w'_1, w'_2, w'_3, \dots, w'_N]$

The moment equation is given by  $E[w'_i \Delta v_i] = 0$

Multiplying the difference equation by  $w'_i$  will give us

$$w'_i \Delta y = w'_i (\Delta y_{i-1}) \delta + w' \Delta w$$

If we apply GLS, it gives one-step consistent estimation for  $\delta$ , represented as follows

$$\hat{\delta}_1 = [(\Delta y_{-1})^{-1} w (w' (I_N \otimes G) w)^{-1} w' (\Delta y_{-1})]^{-1} \times [(\Delta y_{-1})^{-1} w (w' (I_N \otimes G) w)^{-1} w' (\Delta y_{-1})]$$

The optimal GMM estimator for  $\delta$  using the above moment restriction will give a similar

result except  $w' (I_N \otimes G) w = \sum_1^N w'_i G w_i$  in the above expression will be replaced by

$$V_N = \sum_1^N w'_i (\Delta v_i) (\Delta v_i)' w_i$$

The GMM estimator unlike other estimation procedures does not require an initial condition on the type of distribution of both  $\mu_i$  and  $v_i$ .

The two-step differenced GMM estimator is derived as by replacing  $\Delta v$  with differenced residuals obtained from by the first stage estimate of  $\hat{\delta}_1$ .

Arellano bond first difference GMM estimator is given by

$$\hat{\delta}_2 = [(\Delta y_{-1})^{-1} w \hat{V}_N^{-1} w' (\Delta y_{-1})]^{-1} \times [(\Delta y_{-1})^{-1} w \hat{V}_N^{-1} w' (\Delta w)]$$

A consistent estimate for the variance ( $\text{var}(\hat{\delta}_2)$ ) is given by

$$\text{var}(\hat{\delta}_2) = [(\Delta y_{-1})^{-1} w \hat{V}_N^{-1} w' (\Delta y_{-1})]$$

If the idiosyncratic error term is asymptotically normally distributed, i.e.  $v_{it} \sim iid(0, \delta_v^2)$ , then  $\hat{\delta}_1$  (the first stage estimate) will be equal to  $\hat{\delta}_2$ .

When there are equations having additional endogenous variables along with the lagged dependent variable and some other additional strictly exogenous variables, unlike the difference GMM estimator in Arellano and Bond (1991), Blundell and Bond (1998) estimation procedure handles the problem of endogeneity created by the additional endogenous variables as well as the lagged dependent variables using the method referred as system GMM. In system GMM the estimation procedure and the moment conditions are similar but with slight modification. In system GMM, the difference GMM estimator is extended by using lagged differences of  $y_{it}$  as instruments for equations in levels, in addition to lagged levels of  $y_{it}$  as instruments for equations in first differences. That is

$$w = [w'_1, w'_2, w'_3, \dots, w'_N, x'_i]$$

where  $x'_i$ 's are the additional exogenous variables

System GMM uses lagged differences of  $y_{it}$  as instrument for equations in levels in addition to lagged levels of  $y_{it}$  as instruments of equations in first differences. Thus, the set of possible instruments which takes care of endogeneity is given by

$$(y_{i,1}, y_{i,2}, y_{i,3}, \dots, y_{i,T-2}, \Delta y_{i,1}, \Delta y_{i,2}, \Delta y_{i,3}, \dots, \Delta y_{i,T-2})$$

What makes system GMM estimator to provide better estimate are; first it takes care of both the problem of endogeneity created from the lagged dependent variables as well as other endogenous variables that would create inconsistent estimates in either IV or difference GMM.

Using such procedure, the resulting estimates are found to be highly efficient. The matrix of instruments takes care of the problem of endogeneity created as a result of including both lagged dependent variable and other explanatory variables in the model.

In system GMM, the second stage estimates are from the residuals after substituting the first stage estimate. This would result in the second stage estimates to be biased downward. To handle this problem estimation should be made after correcting for the downward bias. To do so, Windmeijer (2005) generated a method of tackling the problem of this downward bias. In the estimation stage, we provide robust standard errors which accounts for the downward bias using such procedure.

### **Appendix 3**

*lrexxval*:- log of real value of export of primary commodity

*l.lrexxval*:- lagged value of export of primary commodity

*lexuvssa*:- price of export

*l.lexuvssa*:-lagged price of export

*lexpdomcpi*:-log of domestic price indices approximated by domestic CPI

*limgdpcg*:-log of importing country domestic GDP

*lexgdinvcop*:- log of exporting country domestic investment

*lpwavafb*:- log of world market price

*lexoexr*:- log of exchange rate of domestic currency per dollar

*limreer*:- log of the real effective exchange rate of the importing country

*lexgdpcg*:- log of GDP of the exporting country

*lgcapcu* :- log of gross capital formation of the exporting country

*lexroad* :- log of roads in kilometer(average)

*l.* in the estimated result (tables) represent lagged values of variable.

## Appendix 4

Illustration on how to run dynamic panel data estimation in stata  
(how to set the command)

```
xtabond2 lrexxval l.lrexxval lexuvssa l.lexuvssa lexpdomcpi limgdpco lexgdinvcop
lpwavafb lexoexr limreer lexgdpco, gmm(l.lrexxval l.lexuvssa) gmm ((lexuvssa
lexoexr limreer), lag(2 .)iv(lpwavafb lexpdomcpi limgdpco lexgdpco lexgdinvcop,
eq(level) p) small twostep r nocons level(99)
```

Dynamic panel-data estimation, two-step system GMM after Windmeijer finite-sample  
correction

```
-----
Group variable: exid                Number of obs    =    1027
Time variable : year                Number of groups =    148
Number of instruments = 180         Obs per group: min =     1
F(10, 148)    =    7048.88          avg =    6.94
Prob > F      =     0.000           max =    10
-----
```

		Corrected				
	Coef.	Std. Err.	t	P> t	[99% Conf. Interval]	
lrexxval						
l1.	.6768099	.0551935	12.26	0.000	.5327849	.8208348
lexuvssa						
--.	.233601	.4537124	0.51	0.607	-.9503416	1.417544
l1.	-.6698901	.6555476	-1.02	0.309	-2.380513	1.040733
lexpdomcpi	-.4406341	.2039722	-2.16	0.032	-.9728905	.0916224
limgdpco	.0296511	.0596347	0.50	0.620	-.1259631	.1852654
lexgdinvcop	-.5532946	.204872	-2.70	0.008	-1.087899	-.0186901
lpwavafb	.5790524	.4086908	1.42	0.159	-.4874086	1.645513
lexoexr	.1329373	.0345204	3.85	0.000	.0428577	.2230168
limreer	-1.523595	.4660763	-3.27	0.001	-2.739801	-.3073889
lexgdpco	1.028137	.2429695	4.23	0.000	.3941187	1.662155

```
-----
Arellano-Bond test for AR(1) in first differences: z = -3.97 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = 2.02 Pr > z = 0.043
Hansen test of overid. restrictions: chi2(170) = 143.52 Prob > chi2 = 0.931
-----
```

## Appendix 5

Formula for computing real effective exchange rate (REER) using consumer price index is defined as:

The REER for country j at time t is defined as

$$REER_{jt} = \sum_{i=1}^n \alpha_{ij} \left[ \frac{(P_j R_{ji} / P_i)_t}{(P_j R_{ji} / P_i)_b} \times 100 \right]$$

Where n is the number of trading partners

t is the time period

P<sub>j</sub> is prices of country

b represents time period preferred to be the base year, in the data set the base year is 2000.

R<sub>ji</sub> is the exchange rate defined as the number of country i's currency per unit of country j's currency (in the data set all the currencies are described in terms of us dollar)