# REAL EXCHANGE RATE MISALIGNMENT AND AGRICULTURAL TRADE: A PANEL ANALYSIS

**BY**

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## CERTIFICATION OF DISSERTATION

The undersigned certify that they have read and recommended for submission to the department of Agricultural Economics and Development, in partial fulfilment of the requirements for the Bachelor of Science Honours degree in Agricultural Economics and Development, a research project by Mazorodze Brian Tavonga entitled:

**REAL EXCHANGE RATE MISALIGNMENT AND AGRICULTURAL TRADE: A PANEL ANALYSIS**

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# DEDICATION

To Hellen T Kajawu

## ABSTRACT

Literature focusing on real exchange rate (RER) misalignment and agricultural trade is inconclusive and far from convincing. Against this background, the study sought to examine the impact of RER misalignment on agricultural exports using a panel data set of 20 countries covering the period 1983-2006. The equilibrium RER is first estimated using the Dynamic Ordinary Least Squares technique and deviations from this equilibrium level are termed RER misalignment. The calculated misalignment measure is then inserted in the export model as a covariate. Pre-estimation checks suggested that export determinants follow a non-stationary process (a random walk with a drift) and are cointegrated. Using the Feasible Generalized Least Squares technique to control for heteroscedasticity and contemporaneous correlation across countries, the study indicates that RER misalignment has a detrimental effect on agricultural exports and the effect is non-linear. This result is robust to estimation by the instrumental variable technique to control for endogeneity and simultaneity of the exchange rate. Against this background, policymakers in these countries should work to eliminate currency misalignment through maintaining clean floats otherwise pegged rates should remain in tandem with the equilibrium level suggested by their long term fundamentals.

**Key Words:** Real Exchange Rate, Equilibrium Real Exchange Rate, Real Exchange Rate Misalignment, Overvaluation, Undervaluation, Agricultural Exports, Fundamentals

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## LIST OF ABBREVIATIONS AND ACRONYMS

BEER……………………………….....Behavioural Equilibrium Exchange Rate

DEER…………………………………Desired Equilibrium Exchange Rate

FEER……………………………….....Fundamental Equilibrium Exchange Rate

FELS…………………………………Fixed Effects Least Squares

FGLS…………………………………Feasible Generalised Least Squares

GDP…………………………………..Gross Domestic Product

PDOLS……………………………….Panel Dynamic Ordinary Least Squares

PEER……………………………….....Permanent Equilibrium Exchange Rate

PMG………………………………….Pooled Mean Group

POLS…………………………………Pooled Ordinary Least Squares

PPP…………………………………...Purchasing Power Parity

REER…………………………………Real Effective Exchange Rate

RER…………………………………..Real Exchange Rate

UNCTAD…………………………….United Nations Conference of Trade and Development

WDI…………………………………..World Development Indicators

WTO…………………………………World Trade Organisation

# CHAPTER ONE – INTRODUCTION

## 1.1 Background of the study

The sluggish growth in agricultural exports in Sub-Saharan Africa and the outstanding record in developing Asia over the years is not without posing serious concerns to policy makers across the globe as to why export growth differs so much across countries. The reason for this economic disparity is a central issue for economic policy and planning, and cross country empirical work on this topic has evolved over the last three decades. Amid the existing debate is the question: what drives agricultural trade in developing countries?

Basically, trade in developing countries and in particular Africa has been hampered by deep macroeconomic constraints ranging from, but not limited to, inadequate economic incentives, institutional rigidities and inappropriate exchange rate policies. Sachs (1985), Toulaboe (2006) and Dubas (2005) however alludes to the fact that differences in economic experiences across continents is due to exchange rate policies while the World Bank (1984) indicated that overvalued currencies ignited a concomitant decline in agricultural exports in developing economies.

While theory suggests that trade is mainly driven by resource endowments and comparative advantage, empirical studies stress the role of domestic and external policies in fostering trade and the gap between theory and application has been widening over the years. Among domestic policies are the fiscal, monetary and exchange rate policies which when taken together are arguably fundamental determinants of trade (Mazorodze, 2013 and Eichengreen, 2008). Central to the latter policy is the concept of real exchange rate (RER) misalignment, a topic which has ignited extensive debate among policymakers and whose literature remains unsettled.

Conceptually, RER misalignment denotes a deviation of the actual RER from its long run equilibrium level where equilibrium level refers to the RER that prevails when the economy is simultaneously in internal and external balance (Edwards, 1989 and Elbadawi and Soto, 1995*).* Accordingly, internal balance occurs when the economy is operating at full capacity output while external balance refers to a sustainable current account position given a country's desired capital stance (Terra and Valladares, 2010).

The effect of RER misalignment on agricultural trade is not so obvious. As indicated by World Trade Organisation (WTO) director Pascal Lamy when opening a WTO Geneva seminar on exchange rates in 2012, the debate concerning currency misalignments and trade is as old as the general agreement on tariffs and trade (GATT) but the relationship remains far from clear. Conventional wisdom however suggests that misalignment can either distract or promote trade depending on whether the currency is overvalued or undervalued. These two forms of misalignment are presumed to have counter effects on trade. In particular, it is believed that undervaluation may encourage exports as confirmed by Jian (2007), Rodrick (2009) and Gala and Lucinda (2006) while overvaluation is generally perceived as a greater concern as it is expected to deter economic growth (Rey, 2006). Contrary to that, Collins and Razin (1997) argue that overvaluation only hurts growth when it exceeds the 25 percent mark otherwise it would be beneficial to economic perfomance. On the other hand, Abeysinghe and Yeok (1998) argue that undervaluation lowers the propensity to import while overvaluation may not necessarily hurt growth as it promotes importation of inputs that stimulate local production. Against this background, uniform policy guidance can hardly build up upon these ambiguous outcomes.

### 1.2 Problem Statement

Empirical literature remains inconclusive regarding the impact of RER misalignment on trade despite economics of exchange rates being topical for quite long. As a result, it is extremely difficult to make policy inferences. It is also against this background that concerns about RER misalignment and trade have remained recurrent in international policy discussions (including the 2011 G20 meeting held in Paris and the 2012 WTO exchange rate-trade seminar held in Geneva). For some authors (Collins and Razin, 1997 and Ganyaupfu, 2013) RER overvaluation distracts economic growth through the loss in export competitiveness while undervaluation would promote exports (Korinek and Serven, 2010). Within the bag of mixed results Masunda (2011) seems to hold a long standing view that neither overvaluation nor undervaluation is palatable for growth while the success stories of Asia through currency undervaluation casts doubts and questions on the validity of Masunda’s (2011) finding. Combining all this evidence makes it difficult to answer conclusively how misalignment affects international trade rendering this study timely.

### 1.3 Main objective

To examine non-linear effects of real exchange rate misalignment on agricultural trade

#### 1.3.1 Specific objectives

1. To establish the impact of real exchange rate undervaluation on agricultural exports.
2. To establish the impact of real exchange rate overvaluation on agricultural exports.

### 1.3.2 Research hypotheses

1. Real exchange rate undervaluation has no impact on agricultural exports.
2. Real exchange rate overvaluation has no impact on agricultural exports.

### 1.4 Justification of the study

In spite of the general view that RER is a fundamental economic variable, the non-linear effects of RER misalignment are not thoroughly understood against the background of limited literature on RER misalignment and agricultural trade. To the best of my knowledge, emphasis on non-linear effects of RER misalignment has much been skewed towards economic growth and less effort has been made to examine the same concept on agricultural trade. The critical feature that many developing countries are agro-based whose success and failure is broadly embedded in the ticking of the agricultural sector makes them much more worried about RER fluctuations. This is certainly true because policies that cause instability in agricultural trade may cripple the entire economy through the forward and backward linkages which the agricultural sector has with other key sectors of the economy.

In this regards, the study is imperative as it adds to the existing scant literature on RER misalignment and agriculture trade by addressing the issue of non-linear effects using a relatively large sample that consists of diverse countries at different stages of economic growth. In a wider sense, the study facilitates an understanding of the relationship between RER misalignment and agricultural trade by probing whether overvaluation (undervaluation) promotes (distracts) export performance. The study is also timely in view of the current trade deficits in most parts of the world as well as international policy discussions on exchange rates whose tenet is to seek proper exchange rate policies that enhance export growth. Against the background of inconclusive literature, the study also helps in the formulation of national and international policies, (including the exchange rate policy) that would go a long way to help address not only agriculture trade but economic growth at large.

### 1.5 Organisation of the study

The remainder of this paper is organized as follows. Section 2 provides literature review. Section 3 describes methodology while results are presented and discussed in section 4. Section 5 contains conclusion, implications and suggestions for further study.

# CHAPTER TWO – LITERATURE REVIEW

## 2.1 Introduction

The entry point in this chapter involves definition of key terms. Thereafter, the chapter will present a theoretical model of deriving the equilibrium RER, theoretical literature as well as empirical studies related to RER misalignment and agricultural trade.

## 2.2 Definition of key terms

**Real exchange rate –** Following Baffes, Elbadawi and O'Connell (1999), the RER is defined in this study as the relative price of tradable to non-trade goods.

**RER misalignment –** According to Cheng and Orden (2005), RER misalignment refers to situation when the exchange rate is too depreciated or too appreciated. On the other hand, Baffes, Elbadawi and O'Connell (1999), defines RER misalignment as the gravitation of the actual RER from the equilibrium RER. Since the definition of Cheng and Orden (2005) does not have a certain benchmark or threshold which enables us to identify whether or not the exchange rate has been misaligned, this study follows the definition of Baffes, Elbadawi and O'Connell (1999), which has a certain benchmark such that an actual RER above the equilibrium value denotes RER overvaluation while an actual RER below the equilibrium value signify RER undervaluation.

**Equilibrium real exchange rate –** Following the Baffes, Elbadawi and O'Connell (1999), this study defines the equilibrium real exchange rate as the predicted values of RER obtained after regressing the actual RER against a set of fundamentals.

**Fundamentals –** These are macro-economic variables that influence the RER in the long run and they include government consumption, capital inflows, openness and excess credit.

**Overvaluation –** Following the Baffes, Elbadawi and O'Connell (1999), the real exchange rate is said to be overvalued if the actual RER is above the equilibrium RER.

**Undervaluation –** Following the Baffes, Elbadawi and O'Connell (1999), the real exchange rate is said to be undervalued if the actual RER is below the equilibrium RER.

**Agricultural exports –** Agricultural exports can be categorised into different digit levels but this study defines them as the monetary value of all agricultural exports at aggregate level.

### 2.3 Theoretical Framework

#### 2.3.1 Estimating the Equilibrium Real Exchange Rate

Estimation of equilibrium RER is a challenging empirical problem because the RER exchange rate is not directly observable. The controversy in estimating the EREER however boils down to three distinct approaches: the purchasing power parity (PPP), the black market premium and the model based approach.

#### 2.3.2 The Purchasing Power Parity Approach

The PPP assumes a static equilibrium value throughout the period and calculates the misalignment by deducting the actual RER from some base year in which case the RER is believed to be in equilibrium. This approach however considers the RER as an immutable number which is time invariant. In practical, the equilibrium RER is not static and moves over time as the economy's fundamental factors move.

#### 2.3.3 The Black Market Premium Approach

This approach measures misalignment basing on the black market exchange rate. Under this approach, misalignment occurs when the parallel market and official exchange rates exhibit deviations. However, previous studies found that this method tends to overstate the degree of misalignment in emerging economies (Ghura and Grennes, 1993).

#### 2.3.4 Model Based Approach

The model-based approach offers a wide range of theories and techniques which include the fundamental equilibrium exchange rate (FEER), desired equilibrium exchange rate (DEER), natural rate of exchange rate approach (NATREX), the behavioural equilibrium exchange rate approach (BEER) and the permanent equilibrium exchange rate (PEER). This technique is attractive as it treats the RER as a time variant factor which is determined by a number of economic fundamentals. As a result, we follow in this paper, a model based approach in estimating the equilibrium RER and measuring RER misalignment. Given the wide range of measures under this approach, the study uses the PEER since it is a long run measure. This study employs a cointegration technique which necessitates a PEER unlike other measures like the BEER and NATREX which are short to medium term measures. However, a thorough review of the merits and demerits of these model based approaches suggests that they are more complementary than they are competing.

### 2.3.5 The Theoretical Model of deriving the ERER

A theoretical model is employed to derive the equilibrium RER. Specifically, the study follows the work of Baffes, Elbadawi and O'Connell, (1999) who defines the equilibrium RER as the value which prevails when an economy which produces tradable and non-tradable goods is simultaneously in internal balance (IB) and external balance (EB). The RER is theoretically computed as:

$RER=e=EP_T/P_N$ ……………………………………………………………………..…………1

From expression 1, $P_T$ refers to the price of tradable goods (TG), $P_N$ the local price of nontraded goods (NTG) and $e$ the foreign value of the domestic currency. The IB occurs when the labor and non-traded goods markets clear:

$y_N(e) = c_N + g_N = (1-\theta)\, e^*c + G_N$, where $\partial y_N/\partial ye < 0$………………………..……….2

Where ($y_N$) refers to the supply of NTG under full employment, ($c$) is private spending, ($\theta$) is a share of total spending allocated to TG and $g_N$ is the government spending (GS) of NTG. The above equation implies that IB holds when the supply of NTG under full employment, ($y_N$) is fully absorbed by private ($c_N$) and government spending on ($g_N$) NTG. Equation (2) depicts the link between RER and $c$ that is in line with the IB. From the position of IB, an increase in $c$ facilitates some excess demand for NTG such a real appreciation is required to restore back the balance. Such a real appreciation of exchange rate switches economic resources towards the NTG sector, creating a demand in the TG sector. This therefore implies an inverse relationship between $c$ and the *RER*.

The EB is achieved when the level of spending and RER conforms to a sustainable current account. A balance in the current account ($\Gamma$) is defined as a sum of the trade balance ($\Psi$), unilateral transfers ($\upsilon$) and investment income (rf) that is:

$\Gamma = \upsilon + rf + \Psi$ ……………………………………………………………………….…3

The trade balance is expressed as the supply of TG ($y_T(e)$), sum of both government and private spending ($\phi c$) on TG.

$y_T(e) - g_T - (\theta + \phi)\, c + rf = 0$……………………..…………….............................................4

Where $f$ is the total net foreign assets, $r$ refers to yield on the foreign assets while ($\phi$) is a transaction cost that is associated with economic consumption. It is however reasonable to eliminate $r$ considering that majority of the countries under study are a small open economies which face binding credit ceiling. Additionally, ($\phi$) is dropped for simplicity sake. The EB implies the economy achieving a steady level of change in $f$ in the economy. The change in $f$ is expressed as:

$f = y_T(e) - \theta c - g_T + rf$ where $\partial y_N / \partial ye > 0$

The expression is also capable of tracing the link between *RER* and *c*. From a state of EB, an increase in *c* induces a deficit of current account ceteris paribus. In such a case, a real depreciation is imperative to channel the resources to the tradable goods sector creating a demand NTG to such that an EB can be restored. This shows a positive correlation existing between the *RER* and *c*. Combining equations (2) and (3) assuming EB in the long term, a RER (e*) which facilitates equilibrium can be written as follows:

$e^* = e^*(_{GN}, _{GT}, \eta, \tau)$ ………………………………………………………………...………...5

From expression 5, the symbol $\eta$ refers to a measure of internal trade policy and $\tau$ refers to external terms of trade (TOT). Given that our sample consists of many small economies, it implies that the prices of exportable goods ($P^*_x$) and the importables ($P^*_m$) are determined exogenously implying that the corresponding local prices are:

$P_x = E\,(1 - t_x)\, P^*_x$ and $P_m = E\,(1 + t_m)\, P^*_m$ ……………………………………………6

Tax of imports and exports are represented by $t_x$ and $t_m$ while the nominal exchange rate is denoted by E. The domestic relative price of exports and imports is given by:

$\frac{Px}{Pm} = \frac{(1 - tx)}{(1 + tm)} \frac{P*x}{P*m} = \frac{\tau}{\eta}$ Where $\tau = \frac{P*x}{P*m}$ , $\eta \frac{(1+ tm)}{(1- tx)}$ ……………………………7

Symbol ($\eta$) denotes the terms of trade. The model can also be upgraded by adding an element of technological advancement as well as excess credit. The final model of the equilibrium RER takes the following form.

$e^* = e^*(_{GN}, _{GT}, \eta, \tau, \lambda, \vartheta)$ ……………………………………………………………….8

The final model will then be:

$e^* = \gamma' F_t$ ………………………………………………………………………………….....9

Where $e^*$ denotes the long term equilibrium RER, F signifies a vector of exchange rate fundamentals while and $\gamma$ is a vector containing long run coefficients. The fundamentals included can be considered as representing four major economic positions which include (1) local supply side factors stemming from rapid production growth in a TG sector (2) position of the fiscal policy (3) monetary policy and (4) global or external environment.

**2.4 RER Misalignment-Agricultural Trade Nexus**

Theoretically, RER misalignment affects agricultural trade through several channels. Firstly, an overvalued real exchange rate facilitates a loss in competitiveness of export producing firms within an economy (Pick and Vollrath 1994., and Elbadawi and Soto, 1995). This is because an overvalued exchange rate acts as an implicit tax to foreign customers which may compromise the financial health of agricultural firms. In this scenario, Dornbusch (1988) argues that sell of exports in the foreign economy becomes extremely difficult. If the country witnessing an overvalued exchange rate is large enough to influence the terms of trade, then the severity of overvaluation can be ameliorated through provision of subsidies such that agricultural firms are met half way in terms of costs.

On the other hand, Abeysinghe and Yeok (1998) postulates that the impact of an overvalued exchange rate are compensated by an increase in imports (particularly raw materials) which can be used by local agricultural producers in the production process. This is likely to be the case in developing countries whose agricultural sectors heavily rely on foreign raw materials such as fertilisers, seed and lubricants. For a developed country, the same may not hold.

Additionally, an overvalued real exchange rate means that foreign produced goods are now cheaper hence if overvaluation is not followed by trade restrictions, local residents will have a strong appetite for imports which in overall leads to revenue outflow thereby causing a balance of payment deficit. The net effect of an overvalued real exchange rate in this case will be a loss in the competitiveness of agricultural exports and while agricultural imports become cheaper, so the production of all traded goods is undermined (Elgali and Mustafa, 2012).

In trying to protect the influx proliferation of imports that may be generated by an overvalued exchange rate, another worse off problem may arise. The trade protection which should in the first place help to solve the problem actually fosters chronic overvaluation in the process as the trade restrictions tend to dampen the demand for foreign exchange by raising the price of foreign commodities. This result in an exchange rate that is more overvalued compared to the one which would have prevailed if the demand for foreign currency were not curbed by protection. The two are therefore mutually reinforcing; RER overvaluation ignites pressure for protection against cheap imports and this creates further overvaluation. In the end, local exports will remain negatively affected by real exchange rate overvaluation and exporters will see their profits compromised. As a result, firms in the export sector may cut back their levels of production (Toulaboe, 2006).

Contrary to overvaluation, undervaluation is argued to promote local exports by way of making them cheaper relative to other countries (Collins and Razin, 1997). By making local exports cheaper, the demand for local goods will increase and ceteris paribus, firms in the export sector will see their profits rise (Levy-Yeyati and Sturzenegger, 2007 and Korinek and Serven, 2010). Assuming that these profits are ploughed back in form of investments, it is more likely that agricultural exports will experience further increase. However, economic logic tells us that real exchange rate undervaluation by making local exports cheaper leads to deterioration in the terms of trade. Deterioration in terms of trade, will negatively affect the producer surplus of firms in the exports sector. Therefore apart from increasing the volumes of agricultural exports, an undervalued currency has a welfare effect of decreasing the producer welfare.

Notwithstanding the increase in the volumes of local exports, Kaminsky, Lizondo and Reinhart (1998) suggests that undervaluation gives with one hand by lowering the prices of exports but takes away with another hand by making imports expensive. Others (Masunda, 2011) have also asserted that the extent to which currency undervaluation is expected to improve export performance depends on what other countries will do. The basis of this argument is that even if a real exchange rate undervaluation promotes exports, this scenario would not exist if the trading partners undervalue at once.

**2.5 RER Misalignment and Trade: Empirical literature**

Empirical literature related to RER misalignment and international trade has evolved over the past two decades. Generally, related literature has focused on the effects of misalignment in its total form, overvaluation and undervaluation on agricultural trade using either the export demand model, import demand model or the aggregate trade model. In addition, majority of the studies have managed to base their empirical efforts on the premise of linear effects while few studies like Razin and Collins, (1997) Masunda (2011), Hausmann, Pritchett and Rodrik (2005) and Aguirre and Calderón (2006) have managed to examine non-linear effects. Some have been much concerned in exchange rate regimes basing on real exchange rate misalignment (Coudert and Couharde, 2008). In terms of the findings, there is a bag of mixed results with one category supporting the notion that undervaluation is panacea to exports growth, the other category showing that overvaluation is detrimental to export performance while the third category (Abeysinghe and Yeok, 1998) supports that neither undervaluation nor overvaluation matters for export performance. Others (Cho, Kim, Sun, Jin, and Koo, 2003) have also shown that overvaluation hurts the agricultural sector more than other sectors while the other branch of studies including Masunda (2011) found the effect uniform across sectors.

Using cross-sectional data, Bergstrand (1985) confirmed that exchange rate fluctuations are not important in influencing international trade. However, mixed findings were obtained at sectoral level. In particular, the study found an inverse relationship between export and real exchange rate in 9 cases, but revealed the opposite effect in 12 cases. The first drawback of this study is that the author used cross sectional data which fails to capture time movements and dynamics of macroeconomic variables. Secondly, the exchange rate was supposed to be normalised for a cross sectional comparison. Thirdly, as the study manifests itself, the study was limited only to the exchange rate and the concept of misalignment was not addressed.

Relying on an intertemporal equilibrium model by Edwards' (1989) of a small economy, Asfaha and Huda (2002) examined the impact of RER misalignment on the trade competitiveness in the case of South Africa between 1985:1 and 2000:4. Taking advantage of an Engle-Granger technique, the study found that misalignment of the RER adversely affected South African trade competitiveness. The variance decomposition technique indicated that RER misalignment accounted for a greater percentage in the variation of trade. The study was however technically limited in two aspects: after realising that variables were integrated of different orders, the researchers proceeded to use the Engle Granger technique which, to the best of my knowledge is not feasible when the variables are found to be integrated of different orders. Secondly, the author estimated the equilibrium RER using the ordinary least squares technique (OLS) which is exposed to endogeneity problems if any model covariate is correlated with the stochastic term.

Cho and Kyoung (2005) sought whether RER misalignment as measured by the purchasing parity deviations affects the agricultural sector more than other industries. Their study was motivated by the pre-held notion that agricultural sector is relatively more elastic and could therefore be affected more by an overvalued exchange rate than other sectors. Using the nominal exchange rate, the authors employed a panel data set from 1974-1999 and revealed that nominal overvaluation adversely affects exports while the opposite was true for undervaluation in the agricultural sector. While appreciating their usage of panel data techniques relative to time series, their study was associated with two key drawbacks. The first is that they used nominal exchange rate instead of a RER. Since majority of developing countries experienced different rates of inflation under the floating system, nominal exchange rate may be poor indicators of a country's competitiveness. The second pitfall of their effort is that they measured misalignment using the PPP parity which treats the exchange rate as an immutable number which is time invariant.

Jongwanich (2009) examined the nexus between RER misalignments and export behaviour in 8 Asian economies during the 1995–2008 periods using a reduced form model of export growth. The findings of this empirical effort were mixed as RER misalignment was found to have both negative and positive effects on exports. The pitfall of this empirical effort is that it disregarded the underlying data generation process by relying on the Hodrick and Prescott filter method. The danger of using the smoothed series is that a typical researcher ends up using data generated by a process which may produce misleading results. Moreover, the author did not properly handle estimation of the equilibrium RER and measurement of misalignment as he employed the Johansen and Juselius Maximum likelihood technique which is associated with frequent outliers in small sample sizes as was the case in Asfaha and Huda's (2002) paper.

Bourdon and Korinek (2011) examined the impact of exchange rate misalignment on agriculture, manufacturing and mining trade flows in China, and the United States using an autoregressive distributed lag model (ARDL) for a period of ten years. The authors found real exchange rate misalignment effects to be positive in some cases and negative in some cases. The first shortfall of Bourdon and Korinek's (2011) study is that they used an ARDL of which lagging agricultural exports as a covariate is not supported by conventional theory. Holding that constant, the study was also limited to using a relatively shorter sampling period and on top of that using an ARDL which by including lags in the model affects degrees of freedom leading to micronumerosity (problems of small sample sizes). Lastly, assessing the impact of misalignment on more than two sectors warranted the use of panel data techniques not time series.

Masunda (2011) analysed the effects of RER misalignment on three sectors of Zimbabwe relying on panel data for the period 1980-2003. The result of this empirical analysis revealed what apriori appeared to be a surprising result as undervaluation proved to hamper sectoral output. On the other hand, overvaluation was found to bear an adverse impact on sectoral output as expected. A ten percent increase in overvaluation and undervaluation was confirmed to delete about 7.5

percent and 2.6 percent of sectoral output respectively each year. The study was however limited in that it did not perform pre-estimation checks which include unit root and cointegration tests. These tests are imperatively important as they justify the model which the author ended up choosing. Secondly, the obtained findings could have been exposed to some bias and inconsistency as the study did not handle the reverse causality (simultaneity) as well as the endogeneity of the exchange rate. In practical terms, the real exchange rate responds to a variety policy shocks and in most cases, policies which facilitate a real depreciation are conventionally bad for sectoral growth for instance reversal of capital inflows or reduction in savings. In this regards, this source of endogeneity implies that any economist expect a negative relationship between sectoral growth and undervaluation. Against this background, it is highly likely that the seemingly surprising negative effect of undervaluation reflected the reverse causality from growth to the exchange rate. Lastly, growth in sectors on its own partly explains itself hence the author was supposed to have used a dynamic not a static model.

A study conducted by Elgali and Mustafa (2012) to evaluate the response of selected agricultural commodities to the RER overvaluation policy adopted by the Central Bank of Sudan and their effects on agricultural trade of the country confirmed a negative impact of overvaluation on the Sudanese agricultural exports sector. Taking advantage of a use multi-market model, the result of this study also demonstrated that anticipations of more overvaluation entails more decrease of the producer and consumer prices and resultantly a decrease in exports. Despite the partial equilibrium analysis being informative, the authors could have made their study more robust by taking advantage of econometric modelling. It would have been more interesting if the authors had used the dummy variable approach in which undervaluation would be the control group. As indicated by Baltagi (1991), econometrics remains very useful in estimating relationships and there is just no reasonable alternative.

Ganyaupfu (2013) empirically examined the effects of RER misalignment on South Africa's national exports using a quarterly data set that spanned from 2000:2 to 2011:4. Employing a single equation approach, the effect of real exchange rate misalignment where sought and the result of this empirical test confirms that RER misalignment distracts export growth. The study was however exposed to a number of shortfalls. In particular, the study could not proceed to examine the non-linear effects. Secondly, Ganyaupfu (2013) inherited the same mistake made by Asfaha and Huda (2002) of estimating the static model with OLS which is generally biased and non-normal in finite samples. Moreover, the author appears to have forgotten that data was in natural logarithms and ended up interpreting results as if data was in level terms.

On the other hand, Rodrick (1994) using panel data techniques found evidence in Korea and Taiwan that RER undervaluation does not have any significant impact on national exports. The findings of this study were totally in contrast with the empirical results of other studies like Bourdon and Korinek (2011) as well as Rodrick (2009) who all reported a positive impact of undervaluation on economic performance.

Within this contradictory empirical literature, our work follows the works of Ibrahima (2011) who used panel cointegration techniques for the period 1975-2004 in examining the nexus between RER misalignment and volatility and exports. Relative to other studies, we follow this study because it did not disregard the underlying data generation process and above all, it conducted both unit root and panel cointegration techniques. The results of Ibrahima's (2011) study revealed that misalignment discourages exports. We improve the study of Ibrahima (2011) by examining the non-linearities of misalignment through categorising total misalignment into undervaluation and overvaluation. We also include in our sample quite a number of countries lying at different growth stages.

### 2.6 Conclusion

Careful reading of the empirical literature reveals conflicting evidence. The net effect of misalignment on international trade is ambiguous. It has however been identified that government consumption, excess credit, terms of trade, capital inflows, technological progress and trade openness are the prominent variables that affect the RER. It has been identified as well that most of earlier studies failed to examine the non-linear effects of RER misalignment. The present analysis fills the gap literature by fragmenting misalignment into undervaluation and overvaluation and probe whether the two forms of RER misalignment have non-linear effects on agricultural trade.

In a nutshell, theoretical frameworks have also been detailed before theoretical and empirical literature related to RER misalignment and agricultural trade. In what follows, we provide the methodology used in examining the impact of RER misalignment on agricultural exports.

## CHAPTER THREE – METHODOLOGY

### 3.1 Introduction

This chapter presents the research methods undertaken to examine the relationship between RER misalignment and agricultural trade. The chapter specifically presents model specification and pre and post estimation tests. The entry point involves estimation of the equilibrium RER and measurement of RER misalignment.

### 3.2 Empirical model specification

#### 3.2.1 Equilibrium Real Exchange Rate

There are basically two steps required to compute the equilibrium real exchange rate. The first step is to regress the actual RER against a set of fundamental regressors derived in chapter 2. In the second step, the obtained coefficients are multiplied by the sustainable or permanent values of the RER fundamentals. Following the model derived in chapter 2, the RER is firstly regressed on its fundamentals using the log-log specification in equation 10.

$log(e^*)_{it} = \delta_0 + \delta \, logF_{it} + \varepsilon_{it} + v_{it}$ where $i = 1,2,\ldots, 20 : t = 1,2,\ldots, 24$……………………10

From the above specification, $log(e^*)_{it}$ is the natural logarithm of the equilibrium RER for country $i$ at time period $t$. $\delta$ is a vector of slope coefficients while $logF$ is a vector of long term fundamentals which are presumed to determine the equilibrium RER in their natural logarithm forms. The log-log model is chosen to improve the fit of the model and to reduce noise. The fundamentals contained in vector $F$ are the ones derived in chapter 2 but terms of trade was dropped due to data unavailability. Symbol $\varepsilon_{it}$ is the stochastic white noise error term which absorbs the influence of other factors omitted in the model while $v_{it}$ absorbs country specific effects. The specification also rests on a set of assumption which include linearity in parameters, non-autocorrelation, homoscedasticity, normal distribution of residuals, exogeneity of predictor variables and full rank in which the matrix of predictor variables which is the design matrix has to be invertible.

### 3.3 Variable Description and Justification

This section justifies inclusion of variables in the equilibrium RER model and proceeds to give a brief explanation regarding the theoretical link giving *apriori* expectations.

**3.3.1 Real Exchange Rate –** The RER enters the regression equation as a dependent variable and this rest on the notion that the RER is influenced by a number of fundamentals. The theoretical definition by Baffes, Elbadawi and O'Connell, (1999) is proxied by the CPI based real effective exchange rate obtained from UNCTAD. Note that this definition is not comparable across countries, but this is of no consequence for panel regressions which track the effects of changes in real exchange rates within countries.

**3.3.2 Trade Openness –** Trade openness is, in this study, defined as the sum of imports and exports to total GDP. Openness facilitates capital outflow causing a depreciation of the RER. The coefficient for openness is therefore expected to be negative.

**3.3.4 Government Consumption –** Changes in government consumption expenditure may affect the RER in either way. Since data regarding government expenditure on both TG and NTG is unavailable, government expenditure is used as a proxy for the two.

**3.3.5 Excess Credit –** Excess credit increases demand for non-tradable goods leading to a RER appreciation. The variable is measured as a ratio of money to gross domestic product and a positive sign is expected.

**3.3.6 Technological Progress –**Technological progress can affect the exchange rate in either way. This variable can be measured either using a simple time trend or the GDP per capita. However, Toulaboe (2000) asserts that an increase in GDP is usually associated with technological progress and this makes GDP per capita a better proxy for technological progress. In this regards, the study uses GDP per capita as a proxy variable.

**3.3.7 Capital Inflows –** The variable 'capital inflows' is proxied by the trade balance. Capital inflows create a demand for local goods leading to a higher price of non-tradables and a real appreciation. The sign on capital inflows is therefore expected to be positive.

**3.4 Measurement of RER Misalignment**

RER misalignment is measured by subtracting the estimated equilibrium RER from the actual RER. Defining $e_t$ as the observed value of the real exchange rate and $e_t^*$ as the equilibrium real exchange rate, if $e_t – e_t^* < 0$ then the currency is undervalued and if $e_t – e_t^* > 0$, then the currency is overvalued. In simple terms, a negative value denotes RER undervaluation while the converse holds for a positive value.

### 3.5 Real Exchange Rate Misalignment and Agricultural Trade

The calculated values of misalignment are then inserted in the agricultural export model as one of the explanatory variables. Unlike majority of earlier studies such as Ganyaupfu (2012), this study ensures that the export model consists of both demand and supply factors as follows:

$\log exports_{it} = \alpha + \delta MISAL_{it} + \beta X_{it} + f_i + f_t + \varepsilon_{it}$ where $i = 1,2,\ldots, 24 : t = 1,2,\ldots, 27$………11

The researcher's primary interest lies in the value of δ. Given the fixed-effects framework, what is being estimated is the "within" effect of misalignment (MISAL) namely, the impact of changes in under- or overvaluation on changes in agricultural exports within countries. X is a vector of other explanatory variables that are presumed to influence agricultural exports. $f_i$ and $f_t$ are fixed country and time dummies respectively while $\varepsilon_{it}$ is the disturbance term for country $i$ at time period $t$. Three equations are estimated. In the first equation, RER misalignment enters the specification in its total form, in the second equation, misalignment enters in form of overvaluation and in the third equation misalignment takes the form of undervaluation.

**3.5.1Government expenditure –** state interventions are expected to either increase or distract exports. Some authors are of the opinion that government expenditure crowds out private investment leading to a concomitant decline in sectoral growth. Some argue that government spending stimulates macroeconomic performance through elimination of market failures hence either a positive or a negative sign is expected.

**3.5.2 FDI –** foreign direct investment promotes diffusion of technology and creation of markets. The latter effect is likely to increase domestic agricultural production leading to an increase in agricultural exports. The variable is measured as FDI inflows.

**3.5.3 Capital controls –** capital controls are included to capture how current account liberalization impacts export performance. Theoretically, capital controls minimise global market integration and prevents currency crises thus agricultural exports are likely to increase. However, measuring this variable is far from easy. The traditional measurement is the ratio of exports plus imports to GDP. However this measurement partly contains agricultural exports and therefore the slope coefficient will be biased upwards. Against this background, this study uses a more recent measure by Chinn and Ito (2007). This measure purely takes into consideration current account transactions and therefore is not likely to bias the slope estimate[1].

[1] For more on measurement of capital controls using this measure, see Chinn and Ito (2007)

**3.5.4 Foreign income –** this variable captures foreign demand for agricultural exports and its effect depends on the income elasticity. The variable is measured as GDP of the country's most trading partner.

**3.5.5 Investment –** Investment may stimulate local agricultural production leading to an improvement in agricultural exports. Measured as gross capital formation, a positive sign is expected.

**3.5.6 RER Misalignment –** Total misalignment is expected to distract exports through distorting price signals while overvaluation (undervaluation) is expected to depress (promote) exports via increasing (lowering) the prices of agricultural exports respectively.

**3.6 Panel unit root tests**

Stationarity tests in time series are imperative to avoid running spurious regression (Kao, 1999). The study employs the tests of panel unit root due to Im, Pesaran and Shin (IPS) (2001) and the Fischer Augmented Dickey Fuller (ADF) test. The study employs two tests for robustness sake since each technique is not without its own limitations. The IPS equation is as follows:

$$\Delta y_{i,t} = \gamma_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \phi_{i,j} \Delta y_{i,t-j} + \varepsilon_{i,t} \; : i = 1,2, \ldots, 10 : t = 1,2,\ldots, 27 \ldots\ldots\ldots\ldots 12$$

Where $y_{i,t}$ represents each of the variable in our model, $\gamma_i$ is the unobserved fixed effect and $p$ is a coefficient which ensures the stochastic terms are uncorrelated with time. In this test, the null hypothesis for the IPS test holds that $\rho_i = 0$ *vis a vis* the alternative of $\rho_i < 0$. The IPS test statistic averages individually the ADF test statistics as follows:

$$t = \frac{1}{N} \sum_{i=1}^{N} (t_{i,T})$$

According to this expression, $t_{i,T}$ is the ADF *t-statistic* for *i* based on the individual-specific ADF regression. The IPS technique presumes that the test statistic asymptotically follows a normal distribution. The Fisher ADF test combines the probability values for the test statistic of a unit-root in each of the cross-sectional units. The Fischer statistic ($\Lambda$) is computed as:

$$\Lambda = -2 \sum_{i=1}^{N} \ln \pi_i$$

The study conducts unit root tests for the agricultural export model only not the equilibrium RER. This is because the equilibrium RER model is estimated using the panel dynamic ordinary least squares technique which bypasses the need for unit root tests.

### 3.7 Panel Cointegration Tests

The Pedroni's (1999) cointegration test is employed after establishing the order of integration. This approach captures the heterogeneity by way of including specific parameters that vary across all the individual members in the sample. The equation for this test is as follows:

$$y_{i,t} = \zeta_i + \lambda_i t + \delta_{1i} x_{1,it} + \delta_{2i} x_{2,it} + \ldots + \delta_{Mi} x_{M,it} + \varepsilon_{it} \quad i = 1\ldots N \quad t = 1\ldots T : m = 1\ldots M \quad \ldots 13$$

$N$ represents the number of countries included in the sample, $T$ is the number of observations; $M$ represents the number of all exogenous variables in the model. The Pedroni methodology has seven test statistics on panel cointegration test. Four of the seven tests rely on "within" dimension while the other three statistics rely on "between" dimensions. All of these tests are based on a null of no cointegration in the model.

### 3.8 The Hausman Specification Test

The Hausman test for fixed or random effects was not conducted in this particular study as heteroscedasticity was a serious problem in all specifications. The crucial point here is that the constant error variance assumption is not met, so there is no compelling reason for us to proceed testing whether unobserved effects are correlated or uncorrelated with the error term without dealing with the violation. Instead, the study conducted joint tests for country and time period effects to see whether it was necessary to include them in the model.

### 3.9 Method of Estimation

Several estimators can be used in panel data analysis. The pooled ordinary least squares (POLS) is one technique which does not consider the panel nature of data rendering its estimates biased due to heterogeneity between the error term and the regressors. The Johansen method on the other hand is a full information maximum likelihood technique which corrects for autocorrelation and endogeneity parametrically using a vector error correction mechanism (VECM) specification but is exposed to the problem of frequent outliers and model misspecification in finite samples. As a result, the study employs the Panel Dynamic Ordinary Least Squares (PDOLS) technique in estimating the equilibrium RER which corrects for endogeneity and serial autocorrelation through the Generalised Least Squares (GLS) procedure with the same asymptotic properties as the POLS technique. Moreover, a test for normality for the equilibrium RER model manifested that the disturbance terms were not normally distributed (see appendix 1) indicating the presence of serial autocorrelation and given too that the equilibrium RER model is likely to follow a non-stationary process as will be shown in the next chapter, this necessitated the use of panel DOLS.

With regards to estimation of the agricultural exports model, the Breusch Pagan test manifested that heteroscedasticity was a serious problem and given as well the presence of contemporaneous correlation across the countries, this necessitated the use of Feasible Generalised Least Squares technique. Another worry was the treatment of causality and endogeneity of the exchange rate. Since agricultural exports and the real exchange rate in a particular period are more likely to be jointly determined; the possibility of endogeneity bias in such regressions becomes quite obvious. On the other hand, another empirical difficulty here relates to isolating the causal effect of the exchange rate to exports. On this note, an assumption of a unidirectional causality[2] running from exchange rate to exports is more likely to exist on paper. In practical terms, exchange rate regulation in most countries largely reflects a reaction to export perfomance. For instance if export growth appears to be subdued; governments tend to deliberately undervalue their currencies and vice versa as is currently the case for China. With regards to endogeneity, an empirical difficulty here is that most of the variables that affect the real exchange rate are the same variables that affect exports and these include FDI[3]. These two problems (reverse causality and endogeneity) could bias the results hence effort was sought to ensure that the coefficients reflect the exact relationship between agricultural exports and RER misalignment.

This exercise was also part of robustness checks. To control for endogeneity and reverse causality (simultaneity) several estimators have been suggested in empirical literature. The commonly used is the Generalised Methods of Moments particularly the Arellano and Bond and Arrelano and Bover/Blundell technique. These are dynamic models which include a lagged dependent variable as one of the regressors and capitalises on the lagged terms of variables in level terms as instruments of the differenced or transformed endogenous regressors. However, in this particular case, relying on the GMM technique amounts to all drawbacks associated with an ARDL model since including lagged agricultural exports on the right hand side of the equation is not supported by conventional theory. There is no theoretical justification for such a specification hence proceeding with such a model will invite all problems associated with model misspecification. In

[2] It is also noteworthy that causation does not equal correlation. In practical terms, the experience of many countries has shown that instead, it is export perfomance which causes the exchange rate. Another possibility which may cause technical problems is that of omitted variables which may affect both exports and the exchange rate. Secondly, there is also a possibility that countries with more export growth are likely to face depreciated currencies and vice versa.
[3] It is noteworthy that most variables which drive the exchange rate are usually bad for export performance. For instance, FDI appreciates the RER through increasing the demand for tradable and non-tradable goods which resultantly retards exports growth. For more on endogeneity issues in panel analysis visit Wooldridge (2002).

addition, although the worry about potential endogeneity-bias in the export-misalignment regressions is quite justified in this case, it is not clear whether use of the Arellano-Bond GMM estimator is the best strategy to rectify this bias, because Monte Carlo studies have generally found this estimator to display large small sample bias. This renders the GMM technique inappropriate. Against the background of all these considerations, the study narrows down to the instrumental variable (IV) regression technique. Despite the fact that this technique has theoretical properties which are asymptotic and similar to those of the GMM, Monte Carlo studies have shown that, in general, estimators that do not use lagged values of the dependent variable as one of the explanatory variable perform better than those which do which makes the IV technique more attractive. Noteworthy though is that the lagged terms of endogenous variables are used as instruments and the choice for these instruments is aided by the covariance matrix which displayed some correlation. Moreover, since it is difficult to think of a variable that influences the RER without plausibly also having an independent effect on exports, the researcher had to control for those variables that are likely to influence both the exchange rate and agricultural exports.

### 3.10 Data Frequency and Sources

Data is from United Nations Conference of Trade and Development (UNCTAD), World Development Indicators (WDI) and World Trade Organisation (WTO) which are reliable data sources at international level. Unlike a host of earlier studies which focused on single country analysis, this study covers 20 countries that fall on different stages of economic development. The attractive feature of this broad sample is that it encompasses a greater variation in exchange rate policies in different countries and different continents. In fact, the researcher's view here is that it is quite impossible to use the experience of one country to get an accurate evaluation of trade implications from policies such as exchange rate policy. Moreover, the resultant high variability provided by different countries substantially reduces the problems of colinearity. However, one drawback of this kind of sample is that it is exposed to measurement error but the hope here is that the resultant variation and economic diversity across the countries dominates the noise. The list of countries included is given in appendix. The study stretches from 1980 to 2006 in order to target the era of exchange rate deregulation in the countries under study. To my knowledge, a period of 26 years after adjusting for the number of entities in the panel analysis should be long enough to reveal growth patterns of agricultural exports and to ask questions such as whether the agricultural exports respond to exchange rate policy changes in the long run. Data is annual and as

Barro (1991) asserts, relying on higher frequency data (such as monthly) in panel analysis would be largely guess work.

## 3.11 Diagnostic Tests

### 3.11.1 Model Specification Test

To confirm whether the model is correctly specified or not, we employ the Ramsey regression specification error test (RESET). This test attempts to capture whether any non-linear combination of regressors has power in explaining agricultural exports. If it does, then the model is misspecified. This test has the null hypothesis which holds that the model is correctly specified.

### 3.11.2 Heteroscedasticity

Heteroskedasticity describes a situation where the variance of the error terms is not uniform across all observations. Wooldridge (2002) describes this situation as a nuisance for statistical inference while Gujarati (2004) asserts that using the usual testing procedures in the presence of heteroscedasticity facilitates very misleading conclusions. The Breusch Pagan test is used as it is a large sample test. This test regresses the squared residual term against all the regressors and should the p-value of the whole model turn out to be significant, then null hypothesis of homoscedasticity is rejected otherwise it is accepted.

### 3.11.3 Multicolinearity

Multicolinearity is said to exist when there happens to be an exact linear relationship in the regressors. This is more or less violation of the full rank condition in which **X** has to be an $n \times K$ matrix with rank $K$. If this happens, then it would be difficult to isolate the effect of each of the regressors that are collinear in the model. Nonetheless, the degree of multicollinearity is not measured in this study as it is not much of a problem.  As indicated by Gujarati (2004), only students who are new to econometrics should worry about the multicollinearity because it violates no crucial regression assumptions. Unbiased, consistent estimates will occur, and their standard errors will be correctly estimated.

## 3.12 Conclusion

This chapter has presented model specification and diagnostic tests. In particular, the chapter has shown the equilibrium RER model as well as the agricultural exports model which contains the RER misalignment indicator.  The next chapter presents and discusses findings of the study.

# CHAPTER FOUR – RESULTS AND DISCUSSION

## 4.1 Introduction

This chapter presents the empirical findings of the study following the methodology outlined in the previous chapter. The chapter begins by presenting descriptive statistics followed by results of the equilibrium RER. The chapter proceeds to present pre and post estimation tests results before regression results.

## 4.2 Descriptive Statistics

Descriptive statistics are meant to provide a general description regarding the nature of data. They are imperative as they allow the researcher to observe the variability of variables included in the regression model and specifically, measures of central tendency including the mean, maximum and the minimum are presented. The study also shows the standard deviation, skewness, kurtosis and the total number of observations. This is reported in table 1.

**Table 1: Measures of Variability**

| | RER | Excr | Exports | Gcons | Kinfl | Openness | TechPro | FoY |
|---|---|---|---|---|---|---|---|---|
| Mean | 110. 2 | 45.8 | 1.8 | 14.1 | 59.0 | 58.3 | 34.1 | 10.4 |
| Maximum | 615.4 | 185.8 | 2.5 | 44.1 | 161.0 | 153.9 | 175 | 91.2 |
| Min | 0.1 | 4.9 | 2.3 | 3.8 | 0.09 | 21.8 | 31.5 | -43.5 |
| Std. Dev. | 73.7 | 36.3 | 5.4 | 6.9 | 14.8 | 22.7 | 33.3 | 17.7 |
| Skewness | 3.5 | 1.8 | 2.7 | 1.0 | 3.2 | 1.6 | 2.0 | 2.32 |
| Kurtosis | 3.5 | 3.2 | 3.2 | 2.3 | 3.5 | 3.3 | 3.6 | 3.3 |
| Observations | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

Source: Author's calculations

The above table shows that the RER has the highest variability of 73.7 relative to Exc full with 36.3, technological progress with 33.3 and openness with 22.7. The RER has also the highest mean of 110.2 followed by capital inflow with 59 while Exports have the lowest mean of 1.8. The skewness has values above than zero for all the variables indicating that these series are skewed to the right. This implies that the distribution has a long right tail for these variables. In exception of Gcons, all other variables have kurtosis greater than 3 meaning that the distribution has thicker tails than does the normal distribution.

### 4.3 Panel Dynamic (OLS) ERER Results.

Due to the problem of serial autocorrelation which manifested itself in the error terms which failed to satisfy the normality condition (see appendix 1), the Panel Dynamic Ordinary Least Squares (PDOLS) technique was employed. Moreover, the correlogram displayed highly significant Q-stats indicating presence of AR (1) type of serial correlation hence the PDOLS was augmented by a Markov First Order Auto Regression AR (1) model[4]. Given that the equilibrium RER was, in this study, estimated in the log-log form, it follows that they cease to be coefficients. They automatically become elasticities and hence they have to be interpreted as such. The fundamentals which were found to affect the RER in the long run are technological progress, excess credit and trade openness. Capital inflows and government consumption had expected signs but their effect was not significantly different from zero (see appendix 1).

#### 4.3.1 Measurement of Misalignment

An exposition of the actual RER, fitted and residual series is not displayed here for brevity sake but important is that the disequilibrium residuals are referred to as RER misalignment. The generated misalignment variable is displayed in figure 1.

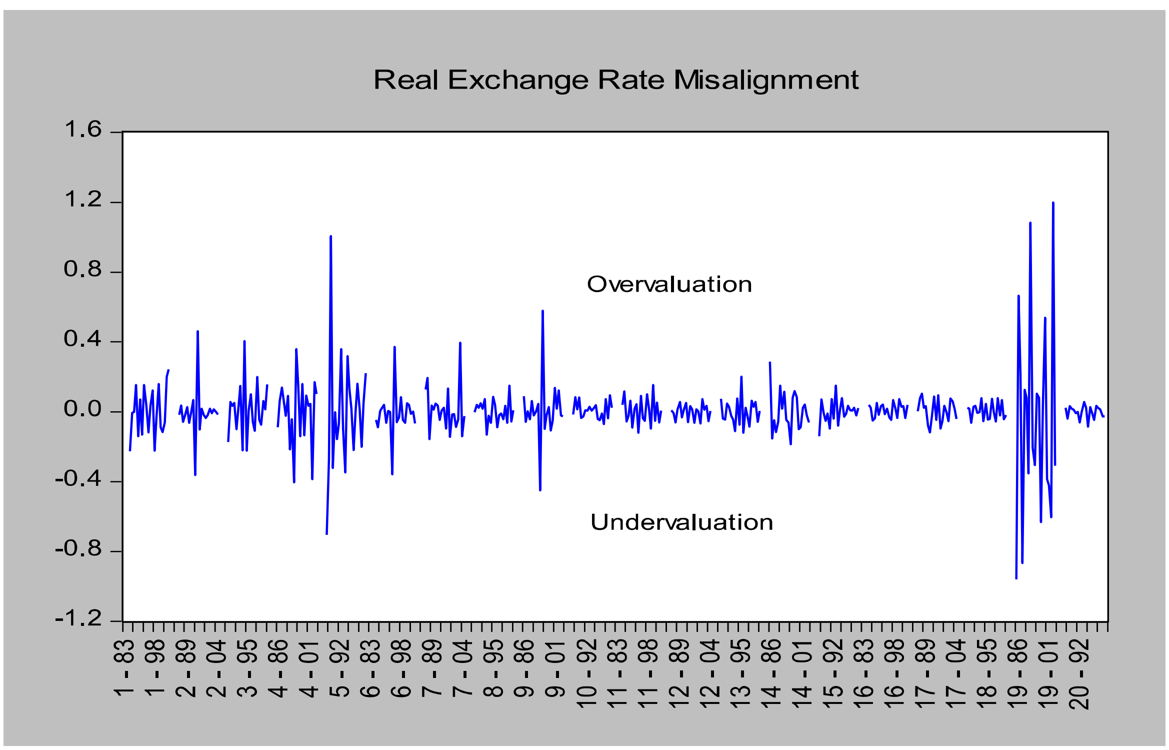


**Figure 1: Real Exchange Rate Misalignment for 20 Countries**

[4] Note that the Durbin Watson statistic is inappropriate in dynamic models as it fails to detect first order correlation.

A visual analysis of figure 1 demonstrates that the RER was misaligned during the study period. A look at the distribution in figure 2 shows that the misalignment variable is almost normally distributed. Evidence also exists in the histogram that the RER has been exposed to all forms of misalignment (undervaluation and overvaluation) in the countries under study.

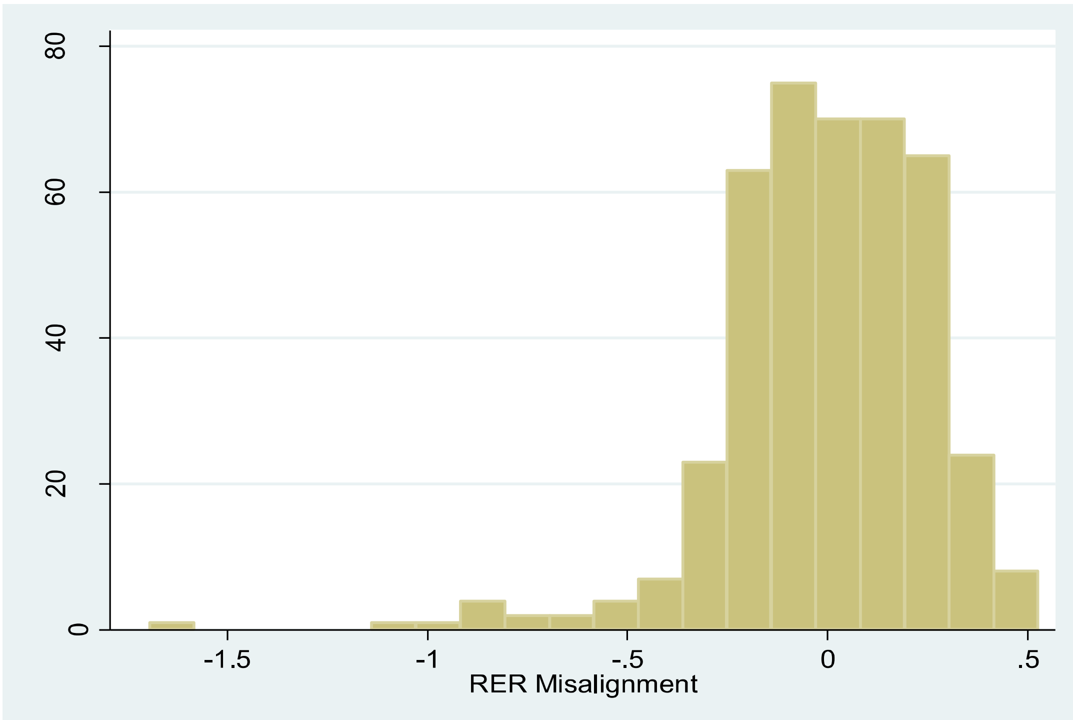


**Figure 2: Distribution of RER Misalignment**

### 4.3.2 Pre and Post Estimation Tests

Having established that the real exchange rate was misaligned in these countries during the study period, the next step was to examine the time series properties of the data before examining the relationship between real exchange rate misalignment and agricultural trade.

### 4.3.3 Unit Root Tests

Results of the unit root tests are reported in table 2.

**Table 2: Panel Unit Root Tests**

| Variable | Levels | | First Difference | | Implication |
|---|---|---|---|---|---|
| | IPS | F-ADF | IPS | F-ADF | |
| Agricultural Exports | 0.9914 | 0.4111 | 0.0000 | 0.0000 | I(1) |
| Government expenditure | 0.700 | 0.9999 | 0.0000 | 0.0000 | I(1) |
| Misalignment | 0.6681 | 0.2502 | 0.0000 | 0.0000 | I(1) |
| Investment | 0.8057 | 0.5817 | 0.0000 | 0.0000 | I(1) |
| Capital controls | 0.8535 | 0.2303 | 0.0000 | 0.0000 | I(1) |
| Foreign direct investment | 0.7631 | 0.6212 | 0.0000 | 0.0000 | I(1) |
| Agpro | 0.7053 | 0.2607 | 0.0000 | 0.0000 | I(1) |
| Foreign income | 0.5517 | 0.2551 | 0.0000 | 0.0000 | I(1) |

The tests were conducted to test the null of a unit root. For the entire tests, the null hypothesis could not be rejected at 10 percent significance level because all the probability values exceed the significance level. Results are attached in appendix 2. This means all variables are non-stationary in their level terms. Given that the tests included an intercept in the specification, it follows that all the variables equivalently follow a random walk with a drift. What this implies then is that the value of each variable at time $t$ is not only equal to its value at time $(t - 1)$ plus a random shock but also includes a drift parameter. However, all the probability values turned out to be zero after first differencing indicating that although our variables are non-stationary in their level terms, they become stationary after first differencing. Technically, all our model variables are integrated of order one (I(1)). In light of these findings, the study proceeded to conduct a test for cointegration since our variables are integrated of the same order.

### 4.4 Cointegration Test

The null hypothesis of no cointegration was tested against the alternative of cointegration relationship among the variables at the 10 percent level of significance level. The results are presented in table 3.

**Table 3: Pedroni Cointegration results**

| Group | Statistic | Statistic | P-value |
|---|---|---|---|
| | Panel v-Statistic | -1.880213 | 0.0998 |
| Within-dimension | Panel rho-Statistic | 1.898807 | 0.0995 |
| | Panel PP-Statistic | -2.519927 | 0.0016 |
| | Panel ADF-Statistic | 1.8076933 | 0.0990 |
| | | | |
| | Group rho-Statistic | 1.797601 | 0.0800 |
| Between-dimension | Group PP-Statistic | 7.226003 | 0.0000 |
| | Group ADF-Statistic | 8.149349 | 0.0000 |

As shown in table 3, the entire probability values fall below the 10 percent and therefore we reject our null hypothesis and conclude that there is a cointegrating relationship between agricultural exports and its corresponding explanatory variables.

### 4.5 Model Specification tests

Results of the Ramsey reset tests are reported in table 4.

**Table 4: Ramsey RESET results**

| Equation | | Chi2(1) | P-value |
|---|---|---|---|
| | Total Misalignment | 0.98 | 0.4027 |
| Equation 11 | Overvaluation | 0.15 | 0.9322 |
| | Undervaluation | 0.74 | 0.5301 |

The null hypothesis of the Ramsey RESET test holds that the model is correctly specified. In this particular case, the probability values exceed the maximum significance level hence the null hypothesis cannot be rejected.

### 4.6 Breusch Pagan Test for Heteroscedasticity

Results of the Breusch Pagan test are reported in table 5.

**Table 5: Breusch Pagan Test Results**

| | | Chi2(1) | P-value |
|---|---|---|---|
| Equation 11 | Total Misalignment | 2.89 | 0.0890 |
| | Overvaluation | 120.21 | 0.0000 |
| | Undervaluation | 596.32 | 0.0000 |

The p-values are less than the 10% hence the null of homoscedasticity is rejected. According to Baltagi (1991), OLS produces inefficient estimates in the presence of heteroscedasticity and as a result, the Feasible Generalised Least Squares technique[5] was employed.

### 4.7 Contemporaneous Correlation Tests

Contemporaneous correlation tests were conducted to examine the degree of cross-sectional dependence across the countries under study. The study employed the Breusch Pagan LM test for cross sectional dependence and results of this test are reported in table 6.

**Table 6: Cross Sectional Dependence**

| Equation | Chi(2) | P-value |
|---|---|---|
| Total Misalignment | 26.5621 | 0.0821 |
| Overvaluation | 23.0843 | 0.0639 |
| Undervaluation | 18.8352 | 0.0561 |

The null hypotheses of uncorrelated residuals across countries are marginally rejected hence there is contemporaneous correlation which further justified the use of FGLS technique.

### 4.8 Time and Country Specific Effects

Results of the test for inclusion of time and country specific effects are reported in table 7.

[5] FGLS estimators are appropriate when one or more of the assumptions of homoskedasticity and non-correlation of regression fails. In this case FGLS estimation is more efficient than POLS estimation leading to smaller standard errors, narrower confidence intervals, and larger t-statistics. This enables more precise estimation of parameters (Cameron, 2009).

**Table 7: Time and Country Specific Effects Results**

| | Time Effects | | Country Effects | |
|---|---|---|---|---|
| | Chi2 | P-value | Chi2 | P-value |
| Total Misalignment | 11.08 | 0.9210 | 23867.38 | 0.0000 |
| Overvaluation | 10.70 | 0.9336 | 9193.96 | 0.0000 |
| Undervaluation | 34.66 | 0.0153 | 29029.16 | 0.0000 |

Basing on the p-values, the null hypotheses that all years' coefficients are jointly equal to zero in the total misalignment and overvaluation specification cannot be rejected hence therefore no time effects are needed in these models. Contrary in the same specifications is that the null that all countries coefficients are jointly equal to zero is highly rejected hence country specific effects are needed. Turning to the undervaluation specification, both null hypotheses are rejected hence both time and country effects have to be included in the undervaluation model.

**4.9 Real Exchange Rate Misalignment and Agricultural Exports**

Having conducted all the necessary and required tests in panel data analysis, the next step was to examine the relationship between RER misalignment and agricultural exports. Before regression analysis, the study first presents a graphical correlation analysis in figure 3.

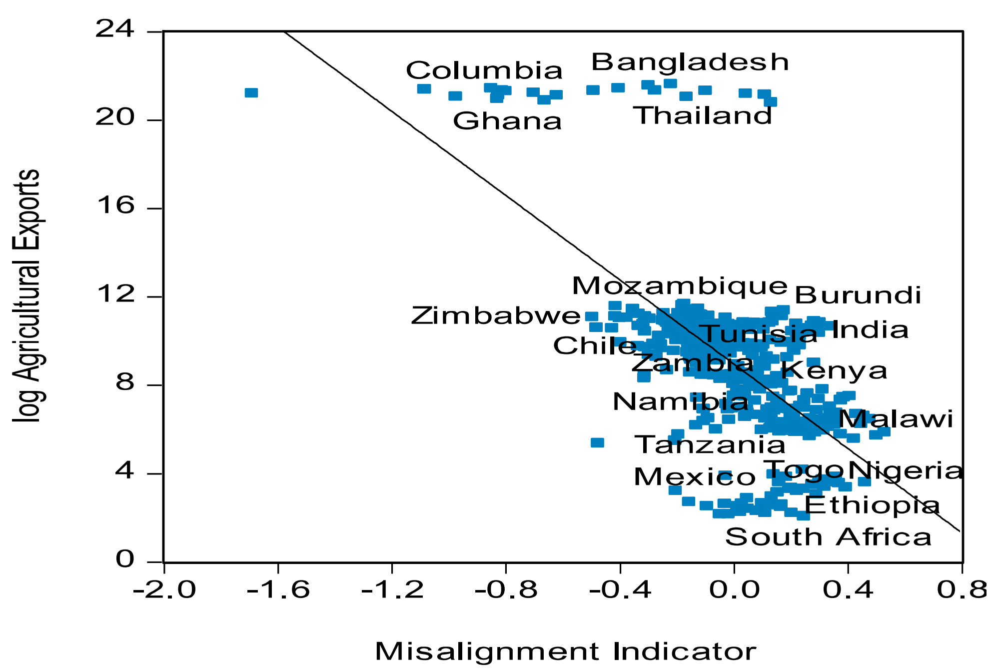


**Figure 3: Total RER Misalignment and Agricultural Exports**

The correlation analysis in figure 3 indicates an inverse relationship between the total RER misalignment indicator and agricultural exports in the 20 countries. For countries like South Africa, Ethiopia, Malawi, Kenya, India, Togo and Burundi, the average misalignment indicator is positive indicating that the RER has been, on average, overvalued in these countries. For Zimbabwe, Ghana, Chile, Columbia, Bangladesh, Thailand and Mexico the average misalignment indicator is negative suggesting that the RER has been undervalued on average in these countries during the study period. It is also noteworthy that countries like Zimbabwe, South Africa, Mexico, Namibia, Chile and Zambia have an effect of making the linear line flatter while the opposite holds for the remaining countries. The main picture however is that high levels of misalignment coincide with low levels of agricultural exports. This is also illustrated in figure 4.

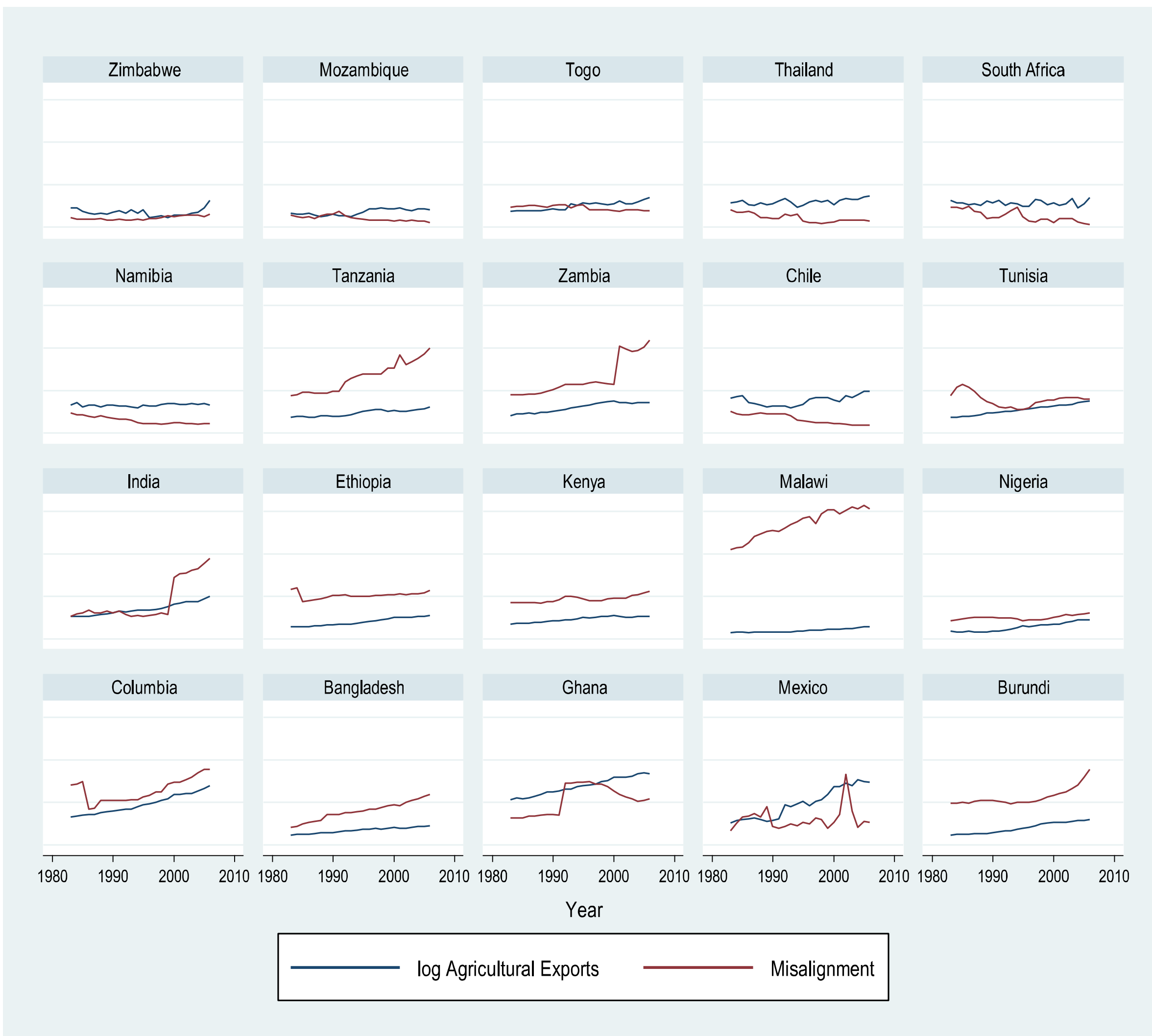


**Figure 4: A Trend Analysis: Misalignment and Agricultural Exports**

Figure 4 indicates that the RER was seriously misaligned in countries like Mexico, Ghana, Zambia, South Africa while for countries like Burundi, Togo, Namibia and India, the degree of misalignment has been considerably less so. A closer look at the line graph for Mozambique reveals a steady increase in agricultural exports mid 90s following a decrease in RER misalignment during the same period. Same is the case for Malawi, Thailand and Chile. For some other countries, the picture is less clear cut suggesting the need to go beyond a graphical analysis. In the next and final step before presenting regression results, a tabular analysis on seven randomly selected countries is conducted. This exercise is reported in appendix 3 for brevity sake.

To begin with the most interesting case, the extent to which agricultural exports growth in Zimbabwe behaves in response to RER misalignments is interesting. The sharp decline in the natural logarithm of exports in 1983 from 1.3 to 0.2 following an increase in overvaluation by 50 percent suggests an inverse relationship between overvaluation and exports. A 30 percent undervaluation in 1984 saw an increase in agricultural exports from 0.2 to 4.3 respectively. In 1886 and 1987, our data suggests that the exchange rate of Zimbabwe was aligned to its fundamental determinants and agricultural exports performed fairly well. From 1988 to 1991, the Zimbabwean dollar was undervalued and this was parallel to a steady increase in agricultural exports before facing a sharp drop in 1992 perhaps owing to the drought which hard the economy during this year. The trend appears to be true across all the years and most overvalued cases were associated with slumps in exports although the issue of political economy cannot be sparred.

Interesting is that these regularities are more pronounced in Southern African and Latin American countries but hardly exists in Asian and even central African countries. Togo for instance provides a contrary experience. The period 1984-1987 saw a persistent RER undervaluation but agricultural exports did not register any meaningful growth during these periods casting doubt on the role of undervaluation as an export promoting strategy. In a similar vein, a closer look at agricultural exports and exchange rate misalignment in Nigeria reveals that agricultural exports were mute from 1994-2000 despite an undervalued currency which increased each year up to 2000 suggesting that other export hindering factors could have been at play.

As will be shown using regression analysis in table 8, the presented evidence particularly through a correlation analysis demonstrates an inverse relationship between exports and misalignment. On the other hand, the tabular analysis has also shown that countries which have registered growth in exports have done so in most cases on the back of undervalued currencies. The overall picture is systematically illustrated in table 8.

**Table 8: Regression Results**

| | | Non-Linear Effects | | | | |
|---|---|---|---|---|---|---|
| | RER Misalignment | Overvaluation | | | Undervaluation | |
| | FGLS | IV Regression[6] | FGLS | IV Regression | FGLS | IV Regression |
| Government expenditure | 0.014** | 0.010 | 0.020** | 0.040 | 0.001 | -0.010 |
| | (0.007) | (0.011) | (0.009) | (0.040) | (0.009) | (0.026) |
| Foreign Direct Investment | -0.0001 | -0.0003 | 0.001 | 0.008 | 0.0009 | 0.002** |
| | (0.0008) | (0.0009) | (0.001) | (0.002) | (0.0007) | (0.001) |
| Foreign Income | 0.0001*** | 0.0001*** | 0.00003 | -0.00001 | 0.0001*** | 0.00009*** |
| | (8.89e-0) | (0.00001) | (0.00002) | (0.00005) | (7.5806) | (0.00001) |
| Investment | -0.00002*** | 0.00001 | -0.00003** | -0.00006 | -0.00002*** | -0.00004** |
| | (8.89e-0) | (0.00001) | (0.00001) | (0.00004) | (8.5606) | (0.00001) |
| Agriculture production | 0.417*** | 0.436*** | -2.9206 | -3.7206 | -3.330** | -2.770 |
| | (0.112) | (0.122) | (2.5106) | (4.4506) | (1.6706) | (2.130) |
| Capital Controls | 0.012*** | 0.013*** | 0.0255*** | 0.043** | 0.006*** | 0.008*** |
| | (0.001) | (0.001) | (0.003) | (0.017) | (0.001) | (0.002) |
| Misalignment | -3.8806** | -0.00001 | -0.522* | -5.634 | 0.450*** | 1.452** |
| | (1.6706) | (4.0206) | (0.285) | (4.854) | (0.113) | (0.642) |
| Constant | 7.770*** | 6.4128*** | 19.0414*** | 5.137*** | 6.221*** | 9.056*** |
| | (0.217) | (0.291) | (0.342) | (0.639) | (0.235) | (0.595) |
| Country Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Time Effects | No | No | No | No | Yes | Yes |
| R-squared (within) | ---- | 0.5326 | ---- | 0.4869 | ---- | 0.6529 |
| Wald chi2 | 62306.80 | 310773.54 | 16396.08 | 32341.46 | 71971 | 382201.33 |
| Pro>chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| No. of Obs | 420 | 420 | 223 | 185 | 201 | 166 |
| No. of countries | 20 | 20 | 20 | 20 | 20 | 20 |

Note: *, **, *** denote $p < 0.1$, $p < 0.05$ &$p < 0.01$ respectively. The dependent variable is agricultural exports in logarithm form and figures in parentheses are standard errors.

[6] Capital controls, government expenditure, misalignment, investment and FDI are instrumented by lagged terms while the remaining variables are instrumented by their contemporaneous values. Given that heteroskedasticity in the context of IV regression raises essentially the same issues as with OLS, the standard errors were corrected through the Newey West procedure.

The dependent variable is agricultural exports in all specifications. The coefficient of determination (R-squared) which measures the goodness of fit confirms that the covariates explain on average 55 percent, variation in agricultural exports while about 45 percent variation is captured in the disturbance term. This should however not be relied much upon as a measure of the goodness of fit in this case since the r-squared is a non-decreasing function of the number of regressors included in the model. The appropriate measure to use in a multivariate framework is rather the adjusted r-squared which is unfortunately not computed by STATA. The probability values for the whole model are 0.0000 across all specifications signifying that all the models are statistically significant at 1 percent. The standard errors which measure the statistical reliability of the coefficient estimates are relatively low (below 30%) for most of the coefficients suggesting less statistical noise and high reliability of the model estimates. Country specific effects are included in all specifications while time effects are only included in the last specification. A full set of regression results and tests for time and country specific effects is provided in appendix. On the same note, the results documented in table 8 for the first two specifications correspond to results which include only country specific effects in appendix and they need not to be confused with those estimated with time effects. The ones with time effects were simply estimated for the purpose of testing whether time effects were needed in the specification and the result proved otherwise. For the last specification, both time and country specific effects are included as suggested by their tests. For brevity sake however, country specific effects are not reported in table 8.

Nonetheless, Zimbabwe is treated as the control group in all specifications and interesting is that most country dummies are negative and statistically significant except for country 13 which is Kenya (see results in appendix). This result suggests that agricultural exports were relatively lower in the former countries as compared to Zimbabwe during the study period. This is empirically reasonable considering that Zimbabwe was considered a bread basket of Southern Africa during the study period characterised by a well-functioning agricultural sector. The coefficient attached to the country dummy 13 suggests however that there was no significance difference in Zimbabwe and Kenya's agricultural exports.

Now shifting attention to table 8, government expenditure was included to capture the effect of fiscal policy and in most cases the coefficient on government expenditure is found to be positive but statistically insignificant. The variable is however found to be significant in two particular cases suggesting that government expenditure may conditionally influence agricultural exports. The interpretation of the result in the first specification for instance indicates that a 50 percent increase in government expenditure generates at most a 50.7 percent increase in agricultural exports. Given that the dependent variable is in logarithm form, it follows that by interpretation, the effect of each regressor is the antilog of the semi-elasticity multiplied by the percent change in that variable. In this case, it would be the antilog of 0.014 which gives us 1.014 then multiplied by 50 percent yields 50.7. In a similar vein, the results also demonstrate that the magnitude of change in agricultural exports ranges between 0.0001 and 0.0291 at the 95 percent confidence interval where the former and the latter value denotes the lower and the upper bound respectively.

It is however interesting to note that the coefficient turns out to be insignificant after controlling for the reverse causality of government expenditure. As I indicated earlier, most of state interventions are mere reactions to economic events hence the direction of causality is likely to come from exports to government expenditure and not the reverse. Another noteworthy result is that the coefficient turns out to be negative albeit insignificantly when controlling for undervaluation (see equation 3) under instrumental variable estimation. The insignificance part should however not come as a surprise considering that government expenditure on its own may affect the exchange rate such that it is likely to bear an indirect effect on agricultural exports that goes via the exchange rate.

On the same note, the negative coefficient also requires caution in its interpretation. Despite bearing what appears to be a surprising result, one way of looking at this coefficient is to remember that tax rates are not being held constant. The negative sign might explain the fact that an increase in government expenditures is associated with a corresponding increase in corporate taxes and as a result of this, agricultural exports are likely to dwindle. Against the backdrop of different signs attached to the government coefficient, we show a partial relation between the two variables through a scatter plot. This is illustrated in figure 5 and noteworthy is that other regressors are not being held constant.

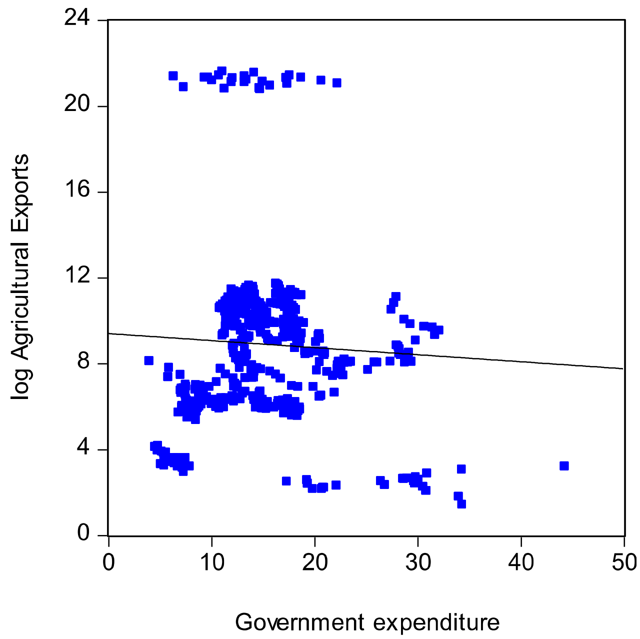


**Figure 5: The correlation between government expenditure and agricultural exports.**

A visual analysis clearly shows a negative correlation between government interventions and agricultural exports hence substantiating the coefficient reported in equation 3 under the instrumental variable estimation. A probable interpretation of this result is that state interventions normally crowd out private investment which may retard agricultural exports.

In addition, foreign direct investment appears to have no impact at all in the first two specifications in which the model controls for total misalignment and overvaluation respectively. In these equations, the coefficient is not significantly different from zero hence the role of FDI as an export promotion strategy is highly questioned. Given that FDI is conventionally believed to be a fundamental factor explaining macroeconomic perfomance, the insignificance could be an indication that dynamics are still at work across the countries under study. Nonetheless, it is quite comforting to note that the coefficient turns out to be positive and statistically significant with 5 percent chance of committing a type 1 error when controlling for misalignment in form undervaluation. The latter result suggests something special about FDI and undervaluation in explaining agricultural exports.

The interpretation of the result in equation 3 under IV estimation technique is that in response to every 50 percent increase in FDI, agricultural exports are expected to increase by [(antilog of 0.002 = 1.002)*50] = 50.1 percent. In many empirical studies including the one by Zingwena (2014), FDI is treated as a factor of production and the hypothesis that more FDI coincide with improved macroeconomic performance has survived a wide range of empirical studies which makes the result documented in table 8 less novel. For robustness sake, figure 6 shows a partial relation between FDI and agricultural exports through a scatter plot.

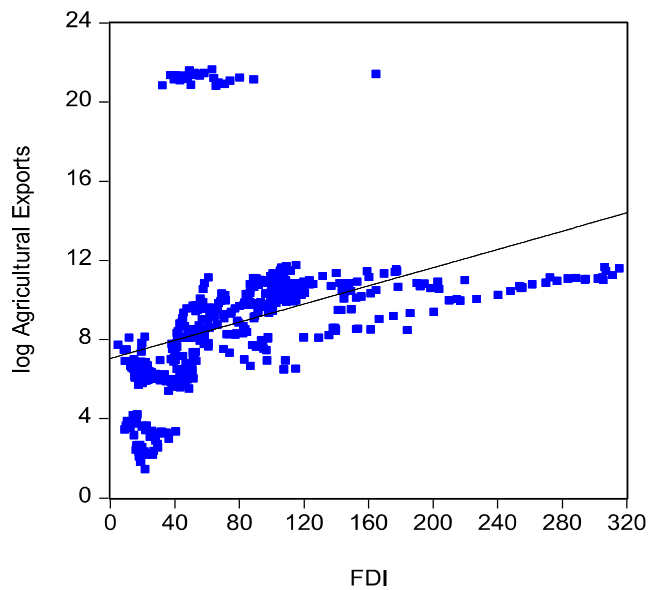


**Figure 6: The correlation between FDI and agricultural exports.**

Figure 6 displays a positive correlation between FDI and agricultural exports corroborating the view that FDI promotes diffusion of technology leading to improved macroeconomic perfomance. This result we found here is in conformity with the finding of Sharma (2000) who found a positive relationship between FDI and Indian exports despite being insignificant in statistical terms. Hoekman and Djankov (1998) also found a very similar result in the case of Poland which is empirically reassuring.

On a more surprising note, the coefficient of the domestic investment variable as proxied by gross capital formation is negative and statistically significant (except for a few cases) across all specifications. This finding is contrary to apriori expectations. In general, an increase in investment level is expected to facilitate an increase in economic output assuming away the law of diminishing returns and the resulting higher savings on the other hand should increase the steady state output level per worker facilitating a rise in agricultural output thus expanding the exports base. Despite this strong theoretical link suggested by neoclassical economists, this study finds no econometric evidence in support of this explanation. A possible explanation of this surprising result is that usually agricultural production is labour intensive in developing countries hence investing in machinery may cause more harm than good on agricultural exports through increasing the costs of production. The partial relation between agricultural exports and domestic investment is shown in figure 7.

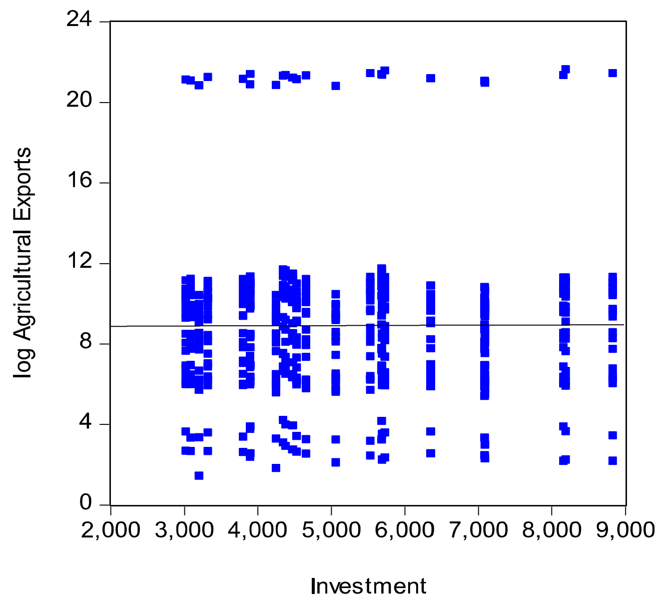


**Figure 7: The correlation between Domestic Investment and agricultural exports.**

The scatter plot in figure 7 does not show a significant correlation between agricultural exports and domestic investment. Both results from regression and correlation analysis go against the findings of Majeed and Ahmad (2006) and Majeed and Ahmad (2007) who found domestic investment facilitating export expansion in most Asian countries. However, our sample consists of very few Asian countries as the dominant group are African countries. Against this background, the result contradiction may owe to differences in macroeconomic environments in Asian and African countries.

In table 8, there are also some indications that capital controls contribute favourably to agricultural exports growth. The coefficient is positive and significantly different from zero across all specifications. In the first specification under FGLS estimation technique, the interpretation of the result is that a 25 percent restriction on capital inflows and outflows translates into a 25.3 percent increase in agricultural exports which is the antilog of 0.012 multiplied by 25 percent. Capital controls generally minimise the integration of an economy in the global capital market which resultantly prevents the occurrence of currency crises and external shocks. Given that currency crises are not palatable for macroeconomic perfomance in general, it follows that capital controls have an indirect impact on agricultural exports which goes via prevention of currency crises. The partial relation between agricultural exports and capital controls is shown in figure 8.

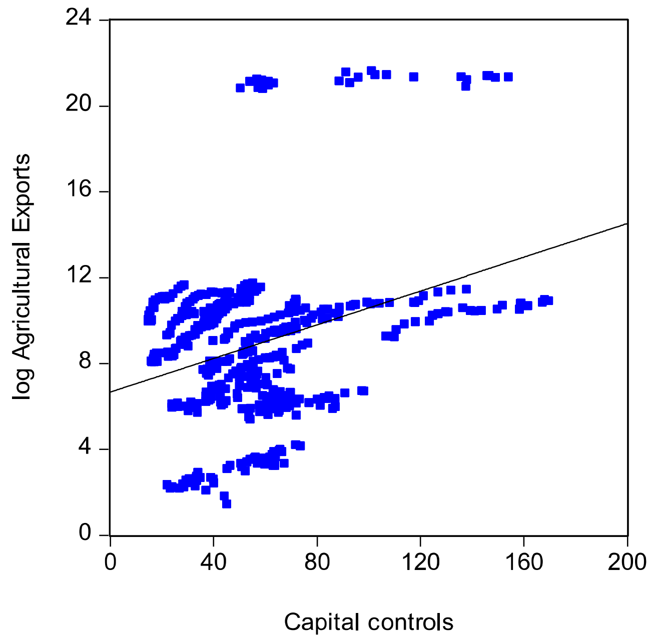


**Figure 8: The correlation between Capital Controls and agricultural exports.**

The correlation analysis in figure 8 clearly shows a positive correlation between capital controls and agricultural exports as reported in table 8. The result suggests that liberalizing the current account negatively affects the performance of agricultural exports in these countries. The result however contradicts with the finding of Chigavanyika (2014) who found the removal of capital controls beneficial to agricultural exports. A possible explanation for this contradiction is that Chigavanyika (2014) used a two-step error correction method which does not capture the reverse causality of capital controls. Given that the performance of agricultural exports may also influence governments to alter capital controls, it follows that the negative sign obtained by Chigavanyika could reflect the reverse causality. This technical failure to control for reverse causality partly explains the reason why some authors favour removal of capital controls. This finding confirms earlier position maintained by Wong (2010). However, there is still need for other measures of capital controls to be used to probe the robustness of this result.

It emerged from the regression results that foreign income bears a positive albeit a small effect on agricultural exports which is statistically significant in all the nine variants (except for a few cases). This result is substantiated by a correlation analysis in figure 9.

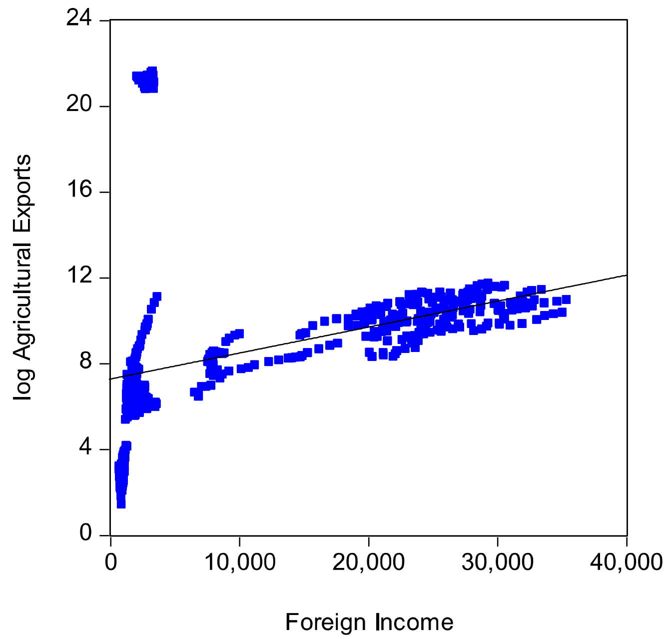


**Figure 9: The correlation between Foreign Income and agricultural exports.**

The positive value of the coefficient of GDP of trade partners means that when the trade partners witness a high economic growth which is a proxy for foreign demand, this results in an increase in agricultural exports going to that country. The coefficient suggests that a 50 percent increase in foreign income brings out a 0.0005 percent increase in agricultural exports holding other variables constant. This result tallies with that of Bourdon and Korinek (2011) also shared a positive relationship between foreign income and export growth.

Contrary to the a *priori* expectations, the agricultural production variable is surprisingly negative in most cases. It is only two cases where the variable turns out to be positive and statistically significant. A possible explanation of this result is that RER misalignment is that agricultural production on its own may affect the exchange rate through the Balassa Samuelson effect hence an increase in agricultural productivity is likely to appreciate the exchange rate leading to a decrease in the volume of agricultural exports.

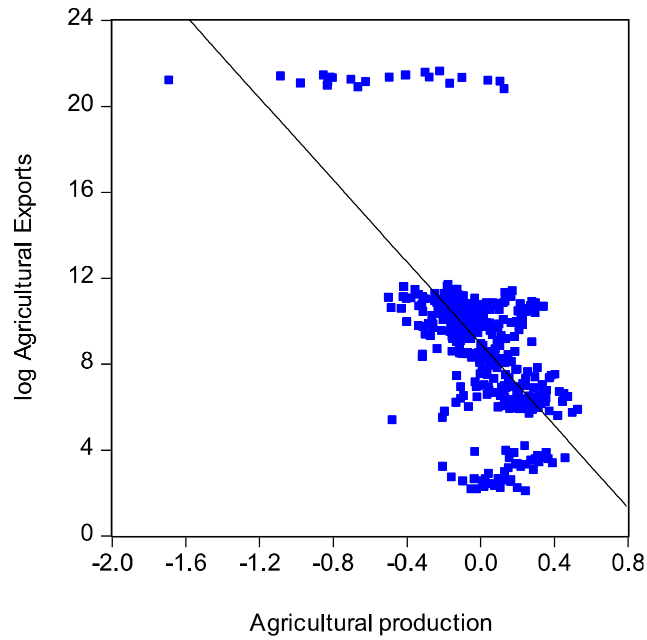


**Figure 10: The correlation between Agricultural production and agricultural exports.**

Turning to the variable which of interest, the study examines the impact of RER misalignment on agricultural exports. In the first specification, RER misalignment entered the regression equation in its total form and the result demonstrates that RER misalignment has a deleterious effect on agricultural exports with only 5 percent possibility of committing a type 1 error. This result is robust to the other specification estimated by the IV technique which is reassuring. By interpretation, the coefficient suggests that a 75 percent increase in RER misalignment deletes about 1.5 percent of agricultural exports (antilog of -3.8806*75) adding weight to the fact that maintaining the exchange rate at an inappropriate level may hamper export growth. The most presumable operative channel is that RER misalignment transmits wrong signals and distorts investment decisions through misallocation of resources which resultantly distracts agricultural exports growth.

The next step was to probe for non-linear effects. Here the researcher attempted to answer the questions: Does overvaluation distract exports and does undervaluation facilitate the opposite? To achieve this, the total sample was fragmented into two categories: the first one with undervaluation episodes and the second with overvaluation. Conventional wisdom believes that undervaluation promotes exports through making domestic goods cheaper. Basing on the result of both the FGLS and IV technique, we fail to reject the hypothesis that undervaluation promotes agricultural exports. The coefficient is positive and highly significant across the two specifications. With regards to the result of FGLS technique, the implication of the result is that for a country like Nigeria whose log agricultural exports was 7.7 in 2006 to catch up with South Africa, it would need to undervalue its Naira by about 9 percent. Note that this is in tandem with the result of Calderon and Aguire (2006) who indicated that undervaluation is beneficial if it is below the 25 percent mark.

This result however disagrees with a provocative analysis by Rodrik (2008) which found undervaluation detrimental to agricultural trade. In trying to show that growth channel of undervaluation, Rodrik (2008) argued that the agricultural sector suffers from trade restrictions which convert many agricultural exports into non-tradable goods at the margin. In this study, we have shown that undervaluation has a strong positive impact even when controlling for capital controls rendering Rodrik's (2008) argument questionable. The result of the present analysis does not only show that undervaluation is good for agricultural trade but also suggests that the operative channel of undervaluation in Asian countries like China is largely a story of export led growth. This is especially true when we consider the large and significant coefficient suggested by the IV technique. The coefficient is actually suggesting that a 10 percent undervaluation translates into a 42.7 percent increase in agricultural exports (antilog of 1.452*10). Similarly, policies which facilitate a decrease in undervaluation like savings schemes and deterioration in the terms of trade despite being exogenously determined in many developing countries are expected to distract perfomance of agricultural exports in these countries.

Turning to technical issues surrounding the interpretation of this coefficient, it is true that omitted variables which drives both undervaluation and agricultural exports like productivity via the Balassa-Samuelson effect may bias the undervaluation coefficient upwards. Although it is a bit difficult to estimate the magnitude of the upward bias induced by such omitted country specific effects, the IV technique has at least given us the upper bound regarding the impact of undervaluation. From the two extremes (the lower value 0.45 and the upper value 1.45) even if we are to take the least magnitude, still it implies a 15.7 percent increase in agricultural exports (antilog of 0.45*10) for every 10 percent undervaluation which is quite large to call for policy attention in developing countries.

Moreover, the issue of omitted variable bias is just necessary but not sufficient for one to distrust the estimate of undervaluation under the IV estimation technique given that the use of instruments largely deals with this problem. Therefore the results produced by the IV strategy represent a useful and encouraging robustness check. It is however important to clarify the robustness of the undervaluation coefficient once more against the background of potential endogeneity and reverse causality of the exchange rate. Generally, the source of endogeneity which any econometrician may think of in a model of this kind will be expected to produce a negative relationship between RER misalignment and agricultural exports not the positive documented in table 9. As indicated earlier in the review of literature as a criticism against a particular study by Masunda (2011), most variables that facilitate a real depreciation are usually bad for macroeconomic perfomance. For instance the restriction of FDI inflows lowers the demand for tradable and non-tradable goods hence leading to a real depreciation but at the same time this may compromise growth prospects of agricultural exports. It is however quite encouraging and comforting to note in this study that the undervaluation coefficient is positive and significant when controlling for most variables that affect both the RER and agricultural exports. This simply rules out the possibility of reverse causality of exports on exchange rate hence unlike the negative coefficient documented in Masunda (2011), one should interpret the coefficient in table with some confidence.

Absent any macroeconomic distortions, overvaluation and undervaluation are believed to have two opposite (asymmetrical) effects that may be in effect cancel each other out. For instance Rodrik (2008) argues in his introduction that just as overvaluation hurts growth, so undervaluation facilitates it. This statement suggests that a decrease in overvaluation is as powerful as an increase in undervaluation. As documented in table 9, the coefficient associated with overvaluation is negative and marginally significant under FGLS technique. Note that should we consider the overvaluation hypothesis as a two tailed test, then the corresponding probability value of observing the calculated t-static here would be taken as evidence to reject the null hypothesis. However, in this particular case, theory suggests that the coefficient on overvaluation cannot be positive such that a one-sided test will reject the null hypothesis at the marginal level. The interpretation of the coefficient is that a 10 percent decrease in overvaluation is expected to boost agricultural exports by 5.9 percent. Given that a 10 percent increase in undervaluation proved to add at least a 15.7 percent increase in agricultural exports, it follows that Rodrik's (2008) standpoint that an increase in undervaluation is just as powerful as a decrease in overvaluation is substantiated. It is quite interesting and comforting to note that the effect of a decrease in overvaluation and that of an increase in undervaluation are so similar (-0.52 and 0.45) in semi elasticity terms.

The reason why overvalued currencies coincide with a slowdown in export performance is growth is not explicitly theorized, but most authors link it to macroeconomic instability. RER overvaluation is theoretically believed to make domestic exports relatively expensive while imports turn out to be more attractive. Against this background, an economy facing an overvalued exchange rate is likely to witness subdued export growth on the back of balance of payment deficit resulting from high importation of foreign goods on the assumptions of less if not none trade restrictions. All these mechanisms are damaging to agricultural exports performance just as they are to economic growth as shown in earlier growth studies.

The last variable in the specification is the constant term which is simply, by definition, the average value of the dependent variable when all other corresponding regressors are equal to zero.

### 4.10 Conclusion

This chapter has presented empirical results of the study. In what follows, conclusion of the study and policy implications of the findings are presented. Suggestions for further study are also provided in the next chapter.

# CHAPTER FIVE – CONCLUSIONS, IMPLICATIONS AND FUTURE STUDIES

## 5.1 Introduction

The previous chapter presented and discussed the empirical findings of the study. In light of these findings reported in chapter 4, the chapter provides the study conclusion and policy implications. This is followed by areas for further study.

## 5.2 Conclusion

Driven by the on-going debate between real exchange rate misalignment and international trade, the study has examined the impact of RER misalignment on agricultural exports using a panel data set of 20 countries. The first step involved estimating the equilibrium RER using the Panel Dynamic Ordinary Least Squares (PDOLS) technique and excess credit, government consumption, capital inflows, technological progress and trade openness were found to be fundamental determinants of the RER. These fundamentals were correctly signed and statistically significant at the 10 percent level of significance. To arrive at the ERER, the coefficients were then multiplied by the permanent values of the RER fundamentals obtained from the Hodrick-Prescot filter method. Having completed this stage, we defined misalignment as deviations of the actual REER from its equilibrium value and negative deviations were referred to as undervaluation while positive deviations denoted overvaluation. We then inserted the calculated values of misalignment in the agricultural export function along with other control variables to appreciate its effect.

The study has revealed that RER has a detrimental effect on agricultural exports and the effect is non-linear. These findings are generally in line with those of earlier studies such as Elgali and Mustafa (2012), World Bank (1984), Ganyaupfu (2013) and Masunda (2011) which confirmed a deleterious effect of real exchange rate overvaluation on economic performance and Rodrick (2009) who concluded that undervaluation promotes economic performance in developing countries.

## 5.3 Policy Implications

The study has found non-linear effects which proved to dampen the overall impact of RER misalignment on agricultural trade. With regards to overvaluation, the study revealed that overvaluation in its worst form can compromise growth prospects of agricultural exports. On the other hand, although RER exchange rate undervaluation was found to have a positive sign in all variants, its effects were found to be outweighed by overvaluation which led to a negative impact of total RER misalignment. In general for policy issues, the result imply that a misaligned currency is not palatable for agricultural exports growth thus policy makers in both developed and developing countries should work to eliminate a misalignment of the exchange rate. Although sector specific policies are of paramount importance, general wide economy policies like the exchange rate policy (in which correcting for exchange rate disequilibria is a principal goal) are also of equal importance. Thus to promote agricultural exports, there is need to develop an exchange rate policy that realigns the RER to the long run equilibrium level as it encourages agricultural exports. This would imply clean floats be put in place otherwise pegged rates would require close monitoring such that they remain in tandem with the equilibrium level suggested by their long term fundamentals.

### 5.4 Areas for Further Study

The study has examined the relationship between agricultural exports and RER misalignment using panel data techniques hence there is need for future researchers to probe the robustness of this result using time series techniques. Given that time series techniques generally suffer from problems of micronumerosity, such studies could probe for non-linear effects of RER misalignment using polynomial second order regressions. In addition to that, the researcher finds the evidence presented in the present analysis less persuasive for two reasons. Firstly, inclusion of RER fundamentals in the export specification is only a necessary but not sufficient measure of ensuring that the remaining variation is exogenous. Secondly, the causal effect of the real exchange rate to agricultural exports is hardly the only possible interpretation.

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# APPENDICES

## APPENDIX 1: EQUILIBRIUM RER REGRESSION RESULTS

Dependent Variable: LOG(EREER)
Method: Panel Least Squares
Date: 12/12/14 Time: 16:54
Sample (adjusted): 1985 2005
Periods included: 21
Cross-sections included: 58
Total panel (balanced) observations:
Convergence achieved after 10 iterations

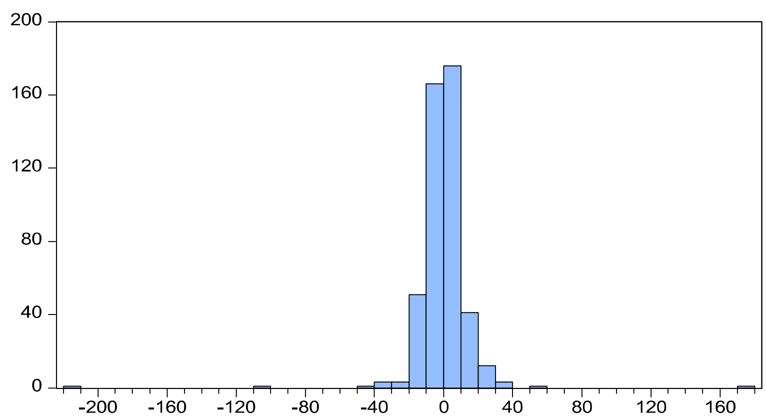
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LNOPENNESS | -0.005287 | 0.001560 | -3.389736 | 0.0008 |
| LNTECHPRO | 7.51E-05 | 2.25E-05 | 3.332448 | 0.0009 |
| LNKINFL | 6.03E-08 | 8.20E-07 | 0.073488 | 0.9415 |
| LNEXCRE | 4.123322 | 0.180120 | 22.89208 | 0.0000 |
| LNGCONS | 0.006492 | 0.004843 | 1.340340 | 0.1809 |
| LNOPENNESS(1) | -0.007909 | 0.001559 | -5.071743 | 0.0000 |
| LNOPENNESS(-1) | -0.004443 | 0.001621 | -2.740320 | 0.0064 |
| LNTECHPRO(-1) | -2.10E-05 | 2.26E-05 | -0.926593 | 0.3547 |
| C | 4.653680 | 0.191906 | 24.24974 | 0.0000 |
| AR(1) | 0.755863 | 0.029408 | 25.70225 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.975394 | Mean dependent var | 4.501459 |
| Adjusted R-squared | 0.973699 | S.D. dependent var | 0.869850 |
| S.E. of regression | 0.141068 | Akaike info criterion | -1.014813 |
| Sum squared resid | 7.800841 | Schwarz criterion | -0.745462 |
| Log likelihood | 241.1107 | Hannan-Quinn criter. | -0.908353 |
| F-statistic | 575.5240 | Durbin-Watson stat | 1.719391 |
| Prob(F-statistic) | 0.000000 | | |

| | |
|---|---|
| Inverted AR Roots | .76 |




Series: Standardized Residuals
Sample 1984 2006
Observations 460

| | |
|---|---|
| Mean | -4.89e-15 |
| Median | 0.181436 |
| Maximum | 173.9004 |
| Minimum | -213.0265 |
| Std. Dev. | 17.17660 |
| Skewness | -2.382449 |
| Kurtosis | 78.73428 |
| Jarque-Bera | 110369.0 |
| Probability | 0.000000 |

## APPENDIX 2: MISALIGNMENT- EXPORTS REGRESSION RESULTS

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       420
Estimated autocorrelations =         0          Number of groups   =        20
Estimated coefficients     =        27          Time periods       =        21
                                                Wald chi2(26)      =  62306.80
Log likelihood             =  -98.8502          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDI | -.00014 | .0008572 | -0.16 | 0.870 | -.00182 | .00154 |
| FoY | .0001108 | 9.84e-06 | 11.26 | 0.000 | .0000915 | .0001301 |
| Inv | -.0000254 | 8.89e-06 | -2.86 | 0.004 | -.0000429 | -8.02e-06 |
| Ccont | .0124554 | .0015521 | 8.03 | 0.000 | .0094134 | .0154974 |
| Agpro | .4172636 | .1124937 | 3.71 | 0.000 | .1967801 | .6377471 |
| Gvtexp | .0146464 | .0073731 | 1.99 | 0.047 | .0001954 | .0290973 |
| misal | -3.88e-06 | 1.67e-06 | -2.32 | 0.020 | -7.16e-06 | -6.05e-07 |
| _Icountry_2 | -1.584395 | .1244113 | -12.74 | 0.000 | -1.828237 | -1.340554 |
| _Icountry_3 | -2.112293 | .1780307 | -11.86 | 0.000 | -2.461227 | -1.763359 |
| _Icountry_4 | -6.017614 | .2080943 | -28.92 | 0.000 | -6.425471 | -5.609757 |
| _Icountry_5 | -2.290444 | .1886144 | -12.14 | 0.000 | -2.660122 | -1.920767 |
| _Icountry_6 | -1.408383 | .1107078 | -12.72 | 0.000 | -1.625366 | -1.191399 |
| _Icountry_7 | -1.926778 | .1362699 | -14.14 | 0.000 | -2.193862 | -1.659694 |
| _Icountry_8 | -2.822317 | .22126 | -12.76 | 0.000 | -3.255979 | -2.388655 |
| _Icountry_9 | -2.035037 | .1320924 | -15.41 | 0.000 | -2.293933 | -1.77614 |
| _Icountry_10 | .2705483 | .108423 | 2.50 | 0.013 | .0580431 | .4830535 |
| _Icountry_11 | .3965877 | .2084232 | 1.90 | 0.057 | -.0119144 | .8050897 |
| _Icountry_12 | -.1876727 | .1045687 | -1.79 | 0.073 | -.3926237 | .0172782 |
| _Icountry_13 | .0433375 | .1692222 | 0.26 | 0.798 | -.2883319 | .375007 |
| _Icountry_14 | -1.595602 | .2038627 | -7.83 | 0.000 | -1.995165 | -1.196038 |
| _Icountry_15 | -5.093118 | .2258832 | -22.55 | 0.000 | -5.535841 | -4.650395 |
| _Icountry_16 | -1.458625 | .1339371 | -10.89 | 0.000 | -1.721137 | -1.196113 |
| _Icountry_17 | -1.887854 | .2154277 | -8.76 | 0.000 | -2.310084 | -1.465623 |
| _Icountry_18 | -2.903957 | .2171449 | -13.37 | 0.000 | -3.329554 | -2.478361 |
| _Icountry_19 | -1.107422 | .1785085 | -6.20 | 0.000 | -1.457292 | -.7575516 |
| _Icountry_20 | 12.13817 | .2394169 | 50.70 | 0.000 | 11.66892 | 12.60742 |
| _cons | 7.770338 | .2177784 | 35.68 | 0.000 | 7.3435 | 8.197176 |

```
. testparm _Icountry*

 ( 1)  _Icountry_2 = 0
 ( 2)  _Icountry_3 = 0
 ( 3)  _Icountry_4 = 0
 ( 4)  _Icountry_5 = 0
 ( 5)  _Icountry_6 = 0
 ( 6)  _Icountry_7 = 0
 ( 7)  _Icountry_8 = 0
 ( 8)  _Icountry_9 = 0
 ( 9)  _Icountry_10 = 0
 (10)  _Icountry_11 = 0
 (11)  _Icountry_12 = 0
 (12)  _Icountry_13 = 0
 (13)  _Icountry_14 = 0
 (14)  _Icountry_15 = 0
 (15)  _Icountry_16 = 0
 (16)  _Icountry_17 = 0
 (17)  _Icountry_18 = 0
 (18)  _Icountry_19 = 0
 (19)  _Icountry_20 = 0

           chi2( 19) =23867.38
         Prob > chi2 =    0.0000
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       420
Estimated autocorrelations =         0          Number of groups   =        20
Estimated coefficients     =        27          Time periods       =        21
                                                Wald chi2(26)      =    693.35
Log likelihood             = -945.4467          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| FDI | .008679 | .0026431 | 3.28 | 0.001 | .0034987 | .0138594 |
| FoY | -.0000115 | .0000157 | -0.74 | 0.462 | -.0000422 | .0000192 |
| Inv | .0001853 | .021786 | 0.01 | 0.993 | -.0425145 | .042885 |
| Ccont | .0549196 | .0041864 | 13.12 | 0.000 | .0467144 | .0631248 |
| Agpro | -9.814591 | .5026451 | -19.53 | 0.000 | -10.79976 | -8.829424 |
| Gvtexp | .0279017 | .019866 | 1.40 | 0.160 | -.011035 | .0668384 |
| misal | 7.55e-06 | .0000109 | 0.69 | 0.489 | -.0000138 | .000029 |
| _Iyear_1984 | 0 | (omitted) | | | | |
| _Iyear_1985 | .036084 | 15.1923 | 0.00 | 0.998 | -29.74028 | 29.81245 |
| _Iyear_1986 | -.9593637 | 59.37993 | -0.02 | 0.987 | -117.3419 | 115.4232 |
| _Iyear_1987 | -.4449661 | 59.34837 | -0.01 | 0.994 | -116.7656 | 115.8757 |
| _Iyear_1988 | .2973105 | 43.38127 | 0.01 | 0.995 | -84.72841 | 85.32303 |
| _Iyear_1989 | .2171018 | 3.621287 | 0.06 | 0.952 | -6.880491 | 7.314695 |
| _Iyear_1990 | .6539613 | 22.73539 | 0.03 | 0.977 | -43.90659 | 45.21452 |
| _Iyear_1991 | .5876716 | 29.28433 | 0.02 | 0.984 | -56.80857 | 57.98391 |
| _Iyear_1992 | .1010703 | 27.89251 | 0.00 | 0.997 | -54.56724 | 54.76938 |
| _Iyear_1993 | .655105 | 12.26799 | 0.05 | 0.957 | -23.38971 | 24.69992 |
| _Iyear_1994 | -.2811314 | 6.403954 | -0.04 | 0.965 | -12.83265 | 12.27039 |
| _Iyear_1995 | -.0871794 | 25.486 | -0.00 | 0.997 | -50.03883 | 49.86447 |
| _Iyear_1996 | .1114832 | 29.77829 | 0.00 | 0.997 | -58.25289 | 58.47585 |
| _Iyear_1997 | -.4923525 | 83.37468 | -0.01 | 0.995 | -163.9037 | 162.919 |
| _Iyear_1998 | -.9362623 | 97.24044 | -0.01 | 0.992 | -191.524 | 189.6515 |
| _Iyear_1999 | -1.171161 | 82.71523 | -0.01 | 0.989 | -163.29 | 160.9477 |
| _Iyear_2000 | -.7396103 | 28.94587 | -0.03 | 0.980 | -57.47248 | 55.99326 |
| _Iyear_2001 | -.4003017 | 10.2307 | -0.04 | 0.969 | -20.45211 | 19.65151 |
| _Iyear_2002 | -.5997598 | 10.11495 | -0.06 | 0.953 | -20.4247 | 19.22518 |
| _Iyear_2003 | -.6726565 | 2.543473 | -0.26 | 0.791 | -5.657772 | 4.312459 |
| _Iyear_2004 | 0 | (omitted) | | | | |
| _Iyear_2005 | 0 | (omitted) | | | | |
| _Iyear_2006 | 0 | (omitted) | | | | |
| _cons | 4.000027 | 95.00216 | 0.04 | 0.966 | -182.2008 | 190.2008 |

```
. testparm _Iyear*

 ( 1)  _Iyear_1985 = 0
 ( 2)  _Iyear_1986 = 0
 ( 3)  _Iyear_1987 = 0
 ( 4)  _Iyear_1988 = 0
 ( 5)  _Iyear_1989 = 0
 ( 6)  _Iyear_1990 = 0
 ( 7)  _Iyear_1991 = 0
 ( 8)  _Iyear_1992 = 0
 ( 9)  _Iyear_1993 = 0
 (10)  _Iyear_1994 = 0
 (11)  _Iyear_1995 = 0
 (12)  _Iyear_1996 = 0
 (13)  _Iyear_1997 = 0
 (14)  _Iyear_1998 = 0
 (15)  _Iyear_1999 = 0
 (16)  _Iyear_2000 = 0
 (17)  _Iyear_2001 = 0
 (18)  _Iyear_2002 = 0
 (19)  _Iyear_2003 = 0

           chi2( 19) =   11.08
         Prob > chi2 =    0.9210
```

```
Fixed-effects (within) IV regression         Number of obs      =        420
Group variable: id                           Number of groups   =         20

R-sq:  within  = 0.5326                      Obs per group: min =         21
       between = 0.1510                                     avg =       21.0
       overall = 0.1570                                     max =         21

                                             Wald chi2(7)       =  310773.54
corr(u_i, Xb)  = -0.0104                     Prob > chi2        =     0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| misal | -.0000133 | 4.02e-06 | -3.31 | 0.001 | -.0000212 | -5.40e-06 |
| Ccont | .0133285 | .0019461 | 6.85 | 0.000 | .0095143 | .0171428 |
| Gvtexp | .0104093 | .0114927 | 0.91 | 0.365 | -.012116 | .0329346 |
| Inv | -.0000102 | .0000128 | -0.79 | 0.428 | -.0000353 | .000015 |
| Agpro | .4364578 | .1228817 | 3.55 | 0.000 | .195614 | .6773016 |
| FoY | .0001324 | .0000136 | 9.74 | 0.000 | .0001057 | .000159 |
| FDI | -.0003515 | .0009326 | -0.38 | 0.706 | -.0021794 | .0014765 |
| _cons | 6.412837 | .2919081 | 21.97 | 0.000 | 5.840708 | 6.984967 |
| sigma_u | 3.5098827 | | | | | |
| sigma_e | .32921349 | | | | | |
| rho | .99127901 | (fraction of variance due to u_i) | | | | |

```
F  test that all u_i=0:     F(19,393) =  1080.86         Prob > F    = 0.0000

Instrumented:   misal Ccont Gvtexp Inv
Instruments:    Agpro FoY FDI L.misal L.Ccont L.Gvtexp L.Inv
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       223
Estimated autocorrelations =         0          Number of groups   =        15
Estimated coefficients     =        22          Obs per group: min =         1
                                                               avg =  14.86667
                                                               max =        21
                                                Wald chi2(21)      =  16396.08
Log likelihood             = -70.03388          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| fdi | .001008 | .001587 | 0.64 | 0.525 | -.0021025 | .0041185 |
| foy | .00003 | .0000256 | 1.17 | 0.242 | -.0000202 | .0000802 |
| inv | -.0000304 | .0000133 | -2.28 | 0.022 | -.0000565 | -4.31e-06 |
| ccont | .0255331 | .0033687 | 7.58 | 0.000 | .0189305 | .0321357 |
| agpro | -2.92e-06 | 2.51e-06 | -1.17 | 0.244 | -7.83e-06 | 1.99e-06 |
| gvtexp | .0204298 | .0096399 | 2.12 | 0.034 | .001536 | .0393237 |
| misal | -.5228932 | .2852597 | -1.83 | 0.067 | -1.081992 | .0362056 |
| _Icountry_2 | -13.05368 | .4793675 | -27.23 | 0.000 | -13.99323 | -12.11414 |
| _Icountry_3 | -17.73523 | .2478462 | -71.56 | 0.000 | -18.221 | -17.24946 |
| _Icountry_4 | -13.73301 | .258603 | -53.10 | 0.000 | -14.23986 | -13.22616 |
| _Icountry_5 | -11.50511 | .6820225 | -16.87 | 0.000 | -12.84185 | -10.16837 |
| _Icountry_6 | -12.94351 | .3391127 | -38.17 | 0.000 | -13.60816 | -12.27887 |
| _Icountry_7 | -14.66196 | .2222633 | -65.97 | 0.000 | -15.09759 | -14.22633 |
| _Icountry_8 | -12.29569 | .6573356 | -18.71 | 0.000 | -13.58404 | -11.00733 |
| _Icountry_9 | -11.02243 | .2698611 | -40.84 | 0.000 | -11.55135 | -10.49351 |
| _Icountry_10 | 0 | (omitted) | | | | |
| _Icountry_11 | -13.27734 | .2241133 | -59.24 | 0.000 | -13.71659 | -12.83808 |
| _Icountry_12 | -16.88784 | .2439847 | -69.22 | 0.000 | -17.36604 | -16.40964 |
| _Icountry_13 | -11.96997 | .5763902 | -20.77 | 0.000 | -13.09968 | -10.84027 |
| _Icountry_14 | -13.48018 | .2404083 | -56.07 | 0.000 | -13.95137 | -13.00899 |
| _Icountry_15 | -14.72468 | .217633 | -67.66 | 0.000 | -15.15123 | -14.29813 |
| _Icountry_16 | -12.43187 | .2858506 | -43.49 | 0.000 | -12.99213 | -11.87162 |
| _Icountry_17 | 0 | (omitted) | | | | |
| _Icountry_18 | 0 | (omitted) | | | | |
| _cons | 19.04141 | .3423091 | 55.63 | 0.000 | 18.3705 | 19.71233 |

```
. testparm _Icountry*

 ( 1)  _Icountry_2 = 0
 ( 2)  _Icountry_3 = 0
 ( 3)  _Icountry_4 = 0
 ( 4)  _Icountry_5 = 0
 ( 5)  _Icountry_6 = 0
 ( 6)  _Icountry_7 = 0
 ( 7)  _Icountry_8 = 0
 ( 8)  _Icountry_9 = 0
 ( 9)  _Icountry_11 = 0
 (10)  _Icountry_12 = 0
 (11)  _Icountry_13 = 0
 (12)  _Icountry_14 = 0
 (13)  _Icountry_15 = 0
 (14)  _Icountry_16 = 0

           chi2( 14) = 9193.96
         Prob > chi2 =    0.0000
```

```
Fixed-effects (within) IV regression         Number of obs      =       185
Group variable: id                           Number of groups   =        12

R-sq:  within  =      .                      Obs per group: min =        11
       between = 0.5069                                     avg =      15.4
       overall = 0.4869                                     max =        20

                                             Wald chi2(7)       =  32341.46
corr(u_i, Xb)  = 0.3241                      Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       logex |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ccont |   .0430409   .0178386     2.41   0.016      .008078    .0780038
         inv |  -.0000623   .0000415    -1.50   0.133    -.0001435     .000019
      gvtexp |   .0405889    .040637     1.00   0.318    -.0390582    .1202359
       misal |  -5.634626   4.854879    -1.16   0.246    -15.15001    3.880762
       agpro |  -3.72e-06   4.45e-06    -0.84   0.403    -.0000124    5.00e-06
         foy |  -.0000141   .0000557    -0.25   0.800    -.0001234    .0000951
         fdi |   .0008567   .0029838     0.29   0.774    -.0049915    .0067049
       _cons |   5.137772   .6390849     8.04   0.000     3.885189    6.390356
-------------+----------------------------------------------------------------
     sigma_u |  1.8777296
     sigma_e |  .53988371
         rho |  .92364469   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(11,166) =   114.41          Prob > F    = 0.0000
------------------------------------------------------------------------------
Instrumented:   ccont inv gvtexp misal
Instruments:    agpro foy fdi L.ccont L.inv L.gvtexp L.misal
------------------------------------------------------------------------------
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       223
Estimated autocorrelations =         0          Number of groups   =        15
Estimated coefficients     =        27          Obs per group: min =         1
                                                               avg =  14.86667
                                                               max =        21
                                                Wald chi2(26)      =    189.43
Log likelihood             = -482.1646          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| fdi | .0242228 | .0055857 | 4.34 | 0.000 | .0132751 | .0351706 |
| foy | 1.68e-06 | .0000412 | 0.04 | 0.967 | -.0000791 | .0000824 |
| inv | -.0059042 | .0258187 | -0.23 | 0.819 | -.0565079 | .0446996 |
| ccont | .0321299 | .0109352 | 2.94 | 0.003 | .0106973 | .0535625 |
| agpro | -9.81e-06 | .0000145 | -0.68 | 0.499 | -.0000383 | .0000186 |
| gvtexp | .0248538 | .0236558 | 1.05 | 0.293 | -.0215107 | .0712183 |
| misal | -4.939626 | 1.741915 | -2.84 | 0.005 | -8.353717 | -1.525535 |
| _Iyear_1984 | 0 | (omitted) | | | | |
| _Iyear_1985 | 4.847797 | 18.01487 | 0.27 | 0.788 | -30.4607 | 40.15629 |
| _Iyear_1986 | 14.98782 | 70.37522 | 0.21 | 0.831 | -122.9451 | 152.9207 |
| _Iyear_1987 | 15.64829 | 70.33501 | 0.22 | 0.824 | -122.2058 | 153.5024 |
| _Iyear_1988 | 12.51523 | 51.41362 | 0.24 | 0.808 | -88.25361 | 113.2841 |
| _Iyear_1989 | .5376771 | 4.296398 | 0.13 | 0.900 | -7.883108 | 8.958462 |
| _Iyear_1990 | -6.676477 | 26.94557 | -0.25 | 0.804 | -59.48883 | 46.13587 |
| _Iyear_1991 | -8.395502 | 34.7072 | -0.24 | 0.809 | -76.42037 | 59.62936 |
| _Iyear_1992 | -8.003257 | 33.05861 | -0.24 | 0.809 | -72.79695 | 56.79044 |
| _Iyear_1993 | -2.694576 | 14.54023 | -0.19 | 0.853 | -31.1929 | 25.80375 |
| _Iyear_1994 | .920804 | 7.585167 | 0.12 | 0.903 | -13.94585 | 15.78746 |
| _Iyear_1995 | 6.260851 | 30.20547 | 0.21 | 0.836 | -52.94078 | 65.46248 |
| _Iyear_1996 | 7.694805 | 35.28728 | 0.22 | 0.827 | -61.46698 | 76.85659 |
| _Iyear_1997 | 22.29879 | 98.80965 | 0.23 | 0.821 | -171.3646 | 215.9621 |
| _Iyear_1998 | 26.41496 | 115.2401 | 0.23 | 0.819 | -199.4515 | 252.2814 |
| _Iyear_1999 | 22.24847 | 98.01736 | 0.23 | 0.820 | -169.862 | 214.359 |
| _Iyear_2000 | 7.37909 | 34.29286 | 0.22 | 0.830 | -59.83367 | 74.59185 |
| _Iyear_2001 | -2.961618 | 12.12789 | -0.24 | 0.807 | -26.73184 | 20.80861 |
| _Iyear_2002 | -2.52299 | 11.99283 | -0.21 | 0.833 | -26.0285 | 20.98253 |
| _Iyear_2003 | 1.038141 | 3.028341 | 0.34 | 0.732 | -4.897299 | 6.973582 |
| _Iyear_2004 | 0 | (omitted) | | | | |
| _Iyear_2005 | 0 | (omitted) | | | | |
| _Iyear_2006 | 0 | (omitted) | | | | |
| _cons | 30.33003 | 112.6097 | 0.27 | 0.788 | -190.381 | 251.0411 |

```
. testparm _Iyear*

 ( 1)  _Iyear_1985 = 0
 ( 2)  _Iyear_1986 = 0
 ( 3)  _Iyear_1987 = 0
 ( 4)  _Iyear_1988 = 0
 ( 5)  _Iyear_1989 = 0
 ( 6)  _Iyear_1990 = 0
 ( 7)  _Iyear_1991 = 0
 ( 8)  _Iyear_1992 = 0
 ( 9)  _Iyear_1993 = 0
 (10)  _Iyear_1994 = 0
 (11)  _Iyear_1995 = 0
 (12)  _Iyear_1996 = 0
 (13)  _Iyear_1997 = 0
 (14)  _Iyear_1998 = 0
 (15)  _Iyear_1999 = 0
 (16)  _Iyear_2000 = 0
 (17)  _Iyear_2001 = 0
 (18)  _Iyear_2002 = 0
 (19)  _Iyear_2003 = 0

           chi2( 19) =   10.70
         Prob > chi2 =    0.9336
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       201
Estimated autocorrelations =         0          Number of groups   =        19
Estimated coefficients     =        26          Obs per group: min =         1
                                                               avg =  10.57895
                                                               max =        21
                                                Wald chi2(25)      =  71971.82
Log likelihood             =  41.04926          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| fdi | .0009525 | .0007438 | 1.28 | 0.200 | -.0005052 | .0024103 |
| foy | .0001199 | 7.58e-06 | 15.81 | 0.000 | .000105 | .0001348 |
| inv | -.0000253 | 8.56e-06 | -2.96 | 0.003 | -.0000421 | -8.54e-06 |
| ccont | .0065763 | .0013527 | 4.86 | 0.000 | .003925 | .0092276 |
| agpro | -3.33e-06 | 1.67e-06 | -2.00 | 0.046 | -6.60e-06 | -6.66e-08 |
| gvtexp | .0015714 | .0090851 | 0.17 | 0.863 | -.0162351 | .0193778 |
| misal | .4505402 | .1133701 | 3.97 | 0.000 | .2283388 | .6727415 |
| _Icountry_2 | -3.930088 | .2222249 | -17.69 | 0.000 | -4.365641 | -3.494535 |
| _Icountry_3 | -.7105579 | .264693 | -2.68 | 0.007 | -1.229347 | -.1917692 |
| _Icountry_4 | .2806479 | .0814103 | 3.45 | 0.001 | .1210867 | .440209 |
| _Icountry_5 | -.2781804 | .1722377 | -1.62 | 0.106 | -.6157602 | .0593994 |
| _Icountry_6 | -.5678326 | .2739903 | -2.07 | 0.038 | -1.104844 | -.0308216 |
| _Icountry_7 | -.1649769 | .1002652 | -1.65 | 0.100 | -.3614931 | .0315394 |
| _Icountry_8 | 1.938547 | .0895908 | 21.64 | 0.000 | 1.762952 | 2.114142 |
| _Icountry_9 | 1.944638 | .225174 | 8.64 | 0.000 | 1.503305 | 2.385971 |
| _Icountry_10 | 1.475141 | .0709934 | 20.78 | 0.000 | 1.335996 | 1.614285 |
| _Icountry_11 | 1.331647 | .1594737 | 8.35 | 0.000 | 1.019084 | 1.644209 |
| _Icountry_12 | .1552933 | .2378094 | 0.65 | 0.514 | -.3108046 | .6213913 |
| _Icountry_13 | -2.961672 | .2472969 | -11.98 | 0.000 | -3.446365 | -2.476979 |
| _Icountry_14 | .5454203 | .1294651 | 4.21 | 0.000 | .2916733 | .7991673 |
| _Icountry_15 | -.4376494 | .2208796 | -1.98 | 0.048 | -.8705654 | -.0047334 |
| _Icountry_16 | -.6933784 | .2752496 | -2.52 | 0.012 | -1.232858 | -.1538991 |
| _Icountry_17 | .5074992 | .2099117 | 2.42 | 0.016 | .0960798 | .9189186 |
| _Icountry_18 | 1.62304 | .0912152 | 17.79 | 0.000 | 1.444262 | 1.801819 |
| _Icountry_19 | 14.41741 | .2270376 | 63.50 | 0.000 | 13.97242 | 14.86239 |
| _cons | 6.221108 | .2350015 | 26.47 | 0.000 | 5.760513 | 6.681702 |

```
Fixed-effects (within) IV regression         Number of obs      =        166
Group variable: id                           Number of groups   =         14

R-sq:  within  = 0.6529                      Obs per group: min =          1
       between = 0.0406                                     avg =       11.9
       overall = 0.1681                                     max =         20

                                             Wald chi2(7)       =  382201.33
corr(u_i, Xb)  = -0.6045                     Prob > chi2        =     0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| ccont | .0085239 | .0027652 | 3.08 | 0.002 | .0031041 | .0139436 |
| inv | -.0000401 | .0000186 | -2.15 | 0.032 | -.0000766 | -3.53e-06 |
| gvtexp | -.0107639 | .0266158 | -0.40 | 0.686 | -.06293 | .0414022 |
| misal | 1.452853 | .6421179 | 2.26 | 0.024 | .1943249 | 2.711381 |
| agpro | -2.77e-06 | 2.13e-06 | -1.30 | 0.194 | -6.94e-06 | 1.41e-06 |
| foy | .0000954 | .0000107 | 8.92 | 0.000 | .0000744 | .0001163 |
| fdi | .0026411 | .0011092 | 2.38 | 0.017 | .0004671 | .0048151 |
| _cons | 9.056586 | .5962144 | 15.19 | 0.000 | 7.888028 | 10.22515 |
| sigma_u | 4.0871214 | | | | | |
| sigma_e | .23287207 | | | | | |
| rho | .99676412 | (fraction of variance due to u_i) | | | | |

```
F  test that all u_i=0:     F(13,145) =    718.35          Prob > F     = 0.0000

Instrumented:   ccont inv gvtexp misal
Instruments:    agpro foy fdi L.ccont L.inv L.gvtexp L.misal
```

```
. testparm _Icountry*

 ( 1)  _Icountry_2 = 0
 ( 2)  _Icountry_3 = 0
 ( 3)  _Icountry_4 = 0
 ( 4)  _Icountry_5 = 0
 ( 5)  _Icountry_6 = 0
 ( 6)  _Icountry_7 = 0
 ( 7)  _Icountry_8 = 0
 ( 8)  _Icountry_9 = 0
 ( 9)  _Icountry_10 = 0
 (10)  _Icountry_11 = 0
 (11)  _Icountry_12 = 0
 (12)  _Icountry_13 = 0
 (13)  _Icountry_14 = 0
 (14)  _Icountry_15 = 0
 (15)  _Icountry_16 = 0
 (16)  _Icountry_17 = 0
 (17)  _Icountry_18 = 0
 (18)  _Icountry_19 = 0

           chi2( 18) =29029.16
         Prob > chi2 =    0.0000
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       201
Estimated autocorrelations =         0          Number of groups   =        19
Estimated coefficients     =        27          Obs per group: min =         1
                                                               avg =  10.57895
                                                               max =        21
                                                Wald chi2(26)      =    380.88
Log likelihood             =  -443.417          Prob > chi2        =    0.0000
```

| logex | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| fdi | .0095892 | .0032186 | 2.98 | 0.003 | .0032809 | .0158975 |
| foy | -.0000152 | .0000223 | -0.68 | 0.496 | -.0000588 | .0000285 |
| inv | .00085 | .001584 | 0.54 | 0.592 | -.0022545 | .0039545 |
| ccont | .0731622 | .0077122 | 9.49 | 0.000 | .0580464 | .0882779 |
| agpro | .0000401 | .0000156 | 2.57 | 0.010 | 9.53e-06 | .0000708 |
| gvtexp | .0345592 | .0408276 | 0.85 | 0.397 | -.0454614 | .1145798 |
| misal | -9.259448 | .924035 | -10.02 | 0.000 | -11.07052 | -7.448372 |
| _Iyear_1986 | -1.084093 | 3.721874 | -0.29 | 0.771 | -8.378831 | 6.210645 |
| _Iyear_1987 | -.5649261 | 3.754856 | -0.15 | 0.880 | -7.924308 | 6.794456 |
| _Iyear_1988 | -.2221197 | 2.658878 | -0.08 | 0.933 | -5.433425 | 4.989185 |
| _Iyear_1989 | 1.879232 | .9845685 | 1.91 | 0.056 | -.0504864 | 3.808951 |
| _Iyear_1990 | 3.332117 | 2.463304 | 1.35 | 0.176 | -1.495871 | 8.160105 |
| _Iyear_1991 | 3.531481 | 2.929343 | 1.21 | 0.228 | -2.209927 | 9.272888 |
| _Iyear_1992 | 2.615716 | 2.821299 | 0.93 | 0.354 | -2.913928 | 8.14536 |
| _Iyear_1993 | 1.860098 | 1.795861 | 1.04 | 0.300 | -1.659726 | 5.379921 |
| _Iyear_1994 | .5270123 | .8477772 | 0.62 | 0.534 | -1.1346 | 2.188625 |
| _Iyear_1995 | .6739775 | 1.498655 | 0.45 | 0.653 | -2.263332 | 3.611287 |
| _Iyear_1996 | 1.271619 | 1.808789 | 0.70 | 0.482 | -2.273543 | 4.816781 |
| _Iyear_1997 | -1.823744 | 5.544397 | -0.33 | 0.742 | -12.69056 | 9.043074 |
| _Iyear_1998 | -3.337901 | 6.527928 | -0.51 | 0.609 | -16.1324 | 9.456604 |
| _Iyear_1999 | -2.94628 | 5.504986 | -0.54 | 0.593 | -13.73585 | 7.843294 |
| _Iyear_2000 | -1.111711 | 1.880349 | -0.59 | 0.554 | -4.797127 | 2.573706 |
| _Iyear_2001 | .2542392 | 1.578046 | 0.16 | 0.872 | -2.838675 | 3.347153 |
| _Iyear_2002 | -.6435563 | 1.553675 | -0.41 | 0.679 | -3.688704 | 2.401591 |
| _Iyear_2003 | -1.311458 | .960848 | -1.36 | 0.172 | -3.194685 | .57177 |
| _Iyear_2004 | .6183415 | 1.07609 | 0.57 | 0.566 | -1.490756 | 2.727439 |
| _Iyear_2005 | 0 | (omitted) | | | | |
| _cons | -.9831484 | 7.812178 | -0.13 | 0.900 | -16.29474 | 14.32844 |

```
. testparm _Iyear*

 ( 1)  _Iyear_1986 = 0
 ( 2)  _Iyear_1987 = 0
 ( 3)  _Iyear_1988 = 0
 ( 4)  _Iyear_1989 = 0
 ( 5)  _Iyear_1990 = 0
 ( 6)  _Iyear_1991 = 0
 ( 7)  _Iyear_1992 = 0
 ( 8)  _Iyear_1993 = 0
 ( 9)  _Iyear_1994 = 0
 (10)  _Iyear_1995 = 0
 (11)  _Iyear_1996 = 0
 (12)  _Iyear_1997 = 0
 (13)  _Iyear_1998 = 0
 (14)  _Iyear_1999 = 0
 (15)  _Iyear_2000 = 0
 (16)  _Iyear_2001 = 0
 (17)  _Iyear_2002 = 0
 (18)  _Iyear_2003 = 0
 (19)  _Iyear_2004 = 0

           chi2( 19) =   34.66
         Prob > chi2 =    0.0153
```

```
Cross-sectional time-series FGLS regression

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

Estimated covariances      =         1          Number of obs      =       201
Estimated autocorrelations =         0          Number of groups   =        19
Estimated coefficients     =        45          Obs per group: min =         1
                                                               avg =  10.57895
                                                               max =        21
                                                Wald chi2(44)      = 199877.74
Log likelihood             =  143.5238          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       logex |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |    .001758   .0004841     3.63   0.000     .0008092    .0027067
         foy |   .0000531   7.04e-06     7.54   0.000     .0000393    .0000669
         inv |  -.0016621   .0001459   -11.39   0.000     -.001948   -.0013761
       ccont |  -.0025161   .0011936    -2.11   0.035    -.0048555   -.0001766
       agpro |  -2.21e-06   1.10e-06    -2.00   0.046    -4.37e-06   -4.26e-08
      gvtexp |  -.0043332   .0058759    -0.74   0.461    -.0158497    .0071832
       misal |   .3153983   .0700487     4.50   0.000     .1781054    .4526912
 _Iyear_1986 |    3.54029   .3181798    11.13   0.000     2.916669    4.163911
 _Iyear_1987 |   3.661696    .319707    11.45   0.000     3.035081     4.28831
 _Iyear_1988 |   2.566939    .218096    11.77   0.000     2.139479      2.9944
 _Iyear_1989 |  -.4069494   .0717742    -5.67   0.000    -.5476243   -.2662745
 _Iyear_1990 |  -2.259782   .2290855    -9.86   0.000    -2.708781   -1.810782
 _Iyear_1991 |  -2.720602   .2699416   -10.08   0.000    -3.249678   -2.191526
 _Iyear_1992 |  -2.471361     .25851    -9.56   0.000    -2.978031   -1.964691
 _Iyear_1993 |   -1.33451    .157865    -8.45   0.000     -1.64392   -1.025101
 _Iyear_1994 |   .1062025   .0520194     2.04   0.041     .0042463    .2081587
 _Iyear_1995 |   1.693137   .1224102    13.83   0.000     1.453217    1.933056
 _Iyear_1996 |   2.055941   .1541186    13.34   0.000     1.753874    2.358008
 _Iyear_1997 |   6.127619    .513618    11.93   0.000     5.120946    7.134291
 _Iyear_1998 |   7.142268   .6101952    11.70   0.000     5.946308    8.338229
 _Iyear_1999 |   6.034513   .5182773    11.64   0.000     5.018709    7.050318
 _Iyear_2000 |   1.980587   .1750676    11.31   0.000     1.637461    2.323713
 _Iyear_2001 |  -1.091534   .1126187    -9.69   0.000    -1.312263   -.8708056
 _Iyear_2002 |  -1.001881   .1078641    -9.29   0.000    -1.213291   -.7904713
 _Iyear_2003 |   .1235517   .0533491     2.32   0.021     .0189894    .2281141
 _Iyear_2004 |  -.0044953   .0584462    -0.08   0.939    -.1190477    .1100572
 _Iyear_2005 |          0  (omitted)
_Icountry_2  |  -5.827638   .2230886   -26.12   0.000    -6.264884   -5.390392
_Icountry_3  |  -2.380433   .2120126   -11.23   0.000    -2.795971   -1.964896
_Icountry_4  |   .5627714   .0604595     9.31   0.000     .4442731    .6812698
_Icountry_5  |  -.9840899   .1238032    -7.95   0.000     -1.22674   -.7414402
_Icountry_6  |  -1.902313   .1985752    -9.58   0.000    -2.291513   -1.513113
_Icountry_7  |   .1811146   .0693603     2.61   0.009     .0451709    .3170583
_Icountry_8  |   1.838433   .0557409    32.98   0.000     1.729183    1.947683
_Icountry_9  |   .4066989   .1906649     2.13   0.033     .0330026    .7803953
_Icountry_10 |   1.425205   .0430766    33.09   0.000     1.340777    1.509634
_Icountry_11 |   1.017415   .1006343    10.11   0.000      .820175    1.214654
_Icountry_12 |  -1.081788   .1764687    -6.13   0.000     -1.42766   -.7359152
_Icountry_13 |  -4.641102   .2064654   -22.48   0.000    -5.045767   -4.236437
_Icountry_14 |    1.06849   .0959031    11.14   0.000     .8805232    1.256457
_Icountry_15 |  -1.790373   .1705889   -10.50   0.000    -2.124721   -1.456024
_Icountry_16 |  -2.075223   .2030337   -10.22   0.000    -2.473162   -1.677285
_Icountry_17 |  -.3507068   .1529333    -2.29   0.022    -.6504505   -.0509631
_Icountry_18 |   1.279453   .0596583    21.45   0.000     1.162524    1.396381
_Icountry_19 |   13.33588   .1611754    82.74   0.000     13.01998    13.65178
       _cons |   15.83063   .8665089    18.27   0.000      14.1323    17.52895
------------------------------------------------------------------------------
```

## APPENDIX 3: RER MISALIGNMENT AND EXPORTS: A TABULAR ANALYSIS

| | Southern Africa | | | | Central Africa | | | | Asia | | Latin America | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zimbabwe | | Malawi | | Togo | | Nigeria | | India | | Chile | | Columbia | |
| Year | Mis | Exp | Mis | Exp | Mis | Exp | Mis | Exp | Mis | Exp | Mis | Exp | Mis | Exp |
| 1983 | 0.3 | 0.2 | -0.2 | 1.2 | -0.1 | 2.2 | 0.3 | 2.1 | 0.1 | 2.0 | -0.3 | 3.2 | 0.4 | 0.3 |
| 1984 | -0.3 | 4.3 | -0.2 | 1.0 | 0.3 | 2.1 | 0.4 | 1.7 | 0.3 | 0.6 | 0.1 | 1.4 | 0.2 | 2.1 |
| 1985 | -0.2 | 3.3 | -0.1 | 1.2 | 0.1 | 3.2 | 0.1 | 2.3 | 0.1 | 1.5 | -0.1 | 2.4 | 0.3 | 0.2 |
| 1986 | 0.0 | 2.3 | -0.1 | 1.0 | 0.2 | 4.5 | 0.1 | 2.3 | 0.4 | 0.1 | 0.2 | 0.5 | 0.2 | 0.3 |
| 1987 | 0.0 | 2.2 | -0.2 | 2.1 | 0.2 | 4.5 | 0.0 | 2.1 | -0.2 | 1.7 | 0.0 | 1.4 | 0.1 | 0.6 |
| 1988 | -0.2 | 2.6 | -0.2 | 2.1 | -0.2 | 3.3 | 0.0 | 2.1 | 0.1 | 0.6 | 0.0 | 2.4 | 0.0 | 1.2 |
| 1989 | -0.1 | 2.1 | -0.3 | 3.3 | -0.2 | 0.8 | 0.2 | 2.1 | 0.0 | 1.3 | 0.1 | 1.5 | 0.0 | 2.1 |
| 1990 | -0.2 | 2.3 | -0.2 | 2.1 | -0.3 | 1.0 | 0.3 | 2.2 | -0.1 | 1..5 | 0.1 | 1.3 | 0.0 | 2.0 |
| 1991 | -0.3 | 2.8 | -0.3 | 3.2 | -0.3 | 3.1 | 0.2 | 2.1 | -0.4 | 2.5 | 0.2 | 1.2 | -0.1 | 2.3 |
| 1992 | 0.5 | 0.1 | -0.2 | 2.4 | 0.0 | 2.0 | 0.0 | 2.0 | -0.6 | 3.2 | 0.1 | 1.5 | -0.2 | 2.6 |
| 1993 | -0.3 | 1.3 | 0.0 | 0.3 | -0.1 | 1.1 | 0.0 | 2.0 | -0.5 | 3.1 | -0.2 | 3.2 | 0.0 | 2.3 |
| 1994 | 0.0 | 3.6 | 0.1 | 0.1 | 0.0 | 3.8 | -0.3 | 3.3 | -0.4 | 3.2 | -0.1 | 2.5 | 0.0 | 2.1 |
| 1995 | -0.2 | 1.4 | 0.1 | 0.1 | 0.0 | 2.2 | -0.3 | 3.3 | -0.4 | 3.2 | 0.0 | 2.2 | 0.1 | 0.8 |
| 1996 | 0.1 | 3.3 | 0.1 | 0.0 | 0.0 | 3.9 | -0.4 | 3.3 | -0.2 | 2.8 | 0.0 | 2.1 | 0.1 | 0.8 |
| 1997 | 0.2 | 1.0 | 0.2 | 0.3 | 0.0 | 2.1 | -0.4 | 3.3 | -0.1 | 2.3 | 0.0 | 2.1 | 0.2 | 1.2 |
| 1998 | -0.7 | 2.3 | 0.1 | 0.2 | 0.0 | 3.8 | -0.5 | 3.3 | -0.2 | 2.6 | 0.1 | 2.2 | -0.1 | 2.2 |
| 1999 | -0.1 | 3.0 | 0.2 | 0.0 | -0.1 | 1.8 | -0.6 | 3.3 | -0.2 | 2.5 | 0.0 | 2.2 | -0.1 | 2.3 |
| 2000 | 0.3 | 1.2 | 0.1 | 0.1 | 0.1 | 1.0 | -0.7 | 3.3 | -0.1 | 2.2 | -0.1 | 3.1 | -0.2 | 2.6 |
| 2001 | 0.1 | 0.2 | 0.1 | 0.4 | 0.2 | 3.3 | -0.1 | 3.2 | -0.3 | 3.3 | 0.0 | 2.2 | -0.3 | 3.0 |
| 2002 | 0.2 | 0.2 | 0.0 | 0.3 | 0.1 | 3.4 | -0.1 | 2.4 | -0.2 | 2.7 | 0.1 | 2.1 | -0.3 | 3.2 |
| 2003 | -0.4 | 3.6 | 0.0 | 0.0 | 0.2 | 3.2 | -0.2 | 2.5 | -0.3 | 3.0 | 0.1 | 1.5 | -0.1 | 3.1 |
| 2004 | -0.3 | 4.4 | -0.1 | 1.1 | 0.2 | 2.7 | -0.3 | 2.3 | -0.2 | 2.9 | 0.1 | 1.2 | -0.1 | 3.3 |
| 2005 | 0.1 | 1.6 | -0.1 | 1.1 | 0.4 | 3.6 | -0.3 | 2.2 | -0.2 | 3.1 | -0.1 | 2.3 | -0.2 | 2.3 |
| 2006 | 0.0 | 2.1 | -0.3 | 1.6 | 0.6 | 2.6 | -0.2 | 2.6 | -0.4 | 3.5 | -0.2 | 3.2 | -0.1 | 2.9 |

**APPENDIX 4: LIST OF COUNTRIES INCLUDED**

1. Columbia
2. Ghana
3. Mozambique
4. Chile
5. Burundi
6. Namibia
7. Zimbabwe
8. Tanzania
9. Mexico
10. Malawi
11. Nigeria
12. India
13. Kenya
14. Ethiopia
15. Thailand
16. Bangladesh
17. South Africa
18. Togo
19. Tunisia
20. Zambia