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On the Dynamics of the Greek Twin Deficits: Empirical evidence over the period 1960 – 2007

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Abstract

One of the most important open macroeconomic issues, during the current global economic recession, concerns the sustainability of persistent budget and trade deficits as well as possible interactions between them. These deficits are most crucial due to severe debt servicing costs, faced by today's economies despite their development level. This paper presents time series evidence over the period 1960 up to 2007, using data of the Greek Economy. Our results confirm 'weak' sustainability of both deficits and evidence in favor of the Keynesian rationale regarding the 'twin deficits hypothesis'.

Keywords: Budget and Trade Deficits, Sustainability, Twin Deficits Hypothesis, Cointegration, Greek Economy (1960-2007).

JEL classification: C22, F32, F41, H62.

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 advanced and developing economies. These threatening economic characteristics of today's global recession 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. In particular, 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 an inexorable necessity for financial discipline and control over the public deficit (e.g. Hakkio and Rush, 1991; Haug, 1991).

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Evidently, 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).

Actually, conflicting empirical evidence in the relevant literature does exist on the issue of twin deficits. Bartolini and Lahiri (2006) claim that fiscal deficit reductions in the United States can play only a limited role in correcting the nation's current account imbalance. Their estimates suggest that even if the federal fiscal deficit were fully erased, the nation's current account deficit could improve by only a minimal fraction of its running level. On the contrary, Salvatore (2006) shows that a direct relationship exists between the budget and the current account deficits for all the seven largest and most important industrial countries (USA, Japan, Germany, UK, France, Italy and Canada), with budget deficits leading to current account deficits by one or more years. Normandin (1999), working on the Canadian and the USA economies, also proves that by increasing the budget deficit, through tax cuts, external deficit increases; whereas, these causal responses are positively affected by the degree of the birth rate and the degree of persistence of the budget deficit.

In this study, we investigate the sustainability of twin deficits of the Greek economy, as a first attempt for the period from 1960 and up to 2007. We intentionally leave the current crisis years 2008 – 2009 outside our recent focus, for certain reasons. Namely, we leave the economic storm to calm down, dramatic governmental and economic decisions upon structural reforms to be made, robust and unbiased economic data to emerge, and as long as the economy returns back to its EU Stability and Growth Pact responsibilities, we need to reassess further the challenges that lie ahead.

Accordingly, our objectives here focus on: i) testing for the sustainability of the Greek budget and trade deficits, over the selected time period from 1960 up to 2007, thus adding to the relevant empirical literature and, ii) investigating possible causal linkages between the two deficits in Greece and the directions of the detected causal effects, thus contributing to the ongoing debate regarding the 'twin deficits hypothesis', on both theoretical and empirical aspects.

This paper is divided into four consecutive sections. Namely, Section (2) describes briefly the deficits issue within the Greek Economy. Section (3), presents the theoretical foundation of the sustainability concept for both deficits considered. Section (4) focuses upon the data and empirical results; whereas, last section (5) provides a short summary and conclusions. At the appendix we present our econometric results and relevant statistics.

2. A Brief Reference on the Greek Economy

Beginning from the 1960's, the budget deficit of the Greek economy was growing at low levels, varying from 1.62% of GDP in fiscal year 1960, to 1.52% in 1970, with the highest level in 1968, at 1.92%. At the same decade, the trade deficit varied from 7.6% in 1960, to 7.18% in 1970, with its highest level in 1965, at 11.35%.

The most important event of the decade was the association-for-entry agreement of Greece with the European Economic Community (1962). That agreement demanded gradual reduction of tariffs that created negative impacts on the trade balance. Also, the expansionary fiscal policy influenced income growth and imports' expenditure positively.

The military dictatorship imposed in Greece, over the period 1967-1974, implemented massive public expenditure programs for infrastructure, which contributed to a large increase of G.D.P. (16% for the referred period), resulting to an increase in the budget deficit from 1.71% in 1971, to 3.35% in 1975. The trade deficit remained high and worsened even more, due to the petroleum crisis of 1973, thus having an average of 6.5% during the 1970-1980 period.

The decade 1980-1990, coincides with three important events for Greece, namely: (a) the accession of Greece in the European Economic Community (1981), (b) the second international petroleum crisis (1980) and, (c) the rise of the Greek socialists to power (1981). The failure of the privatization program during the 80's, combined with overall stagnation, has contributed to the high rise of the Greek budget deficit up to 10.34% in 1985. The 1985-1987 stabilization program and the devaluation of the national currency were not sufficient to reverse the aforementioned situation. The budget deficit remained at very high levels, closing at 14.07% in 1989. The trade deficit had been affected also by the petroleum crisis of 1980, reaching 7.83% in 1989, and 9.82% in 1990. Evidently, the huge deficits of the 1980's and the early 1990's, have resulted in exploding debt levels from 24.6 % of GDP in 1976 to 111.3 % in 1996.

In the 1990's, the new conservative government enforced a new stabilization program with minimal results. The socialist government that followed in 1993 implemented the first 'economic convergence to the E.U. standards' program (1993-1998). The goal for Greece was to comply with the economic criteria set by the European Union, at the Maastricht treaty. In addition, European funds helped the Greek economy to achieve a 10% GDP rise average through the entire decade.

The first economic convergence program was followed by a second one (1998-2001), and both programs managed to gradually reduce the budget deficit from 20.79% in fiscal year 1994, to 8.11% in 1997 down to 5.79% in 2000. However, the trade deficit remained at high levels, from 6.23% in 1994, to 13.5% in 2000.

In fact, the basic developments during 1997-2000 that helped decreasing the debt-to-GDP ratio were the following:

(a) Deficits' decline from 10.2 % of GDP in 1995 to less than 1.0 per cent in 2000, while primary surplus increased from 1.0 per cent of GDP in 1995 to around 6.5 per cent in 2000.

(b) Inflation fell from 8.9 per cent in 1995 to 2.5 per cent in 2000, thus reducing nominal interest rates and,

(c) 10-year fixed-interest rate bonds introduced in June 1997 reduced further the interest rates and ended heavy governmental reliance on short-term borrowing.

These three factors then, along with intensive privatization, all favorably affected debt and deficit reduction (Manessiotis and Reischauer, 2001, 122-123).

The recent economic period 2001-2007 is probably the most interesting. The most important fact of this era is the accession of Greece to the European Economic and Monetary Union, and the adoption of the new euro-currency. The fiscal discipline, due to the continuous need for compliance with the Maastricht treaty, resulted in preserving the budget deficit at low levels during 2001-2002. However, the organization of the 2004 Olympics, with their huge public spending, had a negative effect on the budget deficit that reached 9.47% in 2004.

During the recent years and up to the half of the running decade, Greece emerged as one of the fastest growing countries in E.U. Greece succeeded in reducing inflation from double-digit to low single-digit rates during the first half of this decade, eliminated fiscal imbalances and the country joined the euro area by January 2001.

The country's economic performance has changed dramatically by the end of the second half of this decade, partly due to the current economic turmoil and mostly due to its unresolved structural economic deficiencies, such as the chronic imbalances of the social security system. Thus, big failures to stand by the Maastricht Stability and Growth Pact and to cure accumulated structural deficiencies have resulted in explosive debt and deficit problems, along with deepening recession.

The above facts led Greece being under continuous supervision from the European Commission. The trade deficit still remained high at 13.16% in 2001, and 10.49% in 2007, thus indicating a continuous lack of economic competitiveness. Along these lines, a sustainable downward path of debt to GDP ratio can be obtained by substantial expenditure cuts and serious reduction of primary spending, along with sustainable social security system reforms and restructuring (*ibid*).

3. The Concept of Sustainability: Basic Theoretical Issues

3.1 Trade Deficit Sustainability

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

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

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 and Rush, 1991; Husted, 1992):

$$D_0 = \sum_{t=1}^{\infty} d_t (X_t - M_t) + \lim_{n \to \infty} d_n D_n \ , \qquad (2)$$

with d_t being the future external surpluses discount coefficient. In (2) 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 (1) iD_{t-1}, we get:

$$M_t + i_t D_{t-1} = X_t + \sum_{j=0}^{\infty} \lambda^{j-1} (\Delta X_{t+j} - \Delta E_{t+j}) + \lim_{j \to \infty} \lambda^{t+j} D_{t+j}, \qquad (3)$$

where:

$E = M_t + (i_t - I) D_{t-1}$, whereas the left part of (3) 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, (3) above can be transformed as follows:

$$M_t + iD_{t-1} = a + X_t + \lim_{j \to \infty} \lambda^{t+j} D_{t+j} + e_t, \qquad (4)$$

subtracting X_t from both sides of (4) 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:

$$X_t = a + \beta MM_t + e_t, \qquad (5)$$

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 (5) 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.

3.2 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:

$$G_t + (1 + r_t)B_{t-1} = R_t + B_t, \tag{6}$$

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 (6) above, give the following relation for the inter-temporal budget constraint:

$$B_t = \sum_{s=0}^{\infty} \prod_{i=1}^{s} (1 + r_{t+i})^{-1} (R_{t+s} - G_{t+s}) + \lim_{s \to \infty} \prod_{i=1}^{s} (1 + r_{t+i})^{-1} B_{t+s}. \tag{7}$$

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:

$$\lim_{s \to \infty} (1 + r)^{-s} B_{t+s} = 0\,. \tag{8}$$

The above formula (8) 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 (7) and (8) above 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, (8) will be satisfied.

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

$$R_t = a_1 + \beta_1 G_t + u_t\,, \tag{9}$$

where:

$\beta_1 \leq 1$, 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 $0 \prec \beta_1 \prec 1$,
- the deficit is not sustainable if $\beta_1 \leq 0$.

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.

4. Data and Empirical Results

Our empirical analysis engages annual data of the Greek economy, taken from the IFS (IMF) database and the period covered runs from 1960 to 2007. The key variables used for the investigation of the budget deficit sustainability first are the log of the nominal government spending (LEX) and the log of the nominal government revenues (LRE). For the case of the trade deficit sustainability, the analysis involves the log of the Greek exports (LXP) and, the log of the Greek imports (LIM) accordingly. Finally, for the investigation of the twin deficits hypothesis, the budget deficit (LBB) and the trade deficit (LTB) are used in logarithmic form.

4.1 Integration Analysis

We apply the traditional cointegration methodology proposed by Johansen (1988 and 1989), which requires stationary variables of integration order of one, I(1). Accordingly, in the first step we apply Dickey and Fuller's (1979), unit root tests. The results of the unit root test on the levels and the first differences of the variables are presented in tables 2 and 3. The results reveal that the selected variables are integrated of order I(1), therefore we proceed with the investigation of a possible long-run equilibrium between the examined variables, by means of the maximum likelihood methodology proposed by Johansen (1988) and Johansen & Juselious (1990, 1992).

4.2 Trade deficit analysis

Initially, we proceed by testing for cointegration between exports and imports (LIM, LXP). In order to apply the Johansen's cointegration methodology, we must first determine the order of the VAR to be estimated, through the use of the Schwarz Bayesian criterion. The results indicate that a VAR(3) is the most appropriate.

Table 4 presents the results of the cointegration test, which are based on criteria of the trace and maximal eigenvalue of the Stochastic Matrix. The results confirm the hypothesis of cointegration between LIM and LXP, at the 5% significance level. The cointegrating vector is presented in Table 5.

Based on the cointegrating vector, the long-run relationship between LIM and LXP can be written as follows:

$$LXP = 0.91970\ LIM \qquad (10)$$

In the next step, we continue with the estimation of the error correction models for the involved variables (Tables 6 and 8).

From Table 6, with exports as the dependent variable, we observe that the coefficient of the lagged EC term is statistically significant and has the correct negative sign, suggesting that any deviation from the long-term path is corrected each year by 43 %. Thus, we confirm the existence of a long-run causal effect running from imports towards exports. When imports is the dependent variable, from the respective error correction model reported in Table 8, we observe that the coefficient of the lagged EC term is also statistically significant at the 1% level, and has the correct negative sign, suggesting that any deviation from the long-term path is corrected by 25 % each year. Therefore, a long-run causal effect from exports to imports is verified as well. Conclusively, our results suggest the existence of a bidirectional long-run causal relationship between imports and exports.

Regarding the short-run period, after applying Granger causality tests, by means of the Wald x2 statistic (Tables 7 and 9), we do not find evidence of any statistically significant causal effect, either from imports to exports, or vice versa.

Finally, we proceed with testing trade deficit for sustainability, based on Quintos (1995), analysis. Table 10 presents the likelihood ratio statistic test applied on the β coefficient of the long-run equilibrium relationship. The null hypothesis is rejected and thus we conclude that the Greek trade deficit exhibits weak sustainability over the examined sample period.

4.3 Budget deficit analysis

Similar to the above analysis, we next proceed by investigating the relationship between Greek government revenues and spending, as well as the concept of Greek fiscal policy sustainability.

Once again, with the use of the Schwarz Bayesian criterion, a VAR(3) model is selected. The results from the cointegration test are presented in Table 11 and confirm the hypothesis of cointegration between LRE and LEX, at the 5% significance level.

The cointegrating vector is presented in Table 12. Accordingly, the long-run relationship between LRE and LEX is written as below:

$$LRE = 0.62506 + 0.90906\ LEX \qquad (11)$$

Tables 13 and 15 describe the estimation of the respective error correction models for the two considered variables.

Table 13 indicates that the coefficient of the lagged EC term is statistically significant and has the correct negative sign, suggesting that any deviation from the long-term path is corrected each year by 20 %. We accept the existence of a long-run causal effect from government spending to revenues. In Table 15, the coefficient of the lagged EC term is found statistically significant at the 2.5% level having the correct negative sign, thus suggesting that any deviation from the long-term path is corrected each year by 18 %. Therefore, the existence of a long-run causal effect, directed from government revenues to spending, is also confirmed. Conclusively, we have confirmed a bi-directional long-run causal relationship between Greek government revenues and spending.

Regarding the short-run period, after applying Granger causality tests (Tables 14 and 16), we find statistically significant short-run causal effects running from revenues to spending at the 2% significance level, but not from spending to revenues.

Finally, Table 17 presents the test for sustainability, based on Quintos (1995) analysis, for the β coefficient in the cointegration equation of the budget deficit. The likelihood ratio, at the 1% level of significance, indicates that the null hypothesis is rejected and so we conclude that the Greek budget deficit could be also considered as weakly sustainable over the sample period.

4.4 The twin deficits hypothesis

In this final section, we investigate the twin deficits hypothesis for Greece, by testing for cointegration between the trade and budget deficit. Having identified the two variables to be integrated of order I(1), we test for cointegration, using a VAR(2), chosen by means of the Schwarz Bayesian Criterion. Table 18 presents the results of the cointegration tests that indicate the possible existence of a long-run equilibrium relationship between the variables LBB and LTB.

From the cointegrating vector, presented in Table 19, the long-run relationship among the Greek twin deficits is as follows:

$$LTB = 0.46749\ LBB \qquad (12)$$

The results obtained from the error correction model for DLTB (Table 20) show that the lagged EC term in this equation is statistically significant and has the correct negative sign suggesting that, any deviation from the long-run equilibrium path is corrected each year by 78 %. Therefore, a long-run causal effect running from budget deficit to trade deficit is confirmed. Regarding the short-run dynamics, there is also evidence of a causal effect running from budget deficit to trade deficit, as the coefficient of the lagged budget deficit is found statistically significant at the 2%.

On the other hand, no evidence of a long-run or short-run causality is detected running from trade deficit towards budget deficit. From the respective error correction model, the lagged EC term is not negative and statistically insignificant (Table 21), suggesting that a long-run causal effect running from trade deficit to budget deficit does not exist. Furthermore, as the coefficient of the trade deficit in the error correction model is not statistically significant, no evidence of a short-run causal effect is concluded as running from trade deficit to budget deficit.

In general, the twin deficits hypothesis is confirmed for the Greek case, with causality running from the budget deficit to the trade deficit, within both the long and short-run time horizons. Thus, our findings are consistent with the rationale of the Keynesian proposition and support the view that policy measures which are able to reduce the budget deficit may also contribute to the reduction of the trade deficit.

5. Summary and Conclusions

Summarizing our work, we restate that using annual data over the selected 1960-2007 period for the Greek Economy, our analysis attempts to investigate both the budget and trade deficit for sustainability. In fact, we attempt to provide evidence regarding the well known 'twin deficits hypothesis', using time series techniques. We intentionally pursue our empirical research leaving outside the serious recession years of 2008-2009 for certain reasons, namely; we leave: (a) the economic storm to calm down and clear evidence to appear, (b) robust and unbiased new economic data to emerge, (c) dramatic governmental and economic decisions upon structural reforms to be made, and, (d) as long as the economy returns back to its E.U. Stability and Growth Pact responsibilities, we need to reassess the new and risky challenges that lie ahead with respect to the twin deficits sustainability in the future.

Thus, our findings provide substantial statistical evidence that over the examined time span and before the current explosion of the global economic recession, the Greek Economy shows clearly that both budget and trade deficit sustainability holds, *though in the 'weak' form following Quintos terminology.*

The 'twin-deficits-hypothesis' is confirmed for the Greek case, *for the specific time span considered*, thus providing evidence consistent with the rationale of the Keynesian proposition, while suggesting that policy measures that are able to reduce the budget deficit should be seriously considered by economic policy authorities in order to reduce the trade deficit.

Furthermore, a serious economic challenge for the Greek economy seems to be the aging related heavy public expenditure that threatens the long-run sustainability of the social security financing. Moreover, increasing labor productivity, maintaining wages at competitive levels and, promoting disciplined fiscal policies could restrain current account deficits. Finally, a sustainable downward path of debt-to-GDP ratio can be obtained by substantial state expenditure cuts and serious reduction of primary spending, along with sustainable social security and state tax systems' reforms and restructuring.

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Appendix

Table 1: Empirical Results for the Greek economy of the period 1960-2007

Relationship	**Cointegra-tion?**	**Long-run Relationship**	**Short-run Relationship**	**Sustaina-bility?**
Imports-Exports	Yes	Yes, bi-directional	No, in both directions	Yes, weak
Government Revenues-Expenses	Yes	Yes, bi-directional	Yes, from revenues to spending No, from spending to revenues	Yes, weak
Budget Deficit-Trade Deficit	Yes	Yes, from the budget deficit to the trade deficit No, from the trade deficit towards the budget deficit.	Yes, from the budget deficit to the trade deficit No, from the trade deficit towards the budget deficit	n.a.

Table 2: Unit root tests on the levels of the variables

Variables	Include an intercept but not a trend, critical value 5% = -2,9287	Include an intercept and a linear trend, critical value 5% = -3,5136
	ADF Statistic	ADF Statistic
LIM	-1,2631 (1)	-0,68012 (1)
LXP	-1,4684 (1)	-0,62639 (1)
LTB	-0,50755(0)	-2,63090 (0)
LRE	-1,6998 (1)	0,16062 (1)
LEX	-1,7933 (1)	0,31994 (1)
LBB	-1,5756 (*)	-0,47233 (0)

Table 3: Unit root tests on the first differences of the variables

Variables	Include an intercept but not a trend, critical value 5% = -2,9287	Include an intercept and a linear trend, critical value 5% = -3,5136
	ADF Statistic	ADF Statistic
DLIM	-4.4685 (0)	-4.6269 (0)
DLXP	-4.5305 (0)	-5.2867 (1)
DLTB	-7.6839 (0)	-7.5868 (0)
DLRE	-3.8586 (0)	-4.2047 (0)
DLEX	-4.1192 (0)	-4.5237 (0)
DLBB	-6.4568 (0)	-6.6790 (0)

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Table 4: Cointegration with no intercepts or trends in the VAR

```
             Cointegration with no intercepts or trends in the VAR
   Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LXP             LIM
 List of I(0) variables included in the VAR:
 OIL
 List of eigenvalues in descending order:
.37357    .010342
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r = 1        21.0472           11.0300                9.2800
 r<= 1      r = 2         .46779            4.1600                3.0400
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).



             Cointegration with no intercepts or trends in the VAR
          Cointegration LR Test Based on Trace of the Stochastic Matrix
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LXP             LIM
 List of I(0) variables included in the VAR:
 OIL
 List of eigenvalues in descending order:
.37357    .010342
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r>= 1        21.5150           12.3600               10.2500
 r<= 1      r = 2         .46779            4.1600                3.0400
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).
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Table 5: Estimated Cointegrated Vectors in Johansen Estimation

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Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
             Cointegration with no intercepts or trends in the VAR
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LXP             LIM
 List of I(0) variables included in the VAR:
 OIL
*******************************************************************************
                  Vector  1
 LXP                  1.1804
                  (  -1.0000)

 LIM                 -1.0856
                  (   .91970)

*******************************************************************************
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Table 6: ECM for variable LXP estimated by OLS based on cointegrating VAR(3)

```
      ECM for variable LXP estimated by OLS based on cointegrating VAR(3)
*******************************************************************************
 Dependent variable is dLXP
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Regressor             Coefficient       Standard Error         T-Ratio[Prob]
 dLXP1                     .27234              .17698              1.5388[.132]
 dLIM1                     .11136              .21826              .51020[.613]
 dLXP2                   -.085242              .16814             -.50697[.615]
 dLIM2                    -.25108              .20887             -1.2021[.237]
 ecm1(-1)                 -.43271             .090505             -4.7810[.000]
 OIL                       .35488             .067587              5.2508[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLXP = LXP-LXP(-1)
 dLXP1 = LXP(-1)-LXP(-2)
 dLIM1 = LIM(-1)-LIM(-2)
 dLXP2 = LXP(-2)-LXP(-3)
 dLIM2 = LIM(-2)-LIM(-3)
 ecm1 =    1.1804*LXP   -1.0856*LIM
*******************************************************************************
 R-Squared                      .44739   R-Bar-Squared                   .37654
 S.E. of Regression            .090505   F-stat.    F(  5,  39)    6.3149[.000]
 Mean of Dependent Variable     .16202   S.D. of Dependent Variable      .11462
 Residual Sum of Squares        .31946   Equation Log-likelihood        47.4732
 Akaike Info. Criterion        41.4732   Schwarz Bayesian Criterion     36.0532
 DW-statistic                   1.7716   System Log-likelihood         106.6639
*******************************************************************************

                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   1.7452[.186]*F(   1,  38)=   1.5332[.223]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   .37537[.540]*F(   1,  38)=   .31964[.575]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   1.9199[.383]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   .42645[.514]*F(   1,  43)=   .41139[.525]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Table 7: Wald test of restriction(s) imposed on parameters

```
  Wald test of restriction(s) imposed on parameters
*******************************************************************************
 Based on CVAR regression of dLXP on:
 dLXP1           dLIM1           dLXP2           dLIM2           ecm1(-1)
 OIL
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Coefficients A1 to A6 are assigned to the above regressors respectively.
 List of restriction(s) for the Wald test:
                      a2=0; a4=0;
*******************************************************************************
 Wald Statistic                  CHSQ( 2)=   1.7542[.416]
```

Table 8: ECM for variable LIM estimated by OLS based on cointegrating VAR(3)

```
     ECM for variable LIM estimated by OLS based on cointegrating VAR(3)
*******************************************************************************
 Dependent variable is dLIM
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLXP1                      .15934             .18330              .86927[.390]
 dLIM1                      .12596             .22605              .55723[.581]
 dLXP2                      .22992             .17414              1.3203[.194]
 dLIM2                     -.29960             .21633             -1.3850[.174]
 ecm1(-1)                  -.25526            .093735             -2.7232[.010]
 OIL                        .24257            .069999              3.4653[.001]
*******************************************************************************
 List of additional temporary variables created:
 dLIM = LIM-LIM(-1)
 dLXP1 = LXP(-1)-LXP(-2)
 dLIM1 = LIM(-1)-LIM(-2)
 dLXP2 = LXP(-2)-LXP(-3)
 dLIM2 = LIM(-2)-LIM(-3)
 ecm1 =    1.1804*LXP   -1.0856*LIM
*******************************************************************************
 R-Squared                    .16617   R-Bar-Squared                   .059268
 S.E. of Regression          .093735   F-stat.    F(  5,  39)    1.5544[.196]
 Mean of Dependent Variable   .15798   S.D. of Dependent Variable     .096642
 Residual Sum of Squares      .34266   Equation Log-likelihood        45.8954
 Akaike Info. Criterion      39.8954   Schwarz Bayesian Criterion     34.4754
 DW-statistic                 1.8393   System Log-likelihood         106.6639
*******************************************************************************

                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   1.6751[.196]*F(   1,  38)=   1.4692[.233]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   2.6972[.101]*F(   1,  38)=   2.4229[.128]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   5.6521[.059]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   3.7031[.054]*F(   1,  43)=   3.8559[.056]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Table 9: Wald test of restriction(s) imposed on parameters

```
Wald test of restriction(s) imposed on parameters
*******************************************************************************
 Based on CVAR regression of dLIM on:
 dLXP1           dLIM1           dLXP2           dLIM2           ecm1(-1)
 OIL
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Coefficients A1 to A6 are assigned to the above regressors respectively.
 List of restriction(s) for the Wald test:
                         a1=0; a3=0;
*******************************************************************************
 Wald Statistic                  CHSQ( 2)=   2.5845[.275]
*******************************************************************************
```

Table 10: Restricted Cointegrated Vectors in Johansen Estimation

```
Restricted Cointegrated Vectors in Johansen Estimation(Normalized in Brackets)
             Cointegration with no intercepts or trends in the VAR
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LXP            LIM
 List of I(0) variables included in the VAR:
 OIL
*******************************************************************************
 List of imposed restriction(s) on cointegrating vectors:
 -1 1
*******************************************************************************
                  Vector  1
 LXP                 -1.0000
                  (  -1.0000)

 LIM                  1.0000
                  (   1.0000)

*******************************************************************************
 LR Test of Restrictions          CHSQ( 1)=  14.4165[.000]
*******************************************************************************
```

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Table 11: Cointegration with restricted intercepts and no trends in the VAR

```
Cointegration with restricted intercepts and no trends in the VAR
   Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3.
 List of variables included in the cointegrating vector:
 LRE             LEX             Intercept
 List of I(0) variables included in the VAR:
 OIL
 List of eigenvalues in descending order:
.33037     .13167      .0000
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r = 1        18.0461           15.8700                13.8100
 r<= 1      r = 2         6.3532            9.1600                 7.5300
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).


       Cointegration with restricted intercepts and no trends in the VAR
          Cointegration LR Test Based on Trace of the Stochastic Matrix
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3.
 List of variables included in the cointegrating vector:
 LRE             LEX             Intercept
 List of I(0) variables included in the VAR:
 OIL
 List of eigenvalues in descending order:
.33037     .13167      .0000
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r>= 1        24.3993           20.1800                17.8800
 r<= 1      r = 2         6.3532            9.1600                 7.5300
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).
```

Table 12: Estimated Cointegrated Vectors in Johansen Estimation

```
Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
       Cointegration with restricted intercepts and no trends in the VAR
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LRE             LEX             Intercept
 List of I(0) variables included in the VAR:
 OIL
*******************************************************************************
                  Vector  1
 LRE                  1.8533
                  (  -1.0000)

 LEX                 -1.6847
                  (   .90906)

 Intercept           -1.1584
                  (   .62506)

*******************************************************************************
```

Table 13: ECM for variable LRE estimated by OLS based on cointegrating VAR(3)

```
     ECM for variable LRE estimated by OLS based on cointegrating VAR(3)
*******************************************************************************
 Dependent variable is dLRE
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLRE1                    .0059447            .14195             .041880[.967]
 dLEX1                     .062860            .14468              .43449[.666]
 dLRE2                      .16410            .11703              1.4023[.169]
 dLEX2                     -.15652            .12893             -1.2140[.232]
 ecm1(-1)                  -.20738           .049606             -4.1805[.000]
 OIL                        .11578           .028648              4.0416[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLRE = LRE-LRE(-1)
 dLRE1 = LRE(-1)-LRE(-2)
 dLEX1 = LEX(-1)-LEX(-2)
 dLRE2 = LRE(-2)-LRE(-3)
 dLEX2 = LEX(-2)-LEX(-3)
 ecm1 =    1.8533*LRE   -1.6847*LEX   -1.1584
*******************************************************************************
 R-Squared                      .64552   R-Bar-Squared                   .60008
 S.E. of Regression            .049606   F-stat.    F(  5,  39)   14.2041[.000]
 Mean of Dependent Variable     .15305   S.D. of Dependent Variable     .078442
 Residual Sum of Squares       .095971   Equation Log-likelihood        74.5311
 Akaike Info. Criterion        68.5311   Schwarz Bayesian Criterion     63.1111
 DW-statistic                   1.8336   System Log-likelihood         129.9504
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)= .3099E-4[.996]*F(   1,  38)= .2617E-4[.996]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   1.4386[.230]*F(   1,  38)=   1.2549[.270]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   1.1419[.565]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   2.5637[.109]*F(   1,  43)=   2.5978[.114]*
```

Table 14: Wald test of restriction(s) imposed on parameters

```
                Wald test of restriction(s) imposed on parameters
*******************************************************************************
 Based on CVAR regression of dLRE on:
 dLRE1          dLEX1          dLRE2          dLEX2          ecm1(-1)
 OIL
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Coefficients A1 to A6 are assigned to the above regressors respectively.
 List of restriction(s) for the Wald test:
 a2=0; a4=0;
*******************************************************************************
 Wald Statistic                  CHSQ( 2)=   2.2357[.327]
*******************************************************************************
```

Table 15: ECM for variable LEX estimated by OLS based on cointegrating VAR(3)

```
ECM for variable LEX estimated by OLS based on cointegrating VAR(3)
*******************************************************************************
 Dependent variable is dLEX
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLRE1                    -.017140            .22418          -.076456[.939]
 dLEX1                    -.073115            .22849           -.31999[.751]
 dLRE2                      .50986            .18482            2.7586[.009]
 dLEX2                     -.21677            .20363           -1.0645[.294]
 ecm1(-1)                  -.18265           .078345           -2.3314[.025]
 OIL                        .10097           .045245            2.2317[.031]
*******************************************************************************
 List of additional temporary variables created:
 dLEX = LEX-LEX(-1)
 dLRE1 = LRE(-1)-LRE(-2)
 dLEX1 = LEX(-1)-LEX(-2)
 dLRE2 = LRE(-2)-LRE(-3)
 dLEX2 = LEX(-2)-LEX(-3)
 ecm1 =    1.8533*LRE   -1.6847*LEX   -1.1584
*******************************************************************************
 R-Squared                      .40219   R-Bar-Squared                   .32555
 S.E. of Regression            .078345   F-stat.    F(  5,  39)    5.2477[.001]
 Mean of Dependent Variable     .15475   S.D. of Dependent Variable     .095397
 Residual Sum of Squares        .23938   Equation Log-likelihood        53.9661
 Akaike Info. Criterion        47.9661   Schwarz Bayesian Criterion     42.5461
 DW-statistic                   2.1411   System Log-likelihood         129.9504
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   2.3550[.125]*F(   1,  38)=   2.0985[.156]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   .13656[.712]*F(   1,  38)=   .11567[.736]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   .94326[.624]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   1.2431[.265]*F(   1,  43)=   1.2216[.275]*
```

Table 16: Wald test of restriction(s) imposed on parameters

```
   Wald test of restriction(s) imposed on parameters
*******************************************************************************
 Based on CVAR regression of dLEX on:
 dLRE1          dLEX1          dLRE2          dLEX2          ecm1(-1)
 OIL
 45 observations used for estimation from 1963 to 2007
*******************************************************************************
 Coefficients A1 to A6 are assigned to the above regressors respectively.
 List of restriction(s) for the Wald test:
 a1=0; a3=0;
*******************************************************************************
 Wald Statistic                  CHSQ( 2)=   7.6871[.021]
*******************************************************************************
```

Table 17: Restricted Cointegrated Vectors in Johansen Estimation

```
Restricted Cointegrated Vectors in Johansen Estimation(Normalized in Brackets)
       Cointegration with restricted intercepts and no trends in the VAR
*******************************************************************************
 45 observations from 1963 to 2007. Order of VAR = 3, chosen r =1.
 List of variables included in the cointegrating vector:
 LRE             LEX             Intercept
 List of I(0) variables included in the VAR:
 OIL
*******************************************************************************
 List of imposed restriction(s) on cointegrating vectors:
   -1 1 0.62506
*******************************************************************************
                  Vector  1
 LRE                 -1.0000
                  (  -1.0000)

 LEX                  1.0000
                  (   1.0000)

 Intercept            .62506
                  (   .62506)

*******************************************************************************
 LR Test of Restrictions          CHSQ( 2)=  15.0063[.001]
*******************************************************************************
```

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Table 18: Cointegration with unrestricted intercepts and no trends in the VAR

```
Cointegration with unrestricted intercepts and no trends in the VAR
   Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
*******************************************************************************
 46 observations from 1962 to 2007. Order of VAR = 2, chosen r =1.
 List of variables included in the cointegrating vector:
 LTB             LBB
 List of I(0) variables included in the VAR:
 DUM2            DUM5
 List of eigenvalues in descending order:
.30809    .022973
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r = 1        16.9418           14.8800                12.9800
 r<= 1      r = 2         1.0691            8.0700                 6.5000
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).



      Cointegration with unrestricted intercepts and no trends in the VAR
          Cointegration LR Test Based on Trace of the Stochastic Matrix
*******************************************************************************
 46 observations from 1962 to 2007. Order of VAR = 2, chosen r =1.
 List of variables included in the cointegrating vector:
 LTB             LBB
 List of I(0) variables included in the VAR:
 DUM2            DUM5
 List of eigenvalues in descending order:
.30809    .022973
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r>= 1        18.0109           17.8600                15.7500
 r<= 1      r = 2         1.0691            8.0700                 6.5000
*******************************************************************************
 Use the above table to determine r (the number of cointegratingvectors).
```

Table 19: Estimated Cointegrated Vectors in Johansen Estimation

```
Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
      Cointegration with unrestricted intercepts and no trends in the VAR
*******************************************************************************
 46 observations from 1962 to 2007. Order of VAR = 2, chosen r =1.
 List of variables included in the cointegrating vector:
 LTB             LBB
 List of I(0) variables included in the VAR:
 DUM2            DUM5
*******************************************************************************
                 Vector  1
 LTB                 .64553
                 (  -1.0000)

 LBB                -.30178
                 (   .46749)

*******************************************************************************
```

Table 20: ECM for variable LTB estimated by OLS based on cointegrating VAR(2)

```
      ECM for variable LTB estimated by OLS based on cointegrating VAR(2)
*******************************************************************************
 Dependent variable is dLTB
 46 observations used for estimation from 1962 to 2007
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                  1.5024             .38073              3.9460[.000]
 dLTB1                      .12292             .12990              .94624[.350]
 dLBB1                      .29606             .12151              2.4365[.019]
 ecm1(-1)                  -.78024             .20538             -3.7990[.000]
 DUM2                      -.42278             .21697             -1.9485[.058]
 DUM5                      .053802            .013769              3.9076[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLTB = LTB-LTB(-1)
 dLTB1 = LTB(-1)-LTB(-2)
 dLBB1 = LBB(-1)-LBB(-2)
 ecm1 =    .64553*LTB   -.30178*LBB
*******************************************************************************
 R-Squared                     .46471   R-Bar-Squared                    .39780
 S.E. of Regression            .20538   F-stat.    F(  5,  40)    6.9452[.000]
 Mean of Dependent Variable    .14952   S.D. of Dependent Variable      .26466
 Residual Sum of Squares       1.6872   Equation Log-likelihood        10.7570
 Akaike Info. Criterion        4.7570   Schwarz Bayesian Criterion     -.72891
 DW-statistic                  2.0722   System Log-likelihood           9.3303
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   .83253[.362]*F(   1,  39)=   .71885[.402]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   3.7773[.052]*F(   1,  39)=   3.4890[.069]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   3.0406[.219]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   2.9118[.088]*F(   1,  44)=   2.9735[.092]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Table 21: ECM for variable LBB estimated by OLS based on cointegrating VAR(2)

```
      ECM for variable LBB estimated by OLS based on cointegrating VAR(2)
*******************************************************************************
 Dependent variable is dLBB
 46 observations used for estimation from 1962 to 2007
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                 -.49704            .49787            -.99833[.324]
 dLTB1                     .025882            .16987             .15236[.880]
 dLBB1                    -.083118            .15890            -.52309[.604]
 ecm1(-1)                   .40806            .26857             1.5194[.137]
 DUM2                       .67439            .28373             2.3769[.022]
 DUM5                     -.037120           .018005            -2.0617[.046]
*******************************************************************************
 List of additional temporary variables created:
 dLBB = LBB-LBB(-1)
 dLTB1 = LTB(-1)-LTB(-2)
 dLBB1 = LBB(-1)-LBB(-2)
 ecm1 =    .64553*LTB   -.30178*LBB
*******************************************************************************
 R-Squared                     .26107   R-Bar-Squared                   .16871
 S.E. of Regression            .26857   F-stat.    F(  5,  40)    2.8265[.028]
 Mean of Dependent Variable    .16603   S.D. of Dependent Variable      .29456
 Residual Sum of Squares       2.8852   Equation Log-likelihood        -1.5828
 Akaike Info. Criterion       -7.5828   Schwarz Bayesian Criterion    -13.0687
 DW-statistic                  1.8853   System Log-likelihood           9.3303
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   .83622[.360]*F(   1,  39)=   .72209[.401]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=   .64648[.421]*F(   1,  39)=   .55591[.460]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=  17.0153[.000]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)= .0032720[.954]*F(   1,  44)= .0031299[.956]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```