UNIVERSITY of GREENWICH
FOUNDATION FOR EUROPEAN PROGRESSIVE STUDIES
FONDATION EUROPÉENNE D'ÉTUDES PROGRESSISTES
GPERC

Greenwich papers in political economy

The Balance of Payments Constrained Growth Model with Sustainable Debt Accumulation, Interest Payments and the Terms of Trade: Evidence from Sub-Saharan Africa.

Shanaz Sumra
University of Greenwich

Abstract

The relevance of a demand-led growth model for long run economic growth is tested for the sub-Saharan African region using an augmented balance of payments constrained growth model which allows for sustainable debt accumulation, interest rate payments and the terms of trade movements. An autoregressive distributive lag (ARDL) model is used to estimate the model for 22 sub-Saharan African economies. Different specifications of the balance of payments constrained growth model are estimated and compared. The results indicate that the region was balance of payments constrained between the 1960 to 2014 period. In addition, the model which allows for sustainable debt accumulation and interest rate payments abroad best explained the growth experience of the region.

Year: 2016

No: GPERC36

GREENWICH POLITICAL ECONOMY RESEARCH CENTRE (GPERC)

Keywords: Balance of payments, constrained growth, debt, interest payments abroad, terms of trade, sub-Saharan Africa

Acknowledgments: I would like to thank Ozlem Onaran (University of Greenwich), for her valuable comments and suggestions. An earlier version of the paper was presented at the 19th annual conference for The Research Network Macroeconomics and Macroeconomic Policies, (Berlin/2015). Any remaining errors remain mine.

JEL codes: 055, R11, F14, 011.

Corresponding author: Shanaz Sumra, University of Greenwich, Old Royal Naval College, 30 Park Row, London
Email: s.b.sumra@greenwich.ac.uk

1. Introduction

The balance of payments constrained growth model has been tested extensively for developed countries with the results generally giving support to it[1]. It has also been tested for several developing countries particularly in Latin America and Asia (Alvarez-Ude and Gomez, 2008; Bertola et al, 2002; Britto and McCombie, 2009; Moreno-Brid, 2003; Razmi, 2005; Felipe et al, 2010; Tharnpanich and McCombie, 2013). There is very little empirical research regarding the relevance of balance of payments constraints for sub-Saharan Africa. The few studies that do exist on sub-Saharan Africa verify the theoretical expectations of the model (Hussain, 1999; Nell, 2003; Perraton, 2003).

The last comprehensive study on the balance of payments constrained model for the African region was done by Hussain (1999) using data covering the period 1970 to 1990. However although acceptable at the time, the study did not make use of adequate time series estimation techniques therefore casting doubt on the estimated results.

Perraton (2003), using data for the 1973 to 1995 period, applied more appropriate estimation techniques to test the relevance of the balance of payments constrained growth model for a group of developing countries however, relatively few African countries were included in the analysis; 12 and 7 for the weak and strong form of Thirlwall's law respectively. In addition, both Hussain (1999) and Perraton (2003) did not accommodate for sustainable debt accumulation and interest rate payments abroad. According to Perraton (2003) it was "impossible" to measure the growth rate of net capital flows into a country as they fluctuated between deficit and surplus over the period considered. Moreno-Brid (2003) has theoretically and empirically shown that sustainable debt accumulation can be incorporated into the model

[1] See McCombie and Thirlwall (2004) for a survey of the literature up to 2003.

by imposing a long term constraint where the ratio of the current account deficit to income is measured as a constant taken at the beginning of the period.

An empirical study of the balance of payments constrained growth for the sub-Saharan African region which incorporates sustainable debt accumulation, interest rate payments and the terms of trade is necessary, as 33 of the 39 countries described as Heavily Indebted Poor Countries (HIPC) are in sub-Saharan Africa (World Bank, 2015). In addition, majority of the countries depend on production of primary products in international markets making the terms of trade effects more pronounced. A study that uses the above extended version of the model, applying recent data and more appropriate econometric techniques is therefore warranted.

Section 2 is a brief overview of the empirical literature on the balance of payments constrained growth model. Section 3 outlines the data and methodology used to estimate the model for the region. Due to uncertainty regarding the stationarity of the variables as a result of structural breaks in the data, we apply an Autoregressive Distributive Lag (ARDL) model. The results obtained from estimating the import and export demand functions as well as the estimated balance of payments constrained growth model are given in section 4.

2. Literature Review

Thirlwall (1979) developed a post-Keynesian long run growth model, which gives a central role to demand, using Harrod's (1933) foreign trade multiplier. Thirlwall (2013) argues that for most countries demand constraints operate long before supply constraints take effect. The original Thirlwall (1979) model to estimate the balance of payments constrained growth rate starts with the balance of payments equilibrium condition,

$$P_d X = P_f ME \qquad \text{(Equation 2.1)}$$

where P_d is the price of exports in the domestic currency, X is the volume of exports, P_f is the price of imports in foreign currency, M is the volume of imports and E is the exchange rate measured as the domestic price of foreign currency.

Taking the logarithms and differentiating with respect to time Equation 2.1 gives,

$$p_d + x = p_f + m + e \qquad \text{(Equation 2.2)}$$

Where the small case letter x is the growth rate of exports, m is the growth rate of imports, e is the growth rate of the exchange rate, p_d is the growth rate of domestic prices and p_f is the growth rate of import prices.

The import and export demand functions with constant elasticities are as follows:

$$M = a\left(\frac{P_f E}{P_d}\right)^{\psi} Y^{\pi} \qquad \text{(Equation 2.3)}$$

$$X = b\left(\frac{P_d}{P_f E}\right)^{\eta} Z^{\varepsilon} \qquad \text{(Equation 2.4)}$$

where a and b are constants, Y is domestic income, Z is the level of world income, ψ is the price elasticity of demand for imports, η is the price elasticity of demand for exports, π is income elasticity of demand for imports and ε is the income elasticity of demand for exports.

Taking the logarithms of Equations 2.3 and 2.4 and differentiating with respect to time,

$$m = \psi(p_f + e - p_d) + \pi y \qquad \text{(Equation 2.5)}$$

$$x = \eta(p_d - e - p_f) + \varepsilon z \qquad \text{(Equation 2.6)}$$

where m is the growth rate of imports, p_f is the growth rate of foreign prices, e is the growth rate of the exchange rate, p_d is the growth rate of domestic prices, y is the growth rate of domestic income, x is the growth rate of exports, and z is the growth rate of world income.

Equation 2.5 and 2.6 are then substituted into Equation 2.2 giving,

$$p_d + (\eta(p_d - e - p_f) + \varepsilon z) = p_f + (\psi(p_f + e - p_d) + \pi y) + e \qquad \text{(Equation 2.7)}$$

Solving for the growth of income gives the balance of payments constrained growth rate $^{**}y_B$,

$$^{**}\, y_B = [(1 + \eta + \psi)(p_d - p_f - e) + \varepsilon z]/\pi \qquad \text{(Equation 2.8)}$$

Under the assumption that the sum of the price elasticities ($\eta+\psi$) is equal to unity in absolute values, and/or if relative prices in international trade, i.e. the real exchange rates are constant, then Equation 2.8 reduces to,

$$^{*}\, y_B = \varepsilon z/\pi \qquad \text{(Equation 2.9)}$$

where the balance of payments constrained growth rate $^{*}y_B$, is equal to the income elasticity of demand for exports multiplied by the growth in world income, εz, divided by the income elasticity of demand for imports, π. Based on the same assumption of constant relative prices, Equation 2.9 can further be reduced to,

$$y_B = x/\pi \qquad \text{(Equation 2.10)}$$

where the balance of payments constrained growth y_B, is equal to the growth in exports x, divided by the income elasticity of demand for imports, π. Perraton (2003) described Equation 2.9 as the strong version of Thirlwall's law as both the import and export demand functions need to be estimated while Equation 2.10, was recognised as the weak version, as only the import demand function is needed to derive the balance of payments constrained growth rate. Equation 2.10 can also be interpreted as the dynamic Harrod (1933) trade multiplier result[2].

[2] The static Harrod trade multiplier result, Y=X/m where Y is the level of income, X is the level of exports and m is the marginal propensity to import and 1/m is the foreign trade multiplier. The weak version of the balance of payments constrained growth can be seen as the dynamic Harrod trade multiplier result, x/π (Thirlwall, 2011).

The original model described above was extended to include capital flows and terms of trade (Hussain and Thirlwall, 1982). The extension is particularly relevant for developing countries, where capital flows, changes in the terms of trade and the real exchange rate have been very important. An outline of the model can be seen in Appendix A.

The extended model with capital flows and the terms of trade was first empirically tested by Hussain and Thirlwall (1982) for 20 developing countries covering the 1951 to 1969 period. Just three sub-Saharan African countries were included in the study: Kenya, Sudan and Zaire[3]. The weak version of Thirlwall's law as given in Equation 2.10, as well as an extended model which incorporates growth in real capital flows and the terms of trade effects was used. Their results showed that the countries in the sample had a "very mixed" experience, however on balance, changes in the terms of trade constrained growth by 0.6% per annum while capital inflows relaxed the balance of payments constraint and allowed countries to grow faster by about 0.05% per annum.

The researchers also divided the sample of countries into two sub-groups, the first consisting of those countries where the balance of payments constrained growth model given in Equation 2.10 under predicted the actual growth rate, $y>y_B$, and those where it over predicted the growth rate $y<y_B$. As expected, in the first group where $y>y_B$, the rate of growth of real capital inflows was greater than the growth of exports therefore contributing to the positive difference. For the countries where $y<y_B$, the rate of growth of capital flows was below the rate of growth of exports for the majority of the countries in the group; however the dominant constraint to growth was the adverse effects of relative price movements.

Hussain (1999), tested the weak version of Thirlwall's law, extending the model to account for capital flows and the terms of trade as outlined in Hussain and Thirlwall (1982), for 29 African and 11 Asian economies covering the 1970 to 1990 period. His results for the group of African

[3] Zaire is now known as the Democratic Republic of Congo.

and Asian countries, when tested separately, provided evidence that both the original weak version and the extended model were good predictors of actual growth. However when the country groups were combined, the extended model was "superior" to the original model. For the entire sample of 40 countries, the original model gave valid predictions for 55% of cases while the extended model faired at 73%. Hussain (1999) therefore concludes that the extended model developed by Hussain and Thirlwall (1982), is the most appropriate model for sub-Saharan Africa. One of the limitations of the study is that Ordinary Least Squares (OLS) was used to estimate the import demand functions for each country without pre testing the stationarity of the data. The results obtained may therefore be spurious.

Due to the tendency of the Hussain and Thirlwall (1982) model to over predict the rate of growth, the model was extended by Elliott and Rhodd (1999, p.1146) to include interest rate payments for, "demand financed by capital flows generally carries with it debt accumulation and servicing." Drawing from the sample of countries employed in the Hussain and Thirlwall (1982) study and extending the model to include external debt financing, Elliott and Rhodd (1999) were able to reduce the degree of over prediction for 9 out of 13 countries, concluding that economic growth is additionally constrained by debt service payments which drain on the limited financial resources needed for economic growth.

The extended balance of payments constrained growth rate developed by Hussain and Thirlwall (1982) and later modified by Elliott and Rhodd (1999) was further criticised by Moreno-Brid (1999) as the models did not set a limit to the amount of capital flows into a country and therefore assumed that a country can forever increase its level of indebtedness relative to Gross Domestic Product (GDP). In practice, a developing countries creditworthiness and therefore access to global financial markets is influenced by its debt accumulation as perceived by the creditors as the current account to GDP ratio and the foreign debt to GDP ratio. As these ratios increase and reach critical levels, developing countries may experience difficulties in attracting

foreign capital. This was seen in the 1980's debt crisis which affected many developing countries including Latin America and sub-Saharan Africa (Devlin and Ffrench-Davis, 1995). Sustainable debt accumulation is incorporated into the model by imposing a long run constraint taken as a constant ratio of the current account deficit to income (Moreno-Brid, 2003). This version of the model which accounts for sustainable debt accumulation, interest rate payments and the terms of trade has not been tested for the sub-Saharan African region. It has however been tested by Moreno-Brid (2003) for Mexico[4], with the results providing support for the balance of payments constrained growth model as well as the importance of interest rate payments as an additional binding constraint to Mexico's growth rate.

Other extensions of the model include Nell (2003) and Lanzafame (2014). Nell (2003) generalised the balance of payments constrained growth model to include many countries. He was therefore able to analyse South Africa's balance of payments constraint with respect to the OECD and the rest of the Southern African Development Community (RSADC). The results showed that South Africa was only balance of payments constrained with respect to the OECD and faster growth rates may be the result of an improvement in the structural demand feature of its exports to the OECD.

Lanzafame (2014) synthesised the two growth literatures on the Harrod (1939) natural rate of growth and the balance of payments constrained growth model. Using 22 OECD countries for the 1960 to 2010 period, he provided evidence that the natural rate of growth was equal to the balance of payments constrained rate of growth. Applying Granger-causality tests, he provided further evidence that there was unidirectional long run causality from the balance of payments constrained growth to the natural rate of growth, therefore reinforcing the view that long run growth is demand determined and constrained by the balance of payments.

[4] The model empirically tested by Moreno-Brid (2003) assumed that the terms of trade are constant.

3. Data and Methodology

There have been several extensions to the original balance of payments constrained growth model. The chosen model for the sub-Sahara African region is the one modified by Moreno-Brid (2003) which allows for sustainable debt accumulation, interest rate payments and the terms of trade. As far as we are aware, there are no current papers which test this version of the model for the region. Below is an outline of the data, model and the methodology used to estimate and test the balance of payments constrained growth model.

3.1 Data

Data covering the 1960 to 2014 period is used in the analysis. The time period used differs for individual countries due to data availability. The variables used are exports of goods and services, imports of goods and services, Gross Domestic Product (GDP), world income, import price index, export price index, interest payments on external debt and the real effective exchange rate. Please see Appendix B for a full description of the data and sources used.

3.2 The Model

In line with Hussain and Thirlwall (1982), Moreno-Brid (2003) and Thirlwall (2012), the starting point of the extended model of the balance of payments constrained growth model is the balance of payments accounting identity in disequilibrium which will be modified accordingly to accommodate for sustainable debt accumulation, interest rate payments and the terms of trade.

$$P_d X + FP_d = P_f ME \qquad \text{(Equation 3.1)}$$

Where, $P_{d,}$ is the price of exports in the domestic currency, X, is the volume of exports, F is the current account deficit in real terms so that FP_d, is nominal capital flows to finance the deficit,

$P_{f,}$ is the price of imports in foreign currency, M, is the volume of imports and E, is the exchange rate measured as the domestic price of foreign currency[5].

Taking the first difference of the variables in logarithmic form yields,

$$\theta(p_d + x) + (1 - \theta)(f + P_d) = p_f + m + e \quad \text{(Equation 3.2)}$$

Where, θ, and (1-θ), represent the share of exports and capital flows as a proportion of total receipts respectively. Therefore $\theta = P_d X/R$ and $(1 - \theta) = FP_d/R$, where R is total receipts which can also be expressed as the import bill financed by export earnings and capital flows. Lower case letters denote growth rates.

Equation 3.2 is modified to include sustainable debt accumulation and interest rate payments abroad (Moreno-Brid, 2003). We account for interest payments abroad by subtracting interest payments from capital flows,

$$\theta(p_d + x) - \theta_1(p_d + r) + (1 - \theta + \theta_1)(f + P_d) = p_f + m + e \quad \text{(Equation 3.3)}$$

Where, r, is the growth rate of real net interest payments abroad and, $\theta_{1,}$ is the share of foreign exchange used for interest payments abroad. Corresponding to sustainable debt accumulation in the long run, we assume that the current account deficit to GDP ratio is constant, hence we set f=y[6]. Substituting the growth of imports and exports from Equations 2.5 and 2.6, setting f=y and solving for the growth of income[7],

$$y_{BSDART} = \frac{\theta\varepsilon z - \theta_1 r + (\theta\eta + \psi + 1)(p_d - p_f - e)}{\pi - (1 - \theta + \theta_1)} \quad \text{(Equation 3.4)}$$

where $y_{BSDART,}$ is the balance of payments constrained growth rate with sustainable debt accumulation, interest rate payments abroad and the terms of trade.

[5] For simplicity the nominal exchange rate is assumed to be fixed and equal to one (Moreno-Brid, 2003).

[6] Following Moreno-Brid (2003), we set the growth in capital flows equal to the growth in income, $\frac{df}{f} = \frac{dy}{y}$.

[7] Substituting the import and export demand functions in Equation 3.3 yields, $\theta\left(p_d + (\eta\left(p_{d-e-p_f}\right) + \varepsilon z)\right) - \theta_1(p_d + r) + (1 - \theta + \theta_1)(f + P_d) = p_f + (\psi(p_f + e - p_d) + \pi y) + e$.

Under the assumption of constant relative prices[8], Equation 3.4 reduces to,

$$* y_{BSDART} = \frac{\theta x - \theta_1 r + (\psi+1)(p_d - p_f - e)}{\pi - (1 - \theta + \theta_1)} \quad \text{(Equation 3.5)}$$

If the terms of trade are neutral and the Marshall Lerner condition is met, i.e. $\psi = -1$ then Equation 3.5 reduces to,

$$y_{BSDAR} = \frac{\theta x - \theta_1 r}{\pi - (1 - \theta + \theta_1)} \quad \text{(Equation 3.6)}$$

Where, $y_{BSDAR,}$ is the balance of payments constrained growth rate with sustainable debt accumulation and interest payments abroad. If there are no interest payments, hence θ_1=0, then Equation 3.6 becomes,

$$y_{BSDA} = \frac{\theta x}{\pi - (1 - \theta)} \quad \text{(Equation 3.7)}$$

Where, y_{BSDA}, is the balance of payments constrained growth rate with sustainable debt accumulation. If a country does not have a deficit then θ=1, and Equation 3.7 reduces to the weak form of Thirlwall's original law,

$$y_B = x/\pi \quad \text{(Equation 2.10)}$$

When comparing the different models of the balance of payments constraint growth rate we expect,

- the balance of payments constrained growth rate with capital flows to be higher than the original model as we assume the countries under consideration to be net borrowers and hence capital inflows relax the balance of payments constraint.
- the terms of trade effect to be either negative or positive depending on the experience of the country in question.

[8] This specification, $* y_{BSDART} = \frac{\theta x - \theta_1 r + (\psi+1)(p_d - p_f - e)}{\pi - (1 - \theta + \theta_1)}$, does not include estimates from the export demand function, i.e. the income elasticity of demand or the price elasticity of demand for exports.

- the balance of payments constraint growth model with sustainable debt accumulation and interest rate payments to be lower than the model that does not set a limit to capital inflows or account for interest rate payments abroad[9].

3.2.1 Economic Propositions

The higher the income elasticity of demand for imports π, the lower the balance of payments constrained growth rate. A faster growth rate of world income z, will raise the balance of payments constrained growth rate.

Furthermore, the Marshall-Lerner condition is assumed to be true. That is, devaluations or a currency depreciation measured by the increase in the domestic price of foreign currency (e>0), will improve the balance of payments constrained growth rate provided that the absolute value of the sum of the price elasticity of demand for exports weighted by the proportion of the total import bill financed by export earnings and the price elasticity of demand for imports is greater than unity, i.e. $|\theta\eta + \psi| > 1$. However, even if the condition ($|\theta\eta + \psi| > 1$) is satisfied, a once off devaluation will not raise the balance of payments constrained growth rate permanently. After an initial devaluation, e, will fall back to zero and the growth rate will backslide to its former level (Hussain and Thirlwall, 1982).

3.3 Estimation Methodology

The estimation methodology is outlined below, this includes the unit root tests used to test the stationarity of the data, the Autoregressive Distributive Lag (ARDL) model and the bounds testing procedure used to test for cointegration.

[9] We do not estimate the balance of payments constrained growth model with unlimited capital flows as it is not necessary to include this specification of the model in order to obtain the balance of payments constrained growth rate with sustainable debt accumulation. In addition there is a lack of comparable data across countries on capital flows.

3.3.1 Unit Root tests and Structural Breaks

The sub-Saharan African countries have experienced several shocks over the last five decades. It is therefore necessary to account for structural breaks when testing the stationarity of the data. In this case the typical Augmented Dickey Fuller (ADF) test and the Phillips Perron (PP) test, whose null hypothesis is, there is a unit root may be invalid as the tests are biased towards the non-rejection of the hypothesis in the presence of a structural break, finding a unit root when it may actually not exist (Perron, 1989). In addition, Clemente et al (1998) have provided empirical evidence that it is erroneous to account for one structural break if in fact the series contains more breaks. Our preferred unit root test is therefore the Clemente, Montanes and Reyes (CMR) test which allows for two endogenously determined structural breaks. It is a modification of the Perron and Vogelsang (1992) unit root test which accounts for one break in the series. If evidence of only one structural break is found in the series then the Perron and Vogelsang test will be used. If there is no evidence of any structural break in the series then the traditional ADF and PP unit root tests will be used.

The Clemente, Montanes and Reyes unit root test allows for two different types of structural breaks. Sudden changes in the series are captured by the Additive Outliers (AO) model while a gradual shift in the mean of the series is detected by the Innovational Outliers (IO) model (Baum, 2005). Both forms of structural change will be tested.

The null hypothesis is that the series has a unit root with a structural break while the alternative hypothesis is that the series is stationary with breaks. Prior knowledge of the structural break date or appropriate lag order is not needed as they are determined by a two dimensional grid search which looks for the lowest possible value for the t statistic from all the possible break points; allowing for the “strongest rejection” of the null hypothesis. A set of sequential F tests determines the lag order (Baum, 2005).

Endogenously determining the structural break is preferred to exogenously determining it as the latter is considered to be identified ex ante which is inappropriate as it invalidates the distribution theory underlying conventional testing (Christiano, 1992).

Structural breaks in the data will be addressed during estimation through the use of dummy variables. Including dummy variables to account for structural breaks is more efficient than splitting the sample, particularly when the sample size is relatively small (McCombie, 1997). Only significant dummy variables will be retained in the model.

3.3.2 Autoregressive Distributive Lag (ARDL) Model

The presence of structural breaks in the data creates uncertainty as to the stationarity of the variables. An ARDL model will therefore be used to estimate the import and export demand functions needed to calculate the balance of payments constrained growth rate. One advantage of the ARDL model is that it provides consistent estimates irrespective of whether the variables are integrated of order one (I(1)), or zero I(0) (Pesaran and Shin, 1998). The purpose of the unit root tests are to ensure that none of the series included are I(2), as this would invalidate the methodology.

The ARDL model is preferred to the Vector Autoregressive (VAR) model as it utilises a single equation estimation technique, making interpretation relatively simple. Another advantage when using the ARDL model is the lag order of the dependent and independent variables are allowed to vary without affecting the asymptotic result.

In addition, it is possible to test for cointegration using the bounds testing procedure. Other cointegration tests such as the Johansen system-based reduced rank regression approach or the Engle-Granger two step residual-based procedure, are restricted to only I(1) variables. Pesaran and Shin (1998), further show that the bounds cointegration test is superior to the Johansen cointegration test in small samples.

A general ARDL(p,q) is outlined below,

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \emptyset_i y_{t-i} + \beta' x_t + \sum_{i=0}^{q-1} \beta_i^{*\prime} \Delta x_{t-i} + u_t$$

$$\Delta x_t = P_1 \Delta x_{t-1} + P_2 \Delta x_{t-2} + \cdots + P_s \Delta x_{t-s} + \varepsilon_t \qquad \text{(Equation 4.1)}$$

Here the underlying variables are I(1) however the model provides consistent results even when modified to include a mixture of I(1) and I(0) variables or just I(0) variables. The dependent variable y_t, is regressed on its lagged values y_{t-1}, a set of dependent I(1) x_t, variables that are not cointegrated amongst themselves, and the differenced lagged variables of x_t. U_t, and ε_t, are serially uncorrelated disturbances with the usual mean of 0 and constant variance and covariance. Correlation between u_t, and ε_t, can be overcome by including an adequate number of lagged changes in the regressors. P_i, are the k x k coefficient matrices so that the vector autoregressive process in Δx_t, is stable[10]. Two additional assumptions are made, that the roots of, $1 - \sum_{i-1}^{p} \emptyset_i z^i = 0$, all fall outside the unit circle and a long run stable relationship exists between y_t, and x_t (Pesaran and Shin, 1998) [11].

The contemporaneous dependence between u_t, and ε_t, is explicitly modelled in order to derive the short run effects. Pesaran and Shin (1998) have shown that the ARDL approach to estimation and inference is asymptotically valid.

The ARDL model outlined above can be reparametrized in the form of an error correction (EC) model (Hassler and Wolters, 2005),

$$\Delta y_t = c_0 + c_1 t + \gamma y_{t-1} + \vartheta' x_{t-1} + \sum_{i=1}^{p-1} a_i \Delta y_{t-i} + \sum_{i=0}^{n-1} \beta_i' \Delta x_{t-i} + u_t \qquad \text{(Equation 4.2)}$$

Where, $\gamma = -a(1)$, $\vartheta = a(1)\beta = -\gamma\beta$.

The above model contains both an intercept and trend however it can be expressed as having just an intercept or neither an intercept and trend.

[10] X_t is the k-dimensional I(1) variables.

[11] Under this assumption, the elements of z_t, are allowed to be purely I(1), purely I(0) or cointegrated. The possibility of seasonal unit roots and explosive roots are excluded (Pesaran et al 2001).

When using the ARDL model, selecting the right lag order is important for valid inferences. The appropriate lag order will be selected using the Schwarz Bayesian Criterion (SBC) as according to Pesaran and Shin (1998), the ARDL model using the SBC performed slightly better than the ARDL model using the Akaike Information Criterion (AIC). This may be because SBC is a consistent model selection criterion while the AIC is not.

The usual normality tests will be carried out to ensure appropriate model selection. This includes the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity and the Breusch-Godfrey test for serial correlation. The stability of the model over time is tested by calculating and graphing the cumulative sums (CUSUM) as well as the CUSUM squared of the recursive residuals from the variables defined in the model and their respective 95% confidence bands.

Following the selection of the appropriate ARDL model, the long run parameters and valid standard errors need to be obtained[12]. The latter will be estimated using the Ordinary Least Squares (OLS) delta method (Δ-method)[13]. This approach is directly comparable to the fully modified OLS approach of Phillips and Hansen (1990)[14], however Pesaran and Shin (1998) have provided some evidence that the delta method outperforms the latter in small samples. Additionally, the delta method results are asymptotically valid irrespective of whether x_t, is I(1) or I(0).

The static formulation of the cointegrating regression can be expressed as,

$$y_t = \mu + \delta t + \theta' x_t + v_t$$

$$\Delta x_t = e_t \qquad \text{(Equation 4.3)}$$

[12] The ARDL long run variance is defined as, $\sigma_\eta^2/[\phi(1)]^2$.

[13] The Bewley's (1979) regression approach is an alternative method for estimating the long run parameters from the selected ARDL model. It provides identical results to the OLS delta method (Pesaran and Shin, 1998). Preference is based on computational convenience.

[14] Problem with the OLS estimator, the unit root distribution and second order bias arising from the contemporaneous correlation, which may exist between v_t, and e_t, is generally involved in the asymptotic distribution of the OLS estimator of the long run parameter θ. As inferences on θ using the t-tests in the OLS regression are therefore invalid, Phillips and Hansen (1990) suggest the adoption of a fully-modified OLS procedure. Both the fully-modified OLS procedure and the ARDL based are asymptotically valid. Preference between the two is based in computational convenience (Pesaran and Shin, 1998).

Where δ, and θ, are the long run parameters defined in the level ARDL model in Equation 4.1, by the ratio $\delta = \alpha_1/\emptyset(1)$, and $\theta = \beta/\emptyset(1)$, where $\emptyset(1) = 1 - \sum_{i=1}^{p} \emptyset_i$. From the error correction or first differenced ARDL model in Equation 4.2, the long run parameters δ, and θ, are defined as, $\delta = -c_1/\gamma$, and, $\theta = -\vartheta/\gamma$. The long run parameters estimated from the level form and the first difference form are identical (Hassler and Wolters, 2005). We therefore make use of the conditional error correction ARDL model as the existence of a single long run level relationship between the levels of $y_{t,}$ and $x_{t,}$ can easily be tested using the bounds testing procedure.

From the estimated error correction model in Equation 4.2, we can use the Wald or F statistic to test the joint hypothesis that there is no level relationship between the level variables y_t and x_t, i.e. H_0: γ=0 and ϑ=0'. Pesaran et al (2001), provide two sets of critical value bounds covering all possible classifications of the forcing variable $\{x_t\}$, into I(0) which provides the lower bound, I(1) related to the upper bound and mutually integrated process[15]. A conclusive decision regarding cointegration of the variables can be made when the computed F statistic falls outside the critical value bounds. If the computed F statistic is greater than the upper bound critical value, then the null hypothesis of no single long run relationship between the variables is rejected. If the computed Wald or F statistic is below the lower bound critical value, we accept the null hypothesis of no long run level relationship between the variables. If however the computed Wald or F statistic falls within the bounds, inference would be inconclusive and the rank, r, of the forcing variables $\{x_t\}$, would need to be determined in order to proceed.

In the absence of cointegration, we take the first difference of the variables and estimate the import and export demand function using OLS.

[15] The asymptotic critical values are obtained through simulation for when, $r = k$ and $\{x_t\}\sim(1)$ and also for when $r = 0$ and $\{x_t\}\sim(1)$. R, the cointegration rank of the forcing variables $\{x_t\}$ follows the process $0 \leq r \leq k$ (Pesaran et al, 2001).

3.4 Testing the Balance of Payments Constrained Growth Model

Several procedures have been proposed for testing the equivalence of the balance of payments constrained growth rate to the actual growth rate of a country[16]. An informal method is to look at the estimated export demand function. If the income elasticity of demand for exports, $\widehat{\varepsilon}$, is statistically significant and the coefficient on the relative price index, $\widehat{\eta}$, is small and insignificant, we cannot refute the balance of payments constrained growth (Britto and McCombie, 2009).

We make use of two formal approaches. The first approach allows us to formally test the balance of payments constrained growth model for an individual country while the second approach allows us to test the model for a group of countries. For the first approach, we make use of the method proposed by McCombie (1989) which is to calculate the hypothetical income elasticity of demand which exactly equates the actual rate of growth using the balance of payments constrained model. We then test if it is equal to the estimated income elasticity of demand from the import demand function using the Wald test. Failing to reject the null hypothesis for the equivalence between the two elasticities of demand would provide evidence in favour of the balance of payments constrained growth rate.

Due to variations in the export to import ratio, θ, and the interest payment to import ratio, θ_1, we calculate the hypothetical growth rate using both the start value at the beginning of the period concerned and the average value for the period (Britto and McCombie, 2009). The hypothetical income elasticities that would equate the actual rate of growth given by the balance of payments constrained growth model are shown in Table 1.

[16] For a full outline of all the different methods proposed see McCombie (1997).

Table 1; Hypothetical income elasticity of demand for imports, π_H (Moreno-Brid, 2003)

Balance of payments constrained growth model	Solving for the income elasticity of demand
$* y_{BSDART} = \frac{\theta\epsilon z - \theta_1 r + (\theta\eta + \psi + 1)(p_d - p_f - e)}{\pi - (1 - \theta + \theta_1)}$	$* \pi_{HBSDART} = (1 - \theta + \theta_1) + \frac{\theta\epsilon z - \theta_1 r + (\theta\eta + \psi + 1)(p_d - p_f - e)}{y}$
$y_{BSDART} = \frac{\theta x - \theta_1 r + (\psi + 1)(p_d - p_f - e)}{\pi - (1 - \theta + \theta_1)}$	$\pi_{HBSADRT} = (1 - \theta + \theta_1) + \frac{\theta x - \theta_1 r + (\psi + 1)(p_d - p_f - e)}{y}$
$y_{BSDAR} = \frac{\theta x - \theta_1 r}{\pi - (1 - \theta + \theta_1)}$	$\pi_{HBSDAR} = (1 - \theta + \theta_1) + \frac{\theta x - \theta_1 r}{y}$
$y_{BSDA} = \frac{\theta x}{\pi - (1 - \theta)}$	$\pi_{HBSDA} = (1 - \theta) + \frac{\theta x}{y}$
$y_B = \frac{x}{\pi}$	$\pi_{HB} = \frac{x}{y}$

Note: $* y_{BSDART}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad

$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation

$y_{B,}$ is the 'weak' original version of the balance of payments constrained growth model

Our second approach was first proposed by McGregor and Swales (1985) and later modified by McCombie (1997), makes use of pooled data for all the countries. McGregor and Swales (1985) regress the actual rate of growth on the balance of payments constrained growth and test the hypothesis that the intercept and slope coefficient are not statistically different from 0 and 1 respectively. As pointed out by McCombie (1997, p.347), the above regression suffers from a, "misspecification analogous to an error in variables problem," as the balance of payments constrained growth rates are stochastic as they were derived from prior estimation coefficients which have associated standard errors. A simple way to overcome this is to regress the balance of payments constrained growth rate on the actual growth rate[17]. The modified method proposed by McCombie (1997) will be applied. One of the limitations of this approach is that countries that persistently run a balance of payments surplus must be excluded from the regression. According to McCombie (1997), this does not invalidate the balance of payments constrained model as not all countries can be balance of payments constrained. In this case, we are testing that the sub-Saharan African countries are balance of payments constrained.

4. Results

The results obtained from the unit root tests, the estimated import and export demand functions using the ARDL model and the estimates for the balance of payments constrained growth model are presented in this section.

4.1 Unit Root Tests

The results from the unit root tests can be seen in Appendix C. All the variables were either I(0) or I(1) as determined by the Augmented Dickey Fuller (ADF) test, the Phillips Perron (PP) test, the Perron and Vogelsang test and the Clemente, Montanes and Reyes (CMR) test. The

[17] The decision to regress the balance of payments constrained growth on the actual rate of growth does not indicate causality (McCombie, 1997).

appropriate unit root test was chosen based on the presence of no structural break, one structural break or two structural breaks respectively. As all the variables are either I(0) or I(1) we proceed with the ARDL model to estimate the import and export demand functions.

4.2 Import Demand Function

The import demand function is estimated for 22 sub-Saharan African countries. The summary of results derived using the ARDL model can be seen in Table 2. Only the long run estimates for the income elasticity of demand and the price elasticity of demand for imports along with some of the diagnostic tests are reported. Appendix D contains more detailed results, including the short run estimates. Appendix J contains the CUSUM and CUSUM squared graphs which test the stability of the model.

For 13 countries, the price elasticity of demand for imports was small and insignificant, ranging from -1.494 for Kenya to -0.121 for Uganda, highlighting the small role relative prices have played in the region. The income elasticity of demand for imports was significant for 20 countries. For Zambia, the income elasticity of demand for imports was 4.562 which is relatively high as the income elasticity of demand for imports for the rest of the 19 countries ranged from 0.475 for Gambia to 2.310 for Sierra Leone. This provides evidence in favour of the balance of payments constrained growth rate as it shows that relative prices play a very small or no role in the import demand function. What is of importance is the income elasticity of demand for imports which is determined by a countries economic structure.

For Gabon, Democratic Republic of Congo, Mali, Sierra Leone, Sudan and Uganda we do not find any evidence against the null hypothesis of no cointegration between the variables using the bounds testing procedure. We therefore take the first difference of the variables and re-estimate the import demand function using OLS. We follow the same procedure for Togo as we could not estimate a stable import demand function using the ARDL model. A summary of the results can be seen in Table 3.

Table 2; Summary of the long run estimates from the import demand function estimated using the ARDL model

	The income elasticity of demand for imports, π		The price elasticity of demand for imports, ψ		ARDL	SBC	R^2	Bounds F test	Breusch-Pagan/Cook-Weisberg test for heteroscedasticity (P value)	Breusch-Godfrey test for serial correlation (P value)
Benin	1.142***	(0.109)	-1.08***	(0.242)	(1 1 1)	-74.481	0.795	10.289***	0.997	0.508
Botswana	0.896***	(0.023)	-0.53***	(0.168)	(3 1 0)	-67.41	0.756	10.200***	0.471	0.744
Cameroon	1.379***	(0.087)	0.657***	(0.177)	(1 0 0)	-63.204	0.403	5.775**	0.639	0.664
Chad	0.659***	(0.157)	-0.278*	(0.152)	(2 0 0)	-21.17	0.852	20.472***	0.163	0.681
Congo, Dem. Rep.[18]	2.179*	(1.266)	-0.278	(0.546)	(2 1 1)	-12.424[AIC]	0.568	3.754	0.772	0.193
Congo, Rep.	1.483***	(0.291)	-1.036	(0.627)	(3 3 3)	-57.642	0.968	4.221*	0.493	0.293
Gabon	1.275***	(0.155)	-0.85***	(0.226)	(1 1 0)	-57.804	0.659	3.182	0.257	0.751
Gambia	0.475**	(0.193)	-0.25	(0.243)	(2 1 1)	-63.965[AIC]	0.44	4.212*	0.67	0.346
Kenya	0.986***	(0.212)	-1.494***	(0.354)	(1 0 0)	-58.354	0.272	3.892*	0.119	0.644
Mali	2.195**	(1.07)	-0.64	(2.089)	(1 1 1)	-35.912	0.179	0.716	0.136	0.156
Mauritius	1.183***	(0.165)	-1.131	(1.537)	(1 2 4)	-83.903	0.86	5.404**	0.893	0.095*
Mozambique	1.877***	(0.451)	-0.168**	(0.064)	(1 2 1)	-50.439	0.696	9.674***	0.535	0.562
Namibia	1.946***	(0.184)	-0.148	(0.615)	(1 2 2)	-64.769	0.786	5.280**	0.829	0.817
Nigeria	0.941***	(0.299)	-0.148	(0.109)	(1 3 1)	-6.661	0.872	9.114***	0.238	0.135
Senegal	1.107***	(0.081)	-0.126	(0.126)	(1 0 0)	-97.159	0.491	6.911***	0.515	0.452
Sierra Leone	2.310**	(0.977)	0.68	(0.802)	(1 1 1)	-3.750[AIC]	0.363	2.87	0.039**	0.843
South Africa[19]	0.819	(0.59)	-1.064	(0.399)	(1 1 0)	-131.366	0.803	10.590***	0.776	0.263
Sudan	0.957***	(0.197)	0.177	(0.309)	(1 0 0)	-1.585	0.147	2.657	0.743	0.802
Uganda	1.553***	(0.236)	-0.121	(0.157)	(4 4 3)	-83.982	0.953	2.751	0.435	0.886
Zambia	4.562*	(2.169)	-0.267	(0.199)	(1 4 5)	-18.215	0.841	4.912**	0.364	0.953
Zimbabwe	1.167***	(0.237)	-0.281*	(0.146)	(1 0 1)	-19.28	0.695	9.487***	0.008***	0.938

Note: [AIC] indicates that the model was selected using the AIC criterion due to the persistence of autocorrelation when using the model selected by SBC
Standard errors are in parenthesis
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

[18] For the Democratic Republic of Congo we control for the ongoing civil war which started in 1997 till present.
[19] A trend is added for South Africa. We control for apartheid which made very little difference to the outcome. The results can be seen in Appendix F.

Table 3; Summary of results for the import demand function estimated using OLS

Country	The income elasticity of demand for imports, π		The price elasticity of demand for imports, ψ		R^2	Breusch-Pagan/Cook-Weisberg test for heteroscedas-ticity (P value)	Breusch-Godfrey test for serial correlation (P value)
Congo, Dem.Rep.	2.372***	(0.605)	-0.053	(0.127)	0.247	0.805	0.524
Gabon[robust]	0.979***	(0.284)	-0.178	(0.221)	0.579		
Mali	0.049	(0.374)	-0.099	(0.169)	0.352	0.314	0.197
Togo[robust]	1.608***	(0.495)	-0.834***	(0.203)	0.217		
Uganda[robust]	2.061***	(0.613)	-0.225***	(0.059)	0.557		
Sierra Leone	0.775	(0.501)	0.416*	(0.216)	0.173	0.323	0.675
Sudan	0.963	(0.562)	-0.095	(0.094)	0.070	0.172	0.392

Note: Standard errors are in parenthesis
[robust] are heteroscedasticity consistent standard errors
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

The income elasticity of demand using OLS for the Democratic Republic of Congo, Gabon, Uganda and Sudan were close to that estimated using the ARDL model as there was less than a 0.5 point difference. We therefore proceed to estimate the balance of payments constrained growth using both the estimates obtained from the ARDL model as well as OLS for the above mentioned countries.

The income elasticity of demand for imports using OLS ranged from 0.963 for Sudan to 2.372 for the Democratic Republic of Congo. The price elasticity of demand for imports ranged from -0.834 for Togo to -0.05 for the Democratic Republic of Congo.

It was not possible to estimate reasonable import demand functions using OLS for Mali and Sierra Leone as the income elasticity of demand for imports was insignificant at the 10% level. The price elasticity of demand for imports for Mali was insignificant and had the wrong sign for Sierra Leone. We therefore proceed with the results obtained from the ARDL model for these two countries although caution is needed when making inferences.

4.2.1 Comparing the Estimated Income Elasticity of Demand with those from Other Studies

Due to the importance of the income elasticity of demand for calculating the balance of payments constrained growth rate, we compare our estimates with those from other studies. According to McCombie (1997), the income elasticity of demand for imports is stable over time as it represents non price based competition which changes very slowly. It is therefore still informative to compare our results with those from other studies in the region despite the time frame covered being different. The comparison can be seen in Table 4. Our estimates appear reasonable as they are close to those estimated in other studies. The income elasticity of demand ranged from 0.34 to 5.0 in other studies (Senhadji, 1998; Hussain, 1999; Perraton, 2003) while it ranged from 0.475 to 4.562 in our analysis.

Table 4; Comparison of the estimated income elastictity of demand with other studies

Country	Our Estimates	Senhadji (1998)	Hussain (1999)	Perraton (2003)
Benin	1.142	4.91	1.97	
Botswana	0.896			
Cameroon	1.379	1.01	0.84	0.88
Chad	0.656			
Congo Dem. Rep.	2.179			
Congo Rep.	1.483	0.87	1.44	
Gabon	1.275		1.37	
Gabon (OLS)	0.979			
Kenya	1.06	1.14	0.98	1.84
Gambia	0.475	1.51		
Mali	2.195			0.87
Mauritius	1.183	2.25	1.23	1.17
Mozambique	1.877			
Namibia	1.946			
Nigeria	0.941	1.81	2.70	
Senegal	1.107		2.26	0.98
Sierra Leone	2.310		1.54	
South Africa	0.955	0.67	1.38	
Sudan	0.957		1.57	
Togo	1.608		1.93	5.00
Uganda	1.553			
Uganda (OLS)	2.061			
Zambia	4.562	0.34	1.11	
Zimbabwe	1.167		1.64	

Note: OLS indicates the income elasticity of demand from the import demand function using OLS

4.3 Export Demand Function

A summary of the results for the export demand function can be seen in Table 5. Only the long run estimates and the results from the diagnostic tests are shown. For full details of the results including the short run coefficients please see Appendix E.

We were able to estimate the export demand function for 19 countries using the ARDL model. The income elasticity of demand for exports ranged from 0.606 for Senegal to 3.446 for Uganda however it was much higher for Mozambique at 4.786, Zambia at 8.041 and Zimbabwe at 14.607. The price elasticity of demand for exports was less than zero in absolute terms for 12 countries. It was insignificant for 14 countries. For the 5 countries where the price elasticity of demand for exports was significant at the 5% level, it stood at, -1.577 for Botswana, -0.605 for the Republic of Congo, -0.860 for Mali, -6.865 for Sudan and -1.390 for Zimbabwe. These results provide further support for the balance of payments constrained growth model.

For Kenya, Benin, Cameroon, Democratic Republic of Congo, Chad, and Mauritius we fail to find any evidence of cointegration using the bounds testing procedure. For Gabon, we could not estimate a stable export demand function with the ARDL model and therefore proceed with OLS, making the necessary adjustments to account for the non-stationarity of the variables.

Table 5; Summary of results for the export demand function estimated using the ARDL model

	The income elasticity of demand for exports, ε		The price elasticity of demand for exports, η		ARDL	SBC	R^2	Bounds F test	Breusch-Pagan/Cook-Weisberg test for heteroscedasticity (P value)	Breusch-Godfrey test for serial correlation (P value)
Benin[20]	2.673***	(0.54)	0.058	(0.455)	(6 7 6)	13.046	0.591	1.927	0.811	0.223
Botswana	1.937***	(0.188)	-1.577**	(0.689)	(1 1 0)	-48.83	0.621	3.465	0.225	0.212
Cameroon	1.348***	(0.379)	-0.496	(0.749)	(1 1 0)	-51.295	0.574	2.555	0.373	0.75
Chad	2.469**	(0.968)	1.261	(0.896)	(1 2 0)	22.52	0.483	2.26	0.045**	0.181
Congo, Dem. Rep.	2.83	(1.098)	0.74	(0.648)	(1 1 1)	-9.155	0.407	3.724	0.424	0.278
Congo, Rep.	1.018***	(0.113)	-0.605***	(0.125)	(1 2 0)	-98.318	0.65	6.615***	0.892	0.158
Gambia	1.198***	(0.247)	0.873	(0.259)	(2 1 1)	-63.188[AIC]	0.658	7.447***	0.282	0.249
Kenya	1.218***	(0.372)	-0.425	(1.123)	(1 0 1)	-103.528	0.197	0.622	0.662	0.162
Mali	1.851***	(0.248)	-0.860***	(0.279)	(1 0 4)	-62.539	0.745	8.413***	0.852	0.57
Mauritius	1.581***	(0.418)	-0.816	(1.652)	(1 1 1)	-81.53	0.489	0.575	0.034**	0.203
Mozambique	4.786***	(0.44)	-0.45	(0.423)	(1 0 0)	-50.477	0.665	9.997***	0.239	0.283
Namibia	1.299***	(0.052)	0.187	(0.136)	(2 2 2)	-68.298	0.753	13.251***	0.975	0.274
Nigeria	1.668***	(0.263)	0.035	(0.119)	(1 0 0)	1.534	0.389	4.366*	0.456	0.347
Senegal	0.606***	(0.089)	-0.099	(0.128)	(1 3 0)	-61.174	0.717	16.575***	0.040**	0.515
South Africa	1.637**	(0.629)	0.268	(0.839)	(1 1 1)	-175.118	0.598	6.253**	0.095*	0.234
Sudan	0.719	(0.503)	-6.865**	(2.868)	(2 0 3)	-22.575	0.565	13.214***	0.018**	0.598
Uganda	3.466***	(0.586)	-0.011	(0.287)	(1 1 1)	-16.188	0.43	4.599*	0.95	0.201
Zambia	8.041**	(3.557)	-10.155	(7.02)	(2 2 2)	-25.404	0.809	11.132***	0.152	0.599
Zimbabwe	14.607***	(3.615)	-1.390***	(0.278)	(4 1 4)	-36.537	0.806	8.502***	0.074*	0.331

Note: [AIC] indicates that the model was selected using the AIC criterion due to the persistence of autocorrelation when using the model selected by SBC
Standard errors are in parenthesis
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

[20] The export demand function for Benin is from 1974-2015 due to data availability.

Table 6; Summary of results for the export demand function estimated using OLS

Country	The income elasticity of demand for imports, π		The price elasticity of demand for imports, ψ		R^2	Breusch-Pagan/Cook-Weisberg test for heteroscedas-ticity (P value)	Breusch-Godfrey test for serial correlation (P value)
Congo, Dem. Rep.	3.972**	(1.793)	-0.066	(0.111)	0.135	0.389	0.522
Gabon	1.781	(0.988)	-0.071	(0.201)	0.145	0.838	0.908

Note: Standard errors are in parenthesis
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

4.4 The Balance of Payments Constrained Growth

The estimates for the income and price elasticities of demand from the import and export demand functions are applied to calculate the balance of payments constrained growth rates given in Equations 3.4 to 3.7 and 2.9 to 2.10. These can be seen in Table 7 and include the original weak version of Thirlwall's law, y_B, the strong version of Thirlwall's law, $*y_B$, the balance of payments constrained growth rate with sustainable debt accumulation, y_{BSDA}, the balance of payments constrained growth with sustainable debt accumulation and interest rate payments abroad, $y_{BSDAR,}$ and finally the two versions of the balance of payments constrained growth with sustainable debt accumulation, interest rate payments and the terms of trade. In the former version the terms of trade are interacted with the price elasticities of demand for exports and imports, $*y_{BSDART}$, and in the latter the terms of trade are only interacted with the price elasticity of demand for imports, y_{BSDART}.

The different balance of payments constrained growth rates are estimated for the entire sample period which ranges from around the 1960s to 2014 period. This can be seen in Table 7 where the estimated balance of payments constrained growth rates are compared with the actual growth rate for the period concerned. We also estimate the balance of payments constrained

growth rate for the sub-periods 1960 to 1980 and 1980 to 2014 which can be seen in Appendix G.

The balance of payments constrained growth model does a very good job at predicting the actual growth rate for the region. The absolute difference between the actual growth rate and the balance of payments constrained growth rate was less than 0.5 for 17 out of 22 countries and less than one for 19 countries. The simple model best explained the growth process for South Africa, Mali, Uganda and Zimbabwe as the absolute difference between the balance of payments constrained growth rate and the actual growth rate was 0.18, 0.04, 0.84 and 0.06 respectively. The strong version of the model best explained the growth process for Kenya where the difference was 0.42 while the model which allows for sustainable debt accumulation best predicted the growth rate for Cameroon with an absolute error of 0.11.

The model with the most predictive power was the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad. The model closely predicted the growth rates of the Democratic Republic of Congo, Sudan, Mauritius, Senegal, Sierra Leone and Togo with an absolute error of 0.02, 0.15, 0.04, 0.17, 0.01 and 0.17 respectively. This was closely followed by the balance of payments constrained growth which includes the terms of trade interacted with the price elasticities of demand for imports and exports, which closely predicted the growth rates of Nigeria, Botswana, Republic of Congo, Gabon, Mozambique and Zambia with an error of 0.13, 0.98, 0.37, 0.04, 0.02 and 0.58 respectively.

Finally the balance of payments constrained growth rate which included the terms of trade and only the price elasticity of demand for imports best predicted the growth rate of Gambia with a difference of 0.27.

The model failed to make a reasonable prediction for the actual growth rate for three countries. These are Namibia, Benin and Chad where the absolute difference between the actual and predicted growth rate was 1.59, 2.11 and 10.91 respectively.

Table 7; The balance of payments constrained growth rate estimated for the 1960-2014 period

					Start[N]				Average[N]			
Period	Country	Actual	y_B	$*\ y_B$	y_{BSDA}	y_{BSDAR}	$*\ y_{BSDART}$	y_{BSDART}	y_{BSDA}	y_{BSDAR}	$*\ y_{BSDART}$	y_{BSDART}
1975-2014	Benin	3.680	7.197	8.281	6.453	5.830	7.0800	6.066	5.880	5.788	6.981	6.090
1975-2014	Botswana	7.535	9.284	6.552	9.101	9.095	6.158	9.166	9.654	9.657	6.555	9.780
1960-2014	Cameroon	3.647	3.530		3.535	3.371	-0.461	3.314	3.514	3.405	-0.184	3.405
1960-2005	Chad	3.617	14.524		80.780	85.006	-27.788	58.628	67.030	67.866	-20.615	47.611
1960-2014	Congo, Dem. Rep.	1.348	3.030	4.597	3.472	1.438	3.255	1.357	4.523	4.035	6.356	3.983
1960-2014	Congo Dem. Rep.[21] (OLS)	1.348	2.783	5.927	3.222	1.329	5.085	1.254	4.302	3.834	8.709	3.785
1960-2014	Congo, Rep.	4.501	5.082	2.428	5.953	5.326	2.128	4.867	3.418	3.001	0.287	1.831
1960-2014	Gabon	4.47	4.087		4.607	4.162		4.116	4.624	4.460		4.416
1960-2014	Gabon (OLS)[22]	4.47	5.322	6.436	5.263	4.776	5.572	4.430	5.261	5.083	5.871	4.755
1966-2013	Gambia	3.977	8.770	8.330	66.656	107.126	-127.012	-44.516	-13.443	-13.358	10.352	3.707
1960-2014	Kenya	4.789	4.161	4.369	4.167	3.969	3.906	3.621	4.180	4.137	4.034	3.807
1967-2007	Mali	3.731	3.683	2.953	2.271	2.099	1.674	2.152	1.699	1.639	1.343	1.697
1976-2014	Mauritius	4.581	4.872	3.975	4.809	4.617	3.924	4.831	4.558	4.512	3.934	4.778
1980-2014	Mozambique	5.044	4.907	7.399	3.035	2.644	5.021	3.452	1.668	1.625	3.444	2.595
1980-2014	Namibia	3.531	1.626	1.937	1.558		1.551	1.254	1.676		1.687	1.370
1980-2013	Nigeria	4.279	5.566	5.211	5.378	3.489	4.409	4.786	5.747	4.626	8.760	9.149
1960-2014	Senegal	2.829	3.107	1.936	2.996	2.543	0.446	1.630	3.027	2.975	1.014	2.161
1967-2014	Sierra Leone	3.137	3.811		3.150	2.240		2.650	3.382	3.242		3.624
1960-2014	South Africa	3.239	3.058	6.068	3.035	2.851	6.002	2.914	3.014	2.888	5.974	2.939
1960-2014	Sudan	3.934	5.900	2.658	5.901	3.813	-31.232	9.220	5.874	3.346	-32.290	8.212
1960-2014	Sudan (OLS)	3.934	5.864		5.864	3.789		9.161	5.841	3.324		8.164
1960-2014	Togo	3.934	5.243		4.201	3.761		3.692	3.279	3.142		3.058
1982-2014	Uganda	6.089	6.960	6.717	4.826	4.912	1.067	1.240	4.055	4.191	-0.251	-0.099
1982-2014	Uganda (OLS)	6.089	5.245		3.199	3.222		1.356	2.576	2.599		0.536
1960-2013	Zambia	3.389	2.007	6.271	1.607	-0.634	3.965	0.05	1.369	0.865	4.507	1.506
1976-2014	Zimbabwe	1.586	1.528	37.24	1.469	0.319	35.494	1.390	1.502	1.476	35.947	2.396

[21] For the Democratic Republic of Congo both the import and export demand function use OLS.
[22] For Gabon both the import and export demand function use OLS.

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

$y_{B,}$ is the 'weak' original version of the balance of payments constrained growth model

$y_{B,}$ is the 'strong' original version of the balance of payments constrained growth model

$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation

y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad

* y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

OLS indicates the growth rates that have been estimated using the import and export demand functions derived from OLS

4.5 Formally Testing the Balance of Payments Constrained Growth Model

We were able to estimate the balance of payments constrained growth rate for 22 countries. We begin by formally testing the model for each individual country. A summary of the results can be seen in Table 8. For 18 countries, which is almost 82% of the countries included in the analysis, we could not reject the null hypothesis for the equality between the estimated income elasticity of demand for imports and the hypothetical income elasticity of demand for imports that would exactly equate the actual growth rate of the country concerned for at least one of the balance of payments constrained growth models using the Wald test. This provides strong evidence that these 18 African countries were indeed balance of payments constrained during the 1960 to 2014 period. These results are consistent with Hussain (1999) who found evidence in favour of the model for 26 out of 29 African countries[23].

The balance of payments constrained growth with sustainable debt accumulation and interest rate payments abroad best explained the growth process of the region as we found evidence of the equality of the estimated income elasticity of demand and the hypothetical income elasticity of demand for 17 of the 18 countries. This highlights the important role of capital flows to the region as well as the significance of interest rate payments abroad. The results are similar to those obtained by Moreno-Brid (2003) for Mexico.

This was followed closely by the original version of the model which was able to explain the growth experience of 16 countries. This is not surprising as a study by Hussain (1999) found that the basic and extended model which allows for capital flows, were good predictors for the actual growth rate in Africa and Asia. Perraton (2003) for a group of developing countries, additionally found that the original version of the model slightly outperformed the extended model with the terms of trade as it held for the majority of the countries included in the analysis.

[23] Hussain (1999) study included North Africa, which is excluded here.

Using the individual country test, we could not find evidence for any of the balance of payments constrained growth models for Benin, Botswana, Chad and Namibia. This result is not surprising for Benin and Chad as the estimated balance of payments constrained growth rate given in Table 7 had little predictive power for the actual growth rate. For Namibia this may be due to the lack of data on interest payments abroad.

Caution is needed when rejecting the balance of payments constrained growth model for Botswana based on the Wald test as the estimated income elasticity is 0.896 while the hypothetical income elasticity for the model with sustainable debt accumulation, interest payments abroad and the terms of trade is 0.81; a difference of 0.08. No other studies have been done for Botswana, Chad and Namibia; however a study by Perraton (2003) included Benin, found evidence in favour of the original and extended model which includes the terms of trade effects.

There is very little difference in the results from the Wald test when testing the balance of payments constrained growth rate estimated using the average ratios and the start of period ratios for the share of exports in imports and the share of interest payments abroad in imports. For the latter, the result is in line with the literature as we expect the share of interest payments abroad to have a limited effect on the balance of payments constrained growth rate (Thirlwall, 2012).

As the balance of payments constrained model is a long run growth model, the results from the two sub-periods are reported in Appendix H. It is interesting to note that during the overall period and the 1980 to 2014 period, the balance of payments constrained growth model with sustainable debt accumulation and interest rate payments abroad best explained the growth process of the region. However the same model performed relatively worse during the 1960 to 1980 period as it had the least predictive power. This highlights the growing role of capital flows and interest payments abroad in the region.

Table 8; Wald test results for the equality of the estimated income elasticity of demand, $\hat{\pi}$, and the hpothetical income elsasticity of demand, π_H, 1960 − 2014

					Average				Start			
Period	Country	$\hat{\pi}$	π_{HB}	$* \pi_{HB}$	π_{HBSDA}	π_{HBSDAR}	$* \pi_{HBSDART}$	$\pi_{HBSDART}$	π_{HBSDA}	π_{HBSDAR}	$* \pi_{HBSDART}$	$\pi_{HBSDART}$
1960-2013	Benin	1.142	2.233	2.569	1.640	1.512	1.727	1.553	1.440	1.426	1.586	1.466
	F statistic		118.00***	170.28***	20.71***	11.42***	28.58***	14.10***	7.40**	6.72**	16.46***	7.70***
	P Value		0.000	0.000	0.000	0.002	0.000	0.000	0.010	0.014	0.000	0.009
1975-2014	Botswana	0.896	1.104	0.779	1.125	1.121	0.697	1.131	1.078	1.073	0.813	1.084
	F statistic		77.66***	24.59***	94.14***	90.88***	71.13***	99.13***	59.46***	56.23***	12.38***	63.44***
	P Value		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
1960-2014	Cameroon	1.379	1.335		1.336	1.281		1.260	1.329	1.311		1.290
	F statistic				0.25	1.26		1.86	0.33	0.61		1.04
	P Value				0.621	0.268		0.180	0.567	0.438		0.313
1960-2005	Chad	0.656	2.634		1.637	1.623	0.282	1.309	1.655	1.650	0.280	1.337
	F statistic		104.46***		38.90***	37.79***	5.69**	17.22***	40.34***	39.93***	5.75**	18.73***
	P value		0.000		0.000	0.000	0.024	0.000	0.000	0.000	0.024	0.000
1960-2014	Congo, Dem. Rep.	2.179	4.898	7.431	6.099	2.336	5.508	2.195	10.999	9.539	15.896	9.397
	F statistic		4.61**	17.19***	9.58***	0.02	6.91**	0.00	48.49***	33.77***	117.28***	32.48***
	P value		0.038	0.000	0.003	0.902	0.012	0.990	0.000	0.000	0.000	0.000
1960-2014	Congo, Dem. Rep. (OLS)	2.372	4.898	10.431	6.099	2.336	9.431	2.195	10.999	9.539	23.588	9.397
	F statistic		17.41***	177.25***	37.90***	0.00	135.99***	0.09	203.12***	140.18***	1228.56***	134.68***
	P value		0.000	0.000	0.000	0.952	0.000	0.770	0.000	0.000	0.000	0.000
1960-2012	Congo, Rep.	1.483	1.674	0.800	2.224	1.886	0.321	1.662	1.270	1.195	0.675	0.971
	F statistic		0.43	5.49**	6.73**	1.91	15.89***	0.38	0.54	0.98	7.69**	3.09*
	P value		0.522	0.032	0.019	0.186	0.001	0.548	0.474	0.337	0.013	0.098
1960-2014	Gabon	1.275	1.165		1.348	1.116		1.093	1.359	1.269		1.246
	F statistic		0.51		0.22	1.06		1.39	0.29	0.00		0.04
	P value		0.479		0.643	0.308		0.245	0.594	0.965		0.848

1960-2014	Gabon[24] (OLS)	0.979	1.165	1.409	1.348	1.116	1.473	0.961	1.359	1.269	1.642	1.114
	F statistic		0.43	2.28	1.68	0.23	3.01*	0.00	1.78	1.04	5.43**	0.22
	P value		0.517	0.137	0.201	0.633	0.089	0.948	0.188	0.313	0.024	0.638
1966-2013	Gambia	0.475	1.048	0.994	1.027	0.838	0.014	0.304	1.019	1.017	0.276	0.483
	F statistic		8.74***	7.17**	8.11***	3.51*	5.66**	0.78	7.88***	7.82***	1.05	0.00
	P value		0.005	0.011	0.007	0.069	0.022	0.383	0.008	0.008	0.311	0.967
1960-2014	Kenya	0.986	0.857	0.900	0.871	0.875	0.867	0.828	0.892	0.893	0.878	0.846
	F statistic		0.37	0.16	0.29	0.27	0.31	0.55	0.20	0.19	0.26	0.43
	P value		0.547	0.687	0.591	0.604	0.578	0.461	0.660	0.663	0.613	0.513
1967-2007	Mali[25]	2.195	2.166	1.737	1.544	1.478	1.291	1.501	1.371	1.350	1.231	1.374
	F statistic		0.00	0.18	0.37	0.45	0.71	0.42	0.59	0.62	0.18	0.59
	P value		0.978	0.671	0.547	0.508	0.405	0.521	0.447	0.436	0.374	0.449
1976-2014	Mauritius	1.183	1.258	1.026	1.238	1.191	1.028	1.241	1.178	1.170	1.060	1.220
	F statistic		0.20	0.90	0.11	0.00	0.88	0.12	0.00	0.01	0.56	0.05
	P value		0.653	0.354	0.744	0.962	0.360	0.730	0.975	0.937	0.465	0.826
1980-2014	Mozambique	1.877	1.826	2.753	1.356	1.265	1.871	1.471	1.160	1.152	1.538	1.358
	F statistic		0.01	3.75*	1.33	1.84	0.00	0.81	2.52	2.57	0.56	1.32
	P value		0.910	0.066	0.261	0.189	0.989	0.378	0.127	0.123	0.461	0.263
1980-2014	Namibia[26]	1.946	0.896	1.067	0.904		0.901	0.743	0.892		0.909	0.731
	F statistic		32.35***	22.68***	31.86***		32.05***	42.46***	32.60***		31.56***	43.31***
	P value		0.000	0.000	0.000		0.000	0.000	0.000		0.000	0.000
1985-2013	Nigeria	0.941	1.224	1.146	1.504	0.572	1.001	1.177	1.149	0.987	1.504	1.592
	F statistic		0.89	0.47	3.53*	1.52	0.04	0.62	0.48	0.02	3.53*	4.72**
	P Value		0.359	0.504	0.078	0.235	0.845	0.443	0.498	0.881	0.078	0.045
1960-2014	Senegal	1.107	1.215	0.757	1.156	1.027	0.440	0.771	1.169	1.153	0.538	0.897
	F statistic		1.75	18.64***	0.36	0.98	67.61***	17.18***	0.57	0.31	49.21***	7.72**
	P value		0.193	0.000	0.553	0.328	0.000	0.000	0.453	0.578	0.000	0.013

[24] For Gabon both the import and export demand functions are estimated with OLS.
[25] For Mali the ARDL estimates for the import and export demand function are used.
[26] For Namibia there is no data on interest payments abroad.

1967-2014	Sierra Leone[27]	2.310	2.806		2.318	1.747		2.004	2.476	2.380		2.638
	F statistic		0.26		0.00	0.33		0.10	0.03	0.01		0.11
	P value		0.615		0.994	0.567		0.755	0.866	0.944		0.739
1960-2014	South Africa	0.955	0.901	1.789	0.882	0.821	1.905	0.843	0.857	0.805	2.119	0.827
	F statistic		0.01	2.31	0.02	0.06	2.99*	0.04	0.03	0.07	4.50**	0.02
	P Value		0.922	0.136	0.894	0.808	0.09	0.839	0.859	0.785	0.039	0.880
1964-2013	Sudan[28]	0.957	1.435	0.646	1.435	0.978	-7.365	2.208	1.484	0.802	-8.564	2.081
	F statistic		5.87**	2.50	5.87**	0.01	1784***	40.26***	7.14***	0.62	2333***	32.50***
	P Value		0.019	0.121	0.019	0.917	0.000	0.000	0.010	0.434	0.000	0.000
1964-2013	Sudan (OLS)	0.963	1.435		1.435	0.978		2.208	1.484	0.802		2.081
	F statistic		0.76		0.70	0.00		4.89**	0.86	0.08		3.95*
	P Value		0.388		0.406	0.980		0.031	0.359	0.774		0.052
1960-2014	Togo (OLS)	1.608	2.143		1.690	1.555		1.534	1.442	1.408		1.387
	F statistic		1.16		0.03	0.01		0.02	0.11	0.16		0.17
	P value		0.286		0.870	0.914		0.888	0.738	0.687		0.678
1982-2014	Uganda[29]	1.553	1.775	1.713	1.345	1.365	0.753	0.781	1.257	1.294	0.689	0.710
	F statistic		0.87	0.45	0.78	0.64	11.43***	10.64***	1.57	1.20	13.33***	12.69***
	P value		0.369	0.514	0.395	0.440	0.005	0.006	0.233	0.294	0.003	0.003
1982-2014	Uganda (OLS)	2.061	1.775		1.345	1.365		0.912	1.257	1.294		0.841
	F statistic		0.22		1.37	1.29		3.52*	1.72	1.57		3.96*
	P value		0.644		0.252	0.265		0.071	0.200	0.221		0.056
1960-2014	Zambia	4.562	2.702	8.441	2.290	0.085	5.203	0.853	2.065	1.540	5.901	2.308
	F statistic		0.74	3.20*	1.10	4.26*	0.09	2.92	1.32	1.94	0.38	1.08
	P value		0.406	0.097	0.314	0.059	0.772	0.111	0.270	0.187	0.547	0.317
1976-2014	Zimbabwe	1.167	1.124	27.399	1.097	0.440	20.622	1.054	1.111	1.093	24.110	1.708
	F statistic		0.03	12190***	0.09	9.37***	6705***	0.23	0.06	0.10	9324***	5.18**
	P value		0.857	0.000	0.770	0.005	0.000	0.638	0.815	0.758	0.000	0.032

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

[27] Sierra Leone uses the ARDL model.
[28] Sudan uses the ARDL estimate for both the export and import demand function.
[29] For Uganda both import and export demand functions are estimated with the ARDL model.

$\pi_{HB,}$ is the hypothetical income elasticity of demand from the original "weak" version of the balance of payments constrained growth model

$*\ \pi_{HB,}$ *is the hypothetical income elasticity of demand from the original "strong" version of the balance of payments constrained growth model*

$\pi_{HBSDA,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation

$\pi_{HBSDAR,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation and interest payments abroad

$*\ \pi_{HBSDART,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports.

$\pi_{HBSDART,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

*** Indicates significance at the 99% level

** Indicates significance at the 95% level

* Indicates significance at the 90% level

Our second formal test for the balance of payments constrained model can be seen in Table 9. We regressed each of our calculated balance of payments constrained growth rates on the actual growth rate for all 22 countries. We use two different specifications; with and without a trend. When we exclude the trend, we find strong evidence in support of the balance of payments constrained model as the coefficient on the actual rate of growth ranged from 0.846 to 1.14. In addition, using the Wald test, we accept the hypothesis that the coefficient is equal to one. These results confirm and strengthen the results obtained from the single country tests. As Benin, Botswana, Chad and Namibia were included in the regressions below, it would be erroneous to dismiss the balance of payments constrained growth as being irrelevant for these countries. The results below use the logarithmic form, please see Appendix I for the results from the alternative level specification.

Table 9; Regression results of the balance of payments constrained growth, y_B, on the actual growth rate (logarithmic form)

	Dependent variable	Constant, α	Coefficient on the actual growth rate, β	R^2	F statistic	Wald test (β=1) P value	Wald test (α=0) P value
	y_B	0.382 (0.366)	0.834*** (0.268)	0.325	9.65***	0.544	0.308
	y_B		1.104*** (0.072)	0.918	234.95***	0.161	
	$* y_B$	2.371*** (0.578)	-0.539 (0.427)	0.102	1.59	0.002***	0.001***
	$* y_B$		1.132*** (0.184)	0.715	37.75***	0.482	
Average[N]	y_{BSDA}	0.617 (0.791)	0.712 (0.579	0.070	1.51	0.625	0.443
	y_{BSDA}		1.148*** (0.153)	0.726	55.86***	0.344	
	y_{BSDAR}	-0.396 (0.932)	1.403** (0.678)	0.192	4.28**	0.559	0.676
	y_{BSDAR}		1.126*** (0.184)	0.663	37.36***	0.499	
	$* y_{BSDART}$	1.960** (0.798)	-0.457 (0.591)	0.044	0.60	0.028**	0.029**

	$* y_{BSDART}$		0.921*** (0.213)	0.570	18.56***	0.720	
	y_{BSDART}	-0.230 (0.997)	1.008 (0.731)	0.091	1.90	0.990	0.819
	y_{BSDART}		0.846*** (0.195)	0.483	18.71***	0.441	
Start^N	y_{BSDA}	0.793 (0.671)	0.417 (0.492)	0.036	0.72	0.251	0.252
	y_{BSDA}		0.977*** (0.136)	0.719	51.36***	0.869	
	y_{BSDAR}	0.433 (0.513)	0.723 (0.701)	0.038	0.71	0.284	0.316
	y_{BSDAR}		0.941*** (0.143)	0.692	42.86	0.685	
	$* y_{BSDART}$	2.522** (0.906)	-0.854 (0.670)	0.103	1.62	0.015**	0.014**
	$* y_{BSDART}$		0.924*** (0.242)	0.491	14.50***	0.759	
	y_{BSDART}	1.113 (0.724)	0.118 (0.531)	0.002	0.05	0.112	0.140
	y_{BSDART}		0.904*** (0.146)	0.644	38.0***	0.522	

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered.
Standard errors are in parenthesis
$y_{B,}$is the 'weak' original version of the balance of payments constrained growth model
$* y_{B,}$is the 'strong' original version of the balance of payments constrained growth model
$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation
y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad
$* y_{BSDART}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports.
y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

5. Concluding Remarks

The balance of payments constrained growth rate was estimated for 22 sub-Saharan African countries. The model proved to have strong predictive power as it was able to closely predict the growth rate of 17 countries with an absolute error of less than 0.5. This figure increased to 19 at an absolute error below one.

When formally testing the model for each individual country, by testing the equality between the estimated income elasticity of demand for imports and the hypothetical income elasticity of demand for imports that would exactly equate the actual rate of growth, again we find strong evidence in support of the balance of payments constrained growth model. For 18 countries we found evidence in support of at least one of the balance of payments constrained growth models.

The model which accounts for sustainable debt accumulation and interest rate payments abroad outperformed all the other models both in its predictive power and when testing the equality of the estimated and hypothetical income elasticities of demand. It was able to explain the growth experience of 77.3% of the countries included in the study. This highlights the importance of capital flows and interest rate payments in the region.

Unsurprisingly, the same countries where the balance of payments constrained growth model had poor predictive power, failed the formal test. These are Benin, Botswana, Chad and Namibia. Caution however is needed when rejecting the balance of payments constrained growth rate for Namibia as data on interest payments abroad was not available. By applying only the simple balance of payments constrained growth model, we could erroneously reject the model when it actually does apply. This would have been the case for the Democratic Republic of Congo and Gambia. It is therefore important to account for capital flows and interest payments abroad.

When pooling the results from the 22 countries, we find strong evidence in favour of all 6 models for the balance of payments constrained growth for the full sample of countries, including Benin, Botswana, Chad and Namibia. These results strengthen those obtained from the single country tests.

Our results provide strong evidence that the demand-led long run growth model developed by Thirlwall (1979), is relevant for the sub-Saharan African region. One of the implications of the balance of payments constrained growth model is that the structure of production and exports determines the income elasticity of demand for exports which therefore determines the rate of growth of one country relative to another. What a country exports has to do with how its economic activity is structured. Changing the structure of the economy is therefore imperative in order to bring about long term economic growth and development in the region.

References

Adedeji, A., 2002. Structural Adjustment Policies in Africa. *International Social Science Journal*, 51(162), pp. 521-528.

Alvarez-Ude, G. F. & Gomez, D. M., 2008. Long and short run balance of payments adjustment: Argentine economic growth constrained. *Applied Economics Letters* , 15(10), pp. 815-820.

Arezki, R., Hadri, K., Loungani, P. & Rao, Y., 2013. testing the Prebisch-Singer Hypothesis since 1650: Evidence from Panel Techniques that Allow for Multiple Breaks. *IMF Working Paper* .

Baum, C. F., 2005. Stata: The Language of Choice for Time-Series Analysis?. *The Stata Journal*, 5(1), pp. 46-63.

Bewley, R., 1979. The Direct Estimation of the Equlillibrium Response in a Linear Dynamic Model. *Economics Letters*, Volume 3, pp. 357-361.

Britto, G. & McCombie, J. S. L., 2009. Thirlwall's Law and the long-run equilibrium growth rate: an application to Brazil. *Journal of Post-Keynesian Economics*, 35(4), pp. 695-696.

Bumann, S., Hermes, N. & Lensink, R., 2012. *Financial liberalisation and economic growth: a meta-analysis technical report,* London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Byrne, J. P. & Perman, R., 2007. Unit Roots and Structural Breaks: A Survey of the Literature . In: B. B. Rao, ed. *Cointegration for Applied Economist.* Basingstoke: Palgrave Macmillian; 2nd edition.

Chang, H., 2003. *Kicking Away the Ladder: The Real History of Free Trade,* s.l.: FPIF Special Report.

Christiano, L. J., 1992. Searching for a Break in GNP. *Journal of Business Economics and Statistics,* Volume 10, pp. 237-250.

Clemente, J., Montanes, A. & Reyes, M., 1998. Testing for a Unit Root in Variables with a Double Change in the Mean. *Economics Letters,* Volume 59, pp. 175-182.

Crisp, B. F. & Kelly, M. J., 1999. The Socioeconomic Impacts of Structural Adjustment. *International Studies Quarterly,* 43(3), pp. 533-552.

Das-Gupta, A. K., 1954. Keynesian economics and under-developed countries. *Economic Weekly,* Issue 26 January, pp. 101-106.

Devlin, R. & Ffrench-Davis, R., 1995. The great Latin American debt crisis: a decade of asymmetric adjustment. *Revista de Economia Politica,* 15(3), pp. 117-142.

Dray, M. & Thirlwall, A. P., 2011. The endogeneity of the natural rate of growth for a selection of Asian countries. *Journal of Post Keynesian Economics,* 33(3), pp. 451-468.

Easterly, W., 2003. IMF and World Bank Structural Adjustment Programs and Poverty. In: M. P. Dooley & J. A. Frankel, eds. *Managing Currency Crises in Emerging Markets.* s.l.:University of Chicago Press, pp. 361-391.

Elliott, D. R. & Rhodd, R., 1999. Explaining growth rate differences in highly indebted countries: an extension to Thirlwall and Hussain. *Applied Economics,* 31(9), pp. 1145-1148.

Fratzscher, M. & Bussiere, M., 2004. *Financial openness and growth: short-run gain, long-run pain?,* Frankfurt: European Central Bank Working Paper Series No. 348.

Glynn, J., Perera, N. & Verma, R., 2007. Unit Root Tests and Structural Breaks: A Survey with Applications. *Journal of Quantitative Methods for Economics and Business Administration* , 3(1), pp. 63-79.

Harrod, R., 1933. *International Economics.* Cambridge: Cambridge University Press.

Harrod, R. F., 1939. An Essay in Dynamic Theory. *The Economic Journal,* 49(193), pp. 14-33.

Hassler, U. & Wolters, J., 2005. Autoregressive Distributed Lag Models and Cointegration. *Diskussionsbeitrage des Fachbereichs Wirtschaftswissenschaft der Freien Universitat Berlin,* Issue No. 2005/22.

Hausmann, R., Hwang, J. & Rodrik, D., 2007. What you export matters. *Journal of Economic Growth,* 12(1), pp. 1-15.

Helg, R., 1991. A Note on the stationarity of the Primary Commodities Relative Price Index. *Economic Letters,* Volume 36, pp. 55-60.

Hussain, M. N., 1999. The balance of payments constraint and growth rate differences among African and East Asian economies. *African Development Review,* 11(1), pp. 103-137.

Hussain, m. N., 2006. The implications of Thirlwall's law for Africa's Development. In: P. Arestis, J. McCombie & R. Vickerman, eds. *Growth and Economic Development: Essays in Honour of A. P. Thirlwall.* Cheltenham: Edward Elgar Publishing Limited, pp. 47-59.

International Labour Office, 2014. *Global Employment Trends: Risk of a Jobless Recovery?,* Geneva: International Labour Organization.

Kaldor, N., 1966. *Causes of the Slow Rate of Economic Growth of the United Kingdom.* Cambridge : Cambridge University Press.

Kaldor, N., 1967. *Strategic Factors in Economic Development.* New York: Cornell University.

Lanzafame, M., 2014. The balance of payments constrained growth rate and the natural rate of growth: new empirical evidence. *Cambridge Journal of Economics,* Volume 38, pp. 817-838.

McCombie, J. S. L., 1989. Thirlwall's Law and Balance of Payments Constrained Growth: A Comment on the Debate. *Applied Economics ,* Volume 21, pp. 611-629.

McCombie, J. S. L., 1997. On the Empirics of Balance-of-Payments-Constrained Growth. *Journal of Post Keynesian Economics,* 19(3), pp. 345-375.

McCombie, J. & Thirlwall, T., 2004. *Essays on balance of payments constrained growth: theory and evidence.* London: Routledge.

McGregor, P. G. & Swales, J. K., 1985. Professor Thirlwall and Balance of Payments Constrained Growth. *Applied Economics,* Volume 17, pp. 17-32.

McKinnon, R. & Pill, H., 1997. Credible economic liberalisations and overborrowing. *American Economic Review,* Volume 87, pp. 189-193.

McKinnon, R. & Pill, H., 1999. Exchange-rate regimes for emerging markets: moral hazard and international overborrowing. *Oxford Review of Economic Policy,* 15(3), pp. 19-39.

Moreno-Brid, J. C., 2003. Capital Flows, Interest Payments and the Balance of Payments Constrained Growth Model: A Theoretical and Empirical Analysis. *Metroeconomica,* 54(2 & 3), pp. 346-365.

Nell, K., 2003. A generlised version of the balance of payments growth model: an application to neighbouring regions. *International Review of Applied Ecconometrics,* 17(3), pp. 249-67.

OECD, 2013. *Aid to poor countries slips further as governments tighten budgets.* [Online] Available at:
http://www.oecd.org/newsroom/aidtopoorcountriesslipsfurtherasgovernmentstightenbudgets.htm
[Accessed 17 September 2014].

Page, J., 1994. The East Asian Miracle: Four Lessons for Development Policy. In: S. Fischer & J. J. Rotemberg, eds. *NBER Macroeconomic Annual.* s.l.:MIT Press, pp. 219-282.

Perraton, J., 2003. Balance of payments constrained growth and developing countries: an examination of Thirwall's hypothesis. *International Review of Applied Economics,* 17(1), pp. 1-22.

Perron, P., 1989. The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. *Econometrica,* Volume 57, pp. 1361-1401.

Perron, P. & Vogelsang, T., 1992. Nonstationarity and Level Shifts with an Application to Purchasing Parity. *Journal of Business and Economic Statistics,* Volume 10, pp. 301-320.

Perron, P. & Vogelsang, T. J., 1992. Testing for a Unit Root in a Time Series with a Changing Mean: Corrections and Extensions. *Journal of Business and Economic Statistics,* 10(4).

Pesaran, M. H. & Shin, Y., 1998. An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. *Econometric Society Monographs,* Volume 31, pp. 371-413.

Pesaran, M. H., Shin, Y. & Smith, R. J., 2001. Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics,* Volume 16, pp. 289-326.

Phillips, P. C. B. & Hansen, B., 1990. Statistical Inference in Instrumental Variables Regression with I(1) Processes. *Review of Economic Studies,* Volume 57, pp. 99-125.

Poverty Reduction and Economic Management Network, 2000. *Reforming Public Institutions and Strengthening Governance,* s.l.: World Bank.

Razmi, A., 2005. Balance of payments constrained growth model: the case of India. *Journal of Post-Keynesian Economics,* 27(4), pp. 655-687.

Rodrigues, M., 2010. Import Substitution and Economic Growth. *Journal of Monetary Economics,* 57(2), pp. 175-188.

Rodrik, D., 1999. *The New Global Economy and Developing Countries: Making Openness Work.* Washington DC: Overseas Dvelopment Council.

Sapsford, D., 1985. The Statistical Debate on the Net Terms of Trade between Primary Commodities and Manufacturers: A Comment and Some Additional Evidence. *Economic Journal,* Volume 95, pp. 781-788.

Sarkar, P., 1986. The Singer-Prebisch Hypothesis: A Statistical Evaluation. *Cambridge Journal of Economics,* Volume 10, pp. 355-371.

Singer, H., 1950. The Distribution of Gains between Investing and Borrowing Countries. *American Economic Review,* Volume 40, pp. 473-485.

Singh, A., 1994. Asian Economic Success and Latin American Failure in the 1980s: New Analyses and Future Policy Implications. *The Helen Kellogg Institute for International Studies Working Paper 204.*

Stock, J. H., 1987. Asympotic Properties of Least-Squares Estimators of Cointegrating Vectors. *Econometrica,* Volume 55, pp. 1035-1056.

Thirlwall, A. P., 1969. Okun's law and the natural rate of growth. *Southern Economic Journal,* 36(1), pp. 87-89.

Thirlwall, A. P., 2011. *Economics of Development.* 9th edition ed. London : Palgrave Macmillian.

Thirlwall, A. P., 2013. *Economic Growth in an Open Developing Economy: The Role of Structure and Demand.* Cheltenham: Edward Elgar.

Thirlwall, A. P. & Hussain, M. N., 1982. The balance of payments constraint, capital flows and growth rate differences betwen developing countries. *Oxford Economic Papers,* Volume 34, pp. 498-510.

UNCTAD, 2013. *Trade and Development Report,* New York and Geneva: United Nations.

UNDP, 2013. *Official Development Assistance,* s.l.: United Nations .

UNICEF, 2014. *Generation 2030: Africa,* New York: UNICEF.

United Nations, 2013. *Inequality Matters: Report of the World Social Situation,* New York: United Nations.

Wells, H. & Thirlwall, A. P., 2003. Testing Kaldor's growth laws across the countries of Africa. *African Development Review,* 15(2-3), pp. 89-105.

World Bank, 2013. *Evidence-Based Policy, Institutional Change and Poverty Impact,* Washington D.C: The World Bank.

World Bank, 2015. *Heavily Indebted Poor Countries (HIPC).* [Online]
Available at: http://data.worldbank.org/income-level/HPC
[Accessed 9 September 2015].

Appendix A

The starting point for the extended model of the balance of payments constrained growth rate is the balance of payments accounting identity in disequilibrium (Hussain and Thirlwall, 1982)

$$P_d X + C = P_f ME \quad \text{(Equation 1)}$$

where, C, is the nominal value of net capital inflows measured in the domestic currency[30]. If C<0, there are net capital outflows and if C>0, there are net capital inflows. The rest of the variables are defined as before.

The first two terms in Equation 1 represent the items that provide foreign currency inflows while the right hand side of the equation represents the imports that have to be paid for in foreign currency. Taking the first difference of the variables in logarithmic form yields,

$$\theta(p_d + x) + (1 - \theta)(c) = p_f + m + e \quad \text{(Equation 2)}$$

where, θ, and (1-θ), represent the share of exports and capital flows as a proportion of total receipts respectively. Therefore, $\theta = P_d X/R$ and $(1 - \theta) = C/R$, where R is total receipts which can also be expressed as the import bill financed by export earnings and capital flows. x, is the growth rate of exports, c, is the growth rate of capital flows, m, is the growth rate of imports, $p_{d,}$ is the growth rate of domestic prices and $p_{f,}$ is the growth rate of import prices.

The import and export demand functions given in Equations 2.5 and 2.6 are substituted into Equation 2 then solved for the growth of balance of payments constrained income,

$$*** \; y_B = [(1 + \theta\eta + \psi)\big(p_d - p_f - e\big) + \theta\varepsilon z + (1 - \theta)(c - p_d))]/\pi \quad \text{(Equation 3)}$$

It can be seen from Equation 3 that any country's growth rate in principle can be disaggregated into four component parts (Thirlwall, 2011):

1. The growth associated with real terms of trade movements: $(p_d - p_f - e)/\pi$

[30] For simplicity the nominal exchange rate is assumed to be fixed and equal to one (Moreno-Brid, 2003).

2. Growth associated with terms of trade movements combined with price elasticities of exports and imports: $((1 + \theta\eta + \psi)$ (pd – pf –e))/π
3. Growth related to exogenous changes in income growth abroad: $\theta\varepsilon z/\pi$
4. Growth effects of real capital flows[31]: (1-θ)$(c - p_d)$]/π

Note that if relative prices measured in a common currency remain unchanged, that is $p_d = p_f + e$, the current account is balanced and there are no capital flows, then the balance of payments constrained income growth in Equation 3 will be reduced to its basic form expressed in Equation 2.10 in section 2.

[31]Growth in Real capital inflows are defined as (c-p_d).

Appendix B

Data and sources for calculating the balance of payments constrained growth rate

Variable	Source
Exports of goods and services (constant 2005 USD)	World Development Indicators (World Bank)
Imports of goods and services (constant 2005 USD)	World Development Indicators (World Bank)
GDP (constant 2005 USD)	World Development Indicators (World Bank)
GDP deflator (base year 2005)	World Development Indicators (World Bank)
Consumer price index (CPI)	World Development Indicators (World Bank)
World Income, less own country income (constant 2005 USD)	World Development Indicators (World Bank)
Export price index (unit value of exports, f.o.b) (Base year 2005)	International Financial Statistics (IMF)
Import price index (unit value of imports, f.o.b) (Base year 2005)	International Financial Statistics (IMF)
Interest payment on external debt (constant 2005 USD)	World Development Indicators (World Bank)
REER (Real effective exchange rate, CPI-based)	REER database (Bruegel)

REER measures the development of the real value of a country's currency against the basket of the trading partners of the country. It therefore can be expressed as Pd/Pf or Pd/Pm which is domestic to foreign prices.

We use REER to estimate the import and export demand functions. In the export demand function, we make use of the domestic to foreign price ratio, Pd/Pm. REER is therefore used in the export demand function. For the import demand function, we make use of the foreign to domestic price ratio, Pf/Pd, 1/REER is therefore used in the import demand function.

Other price indices were also used when REER was not available. We use the price index recommended by Tharnpanich and McCombie (2013).

$$RPM2 = \frac{Import\ price\ index}{GDP\ deflator}$$

$$RPM3 = \frac{Import\ price\ index}{CPI}$$

$$RPM4 = \frac{Import\ price\ index}{Export\ price\ index}$$

$$RPX4 = \frac{Export\ price\ index}{import\ price\ index}$$

Appendix C

The results from the unit root tests are shown below. Included are the Clemente, Montanes and Reyes (CMR) unit root test where,

- Sudden changes in the series are captured by the Additive Outliers (AO)
- Gradual shift in the mean of the series is detected by the Innovational Outliers (IO)

Results from the unit root tests

Country	Variable	CMR2 (AO)	Breaks	CMR1 (AO)	Break	CMR2 (IO)	Breaks	CMR1 (IO)	Break	ADF^N	ADF NC	ADF trend	PP	PP NC	PP trend
Kenya	ln_X	-3.742	1987*** 2004***			-4.032	1984*** 2001***			-0.543	3.542	-2.222	-0.767	3.882	-2.755
	ΔIn_X	-7.503***	1988 1995	-1.107	1988	-9.532***	1971 1989	-9.105***	1989	-6.169***			-8.607***		
	ln_M	-3.555	1994*** 2007***			-3.449	1991*** 2001***			0.674	2.532	-1.076	0.763	2.179	-1.141
	ΔIn_M	-3.901	1978** 1981**			-5.064	1980 1982*	-4.532**	1982**	-4.745***			-7.012***		
	ln_Y	2.265	1974*** 1991***			-4.802	1969** 2002***			-2.360	5.344	-2.409	-1.362	7.060	-1.491
	ΔIn_Y	-4.532	1968 1973**	-8.264***	1980**	-10.853***	1969*** 1973***			-5.077***			-7.222***		
	ln_ZY	-3.412	1980*** 2000***			-4.406	1982** 1995***			-3.367**			-4.716***		
	ln_REER	-2.234	1987*** 1998***			-3.526	1986*** 1992***			-1.314	0.134	-0.739	-1.478	0.144	-0.921
	ΔIn_REER	-3.361	1986* 1991***			-6.926***	1986*** 1992***			-4.991***			-7.660***		
	ln_RPM3			-1.373	1995***	-0.348	1982** 1989***			0.658 (2lag)	-1.112	-0.897	1.028	-1.278	-0.639
	ΔIn_RPM3			-1.960	1982***			-2.566	1979***	-2.475	-2.117	-3.139*	-3.655***	-3.329***	-4.265***
	ln_RPM4	-4.128	1975*** 1984***			-4.515	1969** 1976**			-1.157	-1.835	-2.230	-1.044	-1.698	-2.701
	ΔIn_RPM4			-5.591***	1975			-8.910***	1976	-4.626***			-7.389***		
Nigeria	ln_X	-5.335	1986** 2003***			-4.980	1995*** 2004***			-0.934	1.015	-2.646	-1.193	0.822	-3.312*
	ΔIn_X			-0.863	2010			-4.131*	2001	-4.547***			-6.907***		
	ln_M	-3.790	1997* 2004***					-3.764	1999***	-1.040	0.232	-3.507**	-4.934***		
	ln_Y	-3.101	1997*** 2005***			-3.891	1986*** 2002***			1.081	2.198	-1.914	1.152	2.642	-1.775
	ΔIn_Y			-5.563***	2002***			-6.362***	2003	-3.431***			-4.158***		

	In_ZY	-2.597	1991*** 2001***					-2.240	2009	-1.551	4.353	-2.759	-0.956	11.493	-1.192
	ΔIn_ZY			-2.898	2007**			-5.469**	2006**	-4.299***			-4.734***		
	In_REER			-5.563***	1988***			-4.201*	1984***	-2.891**			-2.144*	-0.700	-2.043
	ΔIn_REER			-4.368***	1985			-5.225***	1986	-3.329**			-4.133***		
Sudan	In_X	-4.024	1986** 2000***			-4.809	1983** 1996***			-0.497	1.102	-1.261	-0.371	1.265	-1.144
	ΔIn_X			-6.873***	1997**	-8.009***	1996*** 1998**			-8.470***			-5.475***		
	In_M	-3.485	1976*** 2001***					-3.560	1994***	-1.180	0.755	-2.002	-1.462	0.855	-2.231
	ΔIn_M			-3.778**	2010*	-8.419***	1994** 2003**			-4.890***			-7.697***		
	In_Y[32]	-2.829	1978*** 1999***			-2.045	1972** 1994***			0.743	3.138	-2.530	0.797	4.599	-2.131
	ΔIn_Y			-2.873	1988			-3.397	1989	-5.229***			-5.099***		
	In_ZY	-3.412	1980*** 2000***			-4.404	1982** 2005***			-3.367**			-4.719***		
	In_REER			0.921	1989***	1.986	1990*** 2004***			-2.200	0.158	-2.098	-2.908**	0.283	-2.884
	ΔIn_REER			0.572	1990	-16.03***	1990*** 1994***			-5.831***			-9.464***		
South Africa	In_X	-2.680	1989*** 1997***			-4.160	1983* 1991***			-0.337	2.867	-1.779	-0.503	3.819	-1.713
	ΔIn_X			-6.293***	1993	-6.567***	1990* 2007**			-5.198***			-6.034***		
	In_M	-1.136	1992*** 2004***			-3.243	1992*** 2002**			-0.879	2.295	-2.243	-0.379	2.786	-1.879
	ΔIn_M	-5.137*	1975** 1985**			-7.207***	1970** 1984*			-6.040***			-6.488***		
	In_Y[33]	-3.162	1975*** 2001***			-6.091***	1992*** 2002**			-1.999	2.719	-3.240*	-2.625*	6.278	-2.925
	ΔIn_Y	-4.932*	1983*** 1994**					-5.288***	1970***	-3.035**			-4.076***		
	In_ZY	-3.409	1980*** 2000***			-4.394	1982** 1995***			-3.564***			-4.716***		
	In_REER	-5.491**	1981*** 1997***			-4.270	1982*** 1996***			-1.442	-1.036	- 4.388***	-1.157	-1.242	-3.518**
	ΔIn_REER			-4.673***	2000			-6.030***	2001*	-6.379***			-6.285		

[32] For Sudan In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[33] For South Africa In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

Benin	In_X	-3.017	1970*** 1993***					-3.397	1988***	-1.617	2.023	-3.576**	-0.960	2.466	-2.432
	ΔIn_X			-7.207***	1996			-7.315***	1970**	-6.345***			-5.319***		
	In_M	-4.063	1972*** 1994***					-3.996	1988***	-2.143	2.158	-3.368*	-1.353	2.429	-2.212
	ΔIn_M	-3.576	1979** 1987*			-5.691***	1980*** 1988***			-4.244***			-5.760***		
	In_Y[34]	-1.649	1982*** 1998***			-1.143	1977*** 1994**			1.316	5.456	-1.967	1.708	10.022	-1.747
	ΔIn_Y			-3.391*	1098			-3.747	1988***	-6.199***			-7.054***		
	In_ZY	-3.412	1980*** 2000***		-4.403	1982** 1995***				-3.367**			-4.715***		
	In_REER	-2.768	1976*** 1984***		- 6.015***	1973*** 1979***				-2.436	-1.505	-1.408	-2.465	-1.700	-1.195
	ΔIn_REER			-4.673***	1992			-6.914***	1982**	-4.530***			-6.090***		
Botswana	In_X	-3.886	1984*** 1996***					-3.043	1980	-2.068	2.457	-2.423	-2.688*	3.082	-2.709
	ΔIn_X			-3.102	2007			-6.067***	1987***	-4.695***			-6.052***		
	In_M	-3.003	1990*** 2009***			-3.233	1985** 2005**			-0.960	2.351	-3.585**	-0.992	3.724	-2.838
	ΔIn_M			-3.673**	1995	-6.038***	1989** 1996*			-4.952***			-4.750***		
	In_Y	-3.063	1985*** 1999***					-2.149	2012	-3.408**	3.059	-2.175	-4.562***		
	ΔIn_Y	-7.141***	1986*** 1990***					-3.966	1990***	-3.988***			-4.002***		
	In_ZY	-2.901	1989*** 2001***					-1.904	1981	-0.951	4.184	-2.175	-1.611	12.175	-2.692
	ΔIn_ZY			-3.814**	2007**			-5.260***	2006*	-4.363***			-4.701***		
	In_REER	-3.786	1986*** 1999***					-2.029	1983	-1.731	0.147	-1.703	-1.818	0.083	-1.742
	ΔIn_REER	-3.269	1982* 1988***	-4.811***	1983	-7.092***	1983*** 1987***			-4.109***			-5.364***		
Cameroon	In_X	-1.019	1975*** 1981***			-4.472	1967** 1976***			-0.735	2.265	-1.685	-0.567	2.490	-1.784
	ΔIn_X	-3.888	1975*** 1985***			-7.047***	1976*** 1984***			-5.408***			-6.973***		
	In_M[35]	-3.461	1978*** 2001***			-2.190	1974** 1991*			0.233	3.153	-2.488	0.353	3.458	-2.808

[34] For Benin In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[35] For Cameroon In_M, 4 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

	ΔIn_M	-8.078***	1987** 1990**			-8.175***	1985*** 1991***			-6.203***			-7.989***		
	In_Y	-3.229	1979*** 2002***			-3.211	1975** 1999**			-0.898	1.355	-3.051	-0.658	3.431	-1.556
	ΔIn_Y	-2.394	1986*** 1991***			-7.521***	1985*** 1992***			-3.174**			-5.349***		
	In_ZY	-3.415	1980*** 2000***			-4.405	1982** 1995***			-3.365**			-4.713***		
	ΔIn_ZY	-4.469	1971*** 2007**			-7.376***	1972*** 2006***								
	In_REER	-1.525	1985** 1991***			-7.547***	1973** 1992***			-1.568	-0.350	-2.221	-1.945	-0.471	-2.555
	ΔIn_REER			-12.344***	1992					-5.668***			-8.171***		
Chad	In_X	-0.576	1980*** 2002***			-6.354***	1981*** 2002***			-1.046	1.064	-2.853	-0.972	1.244	-2.539
	ΔIn_X			-5.230**	2002**			-7.036***	1981	-6.038***			-7.026***		
	In_M[36]	-1.192	1986*** 1998***			-5.683**	1981*** 2000***			-2.403	0.626	-4.144***	-2.609*	0.385	-3.240*
	ΔIn_M			-3.671**	2000			-4.299**	1999	-4.400***			-5.955***		
	In_Y	-0.472	1993*** 2006***			-3.655	1983*** 2001***			1.352	2.340	-1.017	1.601	2.603	-0.902
	ΔIn_Y			-5.556***	2002**			-7.188***	1978*	-4.311***			-5.945***		
	In_ZY	-3.413	1980*** 2000***			-4.405	1982** 1995***			-3.368**	3.721	-2.958	-4.718***	10.620	-2.691
	ΔIn_ZY	-4.470	1971*** 2007**			-7.374***	1972*** 2006**								
	In_REER	-3.125	1980*** 1991***			-5.845**	1980*** 1992***			-1.275	-1.015	-1.713	-1.219	-1.172	-1.642
	ΔIn_REER	-8.085***	1992* 1996**					-9.213***	1993*	-5.160***			-6.182***		
Congo, Dem. Rep.	In_X	-4.374	1979*** 2004***			-3.167	1981* 2000***			-0.256	1.591	-1.768	-0.294	1.898	-1.771
	ΔIn_X	-8.014***	1989** 1994***			-7.998***	1990*** 1993***			-5.626***			-6.699***		
	In_M	-6.038***	1976*** 2004***					-2.155	1996**	-1.096	1.224	-2.142	-1.174	1.513	-2.098
	ΔIn_M					-5.260*	1990*** 1993***			-5.506***			-6.147***		
	In_Y[37]	-3.793	1994*** 2007***			-3.471	1988*** 2005***			-2.122	0.470	-1.756	-1.078	0.764	-0.906
	ΔIn_Y	-5.070	1989*** 1999***			-5.671**	1988*** 2000***			-1.955	-1.900	-1.998	-3.007**		

[36] For Chad In_M, 3 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[37] For the Democratic Republic of Congo In_Y, 3 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

	In_ZY	-2.953	1980*** 1999***			-4.180	1982** 1995***			-2.671*	3.959	-2.932	-4.221***		
	ΔIn_ZY	-7.444***	1971*** 2007**			-7.228***	1972*** 2006**								
	In_REER			-3.458*	1985***	-5.292*	1982*** 1999**			-1.563	-0.759	-2.495	-2.023	-1.105	-2.693
	ΔIn_REER			-3.141	1997	-7.918***	1999** 2004**			-5.053***			-7.002***		
Congo, Rep.	In_X	-3.563	1981*** 1994***			-3.837	1978** 2007**			-1.298	2.064	-1.657	-2.281	3.640	-2.165
	ΔIn_X			-6.353***	1981*			-6.310***	1982	-4.585***			-5.965***		
	In_M	-4.273	1990*** 2004***			-4.441	1991*** 2004***			-0.174	1.639	-2.554	-0.212	1.827	-2.604
	ΔIn_M			-1.102	1980			-5.873***	1992	-5.348***			-7.076***		
	In_Y[38]	-4.228	1983*** 2007***			-4.643	1976*** 2003***			-1.125	2.046	-2.485	-1.433	3.559	-2.092
	ΔIn_Y	-5.174*	1979*** 1982***					-4.514**	1981***	-3.552***			-3.781***		
	In_ZY	-2.977	1985*** 2000***			-3.023	1982* 1995**			-1.610	4.401	-3.243*	-2.269	12.538	-2.697
	ΔIn_ZY			-5.894***	1980**			-5.898***	1972*	-4.962***			-4.915***		
	In_REER	-1.721	1982*** 1990***			-4.785	1979*** 1986**			-1.444	-0.787	-1.364	-1.531	-1.112	-1.093
	ΔIn_REER			-6.521***	1992			-7.062***	1993*	-4.841***			-5.388***		
Gabon	In_X	-2.111	1971*** 1990***			-8.203***	1972*** 1987***			-3.351**			-3.663***		
	ΔIn_X			-1.856	1977***										
	In_M	-3.771	1971*** 1975***					-6.102***	1972***	-2.758*			-2.962**		
	ΔIn_M			-2.053	1972										
	In_Y	-1.139	1971*** 1991***			-3.872	1971*** 1986***			-1.900	1.867	-2.169	-2.323	2.495	-2.161
	ΔIn_Y	-2.691	1971* 1974***					-2.436	1973	-4.325***			-5.287***		
	In_ZY	-3.412	1980*** 2000***			-4.401	1982** 1995***			-3.363**			-4.711***		
	ΔIn_ZY	-4.474	1971*** 2007***			-7.372***	1972*** 2006**								
	In_REER	-5.376	1975*** 1991***			-7.030***	1973*** 1992***			-0.718	-1.025	-1.793	-0.793	-0.939	-2.033
	ΔIn_REER			-7.870***	1992			-10.043***	1993	-5.290***			-7.629***		

[38] For the Republic of Congo In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

Gambia	In_X[39]			-3.808**	1978***			-4.525***	1979***	-2.332	0.545	-3.250*	-2.055	0.938	-2.532
	ΔIn_X									-4.154***			-5.046***		
	In_M			-2.810	1974***			-4.388**	1975***	-2.425	0.762	-2.810	-2.390	0.748	-2.819
	ΔIn_M									-3.840***			-6.353***		
	In_Y	-2.735	1979*** 2000***			-3.466	1971*** 1996**			-1.480	5.790	-2.554	-1.148	8.763	-2.296
	ΔIn_Y			-6.530***	1973	-6.901***	1973*** 1977***			-5.467***			-7.829***		
	In_ZY	-2.937	1984*** 2000***			-3.537	1982** 1995**			-2.263	4.033	-3.496**	-3.128**	11.364	-3.031
	ΔIn_ZY			-6.283***	1971***	-7.069***	1972*** 2006**								
	In_REER	-6.123***	1983*** 2000***			-6.480***	1984*** 2000***			-0.284	-1.647	-2.028	-0.289	-1.810	-2.005
	ΔIn_REER									-4.350***			-6.159***		
Mali	In_X	-3.096	1981*** 1998***			-3.039	1975*** 1995***			0.149	4.469	-2.440	0.552	5.804	-3.262*
	ΔIn_X			-2.823	1995			-9.233***	2001	-5.994***			-8.900***		
	In_M	-3.051	1981*** 1998***			-4.213	1976** 1995***			-0.621	2.905	-2.780	-0.338	3.524	-3.255*
	ΔIn_M			-5.922***	1983			-8.087***	1984	-5.130***			-7.971***		
	In_Y	-2.688	1980*** 1998***					-1.333	1994**	1.025	3.584	-0.669	0.950	4.206	-0.912
	ΔIn_Y	-1.929	1977** 1985**	-7.197***	1995*			-6.958***	1995**	-4.370***			-6.446***		
	In_ZY[40]	-3.721	1980*** 1996***			-3.741	1982** 1994***			-1.086	4.224	-3.334*	-1.881	12.276	-3.998***
	ΔIn_ZY			-3.183	1971**			-6.121***	1972**						
	In_REER	-5.260	1978* 1991***			-5.804***	1985* 1992***			-0.726	-0.470	-3.077	-0.988	-0.331	-2.940
	ΔIn_REER			-6.981***	1992			-1.128	1993	-4.676***			-7.090***		
Mauritius	In_X	-3.497	1989*** 2002***			-4.748	1984*** 2003***			-0.822	2.970	-1.450	-1.143	4.248	-1.476
	ΔIn_X	-6.688***	1983*** 1988***			-7.214***	1984*** 1988***			-3.518***			-5.121***		
	In_M[41]	-5.267	1989*** 2000***			-5.066	1984*** 1995***			-0.992	1.382	-2.340	-0.856	2.103	-1.742

[39] For Gambia In_X, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[40] For Mali In_ZY, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[41] For Mauritius In_M, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

	ΔIn_M	-5.483*	1984*** 1989***			-6.474***	1984*** 1990***			-2.874**			-3.443***		
	In_Y	-2.813	1989*** 2001***					-4.824***	1983***	-0.058	4.435	-2.114	-0.220	7.862	-1.938
	ΔIn_Y			-2.917	1982*					-3.896***			-5.621***		
	In_ZY	-2.862	1989*** 2001***					-1.819	1981	-0.857	4.155	-2.958	-1.252	12.655	-2.372
	ΔIn_ZY			-3.987***	2007**			-5.155***	2006*	-4.550***			-4.576***		
	In_REER			-2.037	1981**	-3.221	1985** 2008**			-1.966	0.094	-1.822	-2.115	0.118	-2.053
	ΔIn_REER			-2.546	2003			-6.295***	2006*	-3.764***			-5.851***		
Mozambique	In_X[42]	-4.951	1997** 2004**			-4.326	1992*** 1998***			-0.400	1.255	- 4.664***	0.572	1.879	-3.693**
	ΔIn_X	-4.366	1997*** 2004*					-5.580***	1985***						
	In_M	-3.413	1996*** 2006***			-2.513	1997** 2007**			-0.741	1.658	-2.643	0.874	1.564	-2.874
	ΔIn_M			-6.545***	1983*			-3.325	1984	-4.072***			-5.776***		
	In_Y[43]	-2.666	1995*** 2005***					-0.068	1994**	0.701	2.219	- 5.374***	1.499	3.129	-3.466**
	ΔIn_Y			-1.247	1984***			-1.993	1985	-2.820*		-3.299**			
	In_ZY	-2.639	1990*** 2001***					-1.839	1982**	-0.865	4.078	-2.561	-0.752	11.811	-2.015
	ΔIn_ZY			-3.449*	2007**			-6.219***	2008	-4.674***			-4.414***		
	In_REER			-5.567***	1988***	-9.893***	1983*** 1985***			-1.836	-0.392	-2.455	-1.707	0.455	-2.167
	ΔIn_REER									-4.225***			-4.899***		
Namibia	In_X	-4.400	1992*** 2003***			-4.511	1989*** 2000***			-0.550	1.794	-3.812**	-0.165	1.897	-3.838**
	ΔIn_X			-2.837	1988			-5.195***	1989						
	In_M[44]	-4.641	1997*** 2008***			-4.300	1994*** 2005***			2.432	2.438	-0.807	2.011	2.881	-1.034
	ΔIn_M			0.203	2002	-7.391***	2005*** 2008***			-1.966	-0.774	-2.947	-3.926***		
	In_Y	-3.388	1993*** 2005***					0.179	2001	1.841	3.461	-2.671	2.661	5.813	-2.525
	ΔIn_Y	-6.139***	1983** 2002**					-5.502***	1984**	-3.438**			-4.237***		
	In_ZY	-2.639	1990*** 2001***					-1.839	1982**	-0.865	4.078	-2.562	-0.751	11.811	-2.016
	ΔIn_ZY			-3.449*	2007**			-6.217***	2008	-4.674***			-4.414***		

[42] For Mozambique In_X, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[43] For Mozambique In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[44] For Namibia In_M, 4 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

	In_REER[45]			-4.713***	1986***			-4.942***	1982*	-2.702*	-0.737	-2.269	-2.280	-0.735	-2.036
	ΔIn_REER									-3.606***			-4.593***		
Senegal	In_X[46]	-4.751	1978*** 1995***					-2.528	1992***	0.139	3.217	-2.302	-1.057	2.209	-5.192***
	ΔIn_X			-6.903***	1978	-7.130***	1976*** 1980***			-6.614***			-11.304***		
	In_M[47]	-3.608	1978*** 2000***			-2.236	1973*** 1996***			0.618	2.600	-2.539	-0.395	3.214	-3.360*
	ΔIn_M			-2.964	1975	-2.650	1976** 1980*			-4.981***			-10.612***		
	In_Y	-2.768	1983*** 2000***			-2.301	1973** 1996***			2.117	4.850	-0.795	2.303	7.899	-1.135
	ΔIn_Y			-11.586***	1995*			-11.398***	1993***	-4.878***			-10.413***		
	In_ZY	-3.413	1980*** 2000***			-4.404	1982** 1995***			-3.367**	3.712	-2.959	-4.716***	10.621	-2.691
	ΔIn_ZY	-4.470	1971*** 2007**			-7.374***	1972*** 2006**								
	In_REER			-5.242***	1991***			-5.810***	1992***	-0.978	-0.934	-2.062	-1.136	-0.970	-2.299
	ΔIn_REER									-5.027***			-7.543***		
Sierra Leone	In_X	-0.556	1979*** 2004***					-2.645	2011***	0.152	0.735	0.870	0.142	0.860	1.040
	ΔIn_X			-7.797***	2009***	-8.385***	1994** 2011***			-3.020**			-5.595***		
	In_M	-2.858	1977*** 2004***			-2.931	1998*** 2009**			0.050	0.818	-0.412	-0.138	0.853	-0.444
	ΔIn_M			-4.504***	1999***			-4.713***	1999***	-3.688***			-6.789***		
	In_Y	-1.709	1999*** 2008***			-0.088	1990*** 2000***			1.091	2.182	0.217	0.955	2.227	-0.024
	ΔIn_Y	-4.044	1989** 1999***			-6.420***	1990*** 2000***			-3.010**			-5.776***		
	In_ZY[48]	-2.986	1985*** 2000***			-3.259	1982* 1995**			-1.953	3.290	-2.842	-3.037**	11.542	-3.376*
	ΔIn_ZY	-6.859***	1980** 2007*					-6.275***	1972**	-5.010***			-4.858***		
	In_REER	-2.316	1982** 1987***			-4.810	1981*** 1984***			-2.938**	-0.309	-3.350*	-2.531*	-0.326	-2.810
	ΔIn_REER			-2.189	1984	-8.588***	1979*** 1985***			-6.125***			-5.874***		

[45] For Namibia In_REER, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[46] For Senegal In_X, 4 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[47] For Senegal In_M and In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[48] For Sierra Leone In_ZY, 3 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

Togo	In_X	0.460	1968*** 1978***					-1.693	1969	-0.909	2.326	-1.623	-1.350	2.419	-2.183
	ΔIn_X			-0.743	1969			-9.993***	1970	-5.316***			-8.691***		
	In_M[49]	-3.491	1972*** 1978***					-2.613	1973**	-1.414	1.399	-2.578	-1.058	1.581	-2.078
	ΔIn_M			-0.502	2009**			-5.838***	1976	-3.697***			-5.365***		
	In_Y	-3.177	1974*** 1998***			-5.713**	1992*** 2008***			-1.981	3.317	-3.047	-2.450	4.038	-3.300*
	ΔIn_Y			-3.092	1991					-4.390***			-6.584***		
	In_ZY	-3.413	1980*** 2000***			-4.403	1982** 1995***			-3.367**	3.722	-2.959	-4.715***	10.624	-2.691
	ΔIn_ZY	-4.470	1971*** 2007**			-7.373***	1972*** 2006**			-3.877***					
	In_REER	-2.658	1981*** 1991***			-8.130***	1982*** 1992***			-1.408	-0.788	-1.811	-1.577	-0.916	-2.131
	ΔIn_REER			-8.741***	1992			-12.021***	1993	-5.972***			-8.246***		
Uganda	In_X	-4.295	1998*** 2009***			-2.933	1993*** 2003**			0.258	3.023	-2.545	0.468	3.372	-2.832
	ΔIn_X			-2.960	2006			-7.552***	2007	-3.920***			-6.186***		
	In_M[50]	-3.281	1996*** 2007***					0.144	1993***	-0.052	2.621	-2.506	0.178	3.357	-2.434
	ΔIn_M			-5.271***	1993**			-3.244	1994**	-3.234**			-3.604***		
	In_Y[51]	-2.596	1996*** 2005***					-0.798	1991**	0.378	2.934	- 4.670***	1.251	7.918	-3.404**
	ΔIn_Y			-4.973***	1987***			-2.713	1986	-3.823***			-3.105**		
	In_ZY	-2.772	1994*** 2004***					-2.111	1994	-1.593	3.995	-2.789	-1.752	11.845	-1.990
	ΔIn_ZY			-2.802	2007**			-5.160***	2006**	-4.018***			-4.373***		
	In_REER[52]	-4.972	1990*** 1999*					1.270	1989	-2.809*	-2.119	-1.124	-3.882***	-2.161	-3.103
	ΔIn_REER			-6.261***	1990**			-6.829***	1991***	-3.549***					
Zambia	In_X	-5.869***	2000*** 2006***			-3.933	1997*** 2001***			2.101	2.277	0.427	2.365	2.366	0.392
	ΔIn_X					-9.247***	1997*** 2004***			-3.103**			-5.456***		
	In_M[53]	-2.603	1979** 2002***			-3.258	1973** 1997***			0.720	1.417	-0.224	1.419	1.900	0.075

[49] For Togo In_M, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[50] For Uganda In_M, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[51] For Uganda In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[52] For Uganda In_REER, 4 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[53] For Zambia In_M and In_RPM2, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

	ΔIn_M	-6.903***	1970* 1991***					-4.982***	1992***	-2.089			-4.513***		
	In_Y	-1.239	1996*** 2006***			-2.365	1994** 2003***			2.056	3.764	0.770	1.984	4.132	0.520
	ΔIn_Y			-8.567***	2000***			-8.283***	2001***	-3.600***			-6.639***		
	In_ZY	-3.358	1980*** 2000***			-4.399	1982** 1995***			-3.336**	3.693	-2.919	-4.645***	10.561	-2.639
	ΔIn_ZY	-7.069***	1971** 1980*			-7.313***	1972*** 2006**								
	In_REER[54]	-6.444***	1984*** 2003***			-6.480***	1985** 2003***			-0.699	0.600	-1.311	-1.385	0.441	-1.890
	ΔIn_REER									-4.030***			-5.282***		
	In_RPM2	-4.453	1988*** 1993***					-6.164***	1989***	-2.537*	-2.827**	-0.674	-2.184	-3.263***	-0.009
	ΔIn_RPM2	-6.363***	1990*** 1994***			-6.243***	1989*** 1993***								
	In_RPM4	-4.626	1997*** 2007*			1.537	1996** 2004***			-1.615	-1.107	-2.349	-2.043	-1.265	-2.947
	ΔIn_RPM4			-5.950***	2004			-7.866***	2005	-5.023***			-7.912***		
Zimbabwe	In_X	-2.741	1987*** 2004***			-4.145	1978** 2000***			-1.752	0.499	-1.680	-1.675	0.405	-1.546
	ΔIn_X	-4.640	1999*** 2008***			-2.347	1998** 2007***			-3.492***			-5.496***		
	In_M	-2.930	1987*** 2010***					-1.762	1984	-1.287	1.237	-1.745	-1.418	1.210	-2.107
	ΔIn_M	-4.732	1997** 2007***					-2.643	2008*	-4.539***			-7.310***		
	In_Y[55]	-3.578	1990*** 2004***					-1.066	2000**	-2.527	0.799	-2.291	-1.713	0.728	-1.566
	ΔIn_Y	-1.292	1999** 2006**			-7.800***	2000*** 2007***			-2.584*			-3.833***		
	In_ZY	-2.868	1989*** 2001***					-1.818	1981	-0.856	4.155	-2.959	-1.251	12.653	-2.373
	ΔIn_ZY			-3.986***	2007**			-5.156***	2006*	-4.549***			-4.577***		
	In_RPM2			-3.597**	1990***			-4.021	1987***	-1.233	-1.543	-1.134	-1.535	-1.714	-1.507
	ΔIn_RPM2							-5.492**	1987** 1995***	-3.697***			-6.540***		
	In_RPM4			-4.058***	1990***	-6.039***	1983*** 1987***			-2.289	-1.860	-2.513	-3.182**	-2.679	-3.282*
	ΔIn_RPM4									-4.709***					

Note: The ADF unit root test uses one lagged value as determined by the presence of autocorrelation unless otherwise stated.
5% critical value for the CMR2 is -5.490

[54] For Zambia In_REER, 3 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.
[55] For Zimbabwe In_Y, 2 lags were used in the Augmented Dickey fully (ADF) unit root test due to autocorrelation.

5% critical value for CMR1 is -3.560
5% critical value for ADF is -2.928
5% critical value for ADF no constant -1.950
5% critical value for ADF trend -3.497
5% critical value for PP is -2.927
5% critical value for PP trend -3.496
5% critical value for PP no constant -1.950
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

Appendix D

Results from the import demand function

Results from the ARDL model

$$Kenya\ \Delta InM = -2.822(1.641) - 0.347(0.103)InM_{t-1} + 0.342(0.114)InY_t - 0.519(0.211)IniREER_t + 0.260(0.085)D1963to78 + 0.287(0.091)D1990onward$$

$$Sudan\ \Delta InM = 0.035(1.338) - 0.261(0.094)InM_{t-1} + 0.249(0.102)InY_t + 0.046(0.079)IniREER_t$$

$$Nigeria\ \Delta InM = -0.636(3.835) - 0.499(0.163)InM_{t-1} + 0.470(0.288)InY_t - 0.074(0.060)InREER_t + 0.204(0.127)\Delta InM_{t-1} + 3.270(0.778)\Delta InY_t + 1.192(0.419)\Delta InY_{t-1} - 0.947(0.479)\Delta InY_{t-2} + 2.163(0.455)\Delta InY_{t-3} + 0.233(0.111)\Delta InREER_t - 0.473(0.177)D1988 - 0.625(0.192)D1999 - 1.311(0.235)D2004$$

$$South\ Africa\ \Delta InM = -6.526(1.523) - 0.196(0.041)InM_{t-1} + 0.407(0.072)InY_t - 0.135(0.069)IniREER_t + 3.982(0.346)\Delta InY_t - 0.106(0.057)D1982 + 0.167(0.057)D1992$$

$$South\ Africa\ Post\ Apartheid\ \Delta InM = -6.417(1.517) - 0.239(0.054)InM_{t-1} + 0.434(0.075)InY_t - 0.186(0.080)IniREER_t + 3.763(0.403)\Delta InY_t - 0.104(0.057)D1982 + 0.164(0.058)D1992 + 0.050(0.040)D1994onward$$

$$South\ Africa\ trend\ \Delta InM = -15.614(4.418) - 0.208(0.039)InM_{t-1} + 0.170(0.129)InY_t - 0.221(0.077)IniREER_t + 3.872(0.352)\Delta InY_t - 0.091(0.055)D1982 + 0.132(0.058) + 0.007(0.003)t$$

$$South\ Africa\ Post\ Apartheid\ trend\ \Delta InM = -14.170(6.481) - 0.195(0.067)InM_{t-1} + 0.192(0.159)InY_t - 0.209(0.117)IniREER_t + 4.139(0.452)\Delta InY_t - 0.389(0.444)\Delta InY_{t-1} + 0.058(0.106)\Delta IniREER_t - 0.008(0.120)\Delta IniREER_{t-1} + 0.143(0.062)D1992 + 0.004(0.053)D1994onward + 0.006(0.004)t$$

$$Benin\ \Delta InM = -3.329(1.036) - 0.345(0.079)InM_{t-1} + 0.394(0.086)InY_t - 0.373(0.074)IniREER_t + 3.229(0.419)\Delta InY_t + 0.294(0.131)\Delta IniREER_t - 0.129(0.079)D1982 - 0.144(0.074)D1984 + 0.170(0.072)D1992$$

$$Botswana\ \Delta InM = -1.037(0.911) - 0.954(0.196)InM_{t-1} + 0.855(0.168)InY_t - 0.508(0.216)IniREER_t + 0.828(0.173)\Delta InM_{t-1} + 0.094(1.154)\Delta InM_{t-2} + 0.472(0.152)\Delta InM_{t-3} + 0.534(0.318)\Delta InY_t - 0.181(0.067)D1996 - 0.196(0.069)D2005 + 0.291(0.075)D2012$$

$$Cameroon\ \Delta InM = -3.735(1.504) - 0.507(0.123)InM_{t-1} + 0.700(0.170)InY_t + 0.333(0.119)IniREER_t - 0.213(0.100)D1$$

$$Chad\ \Delta InM = 4.976(2.946) - 0.835(0.138)InM_{t-1} + 0.549(0.199)\mathrm{InY}_t - 0.233(0.145)IniREER_t + 0.218(0.129)\Delta InM_{t-1} + 0.715(0.111)\Delta InM_{t-2} + 0.385(0.141)D2001 + 1.080(0.144)D2002$$

$$Republic\ of\ Congo\ InM = 2.852(1.520) + 0.173(0.077)InM_{t-1} - 0.258(0.110)InY_t + 0.180(0.079)IniREER_t - 0.588(0.100)\Delta InM_{t-1} - 0.408(0.124)\Delta InM_{t-2} + 0.556(0.146)\Delta InM_{t-3} - 0.337(0.332)\Delta InY_t + 1.048(0.329)\Delta InY_{t-1} + 1.231(0.329)\Delta InY_{t-2} - 0.964(0.350)InY_{t-3} - 0.420(0.232)\Delta IniREER_t - 0.167(0.219)\Delta IniREER_{t-1} - 0.467(0.227)\Delta IniREER_{t-2} - 0.999(0.231)\Delta IniREER_{t-3} + 0.218(0.102)D1980 + 0.525(0.086)D1981 + 0.870(0.113)D1982 + 0.346(0.090)D1990 + 0.854(0.081)D1991 + 0.556(0.127)D1993 + 0.546(0.160)D1994 + 0.828(0.183)D1995 - 0.239(0.134)D1997 - 0.105(0.066)D2004$$

$$Democratic\ Republic\ of\ Congo\ \Delta InM = -6.153(6.823) - 0.190(0.085)InM_{t-1} + 0.416(0.348)InY_t - 0.053(0.088)IniREER_t + 0.141(0.147)\Delta InM_{t-1} - 0.215(0.124)\Delta InM_{t-2} + 2.367(0.857)\Delta InY_t - 1.285(0.975)\Delta InY_{t-1} - 0.043(0.135)\Delta IniREER_t + 0.352(0.132)\Delta IniREER_{t-1} + 0.388(0.153)D1997onward$$

$$Gabon\ \Delta InM = -3.618(2.052) - 0.313(0.107)InM_{t-1} + 0.399(0.159)InY_t - 0.266(0.119)IniREER_t + 0.580(0.228)\Delta InY_t + 0.402(0.127)D197$$

$$Gambia(AIC)\ \Delta InM = 3.343(2.166) - 0.381(0.113)InM_{t-1} + 0.181(0.087)InY_t - 0.095(0.099)IniREER_t + 0.171(0.140)\Delta InM_{t-1} + 0.312(0.139)\Delta InM_{t-2} + 0.200(0.111)D1977 + 0.200(0.116)D1979 - 0.215(0.109)D1994$$

$$Mali\ \Delta InM = -3.102(2.648) - 0.104(0.081)InM_{t-1} + 0.229(0.165)InY_t - 0.066(0.212)IniREER_t - 0.619(0.431)\Delta InY_t - 0.193(0.206)\Delta IniREER_t - 0.002(0.125)D1960to1992$$

$$Mauritius\ \Delta InM = -1.951(1.426) - 0.179(0.064)InM_{t-1} + 0.212(0.066)InY_t - 0.203(0.229)IniREER_t + 2.280(0.459)\Delta InY_t + 2.527(0.502)\Delta InY_{t-1} + 0.369(0.219)\Delta IniREER_t + 0.592(0.217)\Delta IniREER_{t-1} - 0.109(0.207)\Delta IniREER_{t-2} - 0.603(0.228)\Delta IniREER_{t-3} - 0.155(0.053)D1982 - 0.097(0.049)D1985 + 0.134(0.050)D1990 + 0.150(0.052)D2006$$

$$Mozambique\ \Delta InM = 110.077(48.765) - 0.882(0.174)InM_{t-1} + 1.655(0.464)InY_t - 0.148(0.057)IniREER_t - 1.669(0.590)\Delta InY_t + 0.724(0.324)\Delta InY_{t-1} + 0.203(0.083)\Delta IniREER_t - 0.290(0.095)D1977to1992 - 0.064(0.028)t$$

$$Namibia\ \Delta InM = -6.360(1.887) - 0.281(0.101)InM_{t-1} + 0.548(0.164)InY_t - 0.041(0.175)InREER_t - 0.761(0.494)\Delta InY_t + 0.911(0.534)\Delta InY_{t-1} + 0.171(0.154)\Delta IniREER_t + 0.689(0.161)\Delta IniREER_{t-1} - 0.170(0.073)D2005 + 0.148(0.065)D2007$$

$$Senegal\ \Delta InM = -2.348(1.368) - 0.600(0.137)InM_{t-1} + 0.665(0.146)InY_t - 0.075(0.075)IniREER_t + 0.233(0.066)D1981 + 0.039(0.032)D1982to1989$$

$$Sierra\ Leone\ \Delta InM = -5.053(3.802) - 0.197(0.082)InM_{t-1} + 0.456(0.189)InY_t + 0.134(0.157)IniREER_t + 0.770(0.583)\Delta InY_t + 0.811(0.334)\Delta IniREER_t - 0.672(0.339)D1986 - 0.757(0.246)D1990$$

$$Uganda\ \Delta InM = 3.822(3.030) + 0.284(0.301)InM_{t-1} - 0.442(0.408)InY_t + 0.034(0.057)IniREER_t - 0.670(0.268)\Delta InM_{t-1} - 0.490(0.180)\Delta InM_{t-2} - 0.376(0.175)\Delta InM_{t-3} + 3.559(0.800)\Delta InY_t + 2.660(0.728)\Delta InY_{t-1} + 1.193(0.640)\Delta InY_{t-2} + 1.525(0.595)\Delta InY_{t-3} - 0.151(0.110)\Delta IniREER_t - 0.700(0.115)\Delta IniREER_{t-1} + 0.123(0.082)\Delta IniREER_{t-2} + 0.277(0.063)D1987 - 0.208(0.060)D1994 - 0.068(0.021)D2002to2006$$

$$Zambia\ \Delta InM = -12.547(4.972) - 0.166(0.124)InM_{t-1} + 0.757(0.306)InY_t - 0.044(0.015)InRPM2_t - 0.288(0.198)\Delta InM_{t-1} - 2.639(1.040)\Delta InY_t - 4.526(1.216)\Delta InY_{t-1} - 4.860(1.305)\Delta InY_{t-2} - 3.457(1.196)\Delta InY_{t-3} + 0.768(0.125)\Delta InRPM2_t + 0.151(0.104)\Delta InRPM2_{t-1} + 0.066(0.097)\Delta InRPM2_{t-2} + 0.157(0.095)\Delta InRPM2_{t-3} + 0.509(0.103)\Delta InRPM2_{t-4} - 0.628(0.237)D1985 - 0.297(0.158)D1988$$

$$Zimbabwe\ \Delta InM = -114.102(25.102) - 0.826(0.175)InM_{t-1} + 0.964(0.311)InY_t - 0.232(0.121)InRPM2_t - 0.477(0.149)\Delta InRPM2_t - 0.715(0.126)D1999onward$$

Results from OLS

$$Democratic\ Republic\ of\ Congo\ \Delta InM = 0.039(0.031) + 2.372(0.605)\Delta InY - 0.053(0.127)IniREER$$

$$Gabon, robust, \Delta InM = 0.003(0.020) + 0.979(0.284)\Delta InY - 0.178(0.221)\Delta IniREER + 0.460(0.084)D1974$$

$$Togo, robust, \Delta InM = 0.008(0.025) + 1.608(0.495)\Delta InY - 0.834(0.203)\Delta IniREER$$

$$Uganda, robust\ \Delta InM = -0.036(0.029) + 2.061(0.613)\Delta InY - 0.225(0.059)\Delta IniREER$$

$$Sudan\ \Delta InM = -0.007(0.036) + 0.963(0.562)\Delta InY - 0.095(0.094)\Delta IniREER$$

$$Mali\ \Delta InM = 0.033(0.023) + 0.049(0.374)\Delta InY - 0.099(0.169)\Delta IniREER + 0.338(0.113)D1978 + 0.261(0.121)D1985$$

$$Sierra\ Leone\ \Delta InM = 0.018(0.037) + 0.775(0.501)\Delta InY + 0.416(0.216)\Delta IniREER - 0.491(0.244)D1990$$

Appendix E

Results from the export demand function

Results from the ARDL model

Kenya $\Delta \text{InX} = -1.106(1.293) - 0.077(0.083)InX_{t-1} + 0.0948\ (0.090)InZY - 0.033(0.073)InREER - 0.377(0.159)\Delta InREER$

$$Nigeria\ \Delta InX = -17.597(7.200) - 0.6238(0.172)InX_{t-1} + 1.041(0.333)InZY_t + 0.021(0.074)InREER_t - 0.388(0.210)D2001$$

$$Sudan\ \Delta InX = 3.015(1.711) - 0.094(0.039)InX_{t-1} + 0.067(0.056)InZY_t - 0.648(0.110)InREER_t - 0.131(0.137)\Delta InX_{t-1} - 0.429(0.137)\Delta InX_{t-2} + 0.497(0.114)\Delta InREER_t + 0.431(0.956)\Delta InREER_{t-1} + 0.341(0.093)\Delta InREER_{t-2} + 0.334(0.086)\Delta InREER_{t-3} - 0.480(0.173)D1996 - 0.426(0.160)D1997$$

$$South\ Africa\ \Delta InX = -1.917(1.113) - 0.067(0.035)InX_{t-1} + 0.110(0.038)InZY_t + 0.018(0.054)InREER_t + 2.311(0.350)\Delta InZY_t - 0.126(0.060)\Delta InREER_t + 0.097(0.034)D1993 + 0.074(0.034)D1995$$

$$South\ Africa\ Post\ Apartheid\ \Delta InX = -0.778(1.337) - 0.195(0.057)InX_{t-1} + 0.167(0.041)InZY_t + 0.062(0.057)InREER_t + 1.992(0.375)\Delta InZY_t - 0.137(0.063)\Delta InREER_t + 0.070(0.029)D1994onward$$

$$Benin\ \Delta InX = -32.684(15.866) - 0.505(0.219)InX_{t-1} + 1.351(0.620)InZY_t + 0.029(0.234)InREER_t + 0.648(0.262)\Delta InX_{t-1} - 0.009(0.237)\Delta InX_{t-2} + 0.488(0.256)\Delta InX_{t-3} - 0.327(0.257)\Delta InX_{t-4} + 0.631(0.259)\Delta InX_{t-5} + 1.524(2.425)\Delta InZY_t + 2.173(2.678)\Delta InZY_{t-1} + 1.023(2.743)\Delta InZY_{t-2} + 2.827(3.010)\Delta InZY_{t-3} + 1.327(2.744)\Delta InZY_{t-4} + 3.944(3.513)\Delta InZY_{t-5} + 1.283(3.090)\Delta InZY_{t-6} - 0.707(0.549)\Delta InREER_t + 0.078(0.565)\Delta InREER_{t-1} - 0.432(0.516)\Delta InREER_{t-2} - 0.497(0.457)\Delta InREER_{t-3} - 0.664(0.482)\Delta InREER_{t-4} - 0.278(0.414)\Delta InREER_{t-5}$$

$$Botwana\ \Delta InX = -10.767(3.508) - 0.338(0.108)InX_{t-1} + 0.656(0.208)InZY_t - 0.534(0.305)InREER_t + 6.345(1.337)\Delta InZY_t + 0.275(0.110)D1982 + 0.274(0.102)D1983$$

$$Cameroon\ \Delta InX = -2.982(2.904) - 0.162(0.065)InX_{t-1} + 0.218(0.117)InZY_t - 0.080(0.111)InREER_t - 0.254(0.146)\Delta InX_{t-1} + 2.289(1.131)\Delta InZY_t + 0.301(0.103)D1980 + 0.324(0.105)D1981 + 0.399(0.105)D1984 + 0.235(0.116)D1985$$

$$Chad\ \Delta InX = -28.323(17.026) - 0.455(0.179)InX_{t-1} + 1.124(0.549)InZY_t + 0.574(0.428)InREER_t + 9.010(4.291)\Delta InZY_t - 7.294(4.291)\Delta InZY_{t-1} - 0.504(0.301)D1982$$

$$Democratic\ Republic\ of\ Congo\ \Delta InX = -11.181(3.787) - 0.155(0.074)InX_{t-1} + 0.441(0.132)InZY_t + 0.115(0.076)InREER_t + 6.244(1.882)\Delta InZY_t - 0.070(0.111)\Delta InREER_t - 0.341(0.109)\Delta InREER_{t-1} - 0.410(0.183)D1997$$

$$Republic\ of\ Congo\ (AIC)\ \Delta InX = -2.490(1.708) - 0.372(0.086)InX_{t-1} + 0.379(0.105)InZY_t - 0.225(0.068)InREER_t + 0.378(0.126)\Delta InX_{t-1} - 0.013(0.632)\Delta InZY_t - 0.877(0.607)\Delta InZY_{t-1} - 0.976(0.628)\Delta InZY_{t-2} + 0.172(0.557)D1980 - 0.184(0.060)D1994 - 0.201(0.055)D2007$$

$$Gambia\ (AIC)\ \Delta InX = -9.292(3.974) - 0.409(0.087)InX_{t-1} + 0.490(0.137)InZY_t + 0.357(0.126)InREER_t + 0.340(0.116)\Delta InX_{t-1} + 0.216(0.127)\Delta InX_{t-2} - 2.215(1.308)\Delta InZY_t - 0.278(0.218)\Delta InREER_t - 0.245(0.111)D1994 - 0.391(0.126)D2006$$

$$Mali\ \Delta InX = -13.637(6.445) - 0.410(0.103)InX_{t-1} + 0.759(0.267)InZY_t - 0.353(0.095)InREER_t + 0.473(0.150)\Delta InREER_t + 0.503(0.133)\Delta InREER_{t-1} - 0.565(0.199)\Delta InREER_{t-2} - 0.424(0.123)\Delta InREER_{t-3} - 0.185(0.076)D1978 + 0.364(0.083)D1980 - 0.493(0.113)D1996 + 0.118(0.069)D2001$$

$$Mauritius\ \Delta InX = -2.318(3.065) - 0.098(0.085)InX_{t-1} + 0.155(0.576)InZY_t - 0.080(0.179)InREER_t + 0.868(0.789)\Delta InZY_t - 0.044(0.255)\Delta InREER_t - 0.108(0.067)D1981 - 0.010(0.062)D2000 + 0.110(0.060)D2001 - 0.153(0.061)D2002 - 0.090(0.058)D2003$$

$$Mozambique\ \Delta InX = -25.351(11.402) - 0.199(0.076)InX_t + 0.956(0.406)InZY_t - 0.089(0.058)InREER_t - 0.181(0.089)D1992 + 0.242(0.086)D2001$$

$$Namibia\ \Delta InX = -18.072(3.631) - 0.911(0.157)InX_{t-1} + 1.184(0.204)InZY_t + 0.170(0.136)InREER_t + 0.537(0.186)\Delta InX_{t-1} - 2.238(0.949)\Delta InZY_t - 1.211(0.959)\Delta InZY_{t-1} - 0.411(0.165)\Delta InREER_t - 0.082(0.177)\Delta InREER_{t-1} - 0.237(0.060)D1990 - 0.135(0.078)D1992 - 0.156(0.060)D2001$$

$$Senegal\ \Delta InX = 2.672(2.790) - 0.858(0.126)InX_{t-1} + 0.520(0.123)InZY_t - 0.085(0.108)IniREER_t - 1.800(1.029)\Delta InZY_t - 2.187(0.951)\Delta InZY_{t-1} - 2.671(1.025)\Delta InZY_{t-2} - 0.252(0.085)D1980 - 0.188(0.086)D1991 - 0.252(0.089)D1992 - 0.358(0.092)D1993$$

$$Uganda\ \Delta InX = -32.786(14.364) - 0.374(0.113)InX_{t-1} + 1.298(0.512)InZY_t - 0.004(0.105)InREER_t - 4.156(2.293)\Delta InZY_t + 0.168(0.168)\Delta InREER_t - 0.267(0.157)D1991 - 0.311(0.160)D1993$$

$$Zambia\ \Delta InX = -11.185(5.327) - 0.051(0.031)InX_{t-1} + 0.411(0.183)InZY_t - 0.520(0.143)InRPX4_t - 1.002(0.284)\Delta InX_{t-1} + 1.013(2.086)\Delta InZY_t - 6.524(2.019)\Delta InZY_{t-1} + 0.462(0.122)\Delta InRPX4_t + 0.110(0.112)\Delta InRPX4_{t-1} + 0.332(0.178)D2000 + 0.247(0.133)D2003 + 0.328(0.140)D2004 + 0.323(0.147)D2005$$

$$Zimbabwe\ \Delta InX = 224.114(80.509) - 0.526(0.113)InX_{t-1} + 7.697(2.971)InZY_t - 0.732(0.217)InRPX4_t + 0.639(0.213)\Delta InX_{t-1} + 0.385(0.220)\Delta InX_{t-2} + 0.656(0.187)\Delta InX_{t-3} - 6.335(2.255)\Delta InZY_t + 0.840(0.238)\Delta InRPX4_t + 0.608(0.214)\Delta InRPX4_{t-1} + 0.327(0.151)\Delta InRPX4_{t-2} + 0.305(0.120)\Delta InRPX4_{t-3} + 0.192(0.106)D2001 + 0.311(0.161)D2004 - 0.333(0.140)D2007 - 0.481(0.135)D2008 - 0.226(0.085)t$$

Results from OLS

$$Democratic\ Republic\ of\ Congo\ \Delta InX = -0.122(0.073) + 3.972(1.793)\Delta InZY - 0.066(0.111)\Delta InREER + 0.118(0.060)D1997onward$$

$$Gabon\ \Delta InX = -0.018(0.037) + 1.781(0.988)\Delta InZY - 0.071(0.201)\Delta InREER + 0.231(0.123)D1975 - 0.178(0.111)D2000$$

Appendix F

Results: Import demand function controlling for Apartheid South Africa

	Long run											
	The income elasticity of demand for imports, π		The price elasticity of demand for imports, ψ		ARDL	SBC	R^2	Adjusted R^2	Bounds F test	Breusch-Pagan/Cook-Weisberg test for heteroscedasticity (P value)	Breusch-Godfrey test for serial correlation (P value)	Ramsey regression specification-error test for omitted variables (P value)
South Africa	2.077***	(0.264)	-0.691*	(0.375)	(1 1 0)	-129.922	0.781	0.751	12.078***	0.702	0.155	0.335
South Africa (trend)	0.955*	(0.548)	-1.080*	(0.555)	(1 2 2)	-126.727	0.791	0.746	4.496	0.522	0.116	0.601
South Africa (trend)	0.819	(0.59)	-1.064	(0.399)	(1 1 0)	-131.366	0.803	0.77	10.590***	0.776	0.263	0.535
South Africa Post-Apartheid[56]	1.811	(0.263)	-0.776*	(0.313)	(1 1 0)	-127.77	0.789	0.753	12.110***	0.746	0.153	0.414
South Africa Post-Apartheid (trend)	0.981	(0.641)	-1.072*	(0.561)	(1 2 2)	-122.783	0.791	0.74	3.136	0.525	0.108	0.5994

*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

[56] For South Africa, we estimate the import demand function using two different specifications; in the second specification we control for apartheid by including a dummy variable which takes the value of 1 for the period 1994 onwards and zero otherwise. We include a trend as unit root tests provided evidence that some of the variables are trend stationary.

For South Africa we use the Wald test to formally determine if the income and price elasticities are statistically significantly different for the specification that controls for apartheid and that which does not. The two estimates for the income elasticities of demand are 2.077 for the former and 1.811 for the latter. The F statistic and P value from the Wald test (H_0: 2.077=1.811) were, 1.01 and 0.319 respectively. The two estimates for the price elasticities are -0.691 and -0.776 receptively. The F statistic and P value from the Wald test (H_0:-0.691= -0.776) were, 0.05 and 0.821 respectively. The results from the unit root tests indicated that the South African GDP series is trend stationary. We therefore modify to include a trend and test if the two specifications differ. We test if the income and price elasticities of demand are statistically different from each other. The two respective income elasticities of demand were 0.819 and 0.981 respectively. The F statistic and P value from the Wald test (H_0:0.819=0.981) were 0.07 and 0.786 respectively while the price elasticities of demand were -1.064 and -1.072 respectively. The corresponding F statistic and P value from the Wald test (H_0: -1.064= -1.072) were 0.00 and 0.983 respectively. We also test if the specification with a trend differs from the specification without a trend without controlling for apartheid, the income elasticities were 2.077 and 0.819. The F statistic and P value from the Wald test (H_0: 0.819=2.077) were 4.54 and 0.039. The price elasticities of demand were -0.691 and -1.064. The F statistic and P value for the Wald test (H_0: -1.064=-0.691) were 0.87 and 0.357. We therefore continue with the specification which includes a trend but does not control for apartheid.

Export demand function controlling for Apartheid

	The income elasticity of demand for exports, ε		The price elasticity of demand for exports, η		ARDL	SBC	R^2	Adjusted R^2	Bounds F test	Breusch-Pagan/Cook-Weisberg test for heteroscedasticity P value	Breusch-Godfrey test for serial correlation P value	Ramsey regression specification-error test for omitted variables P value
South Africa	1.637**	(0.629)	0.268	(0.839)	(1 1 1)	-175.118	0.598	0.531	6.253**	0.095*	0.234	0.015**
South Africa Post-Apartheid[57]	0.854***	(0.20)	0.317	(0.306)	(1 1 1)	-172.898	0.545	0.482	6.415***	0.086*	0.752	0.049**

*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

[57] For South Africa, we test if the income and price elasticities of demand for exports differs when controlling for apartheid using the Wald test. The income elasticity of demand was 1.637 and 0.854 when controlling for apartheid. The F statistic and P value were 1.55 and 0.220 respectively. The price elasticity of demand was 0.268 and 0.317 when controlling for apartheid. The F statistic and P value were 0.00 and 0.954 respectively. We therefore continue with the specification which does not control for apartheid.

Appendix G

The balance of payments constrained growth rate for the sub periods 1960-1980

			Average						Start			
Period	Country	Actual	y_B	$*\, y_B$	y_{BSDA}	y_{BSDAR}	$*\, y_{BSDARTOT}$	$y_{BSDARTOT}$	y_{BSDA}	y_{BSDAR}	$*\, y_{BSDARTOT}$	$y_{BSDARTOT}$
1960-1980	Sudan	2.911	3.458	2.187	3.433	2.382	-10.092	3.935	3.443	2.455	-9.913	4.122
1960-1980	Sudan (OLS)	2.911	3.437		3.416	2.369		3.914	3.424	2.441		4.099
1960-1980	Kenya	6.77	4.284	5.962	4.292	1.155	3.273	1.277	4.304	2.912	4.870	3.044
1960-1980	Benin	3.02	10.625	11.300	8.610	7.937	9.278	8.724	8.681	8.353	9.675	9.120
1960-1980	Cameroon	4.705	4.227		4.173	2.721	-0.811	3.589	4.207	3.649	0.177	4.473
1960-1980	Chad	-0.408	3.446		26.566	26.801	0.635	28.059	15.906	15.841	0.352	16.542
1960-1980	Congo, Dem. Rep.	2.026	1.540	6.274	1.888	-0.469	6.051	-0.091	2.299	1.737	9.164	1.998
1960-1980	Congo, Dem. Rep.[58] (OLS)	2.026	1.415	8.089	1.762	-0.436	8.679	-0.085	2.187	1.651	12.352	1.899
1960-1980	Congo, Rep.	5.686	9.328	3.314	10.350	9.626	2.792	9.732	6.273	5.502	1.532	5.730
1960-1980	Gabon	8.504	9.403		10.580	10.417		10.232	10.638	10.405		10.486
1960-1980	Gabon (OLS)	8.504	12.246	8.781	12.112	11.654	8.875	12.300	12.106	11.860	8.997	12.469
1966-1980	Gambia	5.224	9	11.374	-32.518	-26.543	-19.818	-15.844	-13.795	-13.523	-9.843	-8.105
1967-1980	Mali	4.309	4.012	3.806	2.212	2.046	4.401	5.814	1.851	1.712	4.502	5.684
1960-1980	Senegal	2.014	2.474	2.642	2.421	1.378	2.096	1.926	2.410	2.214	2.934	2.769
1967-1980	Sierra Leone	3.526	-1.382		-1.322	-1.543		-2.644	-1.226	-1.328		-2.478
1960-1980	Togo	6.741	10.088		8.078	7.666		7.690	6.309	6.074		6.103
1960-1980	Zambia	2.816	0.315	8.509	0.215	-1.343	4.604	-1.544	0.214	-0.301	5.277	-0.490

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

$y_{B,}$ is the 'weak' original version of the balance of payments constrained growth model

$y_{B,}$ is the 'strong' original version of the balance of payments constrained growth model

$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation

y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad

$*\, y_{BSDARTOT}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

$y_{BSDARTOT}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

OLS indicates the growth rates that have been estimated using the import and export demand functions derived from OLS

[58] Both the export and import demand function are estimated with OLS.

The balance of payments constrained growth rate for the sub periods 1980-2014

					Average				Start			
Period	Country	Actual	y_B	$*\ y_B$	y_{BSDA}	y_{BSDAR}	$*\ y_{BSDARTOT}$	$y_{BSDARTOT}$	y_{BSDA}	y_{BSDAR}	$*\ y_{BSDARTOT}$	$y_{BSDARTOT}$
1980-2014	Kenya	3.786	4.480	3.616	4.484	6.599	4.443	5.677	4.484	7.092	4.790	6.110
1980-2014	South Africa	2.357	3.218	4.981	3.205	3.041	4.903	3.087	3.205	3.041	4.929	3.119
1980-2012	Sudan	4.642	7.485	2.180	7.520	5.004	-45.990	13.701	7.611	-2.360	-55.923	9.474
1980-2014	Sudan (OLS)	4.642	7.439		7.468	4.969		13.604	7.546	-2.338		9.383
1980-2014	Benin	4.172	5.542	6.792	5.163	4.939	6.270	5.051	4.513	4.283	5.517	4.456
1980-2014	Cameroon	3.148	3.236		3.295	3.600	-0.293	3.244	3.411	3.905	-0.234	3.572
1980-2005	Chad	6.955	23.745		90.000	94.035	-26.061	69.232	164.423	166.438	-47.811	118.928
1980-2014	Congo, Dem. Rep.	0.998	3.979	2.718	4.409	2.213	0.386	1.870	4.371	-2.072	-4.097	-2.458
1980-2014	Congo, Dem. Rep. (OLS)	0.998	3.655	3.504	4.081	2.039	1.545	1.723	4.043	-1.891	-2.437	-2.242
1980-2014	Congo, Rep.	3.956	2.790	1.992	3.368	2.781	1.932	2.209	3.442	2.816	2.013	2.297
1980-2014	Gabon	2.284	1.152		1.303	0.830		0.718	1.253	0.588		0.440
1980-2014	Gabon (OLS)		1.500	5.281	1.483	0.949	3.983	0.091	1.488	0.705	3.494	-0.482
1980-2013	Gambia	3.595	8.951	7.354	30.827	41.508	-41.249	-7.233	-5.411	-4.843	10.567	6.683
1980-2007	Mali	3.607	3.672	2.672	2.421	2.304	0.921	1.029	2.002	1.926	0.476	0.565
1980-2014	Senegal	3.384	3.577	1.588	3.425	3.299	-0.319	1.696	3.375	3.153	-0.736	1.331
1980-2014	Sierra Leone	3.09	5.929		4.635	3.372		4.347	3.787	2.850		3.903
1980-2014	Togo	2.437	2.611		2.125	1.689		1.581	2.160	1.580		1.472
1980-2013	Zambia	3.835	3.075	5.139	2.725	0.215	3.338	1.201	2.380	0.246	3.058	1.238

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

$y_{B,}$is the 'weak' original version of the balance of payments constrained growth model

$y_{B,}$is the 'strong' original version of the balance of payments constrained growth model

$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation

y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad

$*\ y_{BSDARTOT}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

$y_{BSDARTOT}$, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

OLS indicates the growth rates that have been estimated using the import and export demand functions derived from OLS

Appendix H

Results from the Wald test for the equality of the estimated income elasticity of demand, $\hat{\pi}$, and the hpothetical income elsasticity of demand, π_H, $1960-1980$

Period	Country	$\hat{\pi}$	π_{HB}	$*\pi_{HB}$	π_{HBSDA}	π_{HBSDAR}	$*\pi_{HBSDART}$	$\pi_{HBSDART}$	π_{HBSDA}	π_{HBSDAR}	$*\pi_{HBSDART}$	$\pi_{HBSDART}$
1960-1980	Kenya	0.986	0.624	0.868	0.664	0.372	0.603	0.385	0.716	0.596	0.794	0.610
	F statistic		2.62	0.31	2.29	8.34***	3.25*	7.99***	1.61	3.37*	0.82	3.13*
	P value		0.112	0.581	0.137	0.006	0.078	0.007	0.210	0.073	0.371	0.083
1964-1980	Sudan[59]	0.957	1.137	0.719	1.164	0.755	-4.002	1.348	1.152	0.795	-3.598	1.387
	F statistic		0.83	1.46	1.10	1.05	633.17***	3.93**	0.97	0.68	534.2***	4.75**
	P Value		0.367	0.232	0.300	0.309	0.000	0.053	0.328	0.414	0.000	0.034
1964-1980	Sudan (OLS)	0.963	1.137		1.164	0.755		1.348	1.152	0.795		1.387
	F statistic		0.09		0.13	0.14		0.47	0.11	0.09		0.57
	P Value		0.759		0.723	0.711		0.497	0.739	0.765		0.455
1960-1980	Benin	1.142	4.017	4.273	2.047	1.928	2.142	2.054	2.077	2.018	2.235	2.143
	F statistic		691.44***	820.09***	68.45***	52.63***	83.59***	69.52***	73.07***	64.23***	99.87***	83.76***
	P Value		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1960-1980	Cameroon	1.379	1.239		1.228	0.845		1.079	1.235	1.079		1.313
	F statistic		2.57		2.99	37.12***		11.74***	2.72	11.74		0.58
	P Value		0.117		0.092	0.000		0.001	0.107	0.001		0.452
1960-1980	Chad	0.656	-5.541		-1.459	-1.411	0.576	-1.506	-1.623	-1.574	0.551	-1.670
	F statistic		1555***		181.32***	173.19***	0.27	189.47	210.52***	201.57	0.45	219.29***
	P Value		0.000		0.000	0.000	0.610	0.000	0.000	0.000	0.506	0.000
1960-1980	Congo, Dem. Rep.	2.179	1.656	6.748	1.996	-0.958	7.240	-0.483	2.685	1.653	15.187	2.129
	F statistic		0.17	13.01***	0.02	6.13**	15.97***	4.42**	0.16	0.17	105.47***	0.00
	P Value		0.682	0.001	0.885	0.018	0.000	0.042	0.619	0.680	0.000	0.968

[59] For Sudan import and export demand function from ARDL.

1960-1980	Congo, Dem. Rep.											
	(OLS)	2.372	1.657	9.471	1.996	-0.958	11.371	-0.483	2.685	1.653	22.172	2.129
	F statistic		1.40	137.54***	0.39	30.28***	221.02***	22.26***	0.27	1.41	1070.04***	0.16
	P Value		0.243	0.000	0.536	0.000	0.000	0.000	0.608	0.240	0.000	0.689
1960-1980	Congo, Rep.	1.483	2.433	0.864	3.056	2.778	0.532	2.813	1.574	1.455	0.852	1.489
	F statistic		10.61***	4.51**	29.09***	19.71***	10.65***	20.79***	0.10	0.01	4.69**	0.00
	P Value		0.005	0.049	0.000	0.000	0.004	0.000	0.760	0.923	0.045	0.984
1960-1980	Gabon	1.275	1.409		1.846	1.717		1.740	1.888	1.814		1.837
	F statistic		0.74		13.52***	8.09***		8.96***	15.58**	12.04***		13.10***
	P Value		0.395		0.000	0.006		0.004	0.000	0.001		0.000
1960-1980	Gabon[60]											
	(OLS)	0.979	1.409	1.010	1.846	1.717	1.045	1.869	1.888	1.814	1.101	1.966
	F statistic		2.28	0.01	9.29***	6.73***	0.05	9.79***	10.21***	8.61***	0.18	12.04***
	P Value		0.137	0.915	0.003	0.012	0.819	0.003	0.002	0.005	0.673	0.001
1966-1980	Gambia	0.475	0.818	1.034	0.916	0.858	0.777	0.729	0.927	0.921	0.834	0.792
	F statistic		3.13*	8.32***	5.18**	3.91**	2.43	1.72	5.44**	5.30**	3.43*	2.68
	P Value		0.085	0.006	0.029	0.056	0.128	0.198	0.025	0.027	0.072	0.110
1967-1980	Mali	2.195	2.043	1.939	1.418	1.361	2.228	2.749	1.331	1.287	2.262	2.675
	F statistic		0.02	0.06	0.53	0.61	0.00	0.27	0.65	0.72	0.00	0.20
	P Value		0.887	0.812	0.473	0.441	0.975	0.608	0.425	0.402	0.950	0.657
1960-1980	Senegal	1.107	1.359	1.452	1.294	0.823	1.143	1.068	1.282	1.195	1.512	1.439
	F statistic		9.60***	18.01***	5.28**	12.28***	0.19	0.24	4.62**	1.16	24.83***	16.18***
	P Value		0.003	0.000	0.027	0.001	0.664	0.629	0.038	0.287	0.000	0.000
1967-1980	Sierra Leone	2.31	-0.905		-0.764	-0.865		-1.555	-0.557	-0.601		-1.291
	F statistic		10.82***		9.89***	10.55***		15.64***	8.61***	8.87***		13.57***
	P Value		0.002		0.003	0.002		0.000	0.005	0.005		0.000

[60] For Gabon both the import and export demand function are estimated using OLS.

1960-1980	Togo (OLS)	1.608	2.406		1.848	1.772		1.777	1.544	1.510		1.514
	F statistic		2.59		0.23	0.11		0.10	0.02	0.04		0.03
	P Value		0.114		0.632	0.743		0.752	0.897	0.843		0.859
1960-1980	Zambia	4.562	0.510	13.786	0.692	-1.077	6.987	-1.329	0.693	0.070	8.108	-0.202
	F statistic		3.49*	18.08***	3.18*	6.76**	1.25	7.37**	3.18*	4.29*	2.67	4.82**
	P Value		0.084	0.001	0.097	0.022	0.283	0.017	0.097	0.058	0.126	0.046

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

$\pi_{HB,}$ is the hypothetical income elasticity of demand from the original "weak" version of the balance of payments constrained growth model

$*\ \pi_{HB,}$ *is the hypothetical income elasticity of demand from the original "strong" version of the balance of payments constrained growth model*

$\pi_{HBSDA,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation

π_{HBSDAR}, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation and interest payments abroad

$*\ \pi_{HBSDART}$, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

$\pi_{HBSDART}$, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

*** Indicates significance at the 99% level

** Indicates significance at the 95% level

* Indicates significance at the 90% level

Results from the Wald test for the equality of the estimated income elasticity of demand, $\hat{\pi}$, and the hpothetical income elsasticity of demand, π_H, $1980-2014$

			Average						Start			
Period	Country	$\hat{\pi}$	π_{HB}	$*\ \pi_{HB}$	π_{HBSDA}	π_{HBSDAR}	$*\ \pi_{HBSDART}$	$\pi_{HBSDART}$	π_{HBSDA}	π_{HBSDAR}	$*\ \pi_{HBSDART}$	$\pi_{HBSDART}$
1980-2014	Kenya	0.986	1.166	0.941	1.157	1.471	1.099	1.312	1.158	1.521	1.148	1.362
	F statistic		0.72	0.04	0.65	5.21**	0.28	2.35	0.65	6.33**	0.58	3.13*
	P value		0.401	0.833	0.425	0.027	0.597	0.132	0.422	0.015	0.450	0.083
1980-2014	South Africa	0.955	1.304	2.018	1.344	1.246	2.089	1.280	1.333	1.251	2.068	1.284
	F statistic		0.40	3.75**	0.50	0.28	4.27**	0.35	0.47	0.29	4.11**	0.36
	P Value		0.528	0.059	0.482	0.598	0.045	0.557	0.494	0.592	0.049	0.552
1980-2014	Sudan	0.957	1.543	0.449	1.493	1.023	-8.216	2.598	1.397	0.025	-7.106	1.600
	F statistic		8.83***	6.65***	5.34**	0.11	2166***	69.29***	4.97**	22.38***	1673***	10.63***
	P Value		0.004	0.013	0.025	0.740	0.000	0.000	0.030	0.000	0.000	0.002

1980-2014	Sudan (OLS)	0.963	1.543		1.493	1.023		2.598	1.397	0.025	1.600
	F statistic		1.06		0.89	0.01		8.44***	0.59	2.79	1.28
	P Value		0.308		0.351	0.916		0.005	0.444	0.101	0.263
1980-2014	Benin	1.142	1.517	1.859	1.325	1.277	1.512	1.297	1.182	1.154	1.295	1.174
	F statistic		11.73***	42.95***	2.79*	1.51	11.42***	2.00	0.13	0.01	1.94	0.08
	P Value		0.001	0.000	0.105	0.228	0.002	0.168	0.720	0.917	0.173	0.775
1980-2014	Cameroon	1.379	1.417		1.446	1.572	-0.096	1.420	1.513	1.726	-0.170	1.573
	F statistic		0.18		0.57	4.80**	282.75**	0.21	2.31	15.57***	311.82***	4.85**
	P Value		0.673		0.454	0.034	0.000	0.648	0.137	0.000	0.000	0.033
1980-2014	Chad	0.656	2.239		1.515	1.507	0.333	1.264	1.471	1.470	0.376	1.227
	F statistic		101.36***		29.81***	29.26***	4.25**	14.92***	26.84***	26.77***	3.20*	13.16***
	P Value		0.000		0.000	0.000	0.049	0.000	0.000	0.000	0.085	0.001
1980-2012	Congo, Dem. Rep.	2.179	8.688	5.935	10.379	4.929	0.794	4.153	10.218	-4.005	-8.083	-4.081
	F statistic		26.41***	8.79***	41.91***	4.71**	1.20	2.43	40.28***	23.84***	65.64***	24.43***
	P Value		0.000	0.005	0.000	0.036	0.281	0.127	0.000	0.000	0.000	0.000
1980-2012	Congo, Dem. Rep.(OLS)	2.372	8.688	8.330	10.379	4.929	3.716	4.153	10.218	-4.005	-5.211	-4.781
	F statistic		108.87***	96.87***	174.97***	17.84***	4.93**	8.65***	168.01***	111.02***	156.98***	139.68***
	P Value		0.000	0.000	0.000	0.000	0.031	0.005	0.000	0.000	0.000	0.000
1980-2014	Congo, Rep.	1.483	1.046	0.746	1.097	0.746	0.213	0.387	1.110	0.694	0.138	0.335
	F statistic		2.25	6.40**	1.76	6.40**	18.98***	14.14***	1.64	7.33**	21.19***	15.51***
	P Value		0.153	0.022	0.203	0.022	0.000	0.001	0.218	0.015	0.000	0.001
1980-2014	Gabon	1.275	0.643		0.226	-0.225		-0.341	0.429	-0.049		-0.165
	F statistic		16.64***		45.81***	93.63***		108.67***	29.81***	72.96***		86.30***
	P Value		0.000		0.000	0.000		0.000	0.000	0.000		0.000
1980-2014	Gabon[61] (OLS)	0.979	0.634	2.263	0.226	-0.225	2.513	-1.00	0.429	-0.049	1.767	-0.823
	F statistic		1.48	20.38	7.03***	17.95***	29.78***	48.48***	3.75*	13.09***	7.67***	40.20
	P Value		0.230	0.000	0.010	0.000	0.000	0.000	0.058	0.000	0.008	0.000

[61] For Gabon both the import and export demand function are estimated using OLS.

1980-2013	Gambia	0.475	1.183	0.971	1.111	1.076	-0.236	0.303	1.054	1.041	0.008	0.268
	F statistic		13.35***	6.55**	10.77***	9.62***	13.46***	0.79	8.93***	8.53***	5.81**	1.14
	P Value		0.000	0.015	0.002	0.003	0.000	0.380	0.005	0.006	0.021	0.292
1980-2007	Mali	2.195	2.235	1.626	1.633	1.588	0.944	0.995	1.487	1.462	0.829	0.868
	F statistic		0.00	0.28	0.28	0.32	1.37	1.26	0.44	0.47	1.63	1.54
	P Value		0.970	0.598	0.603	0.574	0.251	0.271	0.513	0.498	0.211	0.224
1980-2014	Senegal	1.107	1.170	0.519	1.116	1.088	0.288	0.734	1.105	1.062	0.305	0.707
	F statistic		0.59	52.55***	0.01	0.06	101.91***	21.17***	0.00	0.31	97.72***	24.34***
	P Value		0.446	0.000	0.916	0.811	0.000	0.000	0.975	0.578	0.000	0.000
1980-2014	Sierra Leone	2.31	4.433		3.300	2.482		3.080	2.718	2.174		2.771
	F statistic		4.71**		1.02	0.03		0.62	0.17	0.02		0.22
	P Value		0.036		0.318	0.862		0.436	0.679	0.889		0.640
1980-2014	Togo (OLS)	1.608	1.723		1.450	1.237		1.183	1.465	1.178		1.124
	F statistic		0.05		0.10	0.56		0.64	0.08	0.75		0.83
	P Value		0.818		0.750	0.457		0.426	0.773	0.390		0.365
1980-2014	Zambia	4.562	3.658	6.114	3.283	0.988	4.071	1.961	2.935	1.038	3.799	2.011
	F statistic		0.17	0.51	0.35	2.71	0.05	1.44	0.56	2.64	0.12	1.38
	P Value		0.683	0.487	0.565	0.123	0.824	0.251	0.466	0.128	0.730	0.260

Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio. Average refers to the average value for these two ratios for the period considered

$\pi_{HB,}$ is the hypothetical income elasticity of demand from the original "weak" version of the balance of payments constrained growth model

* $\pi_{HB,}$ *is the hypothetical income elasticity of demand from the original "strong" version of the balance of payments constrained growth model*

$\pi_{HBSDA,}$ is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation

π_{HBSDAR}, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation and interest payments abroad

* $\pi_{HBSDART}$, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports

$\pi_{HBSDART}$, is the hypothetical income elasticity of demand from the balance of payments constrained growth model with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)

*** Indicates significance at the 99% level

** Indicates significance at the 95% level

* Indicates significance at the 90% level

Appendix I

Regression results of the balance of payments constrained growth, y_B, on the actual growth rate

	Dependent variable	Constant, α	Coefficient on the actual growth rate, β	R^2	F statistic	Wald test 1 (β=1) P value	Wald test 2 (α=0) P value
	y_B	1.325 (1.881)	0.944** (0.453)	0.178	4.34**	0.903	0.489
	y_B		1.247*** (0.138)	0.795	81.74***	0.086*	
	$* y_B$	15.879** (5.937)	-2.219 (1.432)	0.146	2.40	0.041**	0.018**
	$* y_B$		1.392** (0.567)	0.286	6.03**	0.499	
Average	y_{BSDA}	9.529 (14.675)	0.205 (3.535)	0.000	0.00	0.824	0.523
	y_{BSDA}		2.391** (1.074)	0.190	4.95**	0.209	
	y_{BSDAR}	10.971 (20.166)	0.316 (4.827)	0.000	0.00	0.888	0.592
	y_{BSDAR}		2.810* (1.482)	0.152	3.60*	0.236	
	$* y_{BSDART}$	7.195 (26.454)	-2.395 (6.384)	0.010	0.14	0.603	0.789
	$* y_{BSDART}$		-0.758 (2.061)	0.008	0.14	0.407	
	y_{BSDART}	2.258 (11.417)	0.419 (2.750)	0.001	0.02	0.835	0.845
	y_{BSDART}		0.937 (0.828)	0.057	1.28	0.940	
Start	y_{BSDA}	5.357 (10.116)	0.129 (2.437)	0.000	0.00	0.724	0.602
	y_{BSDA}		1.357* (0.738)	0.138	3.38*	0.633	
	y_{BSDAR}	5.398 (10.600)	0.107 (2.537)	0.000	0.00	0.728	0.616
	y_{BSDAR}		1.334* (0.778)	0.128	2.94*	0.671	
	$* y_{BSDART}$	16.331 (5.860	-2.430 (1.414)	0.174	2.95*	0.029**	0.014**
	$* y_{BSDART}$		1.285** (0.567)	0.254	5.12**	0.622	
	y_{BSDART}	4.912 (6.835)	0.237 (1.646)	0.001	0.02	0.648	0.480
	y_{BSDART}		1.363** (0.501)	0.260	7.39**	0.476	

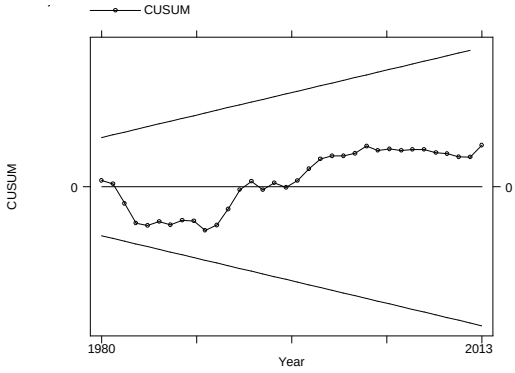
Note: Start refers to the start of period value for the share of exports in import ratio and the share of interest payments in imports ratio
Average refers to the average value for these two ratios for the period considered
Standard errors are in parenthesis

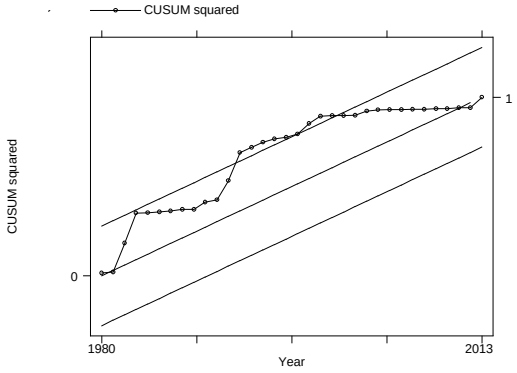
$y_{B,}$ is the 'weak' original version of the balance of payments constrained growth model
$*$ $y_{B,}$ is the 'strong' original version of the balance of payments constrained growth model
$y_{BSDA,}$ is the balance of payments constrained growth with sustainable debt accumulation
y_{BSDAR}, is the balance of payments constrained growth with sustainable debt accumulation and interest payments abroad
$*$ y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments abroad and the terms of trade interacted with the price elasticities of demand for imports and exports
y_{BSDART}, is the balance of payments constrained growth with sustainable debt accumulation, interest payments and the terms of trade (only the income and price elasticities from the import demand function are included)
*** Indicates significance at the 99% level
** Indicates significance at the 95% level
* Indicates significance at the 90% level

Appendix J

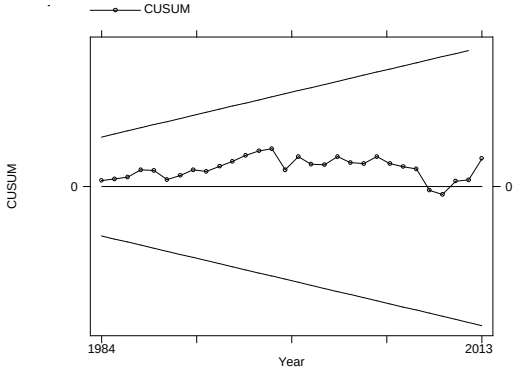
The CUSUM and CUSUM squared graphs from the import demand and export demand functions ordered by country.

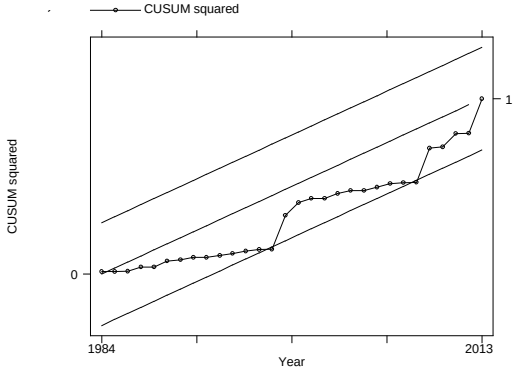
Benin import demand function



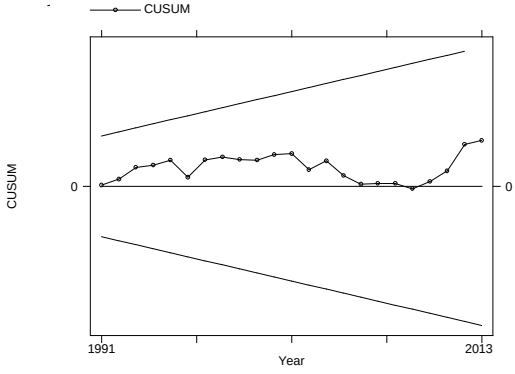


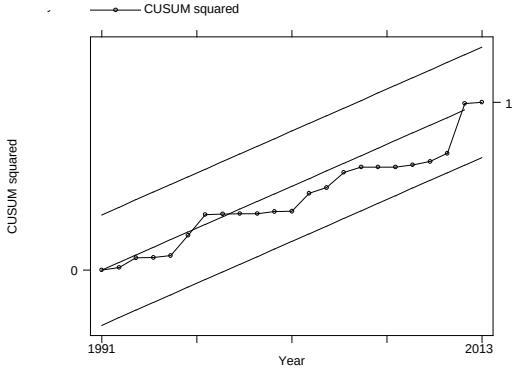
Botswana export demand function



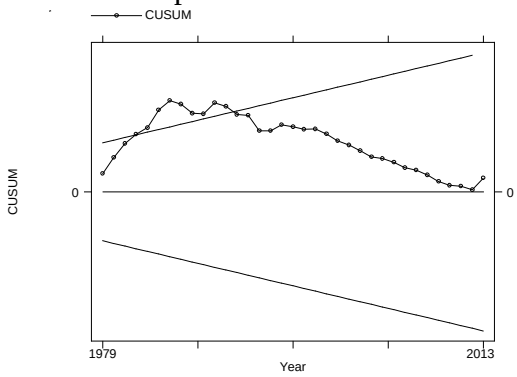


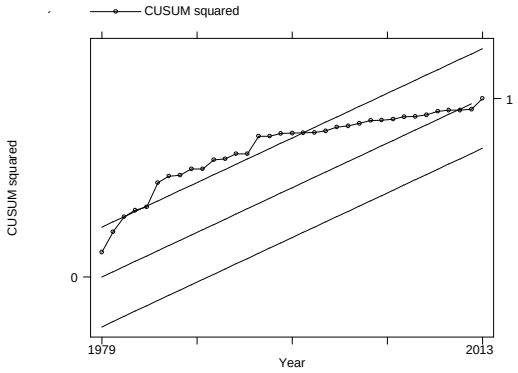
Botswana import demand function



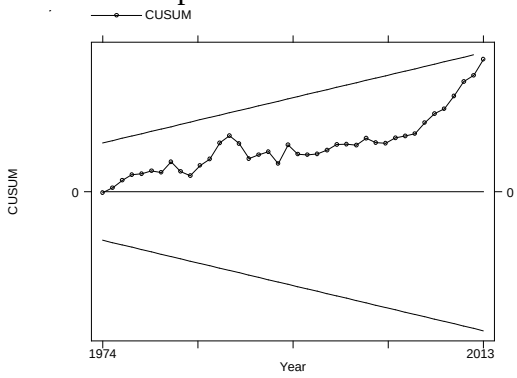


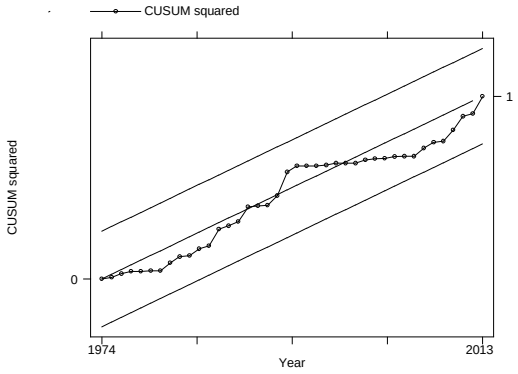
Cameroon export demand function



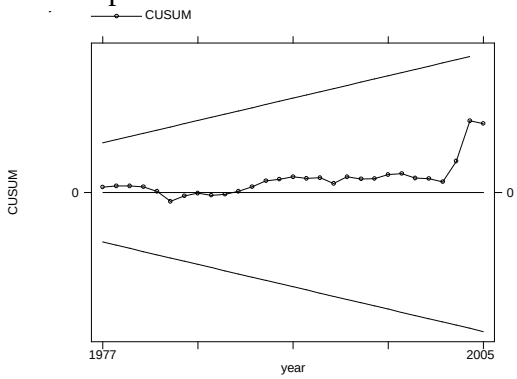


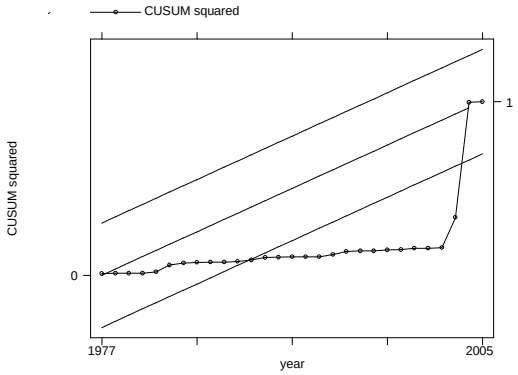
Cameroon import demand function





Chad export demand function





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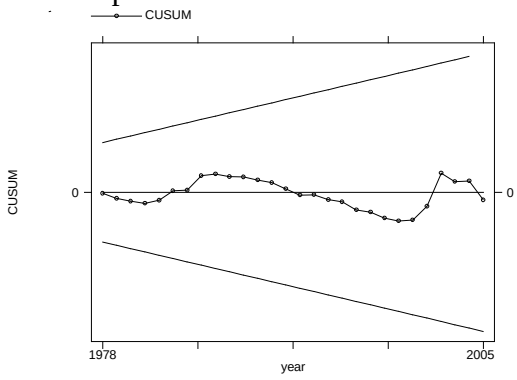
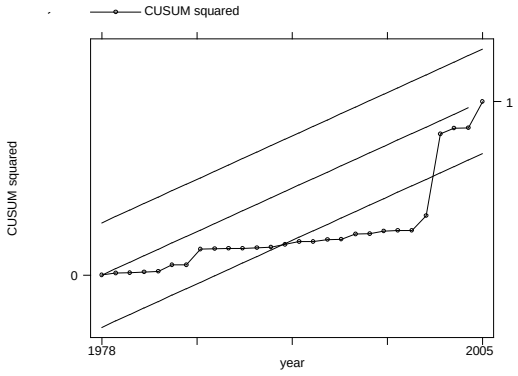
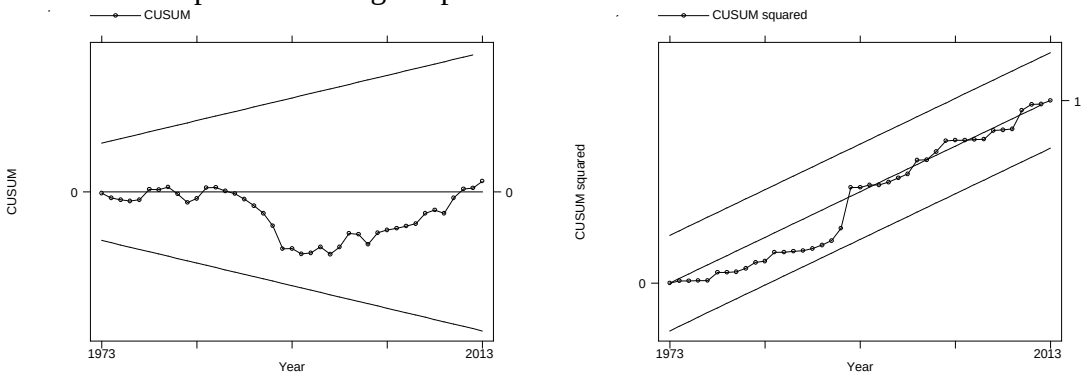
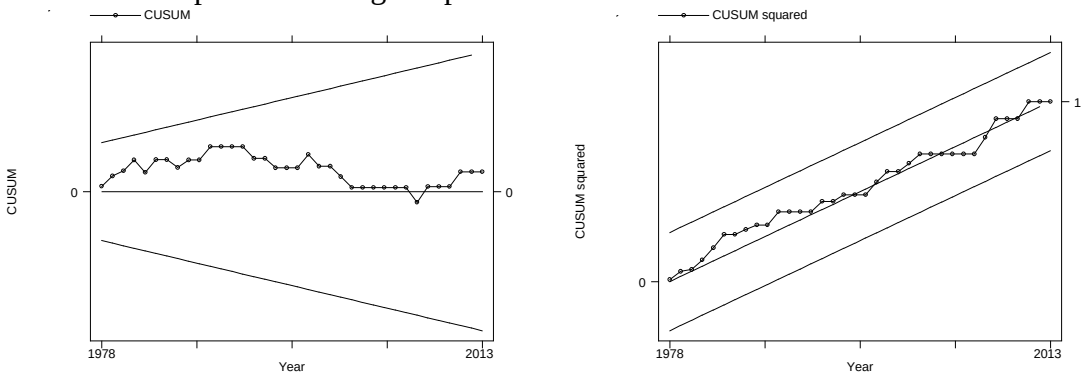




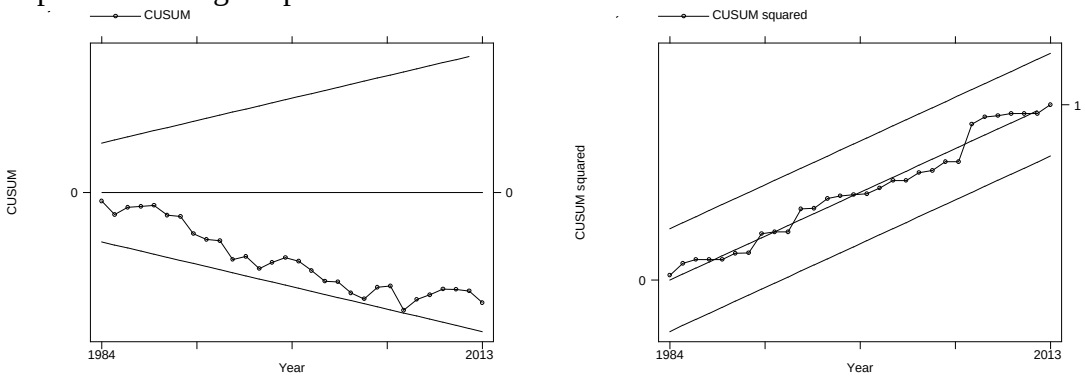
Democratic Republic of Congo export demand function



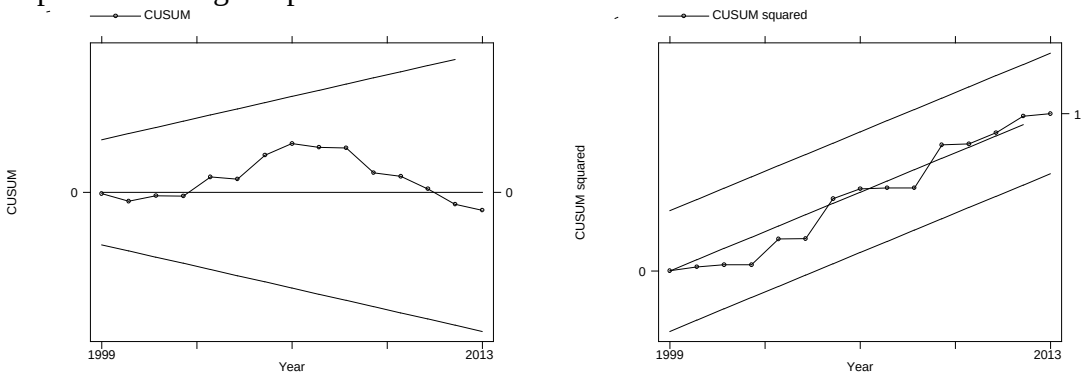
Democratic Republic of Congo import demand function



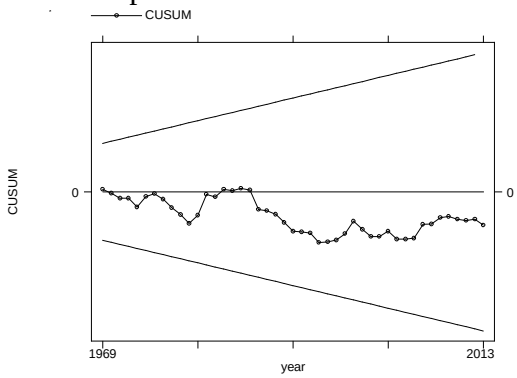
Republic of Congo export demand function

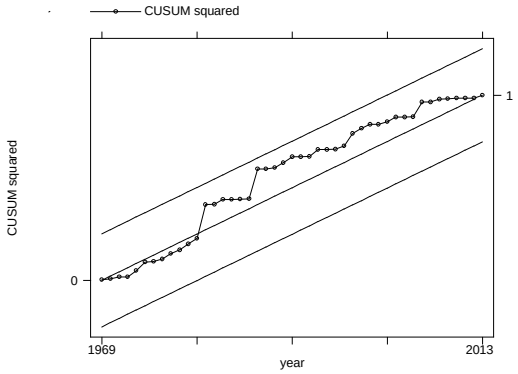


Republic of Congo import demand function

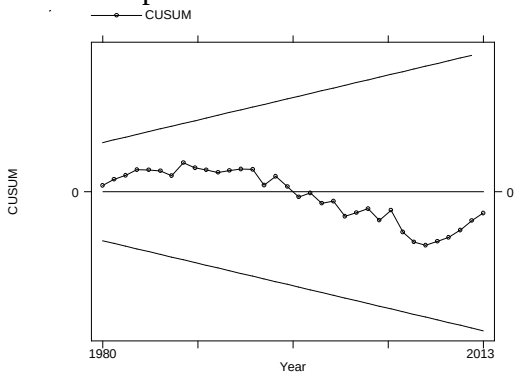


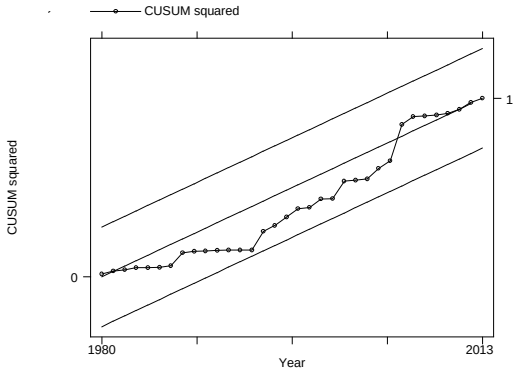
Gabon import demand function



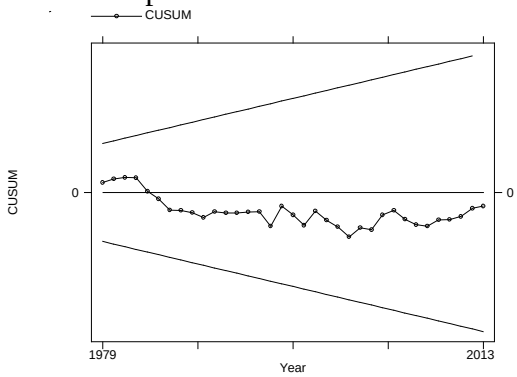


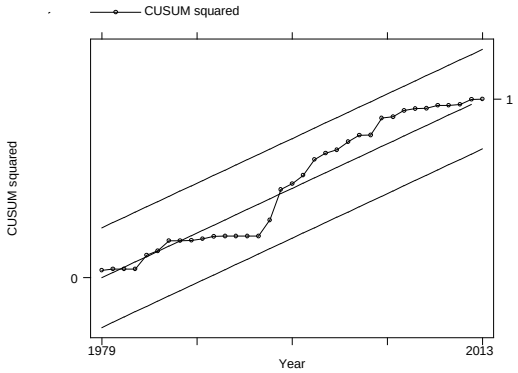
Gambia export demand function



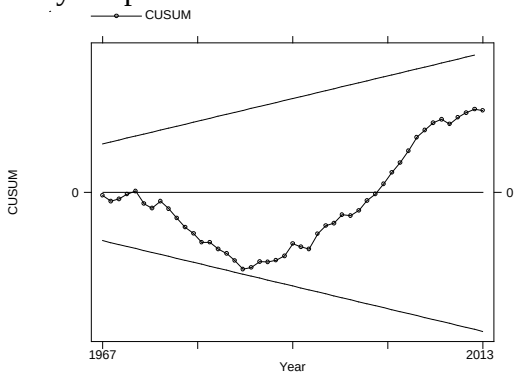


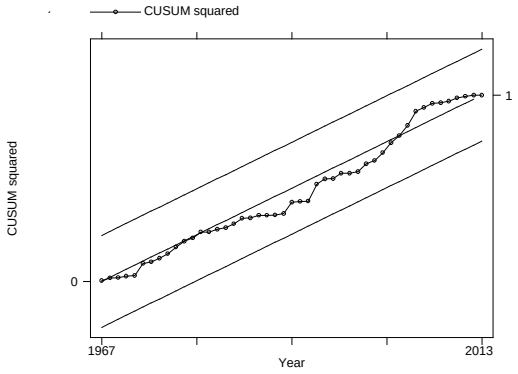
Gambia import demand function



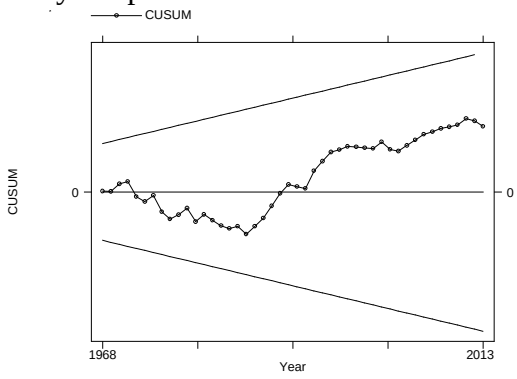


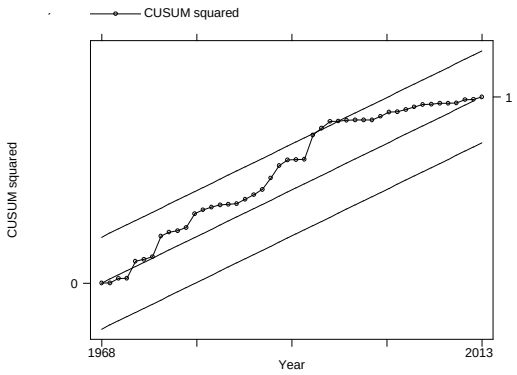
Kenya export demand function



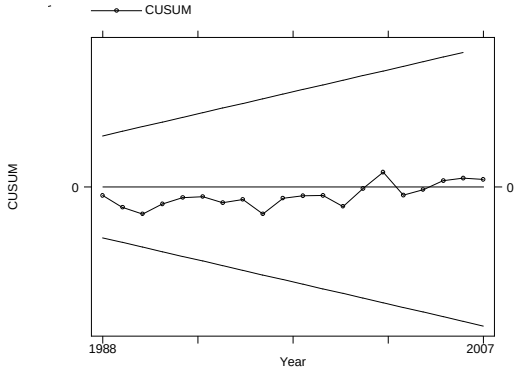


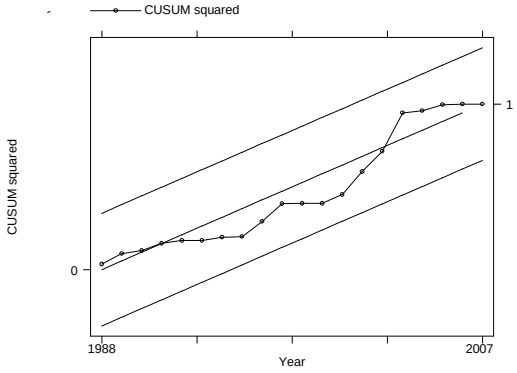
Kenya import demand function



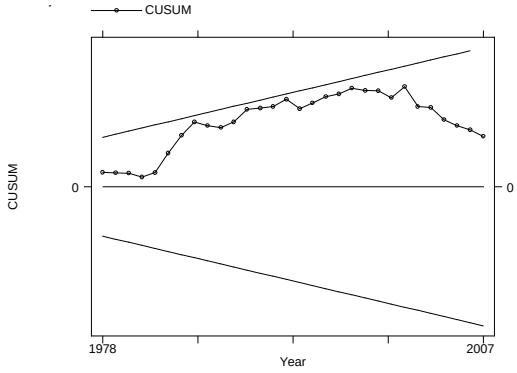


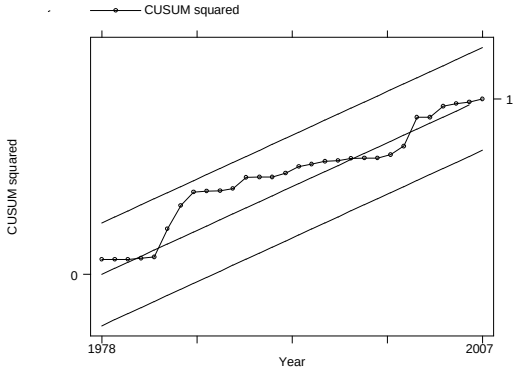
Mali export demand function



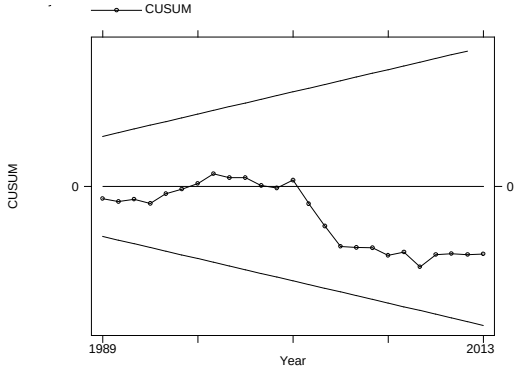


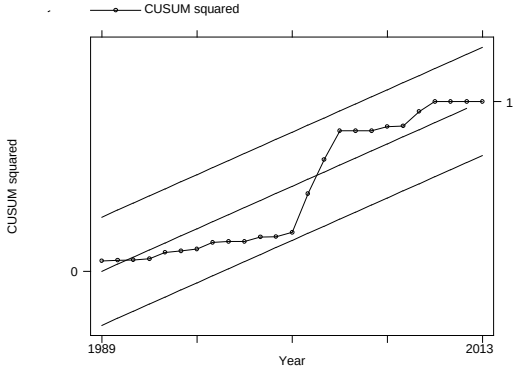
Mali import demand function



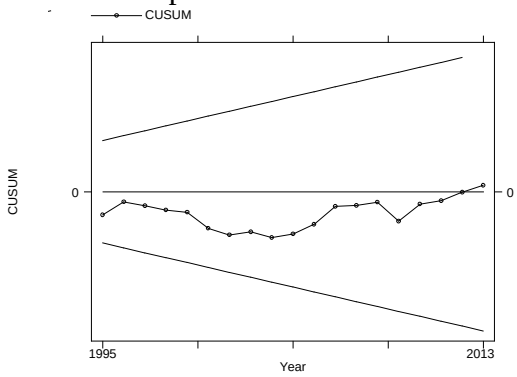


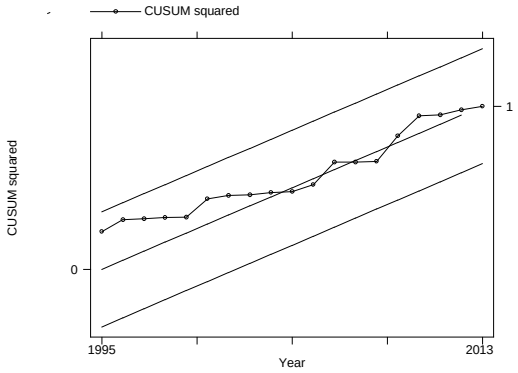
Mauritius export demand function



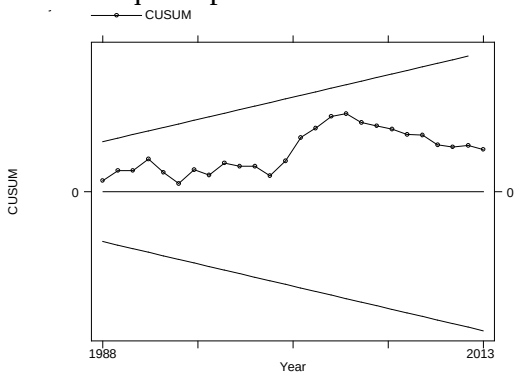


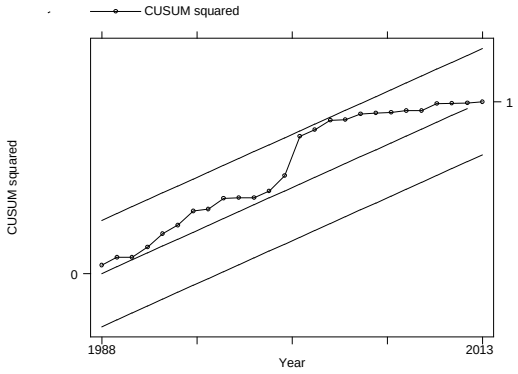
Mauritius import demand function



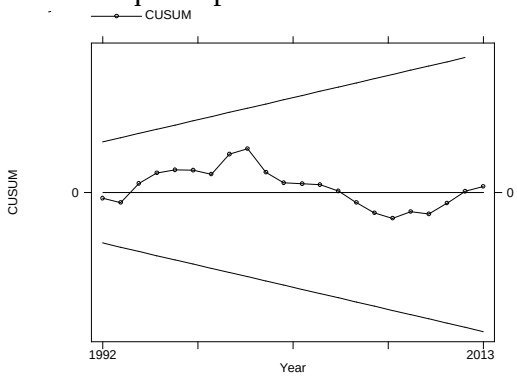


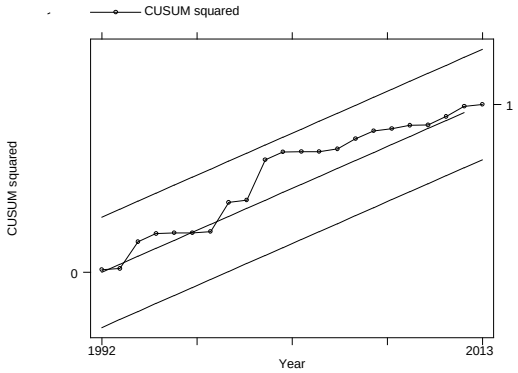
Mozambique export demand function



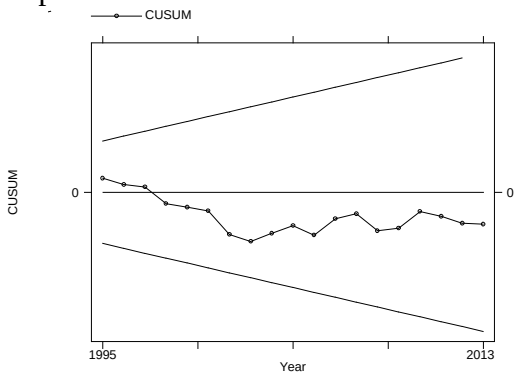


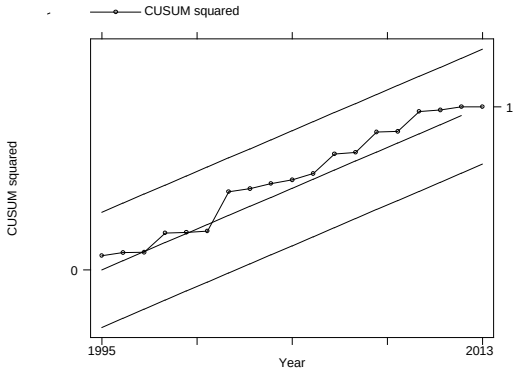
Mozambique import demand function



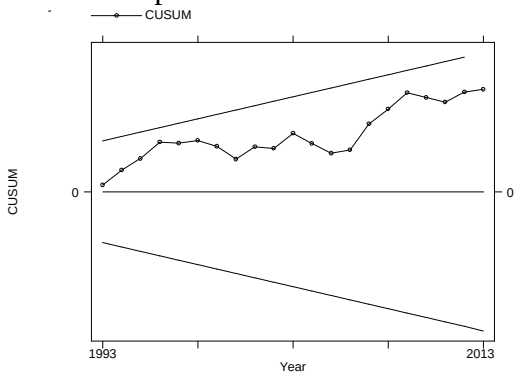


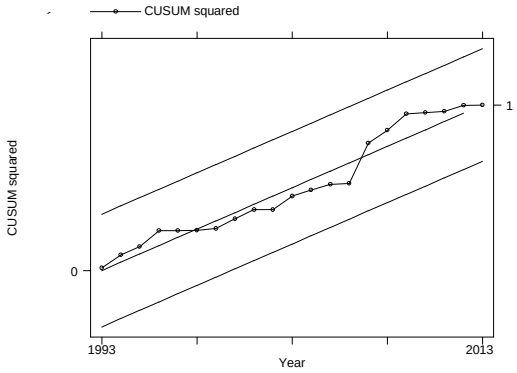
Export demand function Namibia



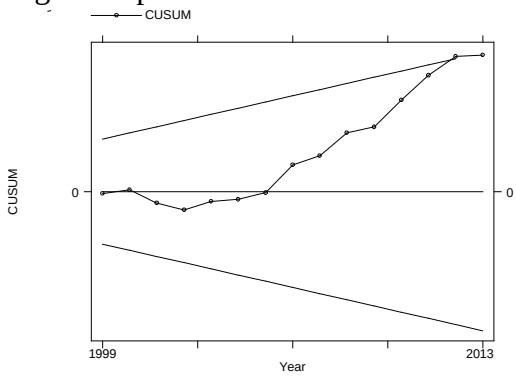


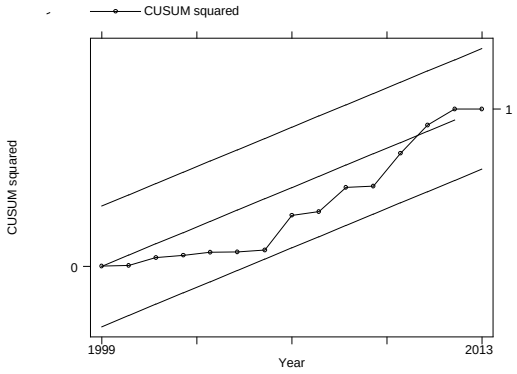
Namibia import demand function



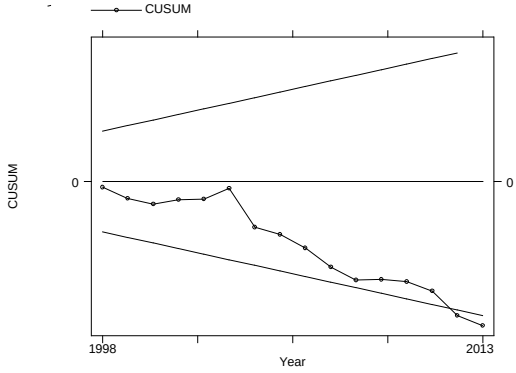


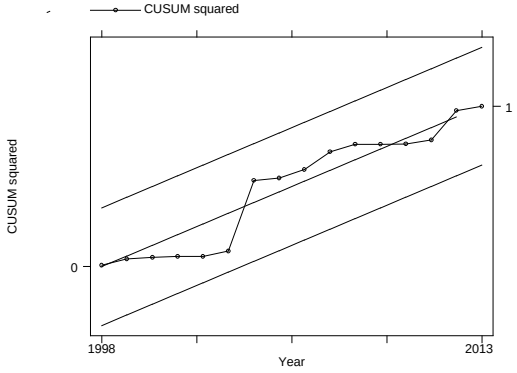
Nigeria export demand function



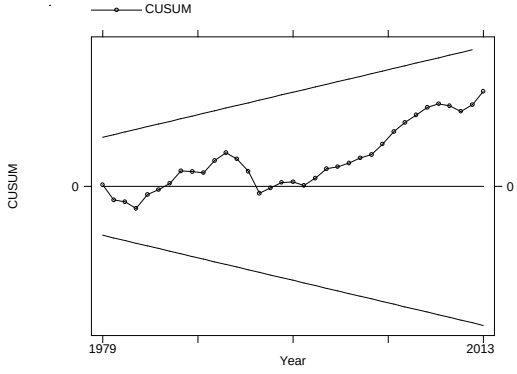


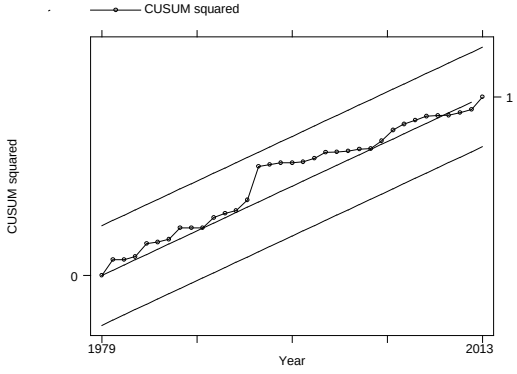
Nigeria import demand function



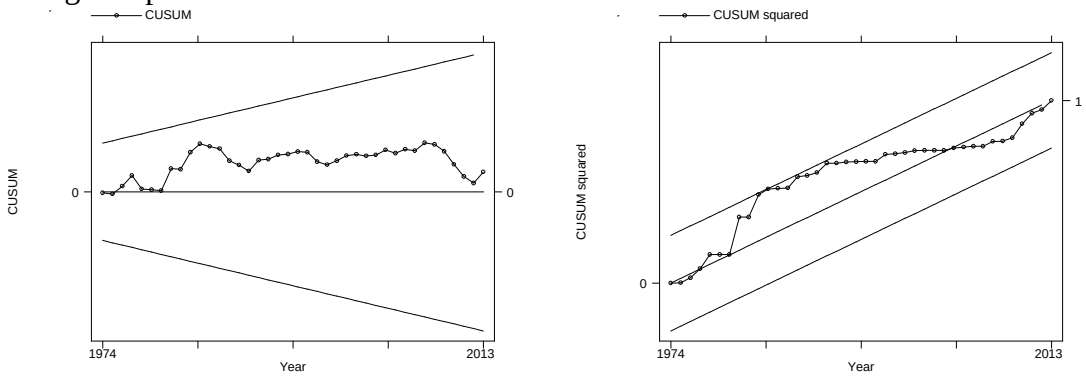


Senegal export demand function

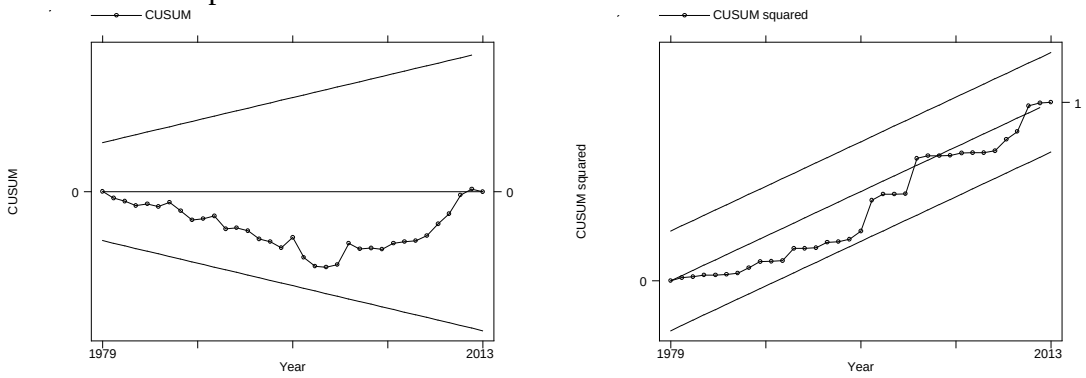




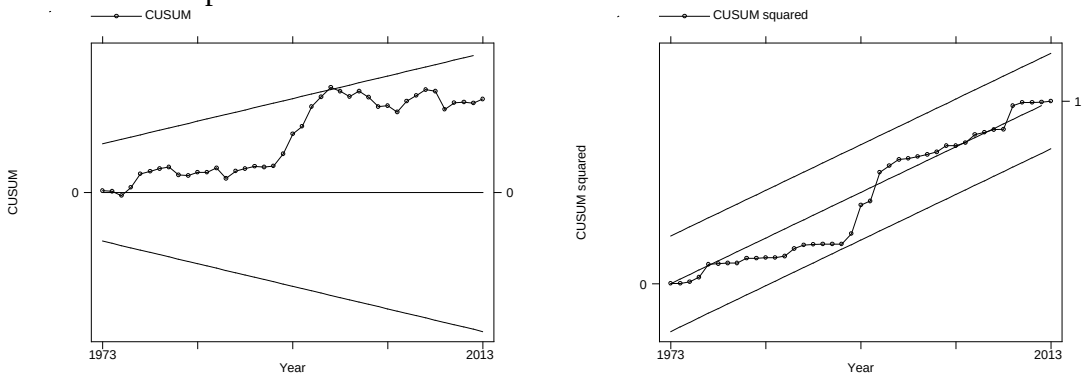
Senegal import demand function



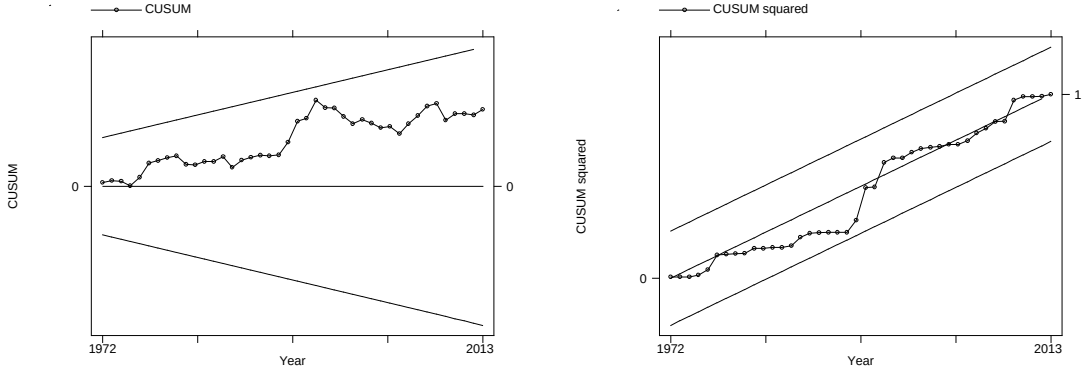
Sierra Leone import demand function



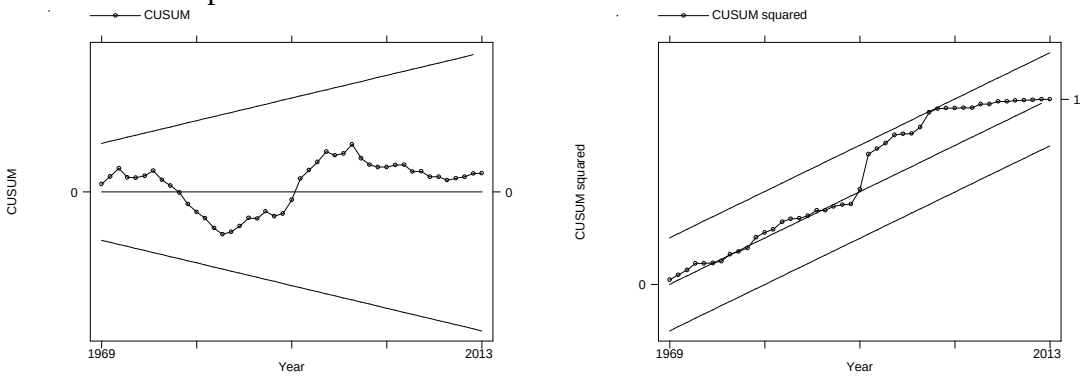
South Africa export demand function



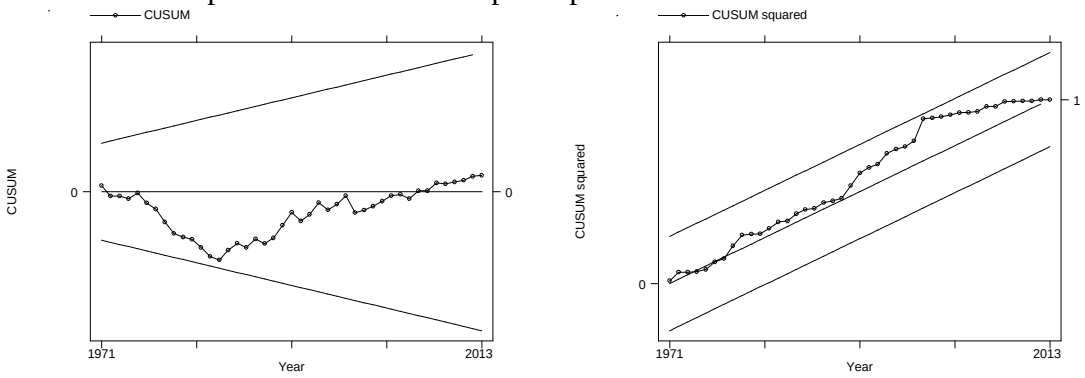
South Africa export demand function post-apartheid



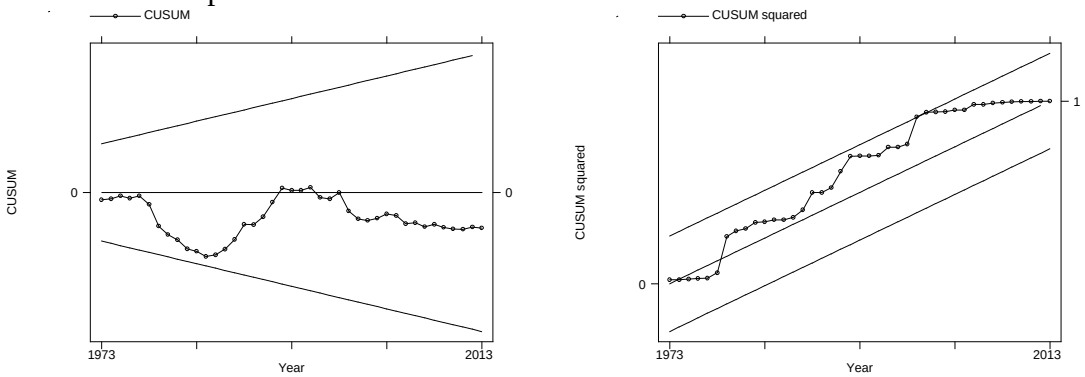
South Africa import demand function



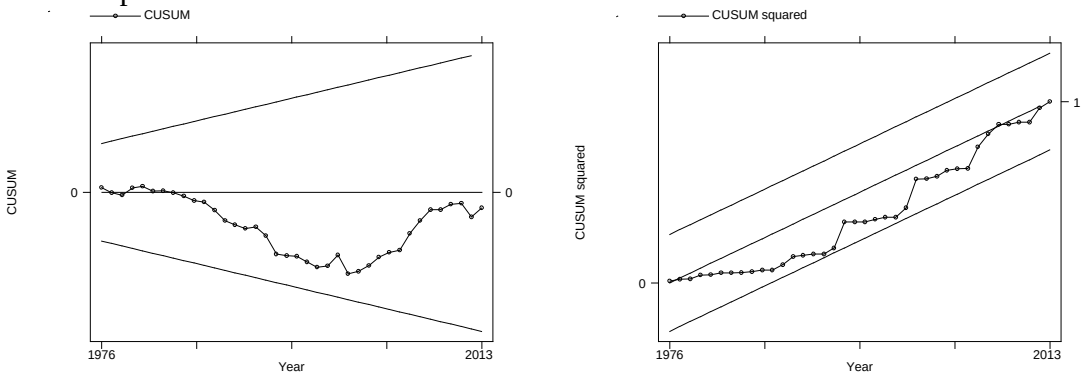
South Africa import demand function post-apartheid



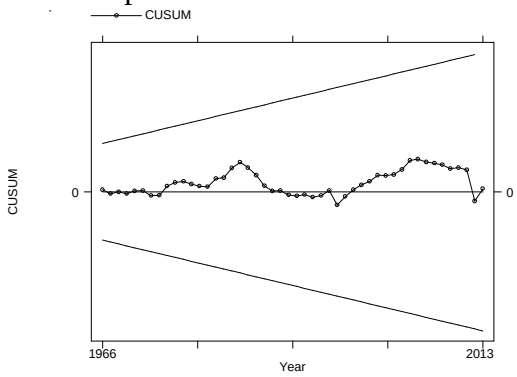
South Africa import demand function with a trend

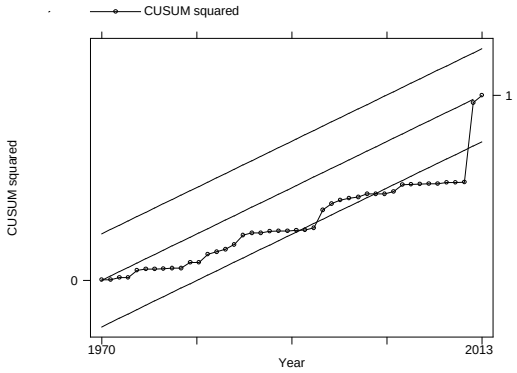


Sudan export demand function

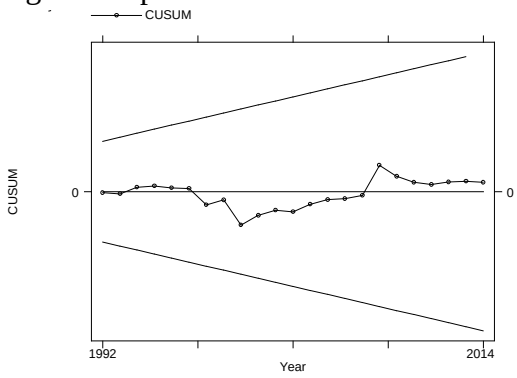


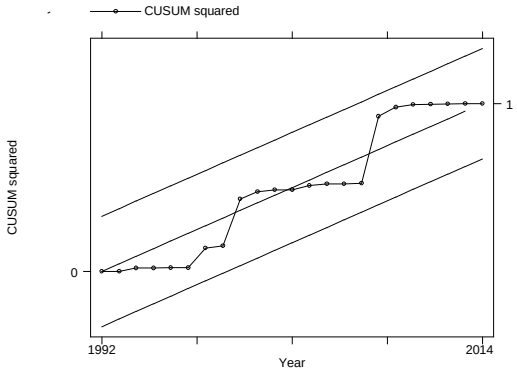
Sudan import demand function



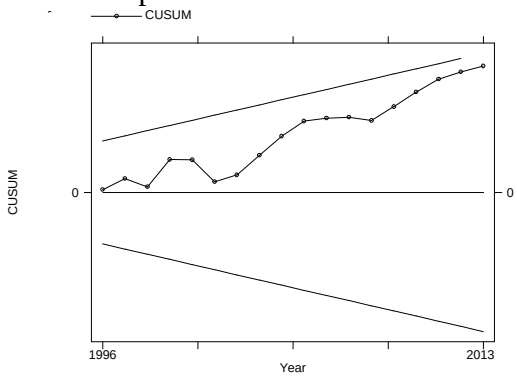


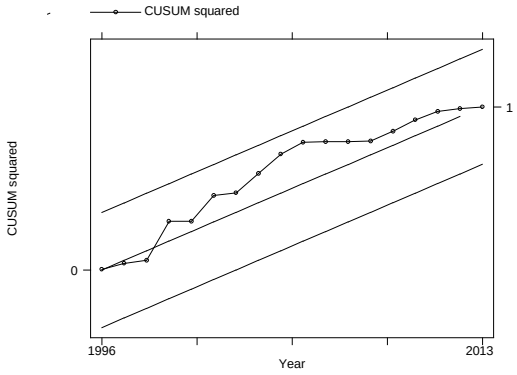
Uganda export demand function



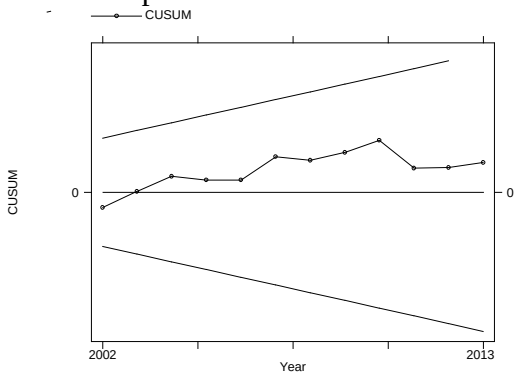


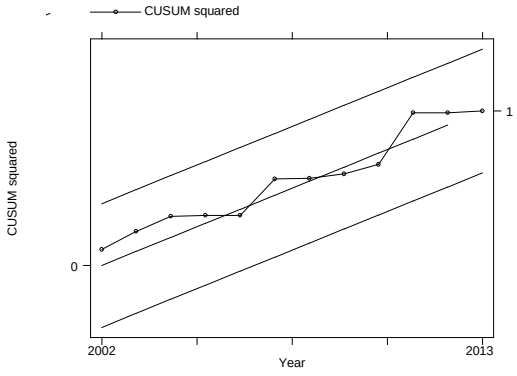
Zambia export demand function



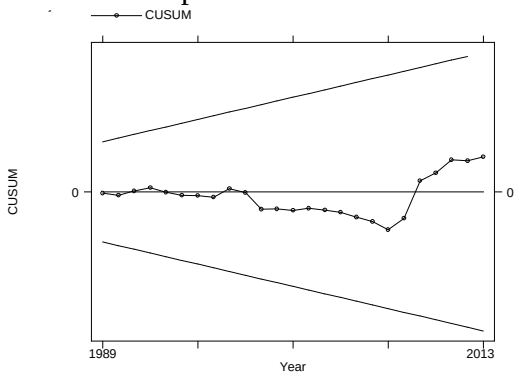


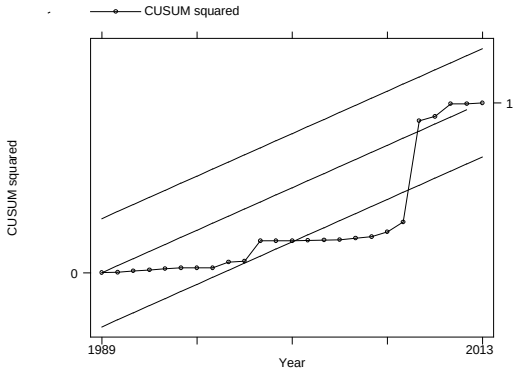
Zambia import demand function





Zimbabwe import demand function





Zimbabwe export demand function