Athanasios L. ATHANASENAS,
Constantinos KATRAKILIDIS,
Panagiotis PANTELIDIS

BUDGET & TRADE DEFICIT SUSTAINABILITY: THE CASE OF CYPRUS

Abstract

One of the most important open macroeconomics issues, during the current global economic turmoil and expanding recession, concerns the sustainability of persistent budget and trade deficits. These deficits are most crucial due to severe debt servicing costs, faced by today's economies despite their development level. Here, we present time series evidence, theoretically consistent with the budget and trade deficit sustainability theory, using quarterly data over the period 1995 up to 2007. We focus on the Cyprus Economy; where, previous research on this issue has not been done, to the best of our knowledge. Our results confirm the fundamental sustainability of both deficits, for the specific time period involved.

Key words:

Budget and Trade Deficits, Sustainability, ARDL – Cointegration.

Athanasenas Athanasios L., Assistant Professor, Department of Business Administration, School of Administration and Economics, Institute of Technology and Education of Serres (A.T.E.I.S.), Greece.
Katrakilidis Constantinos, Associate Professor, Department of Economics, Aristotle University of Thessaloniki, Greece.
Pantelidis Panagiotis, Assistant Professor, Department of Business Administration, School of Administration and Economics, Institute of Technology and Education of Serres (A.T.E.I.S.), Greece.

1. Introduction

One of the hottest macroeconomic issues during the current economic turmoil concerns the sustainability of persistent current account deficits due to severe debt servicing costs, faced by both industrial advanced economies and many developing countries as well. These threatening economic characteristics of today's global depression reinforce the question on the ability of a country to service and repay its debt by avoiding default (Wickens and Uctum, 1993).

Public deficits have created increased borrowing requirements for Governments worldwide. More particularly, developed economies turn, basically, to domestic borrowing, whereas developing ones turn to both domestic and foreign capital. In any case, though, high deficit levels eventually lead to an accumulation of debt, which forces a constant necessity for financial discipline and control over the public deficit (e.g. Hakkio and Rush, 1991; Haug, 1991).

On the other hand, long-run persistent current account deficits tend to have certain harmful effects on domestic economy, such as increase in domestic interest rates relative to their foreign counterparts, so that an excessive accumulated external debt burden is imposed on future generations. Much empirical research on the US economy has been conducted verifying the aforementioned claims (e.g. Husted, 1992; Tanner and Liu, 1994; Liu and Tanner, 1995).

It is well known that over the last decade, the Cyprus economy has experienced persistent current account deficits, partly due to its high dependence on imported oil and the large consecutive increases in imported oil prices, so that its current account deficit increased from 2.0% of GDP in 2003 to 5.9% in 2006. However, if foreign lenders believe that the borrowers will not be capable of reimbursing their loans, borrowing abroad will be denied (Milesi – Ferreti *et al.*, 1996a, 1996b). Thus, it is quite reasonable to investigate the sustainability issue of the inter-temporal budget and trade deficits.

Despite the significant growth of the international literature on the investigation of the dynamic characteristics of the so called «twin deficits» and their sustainability properties, to the best of our knowledge, there is lack of empirical evidence regarding the case of Cyprus. Accordingly, the objectives of this study are i) to test for the sustainability of the Cyprus budget and trade deficits, thus adding to the relevant literature and, ii) to differentiate from other empirical efforts by using a time series technique more suitable and efficient in cases of small data sets. Actually, the empirical analysis is carried over by means of the ARDL cointegration methodology proposed by Pesaran and Shin (1999).

The paper is divided into five consecutive sections. Namely, Section (2) describes briefly the deficits issue within the Cypriot Economy. Section (3), presents the theoretical foundation of the sustainability concept for both deficits considered. Section (4), next, briefly describes the fundamentals of the ARDL approach to cointegration, which is also analysed in Appendix I. Section (5) is focusing upon the data and empirical results; whereas, last section (6) provides a short summary and conclusions subject. Appendix II, presents all our econometric results, statistics and related graphs.

2. A Brief Reference
to the Cypriot Deficits

Since 1990's, Cyprus has enjoyed a steady economic growth around 4% yearly, with low inflation and unemployment, along with a stable exchange rate. The fiscal account, however, has been persistently at a deficit since 1970's, and during 1990's the Cypriot economy faces increasing fiscal deficits partly due to Custom's Union Agreement and the reduction of the revenues from customs duties, and wage increases. In fiscal years 1993 and 1994, deficit improvement is attributed to the VAT rate increase from 5% to 8%.

Nevertheless, exogenous oil shocks along with partial loss of competitiveness in some sectors of the economy all reflect negatively upon the current account deficit. Thus, fiscal deficit and financing constitute a potentially major destabilizing factor in the domestic economy, thus exerting pressure on the trade account (See, especially, Spanos *et al.,* 1997).

Over the current decade, under the requirements of the Stability and Growth Pact and along the lines of the Maastricht convergence criteria, the fiscal deficit that peaked at 6.5% of GDP in 2003 has been reduced to 1.2% of GDP in 2006. Accordingly, public debt, that exceeded 70% of GDP in 2004, declined to 65.2% in 2006.

On the other hand, Cyprus is a small open economy, highly dependent on imported oil. As a consequence, the large consecutive increases in oil prices of the recent past have affected its current account deficit, which increased from 2.0% of GDP in 2003 up to 5.9% in 2006. Moreover, the structural reforms set out in the National Lisbon Programe should be implemented in order to increase diversification of the economy into high value added activities, the promotion of research and development, and the strengthening of the competitive environment.

3. The Concept of Sustainability: Basic Theoretical Issues

3.1. Budget Deficit Sustainability

The more widely acceptable definition of sustainability is based on the concept of inter-temporal budget constraint, which states that the present value of debt, at the limit, tends to zero.

Let us suppose then that the deficit is financed with government bonds maturing in one year. This means that in every time period, government faces the following national budget constraint:

$$G_t + (1 + r_t)B_{t-1} = R_t + B_t, \tag{1}$$

Where:

G equals public spending not including debt servicing costs; that is, public consumption plus transfer payments; r equals the real interest rate per period; B equals the accumulated debt, and R being the public receipts.

Consecutive substitutions in (1) above, give the following relation for the inter-temporal budget constraint:

$$B_t = \sum_{s=0}^{\infty} \prod_{i=1}^{s} (1 + r_{t+i})^{-1} (R_{t+s} - G_{t+s}) + \lim_{s \to \infty} \prod_{i=1}^{s} (1 + r_{t+i})^{-1} B_{t+s}. \tag{2}$$

At this point, two hypotheses accrue: *(a) real interest rate is stable, with average value r, and (b) the real supply of bonds has an annual rate of change that, on average, is no higher than the average interest rate r.* Based on these two hypotheses we have:

$$\lim_{s \to \infty} (1 + r)^{-s} B_{t+s} = 0. \tag{3}$$

The above formula (3) essentially states that the present value of the debt tends to zero. Additionally, it states that the government does not have the option of continually creating deficits. However, Hamilton and Flavin (1986) claim that (2) and (3) before do not exclude the existence of a constant permanent fiscal deficit. As long as deficits are such that they push debt at a rate less than that of the interest rate, (3) will be satisfied.

Alternatively, according to Hakkio and Rush (1991), sustainability of accumulated debt can be estimated using the following regression:

$$R_t = \alpha_1 + \beta_1 G_t + u_t, \tag{4}$$

Where:

$\beta_1 \le 1$, *checking whether* R_t *and* G_t *form a co-integration relationship.* It can be shown that (Quintos, 1995):

- *the deficit is sustainable, in the «strict sense», if and only if the* R_t *and* G_t *series, which are I(1), are co-integrated and* $\beta_1 = 1$;

- *the deficit is sustainable, in the «weak sense», if the* R_t *and* G_t *series are co-integrable and* $0 < \beta_1 < 1$;

- *the deficit is not sustainable if* $\beta_1 \le 0$.

Sustainability in the «strict sense» (i. e. «strong sustainability») means that the limitation of the budget is valid and, at the same time the un-prepaid debt B_t is $I(1)$. Sustainability in the «weak sense» (i. e.: «weak sustainability») means that the limitation is valid but the B_t is magnified at a rate that is lower than the growth rate of the economy, which approaches the average real interest rate. Even if this latter situation is consistent with sustainability, it may have consequences which affect the government's ability to negotiate its debt and, for this reason it is the least desirable scenario. A deficit which is not sustainable is one where B_t is stated as developing at a rate equal to or greater than the rate of growth of the economy, such that it contravenes the inter-temporal budget constraint.

3.2. Trade Deficit Sustainability

Next, according to Hakkio and Rush (1991) and Husted (1992), an economy's external sector can be described by the following identity:

$$M_t + (1+i_t)D_{t-1} = X_t + D_t, \tag{5}$$

Where:

M_t represents country's imports of goods and services, without «sinking funds» (that is, interest plus debt) described by the second term $(1+i_t)D_{t-1}$; X_t describes the country's exports of goods and services, whereas D_t is the country's external borrowing at time t.

Hence, the inter-temporal foreign sector constraint becomes (Hakkio & Rush, 1991; Husted, 1992):

$$D_0 = \sum_{t=1}^{\infty} d_t(X_t - M_t) + \lim_{n \to \infty} d_n D_n,, \tag{6}$$

With d_t being the future external surpluses discount coefficient. In (6) above, with the second term becoming zero, the external borrowing equals the present value of $X_t - M_t$.

Assuming an inter-national interest rate stationary at average price I, adding and subtracting from (5) iD_{t-1}, we get:

$$M_t + i_t D_{t-1} = X_t + \sum_{j=0}^{\infty} \lambda^{j-1}(\Delta X_{t+j} - \Delta E_{t+j}) + \lim_{j=\infty} \lambda^{t+j} D_{t+j}, \qquad (7)$$

Where:

$E = M_t + (i_t - I)D_{t-1}$, whereas the left part of (7) corresponds to the total expenses for imports and interest payments. Assuming non-stationary X and E time series at their levels, but stationary at first-differences, (7) above can be transformed as follows:

$$M_t + iD_{t-1} = \alpha + X_t + \lim_{j=\infty} \lambda^{t+j} D_{t+j} + e_t, \qquad (8)$$

Subtracting X_t from both sides of (8) and multiplying by (–1), the left side becomes:

$$(X_t - M_t - i_t D_{t-1}).$$

Assuming that:

$$\lim_{j \to \infty} \lambda^{t+j} D_{t+j} = 0,$$

we get:

$$X_t = \alpha + \beta MM_t + e_t, \qquad (9)$$

Where:

$MM_t = M_t + i_t D_{t-1}$ represents import expenses plus interest payments. Thus, we fundamentally question whether imports and exports time series become *cointegrated*. If long-run cointegration is justified, then we claim that external sector debt (or, in fact, *the trade deficit*) becomes stable; *that is, sustainable* (Hakkio and Rush, 1991).

In (9) above, following Hakkio and Rush (1991), β must equal 1 and e_t must be stationary for an economy to achieve *sustainability of its external sector debt (i.e. trade deficit sustainability)*. Nevertheless, sustainability holds even if β gets less than unity, but then the un-prepaid net present value of the external debt faces unbounded increase.

4. Methodology
and Model Structure

The autoregressive distributed lag (ARDL) approach to cointegration applied in this paper is a relatively new technique for detecting possible long-run relationships among economic variables. The ARDL approach is a more efficient technique for determining cointegrating relationships in small samples. An additional advantage of the ARDL approach is that it can be applied irrespective of the regressors' order of integration (Pesaran and Shin (1999)); that is, it can be applied regardless of the stationary properties of the variables in the sample, thus allowing for statistical inferences on long-run estimates which are not possible under alternative cointegration techniques. Hence, we are not concerned whether the applied series are $I(0)$ *or* $I(1)$. The general form of the ARDL model (Pesaran and Shin, 1999) is defined as:

$$\Phi(L)y_t = \alpha_0 + \alpha_1 w_t + \beta'(L)x_{it} + u_t, \tag{10}$$

Where: $\Phi(L) = 1 - \sum_{i=1}^{\infty}\Phi_t L^i$ and $\beta(L) = \sum_{j=1}^{\infty}\beta_j L^j,$

with (L) being the lag operator and (w_t) being the vector of deterministic variables such as the intercept, seasonal dummies, time trends or any exogenous variables (with fixed lags). This approach follows three steps; namely, step one is the establishment of the long-run relationship between the variables (unrestricted error correction mechanism regression). Step two is the estimation of the ARDL form of equation (1), where the optimal lag length is chosen according to the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC). Step three refers to the estimation of error correction equation, using the differences of the variables and the lagged long-run solution, where the speed of adjustment of the equilibrium is determined.

5. Data
and Empirical Results

Our empirical analysis engages quarterly data of the Cyprus economy, taken from the IFS (IMF) database and the period covered runs from 1995, 1st quarter to 2007, 3rd quarter. For the case of the budget deficit sustainability, the involved variables are the log of the nominal government spending (LGS) and the log of the nominal government revenues (LRS). For the case of the trade deficit sustainability, we use the log of the country's exports (LXS) and, the log of the country's imports (LMS), accordingly. All four variables are de-seasonalized.

Instead of employing the traditional methodology proposed by Johansen (1988 and 1989), which requires non-stationary variables of integration order I(1), we apply the ARDL Cointegration method proposed by Pesaran (1992). Actually, the ARDL method has the advantage to avoid the problem of pre-testing for the order of integration of the individual series; besides, ARDL is a single equation estimation technique and requires the estimation of a fairly smaller number of parameters compared to the Johansen's method. Consequently, ARDL proves to be more efficient when small data samples are available.

As is usual in the empirical analysis, in the first step of the empirical analysis we examine the integration properties of the variables involved by means of the conventional Augmented Dickey-Fuller (ADF) test. It should be noted that statistical inference with non-stationary data might lead to invalid results. The results (Table 1), suggest that all variables are non-stationary when tested in log-level form, regardless of the existence of an intercept or both an intercept and a linear trend, in the testing equation. Furthermore, when the variables are considered in first-difference form, all of them exhibit stationary properties. Since the variables are integrated of order one, $I(1)$, we proceed with testing for sustainability through the examination of the joint integration properties of the series by applying the ARDL cointegration methodology.

5.1. Budget Deficit Sustainability

We start our analysis with the budget deficit sustainability case by testing for the existence of a possible long-run equilibrium relationship (cointegration) with long-run causality running from government spending (LGS) towards government revenues (LRS). In the first step, we estimate the unrestricted error correction (EC) model described below and, apply an F-test on the group of the lagged level variables. The specific form of the model follows.

$$dLRS_t = d_0 + \sum_{j=1}^{n} f_j dLRS_{t-j} + \sum_{j=1}^{n} g_j dLGS_{(t)} + \lambda_1 LRS_{t-1} + \lambda_2 LGS_{t-1} + e_{lt}, \quad (11)$$

where, the parameter $\lambda_i, (i = 1, 2)$ is the corresponding long-run multiplier, while the parameters f_j, g_j, are the short-run dynamic coefficients of model.

The optimal lag structure of the model is chosen based on the Akaike Information Criterion (AIC), using a max lag length of two periods. The F-test on the group of the lagged level variables along with the critical value bounds are presented in Table (2). Actually, the reported F-value is found slightly lower from the upper critical value bound and hence the evidence is inconclusive. In such a case, we can proceed as if we had detected cointegration and justify our decision later, based on the estimated error correction term at the third step of the ARDL methodology as it is described in Section 4.

Considering cointegration among the involved variables, we proceed with the estimation of the appropriate ARDL model. The optimal ARDL (2,0) specification has been chosen based on the AIC and is presented in Table (3). The corresponding diagnostic tests validate the estimates, while the plots of the corresponding CUSUM and CUSUMSQ tests, based on the recursive residuals (Graph 1), identify long-run structural stability for the model's coefficients.

The estimated long-run coefficients from the implied ARDL structure are reported in Table (4). The estimates reveal strong long-run causal effect (at a smaller than the 1% level of statistical significance) directed from government spending towards government revenues. Next, we apply a Wald's test to check whether $\beta = 1$, i. e. whether strong or weak sustainability holds. The Wald–test, reported in Table (5), suggests that the null hypothesis cannot be rejected (*p*-value less than 10%) and consequently, we could consider that there is evidence is in favor of the existence of strong sustainability.

Finally, Table (6) presents the estimates of the respective Error Correction (EC) specification. The existence of a long-run causal relationship among the examined variables is now clearly confirmed and our decision to proceed despite the inconclusive outcome of the previously reported F-test is now indirectly justified. Actually, the coefficient of the lagged EC term is found statistically significant (the p-value of the applied t-test is smaller than the 1%) and has the correct sign suggesting that any deviation from the long-term equilibrium path is corrected by 39 percent per quarter.

5.2. Trade Deficit Sustainability

Along the same lines, we proceed next on the evaluation of the *trade deficit sustainability*. Tables (7–11) apply here. Accordingly, we test for the existence of a possible long-run equilibrium relationship with long-run causality running from country's imports (LMS) towards country's exports (LXS). In the first step here, we estimate the unrestricted error correction (EC) model described below and, apply an F-test on the group of the lagged level variables. The specific form of the model follows.

$$dLXS_t = \alpha_0 + \sum_{j=1}^{n} b_j dLXS_{t-j} + \sum_{j=1}^{n} c_j dLMS_{(t)} + \lambda_1 LXS_{t-1} + \lambda_2 LMS_{t-1} + e_{lt}, \quad (12)$$

where, the parameter $\lambda_i, (i = 1, 2)$ is the corresponding long-run multiplier, while the parameters b_j, c_j, are the short-run dynamic coefficients of the model.

The optimal lag structure of the model is chosen based on the Akaike Information Criterion (AIC), using a max lag length of four periods. The *F*-test on the group of the lagged level variables along with the critical value bounds are reported in Table (7). The evidence is in favor of the existence of a long-run equilibrium relationship with long-run causality running from LMS towards LXS.

Having detected cointegration among the involved variables, we proceed with the estimation of the appropriate ARDL model. The optimal ARDL (4,0) specification has been chosen based on the AIC and is presented in Table (8). The corresponding diagnostic tests validate the estimates, while the plots of the corresponding CUSUM and CUSUMSQ tests, based on the recursive residuals (Graph 2), identify long-run structural stability for the model's coefficients.

The estimated long-run coefficients from the implied ARDL structure are reported in Table (9). The estimates reveal strong long-run causal effect (at a smaller than the 1% level of statistical significance), directed from country's imports towards country's exports. Next, we apply a Wald's test to check whether $\beta = 1$, i. e. whether strong or weak sustainability holds. The Wald-test, reported in Table (10), suggests that the null hypothesis cannot be rejected and consequently the evidence is in favor of the existence of strong sustainability.

Finally, Table (11) presents the estimates of the respective Error Correction (EC) specification. The existence of a long-run causal relationship among the examined variables is confirmed once again, since the coefficient of the lagged EC term is found statistically significant (the p-value of the applied t-test is smaller than the 1%) and has the correct sign suggesting that any deviation from the long-term equilibrium path is corrected by 75 percent per quarter.

6. Summary
and Conclusive Remarks

Summarizing our work, we restate that using quarterly data over the 1995–2007 period for the

Cyprus economy, our analysis attempts to investigate both the budget and trade deficit (known as «twin deficits») for sustainability using the ARDL approach to Cointegration.

Our conclusions provide substantial statistical evidence that over the examined time span and before the current explosion of the global economic recession, the Cypriot economy shows clearly that *both budget and trade deficit sustainability holds.* Nevertheless, Cyprus accession to the EU along with its full participation to the eurozone financial markets, and definitely the accelerating international recession, all demand much further econometric analyses to verify (or, transform) the aforementioned results.

It is well known that the term «twin deficits» started to worry economists in the early 80's in US, during the Reagan administration, when both budget and trade deficits soared dangerously. It is standard macroeconomics, however, that budget deficits lead to trade deficits only if budget deficits are indeed larger than net private (domestic) savings. Actually, there is an ongoing debate regarding the

existence of a possible causal link between budget and trade deficits, such that the issue itself remains an open research question.

Finally, a serious economic challenge for the Cypriot economy is the aging related public expenditure that threatens the long-run sustainability of public finance. Hence, increasing productivity, maintaining wages at competitive levels and promoting disciplined fiscal policies can restrain current account deficits.

Bibliography

1. Hakkio, C. (1995), 'The US current account: The outer deficit', *Federal Reserve Bank of Kansas City, Economic Review,* 80: 11-24.

2. Hakkio, C. – Rush, M. (1991), 'Is the budget deficit too large?', *Economic inquiry,* 29: 429-45.

3. Haug, A. (1995), 'Has Federal budget policy changed in recent years?, *Economic Inquiry,* 33: 104-18.

4. Haug, A. (1991), 'Cointegration and government borrowing constraints: evidence from the US', *Journal of Business and Economic Statistics,* 9: 97–101.

5. Husted, S. (1992), 'The emerging current account deficit in 1980's: cointegration analysis,' *The Review of Economics and Statistics,* 74: 159–66.

6. Johansen, S. (1988), 'Statistical analysis of cointegration vectors', *Journal of Economic Dynamics and Control,* 12: 213–254.

7. Johansen, S. – Juselius, C. (1990), 'Maximum likelihood estimation and inference on cointegration with applications to the demand for money', *Oxford Bulletin of Economics and Statistics,* 52: 169–210.

8. Liu, P. – Tanner, E. (1995), 'Inter-temporal solvency and breaks in the US deficit process : a maximum-likelihood cointegration approach', *Applied Economics Letters*, 2: 231–5.

9. Milesi-Ferretti, G. M. – Rasin, A. (1996a), 'Sustainability of persistent current account deficits', *NBER Working Paper,* No. 5467.

10. Milesi-Ferretti, G. M. – Rasin, A. (1996b), 'Current account sustainability: selected East Asian and Latin American experiences,' *NBER Working Paper,* No. 5791.

11. Pesaran, H., Shin, Y. (1999). «An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis». In S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium.* Cambridge Un. Press, Cambridge.

12. Spanos, A. – Andreou, E. – Syrichas, G. (1997), *A Var model for the monetary sector of the Cyprus economy*, University of Cyprus & Central bank of Cyprus, Nicolaou, Nicosia, Cyprus.

13. Tanner, E. – Liu, P. (1994), 'Is the budget deficit too large?: some further evidence,' *Economic Inquiry*, 33: 511–18.

14. Wickens, M. R. – Uctum, M. (1993), 'The sustainability of current account deficits: a test of the US inter-temporal budget constraint,' *Journal of Economic Dynamics and Control*, 17: 423–44.

Appendix I

ARDL Method: A brief Theoretical Description

The augmented autoregressive distributed lag model ARDL(p, q1, q2,…,qk) is given by

$$\varphi(L,p)y_t = \sum_{i=1}^{k} \beta_i(L,g_i)x_{it} + \delta' w_t + u_t, \qquad (A1)$$

where $\qquad \varphi(L,p) = 1 - \varphi_1 L - \varphi_2 L^2 - \ldots - \varphi_p L^p,$ $\qquad$ (A2)

$$\beta_i(L,g_i) = \beta_{i0} + \beta_{i1}L + \ldots + \beta_{ig_i}L^{g_i}, , \qquad i=1,2,\ldots,k \qquad (A3)$$

w_t *is a* $s \times 1$ *vector of deterministic variables (intercept, dummies, trend, exogenous variables with fixed lags) and L is a lag operator defined as* $L^r y_r = y_{i-r}.$

At the first step the procedure estimates a total of $(m+1)^{k+1}$ *different ARDL models, by means of the OLS method, for all possible values of p (p = 0,1,…,m), q (q = 0,1,…,m) and i (i = 1,…,k). The maximum lag length can be determined by the researcher though the frequency of the data is crucial. The appropriate ARDL specification can be then chosen by means of alternative criteria such as the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (SBC), the Hannan and Quinn (HQC), the* R^2 *and others.*

The long run coefficients for the response of y_t *to a unit change of* x_{it} *are estimated by (Pesaran* et al*, 1997, pp. 393–394):*

$$\hat{\theta}_i = \frac{\hat{\beta}_i(1,\hat{g}_i)}{\hat{\varphi}(1,\hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \ldots + \hat{\beta}_{i\hat{g}_i}}{1 - \hat{\varphi}_1 - \hat{\varphi}_2 - \ldots - \hat{\varphi}_{\hat{p}}}, \qquad i=1,2,\ldots,k \qquad (A4)$$

where $\hat{p}$ and $\hat{q}_i$, $i = 1,2,\ldots,k$ are the selected values of p and qi. The long run coefficients associated with the deterministic and exogenous variables with fixed lags are estimated by

$$\hat{\psi} = \frac{\hat{\delta}(\hat{p},\hat{q}_1,\hat{q}_2,\ldots,\hat{q}_k)}{1 - \hat{\varphi}_1 - \hat{\varphi}_2 - \ldots - \hat{\varphi}_{\hat{p}}}, \qquad (A5)$$

where $\hat{\delta}(\hat{p},\hat{q}_1,\hat{q}_2,\ldots,\hat{q}_k)$ denotes the OLS estimates of δ in (A1) for the selected ARDL specification.

The ECM representation associated with the implied ARDL model can be obtained by writing (A1) in terms of the lagged levels and the first differences of y_t, $x_{1t}, \ldots, x_{st}$ and w_t.

Based on (A4) and (A5) the error correction term EC_t is defined by

$$EC_t = y_t - \sum_{i=1}^{k} \hat{\theta}_i x_{it} - \hat{\psi}' w_t. \tag{A6}$$

Appendix II

Budget Deficit Sustainability

Table 1

Unit-Root Tests for the Variables

Table 1

Augmented Dickey-Fuller (ADF) Unit Root Tests

Variables	Levels	
	Without Trend	With Trend
LRS (2)	0.720	-2.784
LGS (2)	0.484	-1.859
LXS (2)	-0.826	-2.980
LMS (2)	-0.647	-2.313
Critical Values at 5%	-2.293	-3.511
Variables	First Differences	
	Without Trend	With Trend
DLRS (1)	-6.939	-7.192
DLGS (1)	-7.616	-7.642
DLXS (1)	-5.412	-5.330
DLMS (1)	-7.025	-6.913
Critical Values at 5%	-2.928	-3.514

Notes:

1) The number of lags (indicating in the parentheses in the first column), used for the calculation of the ADF statistics, is based on the Schwarz Bayesian Criterion (SBC) provided by Microfit.

Table 2

Testing the Existence of a Long Run Relationship

Dependent Variable	K	AIC Lags	F-Statistic	Intercept	Trend	Bounds Testing (at 90%)	Outcome
F(LRS/ LGS)	1	1	F(2, 36)= 4.551[.016]	Yes	No	Lower: 4.042 Upper: 4.788	No clear evidence

Table 3

Autoregressive Distributed Lag Estimates

```
                    Autoregressive Distributed Lag Estimates
              ARDL(2,0) selected based on Akaike Information Criterion
*********************************************************************************
Dependent variable is LRS
45 observations used for estimation from 1996Q1 to 2007Q1
*********************************************************************************
Regressor            Coefficient         Standard Error          T-Ratio[Prob]
LRS(-1)               .12671              .12675                  .99966[.323]
LRS(-2)               .47635              .12766                  3.7313[.001]
LGS                   .49314              .14582                  3.3819[.002]
C                     .016396             .013347                 1.2284[.226]
*********************************************************************************
R-Squared                  .92828            R-Bar-Squared                .92303
S.E. of Regression         .083217           F-stat.  F( 3, 41)    176.8796[.000]
Mean of Dependent Variable .026143           S.D. of Dependent Variable   .29995
Residual Sum of Squares    .28393            Equation Log-likelihood     50.1262
Akaike Info. Criterion     46.1262           Schwarz Bayesian Criterion  42.5128
DW-statistic               1.9742
*********************************************************************************
                              Diagnostic Tests
*********************************************************************************
*   Test Statistics  *          LM Version      *              F Version        *
*********************************************************************************

* A:Serial Correlation         CHSQ( 4)= 2.7425[.602]      F( 4, 37)=  .60031[.665]

* B:Functional Form            CHSQ( 1)= .088206[.766]     F( 1, 40)=  .078559[.781]

* C:Normality                  CHSQ( 2)= .99541[.608]          Not applicable

* D:Heteroscedasticity         CHSQ( 1)= .14159[.707]      F( 1, 43)=  .13573[.714]
*********************************************************************************
```

Table 4

Estimated Long Run Coefficients using the ARDL Approach

```
                Estimated Long Run Coefficients using the ARDL Approach
                   ARDL(2,0) selected based on Akaike Information Criterion
*****************************************************************************
Dependent variable is LRS
45 observations used for estimation from 1996Q1 to 2007Q1
*****************************************************************************
Regressor          Coefficient          Standard Error          T-Ratio[Prob]
LGS                 1.2423                 .14068                 8.8311[.000]
C                   .041305                .040150                1.0288[.310]
*****************************************************************************
```

Table 5

Wald test of restriction(s) imposed on parameters

```
Based on long run ARDL regression of LRS on:
LGS          C
45 observations used for estimation from 1996Q1 to 2007Q1
*****************************************************************************
Coefficients A1 to A2 are assigned to the above regressors respectively.
List of restriction(s) for the Wald test:
a1=1;
*****************************************************************************
Wald Statistic          CHSQ( 1)= 2.9677[.085]
*****************************************************************************
```

Table 6

Error Correction Representation for the Selected ARDL Model

```
                 Error Correction Representation for the Selected ARDL Model
                    ARDL(2,0) selected based on Akaike Information Criterion
*******************************************************************************
Dependent variable is dLRS
45 observations used for estimation from 1996Q1 to 2007Q1
*******************************************************************************
Regressor          Coefficient        Standard Error        T-Ratio[Prob]
dLRS1               -.47635              .12766              -3.7313[.001]
dLGS                 .49314              .14582               3.3819[.002]
dC                   .016396             .013347              1.2284[.226]
ecm(-1)             -.39694              .13023              -3.0480[.004]
*******************************************************************************


ecm       = LRS  -1.2423*LGS  -.041305*C
*******************************************************************************
R-Squared                    .54772          R-Bar-Squared                .51462
S.E. of Regression           .083217         F-stat.  F( 3, 41)     16.5505[.000]
Mean of Dependent Variable   .020725         S.D. of Dependent Variable    .11945
Residual Sum of Squares      .28393          Equation Log-likelihood    50.1262
Akaike Info. Criterion      46.1262          Schwarz Bayesian Criterion 42.5128
DW-statistic                1.9742
*******************************************************************************
```

Graph 1

Plot of Cumulative Sum of Recursve Residuals
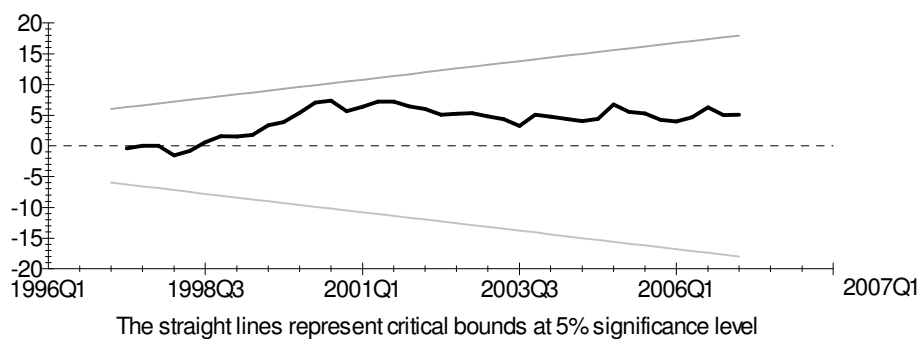
The straight lines represent critical bounds at 5% significance level

Plot of Cumulative Sun of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level
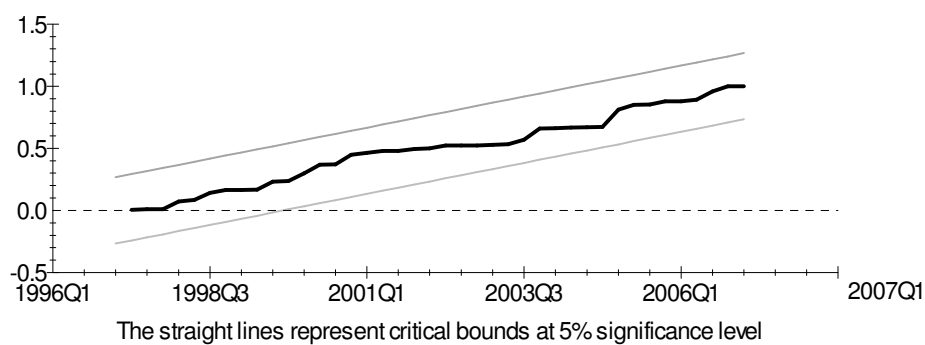
Trade Deficit Sustainability

Table 7

Testing the Existence of a Long Run Relationship

Dependent Variable	K	AIC Lags	F-Statistic	Intercept	Trend	Bounds Testing (at 90%)	Outcome
F(LXS/ LMS)	1	1	F(2, 36)= 5.321[.009]	Yes	No	Lower: 4.042 Upper: 4.788	Cointegration Exists

Table 8

Autoregressive Distributed Lag Estimates

```
                    Autoregressive Distributed Lag Estimates
               ARDL(4,0) selected based on Akaike Information Criterion
*****************************************************************************
Dependent variable is LXS
45 observations used for estimation from 1996Q1 to 2007Q1
*****************************************************************************
Regressor          Coefficient       Standard Error       T-Ratio[Prob]
LXS(-1)            .36845            .12334               2.9872[.005]
LXS(-2)            .014055           .15263               .092085[.927]
LXS(-3)            -.60421           .15433               -3.9152[.000]
LXS(-4)            .46622            .12585               3.7046[.001]
LMS                .71920            .14612               4.9219[.000]
C                  .0085695          .0098536             .86968[.390]
*****************************************************************************
R-Squared                     .94796        R-Bar-Squared                   .94129
S.E. of Regression            .050226        F-stat.  F( 5,  39)    142.0983[.000]
Mean of Dependent Variable    .032191        S.D. of Dependent Variable    .20729
Residual Sum of Squares       .098383        Equation Log-likelihood       73.9727
Akaike Info. Criterion        67.9727        Schwarz Bayesian Criterion  62.5528
DW-statistic                  1.6540
*****************************************************************************

                                Diagnostic Tests
*****************************************************************************
*   Test Statistics  *          LM Version     *             F Version        *
*****************************************************************************

* A:Serial Correlation          CHSQ(  4)=  4.9696[.290]       F(  4, 35)=  1.0863[.378]

* B:Functional Form             CHSQ(  1)=  2.0788[.149]       F(  1, 38)=  1.8404[.183]

* C:Normality                   CHSQ(  2)=  .88844[.641]          Not applicable

* D:Heteroscedasticity          CHSQ(  1)=  .29873[.585]       F(  1, 43)=  .28736[.595]
*****************************************************************************
```

Table 9

Estimated Long Run Coefficients using the ARDL Approach

```
                Estimated Long Run Coefficients using the ARDL Approach
                  ARDL(4,0) selected based on Akaike Information Criterion
*******************************************************************************
Dependent variable is LXS
45 observations used for estimation from 1996Q1 to 2007Q1
*******************************************************************************
Regressor            Coefficient          Standard Error          T-Ratio[Prob]
LMS                    .95198                .048003              19.8316[.000]
C                      .011343               .014390                .78823[.435]
*******************************************************************************
```

Table 10

Wald test of restriction(s) imposed on parameters

```
                  Wald test of restriction(s) imposed on parameters
*******************************************************************************
Based on long run ARDL regression of LXS on:
LMS           C
45 observations used for estimation from 1996Q1 to 2007Q1
*******************************************************************************
Coefficients A1 to A2 are assigned to the above regressors respectively.
List of restriction(s) for the Wald test:
a1=1;
*******************************************************************************
Wald Statistic           CHSQ( 1)=   1.0009[.317]
*******************************************************************************
```

Table 11

Error Correction Representation for the Selected ARDL Model

```
                Error Correction Representation for the Selected ARDL Model
                    ARDL(4,0) selected based on Akaike Information Criterion
************************************************************************************
Dependent variable is dLXS
45 observations used for estimation from 1996Q1 to 2007Q1
************************************************************************************
Regressor           Coefficient        Standard Error        T-Ratio[Prob]
dLXS1                 .12393               .14523               .85334[.399]
dLXS2                 .13799               .14251               .96828[.339]
dLXS3                -.46622               .12585              -3.7046[.001]
dLMS                  .71920               .14612               4.9219[.000]
dC                    .0085695             .0098536             .86968[.390]
ecm(-1)              -.75549               .15218              -4.9644[.000]
************************************************************************************
 ecm      = LXS  -.95198*LMS  -.011343*C
************************************************************************************
R-Squared                    .64204          R-Bar-Squared              .59615
S.E. of Regression           .050226         F-stat.  F( 5, 39)  13.9903[.000]
Mean of Dependent Variable   .015500         S.D. of Dependent Variable  .079035
Residual Sum of Squares      .098383         Equation Log-likelihood    73.9727
Akaike Info. Criterion       67.9727         Schwarz Bayesian Criterion  62.5528
DW-statistic                 1.6540
************************************************************************************
```
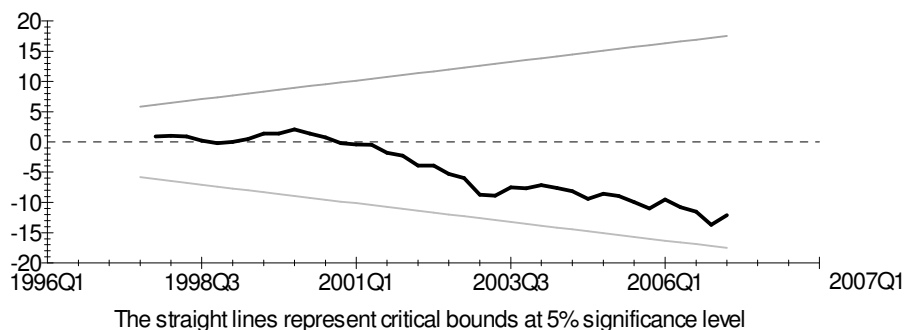
Graph 2

Plot of Cumulative Sum of Recursve Residuals

The straight lines represent critical bounds at 5% significance level

Plot of Cumulative Sun of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level