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Export Trade and Economic Growth in Malawi: A Disaggregated Approach

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Abstract: This paper applies the Vector Autoregressive (VAR) technique to annual data from 1980 to 2013 to provide empirical evidence on the long-run relationship between export trade and economic growth in Malawi. The export trade in this study is disaggregated into services and goods exports. Thus, the paper estimated two models. The first model deals with the relationship between export of services and growth, and the other one determines the relationship between goods export and growth. While the paper finds no evidence for long-run relationship between export of services and goods on economic growth, the empirical results suggest existence of a short-run nexus between export of goods and economic growth in Malawi. The Granger causality test results have also confirmed existence of a unidirectional causality from goods exports to economic growth and another unidirectional causality from goods exports to service exports.

Keywords: Export trade; Economic growth; Vector autoregressive regression (VAR); Granger causality.

1. Introduction

Export trade has a positive impact on economic growth of a country. Export trade brings in foreign exchange which reduces the balance of payments pressure and creates employment opportunities. Another benefit of export trade is its ability to facilitate technology transfer between countries. Furthermore, exports provide the opportunity for domestic producers to expand their productive capacity in order to compete with foreign producers (Glies and Williams, 2000; Yaghmaian, 1994).

Over the years there have been intense discussions on the impact of export trade on economic growth based on both empirical and theoretical studies. There are proponents of the framework of export-led growth hypothesis. Several authors (Esfahani, 2001; Helpman and Krugman, 1985; Lawrence and Weinstein, 1999) have argued that exports promote economic growth by stimulating external demand for domestic products which in turn leads to increases in total factor productivity of domestic firms. The other proponents of this hypothesis include Yu (1998) who argues that export-oriented strategy is extremely important in promoting economic growth and that imports have the potential to harm domestic firms and can therefore distort the overall economic performance. Indeed it has been observed that in developing countries the exporters in the manufacturing sectors grew faster than non-exporters (Bernard and Jensen, 1999). It is believed that their growth was through reallocation of resources from their less efficient to more efficient productive activities. While the general consensus in economics is that export trade increases the total factor productivity (TFP) in developing countries like Malawi, some economists (Coe and Helpman, 1995) have argued that the impact of export trade on TFP is not automatic but it depends on R&D capital stock and R&D stock of the trading partners. On the extreme, there are several studies that have argued that in fact international trade flows are among the factors that contribute to poor economic performance in developing countries due to the fact that it tends to kill the domestic infant firms which are unable to compete with international producers in the world markets and have therefore suggested the adoption of import substitution strategies to counter this problem (Krugman and Anthony, 1995; Rodrigues, 2010).

It is important to mention that most of these studies on the empirical linkage between export trade and economic growth use total exports and have not applied the disaggregated approach to study the relationship between exports and growth. In this study, total exports are disaggregated into services and goods export to determine their potential role in stimulating economic growth of Malawi.

In Malawi, average per capita incomes have increased only slowly over the last 30 years. One reason for this is that over the decades, the rate of increase in the volume of Malawi's trade has barely kept up with population growth.

Over the past three decades, the average annual volume of exports from Malawi has grown by only 2.9 percent; not nearly enough to keep pace with population growth, let alone to facilitate increases in per capita incomes (Hoppe and Newfarmer, 2014). More significantly, export performance has been highly volatile, as has the economy in

general. While global economic growth and the emergence of global supply chains have enabled many African countries to reduce poverty, Malawi's exports grew less rapidly than those of nearly all of its neighbours during the period from 1990 to 2012. Even compared to other land locked, resource poor countries, such as Uganda, Rwanda, or Burkina Faso, Malawi's export performance is poor.

Therefore, securing this balance is essential if the growth in exports is to deliver true economic empowerment of the poor, youth, women and vulnerable groups and help close the trade balance for our economy.

It is for this reason that the Government has developed the Malawi National Export Strategy (NES) to serve as a critical component of the Malawi Growth and Development Strategy II (MGDSII) and hence of the Economic Recovery Plan by providing a framework and focus on how Malawi may build its productive capacity. It provides a clearly prioritised and realistic roadmap that Malawi needs in order to develop the productive base of the economy. The NES is fully aligned to the priorities set out in the MGDS II and the Economic Recovery Plan.

However, it is uncertain whether expanding exports ultimately contribute to all Malawi's economic growth. Since to our best knowledge, the export-led growth of Malawi hasn't been investigated for many years. The last study on this topic was carried out by Sinoha-Lopete (2006). To fill this gap, the aim of our paper is to examine the validity of the export-led growth hypothesis for Malawi. The results of this analysis are expected to be relevant to Malawi's policy makers, economists, and interest groups because promoting growth through export expansion can contribute to poverty reduction.

This paper therefore, applies the Vector Autoregressive (VAR) approach to annual data from 1980 to 2013 to provide empirical evidence on the long run relationship export and economic growth in Malawi. The results suggest the existence of long-run relationship between export of goods and economic growth. The results also indicate the absence of any long-run relationship between export of services and growth. Moreover, the granger causality test reveals the evidence for unidirectional causality from goods exports to economic growth and goods exports to service exports.

The rest of the paper is organized as follows. Section two contains review on the export-growth literature; section three presents the econometric model and methodology; section four presents the empirical findings of the study; and section five presents the summary and conclusion.

2. Review of Literature

Adam Smith and David Ricardo were the pioneers of the theoretical relationship between export trade and economic growth. The classical theory postulates that international trade plays important role in promoting economic growth of the nations. The theory argues that export trade is important for generating foreign exchanges that are in turn used to import goods and services that cannot be domestically produced. This export-growth relationship is described in the framework of export-led growth hypothesis. The paradigm gained more attention after success story of East Asian export-led growth strategies adopted during the period of 1970s and 1980s. The poor performance of the import substitution strategy implemented largely in Africa and Latin America gave rise to the popularity of the export-led growth hypothesis.

The export-led growth hypothesis asserts that export trade is an important engine of growth because it increases the TFP of local firms. Supporters of this theory like Rivera-Batiz and Romer (1991); Grossman and Helpman (1990) further argue that export trade plays crucial role in transfer of technology, improving managerial skills and skills of workers, and increasing the productive capacity of domestic economy. Research focusing on cross country as well as individual countries found that his enables economic agents to allocate economic resources in their most efficient sectors reflecting the true idea of opportunity cost.

The cross-country studies include that of Edwards (1992); Lopez (1991); Ngoc *et al.* (2003); Ram (1985). In a study of 30 developing economies for the period 1960-1988 Sharma S. C. and Dhakal (1994) found mixed impact of exports on economic growth in these developing countries. While there was a positive relationship in some countries, they found no causal relationship in others.

The positive relationship between exports and economic growth is attributed to several factors. According to Khalifa Al-Youssif (1997); Levin and Raut (1997), one of these factors is its positive; impact on economies of scale, capacity utilisation, productivity gains, and enhancing the greater variety of products. The other factor is that export trade provides an opportunity for local firms to enhance their technology and managerial skills through technology transfer to compete in the world markets Gunter *et al.* (2005) arguing that any gain from the liberalised trade is often associated with external effects that are dynamic in nature.

A similar study covering eight Asian countries by Ekanayake (1999) using annual time series data of 1960-1997 found validity of export led growth hypothesis for all countries except one. However, Safdari *et al.* (2011) found a unidirectional reverse causality running from economic growth to exports in 13 developing countries for the period of 1988-2008 using panel VECM.

The results from the individual countries studies also reveal a mixture of results. Thornton (1996) examines validity of export led growth for six European countries, from mid-19th century to 1913, using cointegration and granger causality and found mixed behaviour: Unidirectional running from export to GDP in three countries, causality running from GNP to Exports in one, while bidirectional causality was observed in two countries.

Similar results have also been found in Asia and the Middle East, for example, in China, Tsen (2010) found a bi directional relationship between exports and economic growth using time series data for the period of 1978-2002. Li

et al. (2010) limiting their study to East China added weight to the hypothesis using data from 1981-2008 noted that there is a long run as well as short run bidirectional causality between foreign trade and economic growth.

Studies of the relationship between exports and economic growth in India have come up with mixed results. Mishra (2011) denied the export led growth model using data for the period 1970 to 2009 and concluded that export-led growth hypothesis for not true for India. In contrast, Sahni and Atri (2012) confirmed the export-led growth hypothesis in India.

Iqbal *et al.* (2012) analyzed the relationship between exports and economic growth in Pakistan. The analysis was based on the time series data for the period of 1970 to 2009. Granger causality method is being used in this study. The analysis showed that, there exists a unidirectional causation from GDP to exports called growth-led exports.

Kalaitzi (2013) examined the relationship between exports and economic growth in the United Arab Emirates. Time series data of exports and economic growth for the period of 1980-2010 is used for assessment.

In Africa, others who have found a positive relationship have included Chemeda (2001) in Ethiopia using data for the period from 1950-1986 who found that growth of real exports had a positive effect on economic growth in the short run and not in the long run. About-Stait (2005) found that the export led growth phenomenon was true in Egypt where exports, imports and GDP growth were cointegrated and concluded that exports causes economic growth. Alimi and Muse (2013) have supported the growth-led export hypothesis in case of Nigeria using data for the period of 1970 to 2009. In South Africa using data from 1964-1993, Ukpolo (1998) using Granger causality test failed to validate export led growth but found a reverse causality, while Ramos (2001) in a study of Portugal for the period of 1865-1998, using Johansen cointegration and Granger causality test found no causality in any run.

Using Mexican data for the period 1960-2003, Lorde (2011) investigated validity of export led growth hypothesis for Mexico and found only short run causality from export to growth and a long run inverse causality running from economic growth to exports.

The studies cited above used different statistical approaches in their analysis. The methods applied can be divided into several categories. Studies that were based on correlation between exports and growth; using the aggregate production framework to export as an independent variable; and the analyses based on finding the existence of threshold effects (Sharma A. and Panagiotidis, 2005). The econometric methods applied by most studies are time series dominated by Granger (1988), Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990). Studies based on cross-country analysis have extensively applied the panel data techniques such as pooled OLS, random effects, fixed effects estimation methods. However, most of these studies have used the aggregated approach to evaluate the role of export trade on economic growth. In this study, the attempt has been made to disaggregate exports into export of goods and export of services to compare the relative importance of each category in promoting growth. Thus, the study employs the VAR approach accompanied by impulse response function and variance decomposition techniques to test the robustness of the VAR and Granger causality results.

3. Econometric Model and Methodology

The export led growth model can be expressed in the form of bivariate linear model following the modelling of Thornton (1996), and Ukpolo (1998). The linear model is then expressed as follows:

$$\mathrm{RGDPC_t} = \alpha_0 + \alpha_1 \mathrm{REX_t} + \varepsilon_t \quad (1)$$

Where $RGDPC_t$ represents the level of real per capita GDP at time t and REX_t measures, the level of exports at time t. ε_t is the error term at time t which is assumed to fulfil the assumption classical linear regression model.

The total exports are disaggregated into service exports and goods exports in the analysis in order to determine the relative importance of each category in accelerating economic growth in Malawi. The study further used the impulse response function (IRF) and variance decomposition to test the impact of each category of exports on economic growth. These techniques do also assist in the determining the relative importance of each category of exports in simulating economic growth of Malawi. Based on the model in equation 1, $REXSer_t$ and $REXGd_t$, replaced REX_t, where $REXSer_t$ is service exports and $REXGd_t$ is good exports.

Since the total exports were disaggregated into goods exports and service exports it was important to examine the separate impact of each on economic growth and hence developed two new models that estimated the relationship between economic growth and $REXSer_t$, and $REXGd_t$ in two separate models. The models are presented as follows:

$$\mathrm{RGDPC_t} = \beta_0 + \beta_1 \mathrm{REXSer_t} + \upsilon_t \quad (2)$$

$$\mathrm{RGDPC_t} = \gamma_0 + \gamma_1 \mathrm{REXGd_t} + \mu_t \quad (3)$$

where υ_t and μ_t is error term.

The study employs the Vector Autoregressive (VAR) technique to annual data from 1980 to 2013 in order to investigate the empirical link between economic growth and export trade in Malawi. The main reason for applying the VAR model is because it is a useful technique since it enables the researcher to examine the possible "*causal relationship*" (using Granger Causality test) between the variables (Van Den Berg, 1997).

The VAR was developed by Sims (1980) as an ad hoc dynamic multivariate model, treating simultaneous set of variables equally, in which each endogenous variable is regressed on its own lags and the lags of all other variables in a finite-order system. The objective of the approach is to examine the dynamic response of the system to the shocks without having to depend on "incredible identification restrictions" inherent in structural models. In this study the VAR model will be represented by the following regression equation:

Model 1: Service Exports

$$dRGDPC_t = \pi_0 + \sum_{i=1}^{t} \pi_{1i}\, dRGDPC_{t-i} + \sum_{i=1}^{t} \pi_{2i}\, dREXSer_{t-i} + \emptyset_t \quad (4)$$

$$dREXSer_t = \delta_0 + \sum_{i=1}^{t} \delta_{1i}\, dREXSer_{t-i} + \sum_{i=1}^{t} \delta_{2i}\, dRGDPC_{t-i} + \varphi_t \quad (5)$$

Model 2: Goods Exports

$$dRGDPC_t = \tau_0 + \sum_{i=1}^{t} \tau_{1i}\, dRGDPC_{t-i} + \sum_{i=1}^{t} \tau_{2i}\, dREXGd_{t-i} + \eta_t \quad (6)$$

$$dREXGd_t = \mu_0 + \sum_{i=1}^{t} \mu_{1i}\, dREXGd_{t-i} + \sum_{i=1}^{t} \mu_{2i}\, dRGDPC_{t-i} + \psi_t \quad (7)$$

where all series are in the first difference, $\emptyset_t$, φ_t, η_t , ψ_t represent the error terms

3.1. Data

The variable $RGDPC_t$ represents the annual real per capita GDP. $REXSer_t$ is the value of exports of services, and $REXGd_t$ is the value of exports of goods. Measures of all these variables are taken from United Nations Conference for Trade and Development (UNCTAD) statistical database. The sample period under investigate begins from 1980 to 2013. All data are transformed into natural log to facilitate analysis.

3.2. Unit - Root Tests

Time series data are often assumed to be non-stationary; thus the first step in this analysis is to establish the stationary relationship between the variables to avoid spurious regression. Also, since Granger causality holds only for stationary variables, unit root tests have to be performed on all the variables involved in order to ensure the validity of the usual test statistic (F-statistic t-statistic and R-square). For the purpose, Augmented Dickey Fuller tests (ADF) (Dickey and Fuller, 1981) of stationary are used in the study. Once the testing for stationarity of each series was complete, it was necessary to test for the presence of co-integration between the series. The Augmented Dickey-Fuller (ADF) tests were performed to examine the degree of integration of the series. It has been shown that many macroeconomic series are non-stationary at level and this can lead to spurious results if OLS technique is applied. Once the series are made stationary by appropriately differencing them, they can be used for regression analysis.

The results of Augmented Dickey-Fuller unit root tests are presented Table 1 and 2. As it is seen in Table 1, the null-hypothesis is not rejected at the beginning levels of variables.

Table-1. Augmented Dickey-Fuller unit root tests in levels

	Test with constant			Test with constant and trend		
Variable	**t-statistic**	**Result**	**Lag length**	**t-statistic**	**Result**	**Lag length**
lnRGDPC	-2.0022	Non stationary	1	-1.8810	Non stationary	1
lnREXSer	0.4319	Non stationary	1	-1.9238	Non stationary	1
lnREXGd	-0.0470	Non stationary	1	-2.3953	Non stationary	1

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

3.3. Cointegration Test

The drawback of the method above is the possibility of losing the long-run information that may present in variables. This problem can be overcome by applying the co- integration technique, which shows the long-run relationship between the non-stationary series Mallik (2008). We then determine the existence of long-run co-integration in the series by applying the Johansen test for co-integration. Johansen (1988); Johansen and Juselius (1990) had proposed two likelihood tests for data involving two distinct series. The variables are only co-integrated if and only if a single co-integrating equation exists[1]. The purpose of Johansen test is to determine the number of co-integrating vectors that exist in is the system. Cointegration means that despite being individually non stationary, a linear combination of two or more time series can be stationary. Cointegration of two or more time series suggests that there is a long run or equilibrium relationship between them (Gujrati and Sangeetha, 2010).

3.4. Granger Causality Test

The Granger no-causality test used in time series analysis to examine the direction of causality between two economic series has been one of the main subjects of many econometrics studies for the past three decades. The Granger procedure is selected because it consists the more powerful and simpler way of testing causal relationship (Granger, 1988). According to the Granger (1969) causality approach, a variable 'Y' is granger caused by 'X' if 'Y' can predicts better from past values of 'Y' and 'X' than from past values of 'Y' alone.

4. Empirical Results

Before doing VAR estimation and then finding causality between variables of the model there is need to do unit root test for observing stationarity of time series. Accordingly, the Augmented Dickey-Fuller unit root test was

1 According to Granger (1988), if the variable in a system are co-integrated, then the causal analysis needs to incorporate the error correction term for the adjustments of deviation from its long run equilibrium and avoid misspecification of model.

used. This will help to determine whether the variables of model needed to be differenced in first order or not. That is, this step shows whether the variables have unit root or not. The unit root test results are presented in Table 1. The ADF tests confirmed that all variables are non-stationary at level. However, after taking their first difference, the results show that the series became stationary. In other words, all series under the study, are integrated at order one, i.e. *I*(1).

Since the test results from the ADF indicates that the series exhibit unit root processes in levels. The detection of unit roots in the series indicates that shocks to the series will have permanent effects and not transitory effects.

The next step is to take first differences of variables lnRGDPC, lnREXSer and lnREXGd and test whether they are stationary or not at first difference level. The tests reveal that the null-hypothesis is rejected at the first differences. The results that are presented Table 2 indicate that all series are stationary.

Table-2. Augmented Dickey-Fuller unit root tests in first difference

	Test with constant			Test with constant and trend		
Variable	**t-statistic**	**Result**	**Lag length**	**t-statistic**	**Result**	**Lag length**
dlnRGDPC	-4.3094***	Stationary	1	-4.4243***	Stationary	1
dlnREXSer	-2.9157**	Stationary	2	-3.2510*	Stationary	2
dlnREXGd	-4.5843***	Stationary	1	-4.6112***	Stationary	1

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

This means that the analysed series dlnRGDPC, dlnREXSer and dlnREXGd are integrated series of first grade *I*(1) and for further analysis we will use first differences of series due to their stationarity. In addition the results might indicate there is cointegration between the series. The results of the cointegration test (appendix 1) indicate no cointegration suggesting that there does not exist long-run stable relationship between exports and economic growth.

Table-3. Defining the number of lags for VAR Model

Lags	**Loglik**	**p(LR)**	**AIC**	**BIC**	**HQC**
1	63.2806		-3.662904*	-3.091959*	-3.488361*
2	69.2343	0.2186	-3.445309	-2.446156	-3.139858
3	73.6828	0.4468	-3.120205	-1.692843	-2.683846
4	77.1630	0.6413	-2.725931	-0.870360	-2.158664

*Significant at 10%, ** significant at 5% and *** significant at 1%.
The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion,BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

Since the variables were not cointegrated a vector error correction model (VECM) could not be used an unrestricted vector autoregressive regression (VAR) model constructed using stationary variables and with each variable entering the model according to its order of integration. For a VAR to be estimated there is need to determine the appropriate lag length. An appropriate optimal lag length was found to be one and the results are shown in Table 3.

Table-4. VAR Model estimation results

		Coefficient	**Std. Error**	**t-ratio**	**p-value**	
dlnRGDPC	dlnRGDPC_1	-0.278	0.150	-1.846	0.076	*
	dlnREXser_1	-0.033	0.042	-0.780	0.442	
	dlnREXGd_1	0.118	0.051	2.295	0.030	**
dlnREXser	dlnRGDPC_1	0.573	0.557	1.027	0.313	
	dlnREXser_1	-0.476	0.157	-3.038	0.005	***
	dlnREXGd_1	0.477	0.191	2.505	0.018	**
dlnREXGd	dlnRGDPC_1	0.372	0.575	0.647	0.523	
	dlnREXser_1	-0.027	0.161	-0.168	0.868	
	dlnREXGd_1	0.017	0.197	0.088	0.931	

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

From Table 4, it is evident that in the short-run while GDP per capita growth rate depends significantly on the growth rate of GDP per capita and growth rate of exports of goods in previous period. The table also shows that GDP per capita growth is not significantly dependent on export of services growth in the previous period.

While on the other hand the growth rate of service exports is dependent on its own values in the previous period. The growth rate of service exports is also significantly dependent on the growth rate of goods exports in previous periods. The results from the data in Malawi does not show any evidence that growth rate and exports of services have any significant effect on the rate of growth of exports of goods. This leads one to conclude that Malawi has experienced export led growth and not growth driven export. In addition it is the exports of goods and not exports that drive economic growth.

To assess the causal relationship between economic growth, exports of goods and exports of services Granger causality test was performed. The results of the Granger causality tests are presented in Table 5 below:

Table-5. (Pair wise Granger Causality Tests)

Null hypothesis	Observations	F-statistic	Probability	
RGDPC does NOT Granger Cause REXGd	28	0.41818	0.5231	
REXGd does NOT Granger cause RGDPC		**5.2654**	**0.0295**	**
RGDPC does NOT Granger Cause REXser	28	1.0555	0.3130	
REXser does NOT Granger cause RGDPC		0.60818	0.4420	
REXser does NOT Granger Cause REXGd	28	0.028075	0.8681	
REXGd does NOT Granger cause REXser		6.2746	0.0183	**

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

The test of granger causality is performed so that the direction of influence of these variables can be confirmed. The results of the hypothesis that exports of goods does not granger cause economic growth, and that exports of goods does not granger cause exports of services is rejected on the basis of probability values.

5. Conclusion

This study makes an effort to examine the relationship between economic growth and export trade in Malawi. The study employs the VAR technique to the annual data covering the period of 1980 to 2013. The disaggregated approach is used to study the role of export trade on economic growth. This led to formulation of two regression models; the service exports model, and the goods export model. Impulse response function or innovation accounting techniques are also used to examine the manner through which the shock in one variable affects the others in both models.

The results find no evidence of long-run relationship between export in goods and economic growth but find a short run positive impact of exports on economic growth. However, there is no evidence of causality running from service exports to economic growth. Therefore, the results support the export-led growth hypothesis for the case of Malawi in the case of exports of goods. For the case of relationship between service exports and economic growth, the results rejected the hypothesis for existence of long term relationship. Thus, we can conclude that, for the case of Malawi, export of goods and services do not share any long-run relationship with economic growth. Another significant result is the fact that there is a unidirectional causality from exports of good to economic growth and services in the short run. This makes sense for the Malawian economy as exports increase income; this will in turn lead to an increased demand of various services.

These findings suggest that Malawi should enhance its export orientation and facilitation of international trade in order to spur economic growth. The econometric results above make it clear that exports are important for economic growth as such Malawi needs to increase the value of exports. This can be done in several ways which among others include value addition and reduction of post-harvest loses.

In conclusion, the Malawi economy will benefit from an export-led growth strategy. The results confirm further the advantages of an export-led growth strategy for Malawi. Malawi can expand its limited domestic market by exporting products and not services to the international markets. Policies focusing on export promotion of goods should be used effectively to build export capacity in order to increase economic growth.

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Appendix 1

Table-A1. Cointegrating regression - OLS, using observations 1980-2012 Dependent variable: l_RGDPC

	coefficient	std. error	t-ratio	p-value
Constant	5.4884	0.1592	34.4800	1.08e-025 ***
l_EXser	0.0384	0.0621	0.6191	0.5405
l_EXgds	−0.0057	0.0518	−0.1094	0.9136

Mean dependent variable	5.597053	S.D. dependent var	0.072661
Sum squared resid	0.162378	S.E. of regression	0.073570
R-squared	0.038896	Adjusted R-squared	-0.025178
Log-likelihood	40.86154	Akaike criterion	−75.72308
Schwarz criterion	−71.23356	Hannan-Quinn	−74.21250
rho	0.526004	Durbin-Watson	0.696384

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

Testing for a unit root in uhat
Augmented Dickey-Fuller test for uhat including one lag of (1-L)uhat
sample size 31
unit-root null hypothesis: a = 1
model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.035
estimated value of (a - 1): -0.322645
test statistic: tau_c(3) = -2.15351
asymptotic p-value 0.663
There is evidence for a cointegrating relationship if:
(a) The unit-root hypothesis is not rejected for the individual variables, and
(b) the unit-root hypothesis is rejected for the residuals (uhat) from the cointegrating regression.

Appendix 2: VAR system, lag order 1

OLS estimates, observations 1982-2012 (T = 31)
Log-likelihood = 69.93802
Determinant of covariance matrix = 2.2028436e-006
AIC = -3.9315
BIC = -3.5152
HQC = -3.7958
Portmanteau test: LB(7) = 59.4026, df = 54 [0.2853]

Table-A2.1. Equation 1: d_l_RGDPC

	Coefficient	Std Error	t-ratio	p-value
d_l_RGDPC_1	−0.277527	0.150363	−1.846	0.0755 *
d_l_EXser_1	−0.0329302	0.0422257	−0.779	0.4420
d_l_EXgds_1	0.117956	0.0514051	2.295	0.0295 **

Mean dependent variable	0.000643	S.D. dependent var	0.055244
Sum squared residuals	0.070311	S.E. of regression	0.050111
R-squared	0.232163	Adjusted R-squared	0.177318
F(3, 28)	2.822028	P-value(F)	0.056939
Rho	−0.149121	Durbin-Watson	2.260639

F-tests of zero restrictions:		
All lags of d_l_RGDPC F(1, 28)	3.4067	[0.0755]*
All lags of d_l_EXser F(1, 28)	0.6081	[0.4420]
All lags of d_l_EXgds F(1, 28)	5.2654	[0.0295]**

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

Table-A2.2. Equation 2: d_l_EXser

	Coefficient	**Std Error**	**t-ratio**	**p-value**
d_l_RGDPC_1	0.572707	0.557445	1.027	0.3130
d_l_EXser_1	−0.475506	0.156545	−3.038	0.0051 ***
d_l_EXgds_1	0.477378	0.190576	2.505	0.0183 **

Mean dependent variable	0.029601	S.D. dependent var	0.216715
Sum squared residuals	0.966381	S.E. of regression	0.185778
R-squared	0.327092	Adjusted R-squared	0.279027
F(3, 28)	4.536807	P-value(F)	0.010301
Rho	0.038130	Durbin-Watson	1.876335
F-tests of zero restrictions:			
All lags of d_l_RGDPC F(1, 28)		1.0555	[0.3130]
All lags of d_l_EXser F(1, 28)		9.2265	[0.0051]***
All lags of d_l_EXgds F(1, 28)		6.2746	[0.0183]**

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

Table-A2.3. Equation 3: d_l_EXgds

	Coefficient	**Std Error**	**t-ratio**	**p-value**
d_l_RGDPC_1	0.371870	0.575054	0.6467	0.5231
d_l_EXser_1	−0.0270587	0.161490	−0.1676	0.8681
d_l_EXgds_1	0.0172640	0.196596	0.08781	0.9306

Mean dependent variable	0.050015	S.D. dependent var	0.179565
Sum squared residuals	1.028401	S.E. of regression	0.191647
R-squared	0.015746	Adjusted R-squared	-0.054558
F(3, 28)	0.149314	P-value(F)	0.929259
Rho	0.001678	Durbin-Watson	1.954322
F-tests of zero restrictions:			
All lags of d_l_RGDPC F(1, 28)		0.41818	[0.5231]
All lags of d_l_EXser F(1, 28)		0.02807	[0.8681]
All lags of d_l_EXgds F(1, 28)		0.00771	[0.9306]

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