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Impact analysis of GDP related variables on economic growth of Sri Lanka

By Tharanga Samarasinghe

1. Introduction

Sri Lanka is a developing country which is located in the south Asian region. Midyear population of the country in 2014 was 20.77 million and gross domestic product of the country in 2014 was US\$ 74.9 billion (Central Bank of Sri Lanka, 2015). In 2014, real GDP growth rate of the country was 7.4% and during the period of 2009-2014, the country has continuously shown an economic growth rate over 6% (Ministry of Finance in Sri Lanka, 2015). Per capita GDP of the country was US\$ 3,608 (Central Bank of Sri Lanka, 2015) and according to the country classification by the World Bank, Sri Lanka has been categorized to “lower middle income economies” (The World Bank, 2015). Although Sri Lanka will be able to become an “upper middle income economy” in near future, reaching a state of high income country will be a challenged. To reach the status of high income economy, the country needs to increase its per capita GNI up to US\$ 12,616 (The World Bank, 2015). Raising of GNI per capita depends on GDP growth of the country and GDP growth is affected by many variables. Identification of critical variables for the economic growth of the country enables policy makers to manipulate such variables effectively to achieve growth targets and lead the country to the high income status. Therefore, the objective of this study is to analyse the impacts of GDP related variables in economic growth of Sri Lanka.

Although there are many important variables affects to the GDP growth, this study focuses only on Foreign Direct Investment (FDI), external debt stock, domestic saving rate, net export and final consumption expenditure. Except domestic saving rate, all other variables are measured by using the constant US\$ value in 2005. The domestic saving rate was measured as a % of GDP. Auto Regressive Distributed Lag (ARDL) is proposed as the estimation method and the data set which was taken from World Bank will be analysed using the E-views 8. I.

2. Literature Review:

Economic growth of a country depends on many explanatory variables. Consumption, investments, government expenditure, net exports are the four exogenous variables of expenditure approach of GDP calculation. In addition to that, variables such as saving rate, debt and Foreign Direct Investment (FDI) have a direct effect on GDP.

2.1. Savings and economic growth

Lean and Song, 2008 revealed that saving rate and economic growth have a co-integration relationship and economic growth raises savings. However, level of economic development does not significantly determine the relationship between the economic growth and saving rate (Misztal, 2011).

2.2. Consumption and government expenditure

Although government investment has a bigger impact than consumption, both government investment and consumption are the significant factors of economic growth of Sri Lanka (Ranasinghe and Ichihashi, 2014). Government consumption in education and defence has significantly negative impact on economic growth while Government investments have significant impacts on economic growth in sectors such as education, agriculture and transport (Ranasinghe and Ichihashi, 2014).

2.3. Foreign Direct Investments

Foreign Direct Investment (FDI) plays a major role in capital formation of developing countries. Balamurali and Bogahawatte, 2004 revealed that after 1977, FDI plays a major role in economic growth of Sri Lanka and however protectionism trade policies and regulatory mechanisms by government have discouraged inflows of foreign direct investments. A study conducted in Pakistan (Rahman and Shahbaz, 2011) revealed that economic growth rate can be increased by imports and foreign capital inflows.

2.4. Trade and economic growth

As an open economy, import and export are significant variables in economic growth in Sri Lanka and share of intermediate goods in total import is greater than imports of consumption and investment goods. To increase the export, government should make policy decision to motivate export oriented small and medium enterprises (Velampy and Achchuthan, 2013).

3. Econometric model and assumptions

$$\begin{aligned}
 GDP_t = & \\
 & \delta + \phi_p y_{t-1} + \phi_p y_{t-2} \dots + \phi_p y_{t-p} + \delta_0 DEBT_t + \dots + \delta_q DEBT_{t-q} + \\
 & \delta_{r0} FDI_t + \dots + \delta_{rq} FDI_{t-q} + \dots + \delta_{s0} NEX_t + \dots + \delta_{sq} NEX_{t-q} + \\
 & \delta_{u0} CONS_t + \dots + \delta_{uq} CONS_{t-q} + \delta_{x0} SAVR_t + \dots + \delta_{xq} SAVR_{t-q} + v_t
 \end{aligned}$$

p: number of lag periods for GDP

q: number of lag periods for other variables and q could have different values.

Vt: Independent random error term

δ : Constant

δ_0 to δ_{xq} and Θ : Coefficient associate with variables

4. Description of data

This analysis is expected to be conducted using the World Bank data set on Sri Lanka (the World Bank, 2015). Data for thirty year period will be analysed from year 1984 to year 2013. The measurement units for the FDI and DEBT variable in the data set was measured by current US\$ and therefore the FDI and DEBT variables were deflated to 2005 and converted to constant US\$ (2005).

4.1. Definition of the variables

Variable	Description of the variable	Unit of measurement
GDP	Gross Domestic Product	US\$ Millions (Based on constant US\$ rate in 2005)
DEBT	Total external debt stock	US\$ Millions (Based on constant US\$ rate in 2005)
FDI	Foreign Direct Investment net inflows	US\$ Millions (Based on constant US\$ rate in 2005)
CONS	Final consumption expenditure. This includes final consumption plus government consumption	US\$ Millions (Based on constant US\$ rate in 2005)
SAVR	Domestic saving rate	As a % of GDP
NEX	Net Export	US\$ Millions (Based on constant US\$ rate in 2005)

4.2. Descriptive statistics

	CONS	DEBT	FDI	GDP	NEX	SAVR
<i>Mean</i>	16533.16	16680.70	324.8777	20344.43	-1640.616	15.94353
<i>Median</i>	15116.36	16037.41	276.2122	18562.82	-1139.942	16.00048
<i>Maximum</i>	33200.22	26306.61	842.6352	41053.23	-243.2100	20.04725
<i>Minimum</i>	8209.326	10394.08	89.44486	9719.007	-4910.533	11.86944
<i>Std. Dev.</i>	7593.337	5146.820	158.6236	8996.210	1361.813	2.446055
<i>Skewness</i>	0.738580	0.395013	1.190565	0.762640	-1.087813	-0.104288
<i>Kurtosis</i>	2.486605	1.774682	4.857035	2.549317	3.210395	2.111177
<i>Jarque-Bera</i>	3.056967	2.656932	11.39795	3.161990	5.972014	1.041887
<i>Probability</i>	0.216864	0.264883	0.003349	0.205770	0.050489	0.593960
<i>Sum</i>	495994.9	500420.9	9746.332	610332.9	-49218.49	478.3059
<i>Sum Sq. Dev.</i>	1.67E+09	7.68E+08	729681.9	2.35E+09	53781520	173.5124
<i>Observations</i>	30	30	30	30	30	30

5. Results and Discussion

5.1. Transformation of variables and building the basic model

The original data was transformed to the log variables because it provides a more uniform distribution of the variables and predominantly the log transformed data are used in time series analysis. Variable *nex* cannot be transformed because it contains negative values and for the simplicity of the model, *nex* was omitted from the model. The variables *lncons*, *lnfdi*, *lnsavr* have a positive relationship with *lngdp*. The correlation coefficient between *lndebt* and *lncons* was -0.92 and it proves that there is a very high multicollinearity¹. Separate models were tested for *lndebt* and *lncons* by including the other variables. Considering the lower Akaike Information Criterion (-4.194918) and Schwarz Criterion (-4.008092), the model including *lncons* was selected to improve further (model 1). Table 1 exhibits the descriptive statistics of log transformed variables which were included in the basic model. Jarque-Berra probability of all variables is greater 0.05 and it reveals that the variables are distributed normally. The observation of scatter plots between each variable and residual shows a constant variance of each variable².

¹ See appendix 2

² See appendix 5

Table 1: Descriptive statistics of variables

	<i>lngdp</i>	<i>lncons</i>	<i>lnfdi</i>	<i>lnsavr</i>
Mean	9.830056	9.614717	5.673215	2.757268
Median	9.828694	9.623198	5.621156	2.772618
Maximum	10.62262	10.41031	6.736534	2.998092
Minimum	9.181839	9.013026	4.493622	2.473967
Std. Dev.	0.430397	0.449389	0.484425	0.157716
Skewness	0.198171	0.191427	-0.175056	-0.352694
Kurtosis	1.906123	1.806740	2.970384	2.170832
Jarque-Bera	1.692066	1.963056	0.154319	1.481366
Probability	0.429114	0.374738	0.925742	0.476788
Sum	294.9017	288.4415	170.1965	82.71804
Sum Sq. Dev.	5.371994	5.856572	6.805368	0.721360
Observations	30	30	30	30

Model 1: $lgdp = 0.667371 + 0.956924lncons + 0.014402lnfdi - 0.043368lnsavr + e_i$

6.2. ARDL Approach

The correlogram³ of the residual for the basic model 1 shows an autocorrelation. The Autoregressive Lagged Model was tested because the dynamic effect of the data can be removed using adequate number of lag periods for dependant and explanatory variables in ARDL model (Hill, Griffith, Lim, 2011). By observing changes in the model with different lag periods for each variable, model 2 was selected considering the minimum Akaike Information Criterion, Schwarz criterion, and principle of parsimony. Eviews outputs from different model were summarised in table 2 and results for selected model is shown in column C of the table 2.

Model 2.

$$\begin{aligned}
 lngdp_t = & \\
 & 0.037867 + 0.896452lngdp_{t-1} + 0.508714lncons_t - 0.378012lncons_{t-1} - \\
 & 0.012723lnfdi_{t-4} - 0.066016lnsavr_{t-2} + v_t
 \end{aligned}$$

³ See appendix 6

Table 2: Summary of Eviews results for different models which compared with model 2

Results	A (appendix 7)	B (Appendix 8)	C (Appendix 9)
R square	0.998956	0.999206	0.999288
Adjusted R square	0.998608	0.998808	0.99911
F-Statistics	2869.933	2515.452	5615.636
Probability (F-statistics)	0.0000	0.0000	0.0000
Akaike Info Criterion	-5.24535	-5.40565	-5.87672
Schwarz Criterion	-4.868163	-4.929867	-5.586394
Durbin -Watson Stat	1.306585	1.73064	2.131929
Ramsey Test (Probability, F-Stat)	0.0074	0.1734	0.8652
Correlogram	no autocorrelation	no autocorrelation	no autocorrelation
Breusch-Pagan-Godfrey test	13.49032	11.9552	4.200348

*Results for model 2 is in column C of the table

P value for the model 2 is less than $\alpha=0.05$ and therefore the model is significant at 5% level. Individual coefficients for the each variable are less than $\alpha=0.05$ and all explanatory variables are significant at 5% level. The model followed all the assumptions relevant to the ARDL model⁴. Scatter plot reveals that mean of the residual is zero (MR2)⁵ and according to the Breuch-Pagan-Godfrey test⁶, there is no heteroscedasticity (MR3) in the model. Assumption MR 5 is proved because there is no collinearity between V_t and explanatory variables⁷. P value for Jarque-Berra⁸ is greater than $\alpha=0.05$ and it reveals that the error is normally distributed (MR 6). The correlogram⁹ shows that MR 8 has been proven by the model. In Ramsey RESET test¹⁰, p value is 0.8652 and it is greater than $\alpha=0.05$. Then the null hypothesis is rejected and there is insufficient evidence to conclude that the model is missed

⁴ See section 3.2.

⁵ See appendix 10

⁶ See appendix 9.4

⁷ See appendix 11

⁸ See appendix 12

⁹ See appendix 9.3.

¹⁰ See appendix 9.4.

specified. Table 3 summarises the all the statistical tests which were conducted to estimate the model.

Table 2: Summary of the statistical tests for model 2 (selected model)

Statistical test	Hypotheses	Results
t test to for individual coefficients (Appendix 9.1)	$H_0: \beta_k=0, H_1: \beta_k \neq 0,$	For all coefficients, p value < 0.05 , Reject H_0 , All variables are significant at 5% significance level
F test for entire regression model (Appendix 9.1.)	$H_0: \beta_1 = \dots = \beta_k = 0, H_1:$ Not H_0	P value < 0.05 , Reject H_0 , The entire model is significant at 5% significance level
The Jarque –Berra test to check the normality (Appendix 12)	H_0 : Errors are normal, H_0 : Errors are not normal	P value = $0.458775 > 0.05$ Do not reject H_0 , Errors are normal at 5% significance level
RESET test to check the adequacy of the model (Appendix 9.2.)	$H_0: \gamma_1 = 0, H_1: \gamma_1 \neq 0$	$P = 0.8652 > \alpha = 0.05$, Do not reject H_0 . There is insufficient evidence to conclude that the model is missed specified at 5% level.
Correlogram test to check autocorrelation (Appendix 9.3.)		No autocorrelation
Breuch-Pagan-Godfrey test for heteroscedasticity (Appendix 9.4.)	$H_0: \sigma_i^2 = \sigma^2$ for all i, $H_1:$ $\rho < 0, H_1: \text{Not } H_0$	BP = $4.200348 < \chi^2(0.05, 5) = 11.07$ Do not reject H_0 , No heteroscedasticity at 5% level of significant
Dicky Fuller (DF) Tests (Table 4 and Appendix 13)	$H_0: \gamma = 0, H_1: \gamma < 0$	$P < \alpha = 0.05$ for all variables at first difference: All variables are stationary at 5% level
Cointegration test (Augmented Dicky Fuller Test for V_t) (Appendix 14)	H_0 : the series are not cointegrated H_1 : the series are integrated	$P < \alpha = 0.05$, Reject H_0 . Series are cointegrated at 5% significant level

6.3. Stationarity and cointegration

Stationarity of each variable was tested with unit root test and summary of the Eviews results can be seen in table 4¹¹. According to the unit root test, all the variables became stationary at first difference (I_1) with constant and constant with trend.

Table 4: P values from the unit root test at the first difference

Level of estimation	Incons	lnfdi	lngdp	lnsavr
Constant	0.0034	0.0000	0.0073	0.0000
Constant, trend	0.0069	0.0001	0.0042	0.0002
None	0.6567	0.0000	0.7170	0.0000

For the residual series, the tau value of -8.195882 is less than the Engle-Granger Critical Value at 5% (-3.42) and the conclusion is that the model is cointegrated¹².

7. Conclusion

At the 5% significant level, all the variables and the overall model were significant. The model followed all required assumptions and Ramsey RESET test revealed that the model was not missed specified. The model was cointegrated and all variables became stationary at **I (1)** series. The overall model was significant and it explained a significant relationship between dependant variable *lngdp* and its explanatory variables *lncons*, *lncons(-1)*, *lnfdi(-4)*, *lnsavr(-2)*, *lngdp(-1)*. Each explanatory variable has shown a significant relationship with dependant variable *lngdp* because the coefficients of all the explanatory variables were significant at 5% level. The time series Y_t for all variables became stationary at the first difference and the model was cointegrated. This reveals that variable *lngdp* had a stochastic trend with explanatory variables *lnsavr*, *lncons* and *lnfdi*. The residual of the model V_t was stationary at **I (0)** and therefore, there will not be significant divergence between independent and dependant variables.

In conclusion, consumption, foreign direct investment (FDI) and domestic saving rate (DSR) affect significantly on gross domestic product of Sri Lanka. Further, the gross domestic product shows a stochastic trend with consumption, foreign direct investments and domestic saving rate.

¹¹ See appendix 13 for E views outputs

¹² See appendix 14

8. Policy implications

Gross Domestic Product (GDP) is one of the most important economic variables in any country and identification of most critical variables on GDP allows policy makers to influence on GDP growth. In this model, for the purpose of solving the autocorrelation problem, lagged periods were considered for the variables *lngdp*, *lncons*, *lnfdi* and *lnsavr*. Use of *lncons(-1)*, *lnfdi(-4)* *lnsavr(-2)* are less important in the practical situation. According to this study, current GDP is significantly affected by GDP in previous year, consumption in current year and consumption in previous year, foreign direct investment with 4 year lag period and domestic saving rate with 2 year lag. The log transformed variables were used in this study and therefore the values express the percentage changes of each variable.

According to the estimated model, when GDP growth rate in previous year is 1%, on average, the expected GDP growth rate for current year is 0.896452 %, *ceteris paribus*. If current year consumption is 1 % higher than the last year, the model predicts on average a 0.50871% GDP growth in current year, *ceteris paribus*. If consumption growth rate in last year increased by 1%, on average and *ceteris paribus*, the GDP of current year decreases by 0.378012%. Foreign Direct Investment with 4 year lag period raised by 1%, on average, current year GDP is expected to reduce by 0.012723%, *ceteris paribus*. In addition to that, 1% increase in Domestic Saving Rate with 2 year lag periods leads to decrease the current year GDP by 0.066016%, on average and *ceteris paribus*.

The model explains a positive relationship of GDP in current year with last year GDP and current year consumption and it is consistent with macroeconomic theories. As the model reveals that GDP in current year is affected negatively by previous year consumption, Foreign Direct Investment with 4 year lag period and Domestic Saving Rate with 2 year lag period. Increased consumption in last year leads to reduce the GDP growth rate through reducing the savings and investments. Generally, increasing of Domestic Saving Rate causes an increase in investments. Higher investments create a higher GDP. However, if political and economic conditions of the country are not stable, higher saving rate may not raise the investment. According to the study, Foreign Direct Investments has negatively affected on GDP growth of Sri Lanka. Factors such as increasing of imports, underutilization of labour and other resources, importation of labour may have effect on the negative relationship GDP and FDI.

The estimation of GDP growth rate has done for some years using the model and results were summarized as follows. The measurement errors of data, high variation in economic and political stability of the country throughout the measurement period make differences between observed value and estimated value.

Year	Observed GDP growth rate from data	Estimated GDP growth rate using the model
1992	4.4	4.1
1999	4.3	4.3
2002	4.3	4.0
2009	4.5	3.5

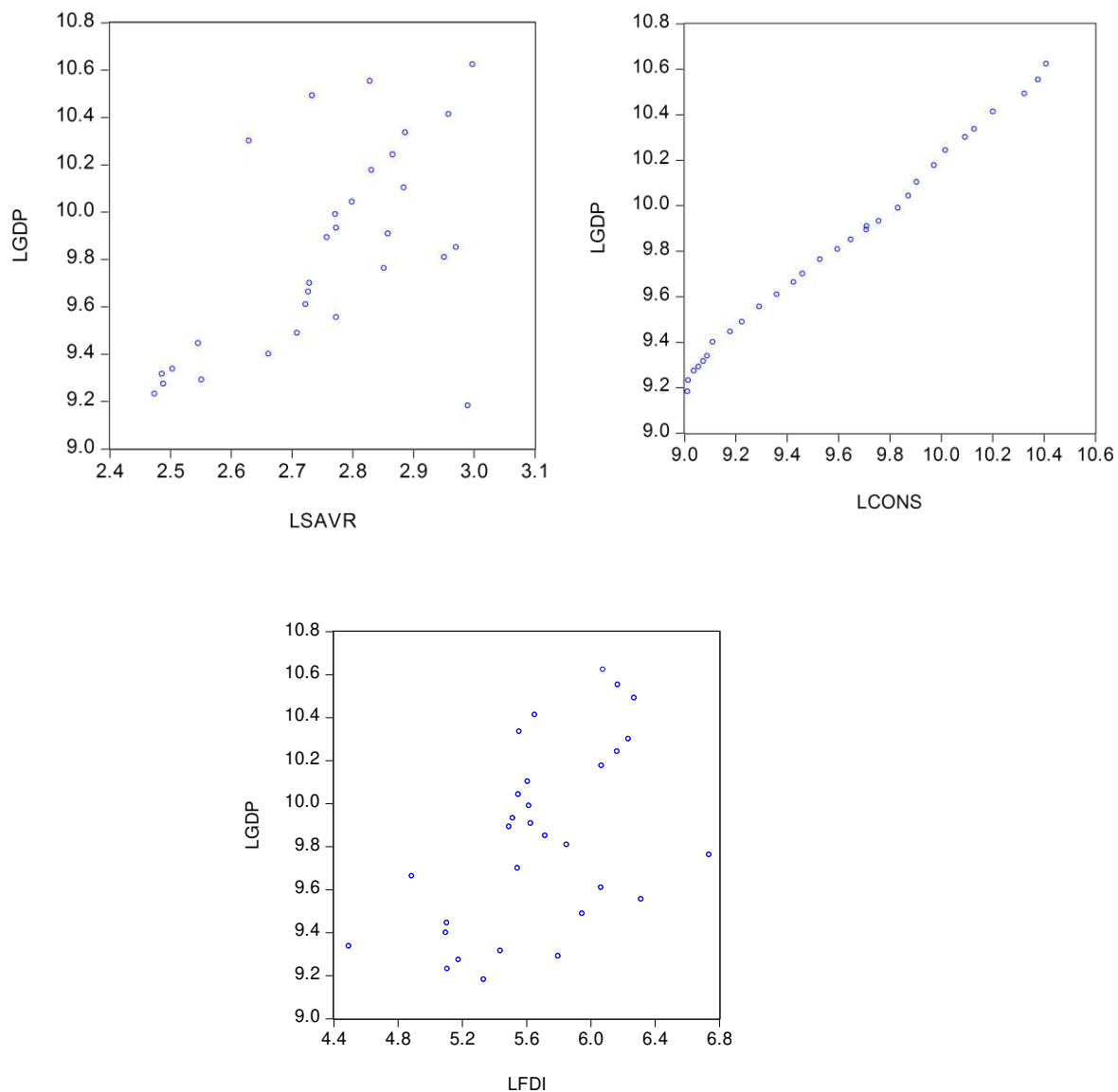
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10. Appendices

Appendix 1. Relationships between dependant and explanatory variables



Appendix 2: Correlation coefficient matrix for explanatory variables

	LNCONS	LNDEBT	LNFDI	LNSAVR
LNCONS	1	-0.9214850364920832	0.5157629433455073	0.6006797248329134
LNDEBT	-0.9214850364920832	1	-0.4631259975315178	-0.6403935909289759
LNFDI	0.5157629433455073	-0.4631259975315178	1	0.4378439466791229
LNSAVR	0.6006797248329134	-0.6403935909289759	0.4378439466791229	1

Appendix 3: Basic model without *lndebt*

Dependent Variable: LNGDP
Method: Least Squares
Date: 11/03/15 Time: 09:48
Sample: 1984 2013
Included observations: 30

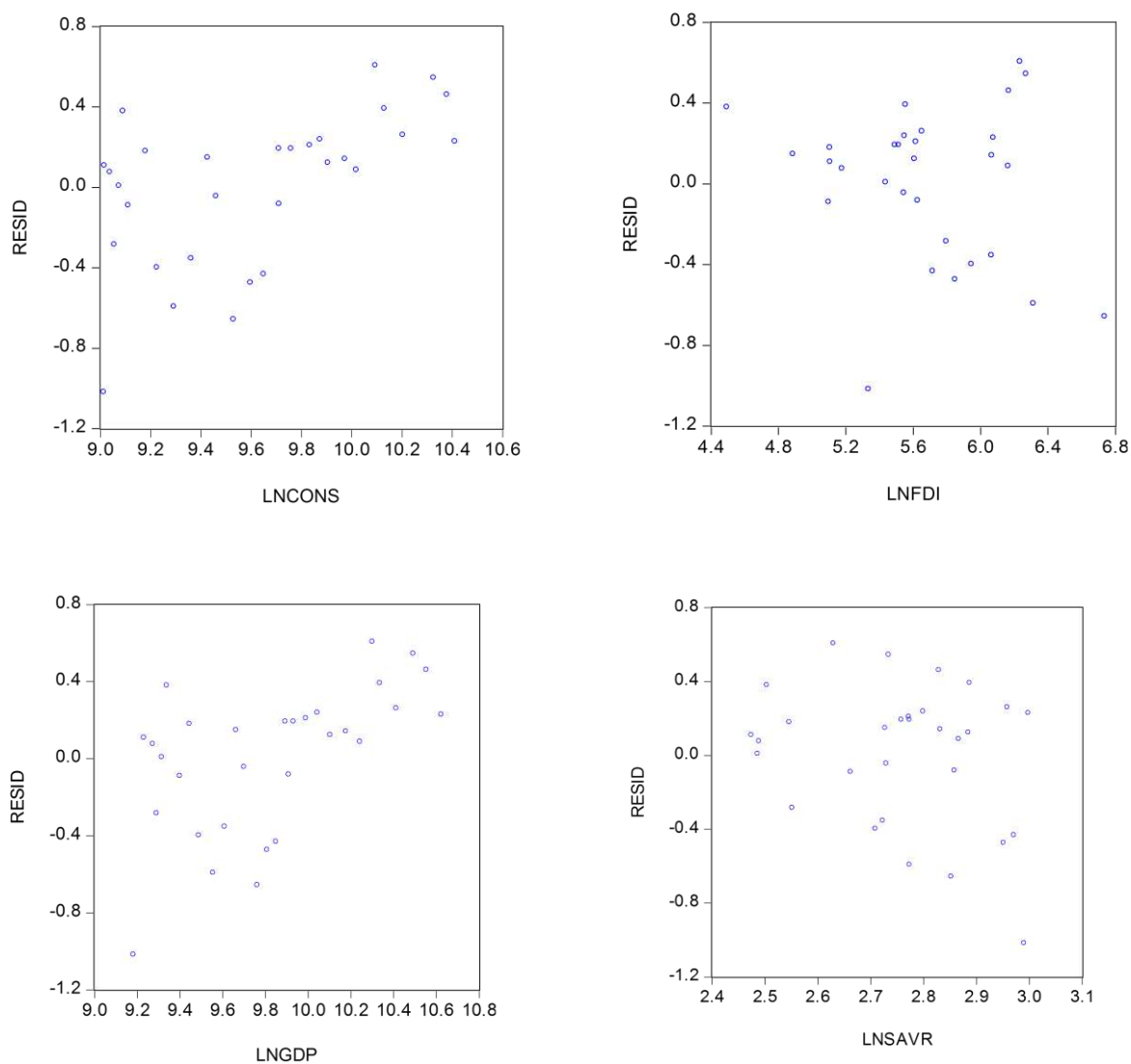
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.667371	0.115068	5.799776	0.0000
LNCONS	0.956924	0.015419	62.06308	0.0000
LNFDI	0.014402	0.012719	1.132295	0.2678
LNSAVR	-0.043368	0.041865	-1.035898	0.3098
R-squared	0.996225	Mean dependent var		9.830056
Adjusted R-squared	0.995790	S.D. dependent var		0.430397
S.E. of regression	0.027926	Akaike info criterion		-4.194918
Sum squared resid	0.020277	Schwarz criterion		-4.008092
Log likelihood	66.92378	Hannan-Quinn criter.		-4.135151
F-statistic	2287.389	Durbin-Watson stat		0.689088
Prob(F-statistic)	0.000000			

Appendix 4: Basic model without *lncons*

Dependent Variable: LNGDP
Method: Least Squares
Date: 11/03/15 Time: 10:34
Sample: 1984 2013
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.93363	2.074302	10.09189	0.0000
LNDEBT	-1.204246	0.148082	-8.132317	0.0000
LNFDI	0.119606	0.080104	1.493131	0.1474
LNSAVR	-0.046928	0.283918	-0.165289	0.8700
R-squared	0.841132	Mean dependent var		9.830056
Adjusted R-squared	0.822802	S.D. dependent var		0.430397
S.E. of regression	0.181175	Akaike info criterion		-0.455139
Sum squared resid	0.853436	Schwarz criterion		-0.268312
Log likelihood	10.82708	Hannan-Quinn criter.		-0.395371
F-statistic	45.88610	Durbin-Watson stat		0.528011
Prob(F-statistic)	0.000000			

Appendix 5: Relationship between error and explanatory variables



Appendix 6: The correlogram for the model 1

Date: 11/03/15 Time: 10:50

Sample: 1984 2013

Included observations: 30

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. *****	. *****	1	0.542	0.542	9.7353	0.002
. ** .	. .	2	0.267	-0.038	12.180	0.002
. ** .	. * .	3	0.250	0.171	14.402	0.002
. .	. ** .	4	0.011	-0.275	14.406	0.006
. * .	. * .	5	-0.184	-0.136	15.707	0.008
. ** .	. ** .	6	-0.319	-0.261	19.773	0.003
. ** .	. .	7	-0.307	0.039	23.713	0.001
. ** .	. .	8	-0.274	-0.064	26.993	0.001

.** .	. * .	9	-0.305	-0.080	31.249	0.000
.** .	.** .	10	-0.313	-0.211	35.939	0.000
.** .	.** .	11	-0.330	-0.257	41.432	0.000
.** .	. * .	12	-0.274	-0.148	45.444	0.000
. * .	. .	13	-0.172	-0.060	47.109	0.000
. .	. * .	14	-0.021	0.107	47.136	0.000
. * .	. .	15	0.102	-0.011	47.805	0.000
. * .	. * .	16	0.165	-0.088	49.672	0.000

Appendix 7: E views output for model A

7.1. Estimated model

Dependent Variable: LNGDP

Method: Least Squares

Date: 11/03/15 Time: 11:17

Sample (adjusted): 1985 2013

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.093299	0.152581	0.611471	0.5475
LNCONS	0.546875	0.167979	3.255610	0.0038
LNCONS(-1)	-0.363050	0.142920	-2.540239	0.0190
LNFDI	0.004429	0.007863	0.563301	0.5792
LNFDI(-1)	-0.007815	0.007472	-1.045897	0.3075
LNSAVR	0.024443	0.029936	0.816532	0.4234
LNSAVR(-1)	-0.010244	0.028040	-0.365337	0.7185
LNGDP(-1)	0.811038	0.151848	5.341136	0.0000
R-squared	0.998956	Mean dependent var		9.852408
Adjusted R-squared	0.998608	S.D. dependent var		0.419920
S.E. of regression	0.015669	Akaike info criterion		-5.245348
Sum squared resid	0.005156	Schwarz criterion		-4.868163
Log likelihood	84.05755	Hannan-Quinn criter.		-5.127219
F-statistic	2869.933	Durbin-Watson stat		1.306585
Prob(F-statistic)	0.000000			

7.2. Ramsey test

Ramsey RESET Test

Equation: UNTITLED

Specification: LNGDP C LNCONS LNCONS(-1) LNFDI LNFDI(-1) LNSAVR
LNSAVR(-1) LNGDP(-1)

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	2.979858	20	0.0074
F-statistic	8.879554	(1, 20)	0.0074
Likelihood ratio	10.65465	1	0.0011

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.001585	1	0.001585

Restricted SSR	0.005156	21	0.000246
Unrestricted SSR	0.003570	20	0.000179
Unrestricted SSR	0.003570	20	0.000179

LR test summary:

	Value	df
Restricted LogL	84.05755	21
Unrestricted LogL	89.38488	20

Unrestricted Test Equation:
 Dependent Variable: LNGDP
 Method: Least Squares
 Date: 11/03/15 Time: 11:24
 Sample: 1985 2013
 Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.794724	1.917740	3.021642	0.0067
LNCONS	-0.012427	0.236108	-0.052631	0.9585
LNCONS(-1)	-0.025408	0.166408	-0.152682	0.8802
LNFDI	-0.002822	0.007133	-0.395630	0.6966
LNFDI(-1)	0.000540	0.006961	0.077622	0.9389
LNSAVR	0.044355	0.026387	1.680932	0.1083
LNSAVR(-1)	0.012367	0.025086	0.493002	0.6274
LNGDP(-1)	-0.154135	0.348823	-0.441873	0.6633
FITTED^2	0.059533	0.019979	2.979858	0.0074

R-squared	0.999277	Mean dependent var	9.852408
Adjusted R-squared	0.998988	S.D. dependent var	0.419920
S.E. of regression	0.013361	Akaike info criterion	-5.543785
Sum squared resid	0.003570	Schwarz criterion	-5.119451
Log likelihood	89.38488	Hannan-Quinn criter.	-5.410889
F-statistic	3454.542	Durbin-Watson stat	1.300592
Prob(F-statistic)	0.000000		

7.3. Correlogram

Date: 11/03/15 Time: 11:42
 Sample: 1985 2013
 Included observations: 29

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. ** .	. ** .	1	0.218	0.218	1.5305	0.216
. *	2	0.094	0.049	1.8271	0.401
. 	3	0.058	0.029	1.9440	0.584
. * .	. * .	4	-0.071	-0.099	2.1265	0.713
. * .	. * .	5	0.110	0.148	2.5772	0.765
. ** .	. ** .	6	-0.237	-0.305	4.7639	0.574
. . .	. * .	7	-0.037	0.100	4.8196	0.682
. . .	. * .	8	-0.065	-0.095	4.9991	0.758
. *	9	-0.104	-0.008	5.4840	0.790
. 	10	0.068	0.029	5.7038	0.840
. ** .	. ** .	11	-0.306	-0.287	10.370	0.497
. * .	. * .	12	-0.151	-0.095	11.579	0.480

7.4. Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.609399	Prob. F(7,21)	0.0418
Obs*R-squared	13.49032	Prob. Chi-Square(7)	0.0610
Scaled explained SS	10.67353	Prob. Chi-Square(7)	0.1535

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 11/03/15 Time: 12:01

Sample: 1985 2013

Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005759	0.002585	-2.228138	0.0369
LNCONS	-0.010699	0.002845	-3.759973	0.0012
LNCONS(-1)	0.007153	0.002421	2.954493	0.0076
LNFDI	5.59E-05	0.000133	0.419859	0.6789
LNFDI(-1)	-0.000150	0.000127	-1.186881	0.2485
LNSAVR	-0.000125	0.000507	-0.247250	0.8071
LNSAVR(-1)	0.001141	0.000475	2.402208	0.0256
LNGDP(-1)	0.003896	0.002572	1.514610	0.1448

R-squared	0.465183	Mean dependent var	0.000178
Adjusted R-squared	0.286911	S.D. dependent var	0.000314
S.E. of regression	0.000265	Akaike info criterion	-13.40164
Sum squared resid	1.48E-06	Schwarz criterion	-13.02446
Log likelihood	202.3238	Hannan-Quinn criter.	-13.28351
F-statistic	2.609399	Durbin-Watson stat	1.999609
Prob(F-statistic)	0.041838		

Appendix 8: Outputs for model B

8.1.: Estimated model B

Dependent Variable: LNGDP

Method: Least Squares

Date: 11/03/15 Time: 11:32

Sample (adjusted): 1986 2013

Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.082396	0.155451	0.530045	0.6026
LNCONS	0.679036	0.163803	4.145457	0.0006
LNCONS(-1)	-0.523746	0.165146	-3.171403	0.0053
LNFDI	0.005618	0.008316	0.675573	0.5079
LNFDI(-1)	-0.008611	0.007023	-1.226118	0.2360
LNFDI(-2)	0.005318	0.008392	0.633702	0.5342
LNSAVR	0.048811	0.031722	1.538747	0.1413
LNSAVR(-1)	-0.061291	0.035874	-1.708514	0.1047
LNSAVR(-2)	-0.023932	0.024573	-0.973937	0.3430
LNGDP(-1)	0.850105	0.156046	5.447769	0.0000

R-squared	0.999206	Mean dependent var	9.874615
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Adjusted R-squared	0.998808	S.D. dependent var	0.409918
S.E. of regression	0.014151	Akaike info criterion	-5.405655
Sum squared resid	0.003604	Schwarz criterion	-4.929867
Log likelihood	85.67916	Hannan-Quinn criter.	-5.260202
F-statistic	2515.452	Durbin-Watson stat	1.730640
Prob(F-statistic)	0.000000		

8.2.Ramsey RESET Test

Equation: UNTITLED

Specification: LNGDP C LNCONS LNCONS(-1) LNFDI LNFDI(-1) LNFDI(-2) LNSAVR LNSAVR(-1) LNSAVR(-2) LNGDP(-1)

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.421080	17	0.1734
F-statistic	2.019467	(1, 17)	0.1734
Likelihood ratio	3.142992	1	0.0763

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000383	1	0.000383
Restricted SSR	0.003604	18	0.000200
Unrestricted SSR	0.003222	17	0.000190
Unrestricted SSR	0.003222	17	0.000190

LR test summary:

	Value	df
Restricted LogL	85.67916	18
Unrestricted LogL	87.25066	17

Unrestricted Test Equation:

Dependent Variable: LNGDP

Method: Least Squares

Date: 11/03/15 Time: 11:36

Sample: 1986 2013

Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.578369	2.464726	1.451832	0.1648
LNCONS	0.191257	0.378432	0.505392	0.6198
LNCONS(-1)	-0.135962	0.316662	-0.429362	0.6731
LNFDI	5.18E-05	0.008989	0.005758	0.9955
LNFDI(-1)	-0.002656	0.008015	-0.331327	0.7444
LNFDI(-2)	-0.000419	0.009108	-0.045981	0.9639
LNSAVR	0.033380	0.032714	1.020357	0.3219
LNSAVR(-1)	0.010147	0.061197	0.165814	0.8703
LNSAVR(-2)	0.000889	0.029606	0.030030	0.9764
LNGDP(-1)	0.213964	0.472687	0.452654	0.6565
FITTED^2	0.036327	0.025563	1.421080	0.1734

R-squared	0.999290	Mean dependent var	9.874615
Adjusted R-squared	0.998872	S.D. dependent var	0.409918
S.E. of regression	0.013766	Akaike info criterion	-5.446476
Sum squared resid	0.003222	Schwarz criterion	-4.923110
Log likelihood	87.25066	Hannan-Quinn criter.	-5.286477

F-statistic	2392.330	Durbin-Watson stat	1.571597
Prob(F-statistic)	0.000000		

8.3. Correlogram

Date: 11/03/15 Time: 11:41
Sample: 1986 2013
Included observations: 28

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
. .	. .	1	0.038	0.038	0.0451	0.832
. .	. .	2	0.025	0.023	0.0651	0.968
. * .	. * * .	3	-0.204	-0.207	1.4688	0.689
. * .	. * .	4	-0.189	-0.181	2.7199	0.606
. .	. .	5	0.009	0.031	2.7228	0.743
. * .	. * .	6	-0.132	-0.175	3.3862	0.759
. * .	. .	7	0.108	0.040	3.8512	0.797
. .	. .	8	-0.030	-0.057	3.8900	0.867
. * .	. * .	9	-0.072	-0.146	4.1188	0.903
. * .	. .	10	0.075	0.066	4.3831	0.928
. * .	. * .	11	-0.118	-0.124	5.0667	0.928
. .	. * .	12	-0.011	-0.112	5.0726	0.956

8.4. Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.490227	Prob. F(9,18)	0.2249
Obs*R-squared	11.95520	Prob. Chi-Square(9)	0.2158
Scaled explained SS	2.715278	Prob. Chi-Square(9)	0.9745

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/03/15 Time: 12:06
Sample: 1986 2013
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001425	0.001400	-1.018013	0.3222
LNCONS	-0.003513	0.001475	-2.381546	0.0285
LNCONS(-1)	0.002819	0.001487	1.895783	0.0742
LNFDI	2.76E-05	7.49E-05	0.369194	0.7163
LNFDI(-1)	-6.06E-05	6.32E-05	-0.958471	0.3505
LNFDI(-2)	-5.51E-05	7.56E-05	-0.729082	0.4753
LNSAVR	0.000110	0.000286	0.385398	0.7045
LNSAVR(-1)	3.05E-05	0.000323	0.094266	0.9259
LNSAVR(-2)	0.000363	0.000221	1.640565	0.1182
LNGDP(-1)	0.000764	0.001405	0.543619	0.5934
R-squared	0.426971	Mean dependent var		0.000129
Adjusted R-squared	0.140457	S.D. dependent var		0.000137
S.E. of regression	0.000127	Akaike info criterion		-14.82575
Sum squared resid	2.92E-07	Schwarz criterion		-14.34996
Log likelihood	217.5605	Hannan-Quinn criter.		-14.68030
F-statistic	1.490227	Durbin-Watson stat		2.412503
Prob(F-statistic)	0.224948			

Appendix 9: Outputs for model c (selected model)

9.1: Estimated model

Dependent Variable: LNGDP
 Method: Least Squares
 Date: 11/03/15 Time: 11:48
 Sample (adjusted): 1988 2013
 Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.037867	0.126450	0.299459	0.7677
LNCONS	0.508714	0.109449	4.647936	0.0002
LNCONS(-1)	-0.378012	0.114143	-3.311743	0.0035
LNFDI(-4)	-0.012723	0.005451	-2.333897	0.0301
LNSAVR(-2)	-0.066016	0.023307	-2.832523	0.0103
LNGDP(-1)	0.896452	0.123163	7.278563	0.0000
R-squared	0.999288	Mean dependent var		9.920215
Adjusted R-squared	0.999110	S.D. dependent var		0.388837
S.E. of regression	0.011598	Akaike info criterion		-5.876724
Sum squared resid	0.002690	Schwarz criterion		-5.586394
Log likelihood	82.39741	Hannan-Quinn criter.		-5.793119
F-statistic	5615.636	Durbin-Watson stat		2.131929
Prob(F-statistic)	0.000000			

9.2. Ramsey RESET Test

Equation: UNTITLED
 Specification: LNGDP C LNCONS LNCONS(-1) LNFDI(-4) LNSAVR(-2)
 LNGDP(-1)

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.172042	19	0.8652
F-statistic	0.029598	(1, 19)	0.8652
Likelihood ratio	0.040472	1	0.8406

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	4.18E-06	1	4.18E-06
Restricted SSR	0.002690	20	0.000135
Unrestricted SSR	0.002686	19	0.000141
Unrestricted SSR	0.002686	19	0.000141

LR test summary:

	Value	df
Restricted LogL	82.39741	20
Unrestricted LogL	82.41765	19

Unrestricted Test Equation:
 Dependent Variable: LNGDP
 Method: Least Squares
 Date: 11/03/15 Time: 11:51
 Sample: 1988 2013
 Included observations: 26

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.366984	2.356779	-0.155714	0.8779
LNCONS	0.542278	0.225057	2.409516	0.0263
LNCONS(-1)	-0.408476	0.212247	-1.924529	0.0694
LNFDI(-4)	-0.013780	0.008304	-1.659430	0.1134
LNSAVR(-2)	-0.074433	0.054445	-1.367112	0.1875
LNGDP(-1)	0.977721	0.488966	1.999570	0.0601
FITTED^2	-0.004057	0.023579	-0.172042	0.8652
R-squared	0.999289	Mean dependent var		9.920215
Adjusted R-squared	0.999065	S.D. dependent var		0.388837
S.E. of regression	0.011890	Akaike info criterion		-5.801357
Sum squared resid	0.002686	Schwarz criterion		-5.462639
Log likelihood	82.41765	Hannan-Quinn criter.		-5.703819
F-statistic	4452.643	Durbin-Watson stat		2.150669
Prob(F-statistic)	0.000000			

9.3. Correlogram

Date: 11/03/15 Time: 11:56
Sample: 1988 2013
Included observations: 26

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
. * .	. * .	1 -0.097	-0.097	0.2738	0.601
. * .	. * .	2 -0.087	-0.097	0.5030	0.778
. * .	. * .	3 -0.119	-0.140	0.9525	0.813
. ** .	. *** .	4 -0.322	-0.374	4.3936	0.355
. .	. * .	5 0.058	-0.083	4.5103	0.479
. * .	. ** .	6 -0.079	-0.228	4.7396	0.578
. .	. .	7 0.211	0.058	6.4429	0.489
. .	. * .	8 -0.034	-0.203	6.4897	0.593
. * .	. ** .	9 -0.203	-0.322	8.2608	0.508
. ***	. **	10 0.415	0.331	16.093	0.097
. ** .	. * .	11 -0.214	-0.195	18.319	0.074
. * .	. ** .	12 -0.079	-0.245	18.647	0.097

9.4. Heteroskedasticity Test: Breusch-Pagan-Godfrey

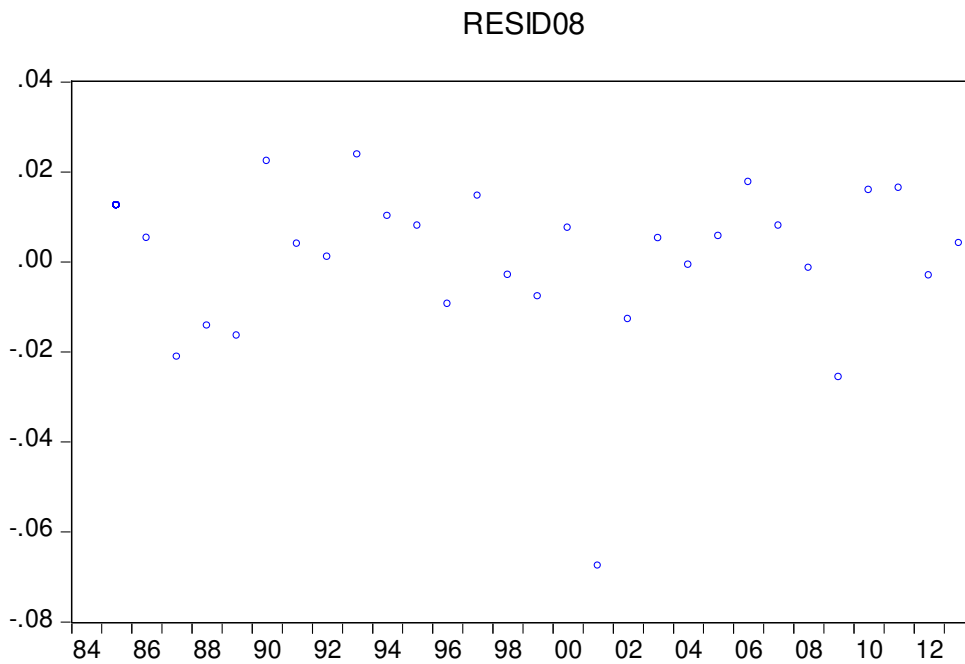
F-statistic	0.770718	Prob. F(5,20)	0.5819
Obs*R-squared	4.200348	Prob. Chi-Square(5)	0.5209
Scaled explained SS	1.570886	Prob. Chi-Square(5)	0.9047

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/03/15 Time: 12:08
Sample: 1988 2013
Included observations: 26

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.48E-05	0.001324	-0.018744	0.9852
LNCONS	-0.001707	0.001146	-1.489376	0.1520
LNCONS(-1)	0.001218	0.001195	1.019207	0.3203

LNFDI(-4)	3.25E-05	5.71E-05	0.569653	0.5753
LNSAVR(-2)	8.80E-05	0.000244	0.360518	0.7222
LNGDP(-1)	0.000457	0.001290	0.354392	0.7268
R-squared	0.161552	Mean dependent var	0.000103	
Adjusted R-squared	-0.048060	S.D. dependent var	0.000119	
S.E. of regression	0.000121	Akaike info criterion	-14.99472	
Sum squared resid	2.95E-07	Schwarz criterion	-14.70439	
Log likelihood	200.9313	Hannan-Quinn criter.	-14.91111	
F-statistic	0.770718	Durbin-Watson stat	2.292737	
Prob(F-statistic)	0.581904			

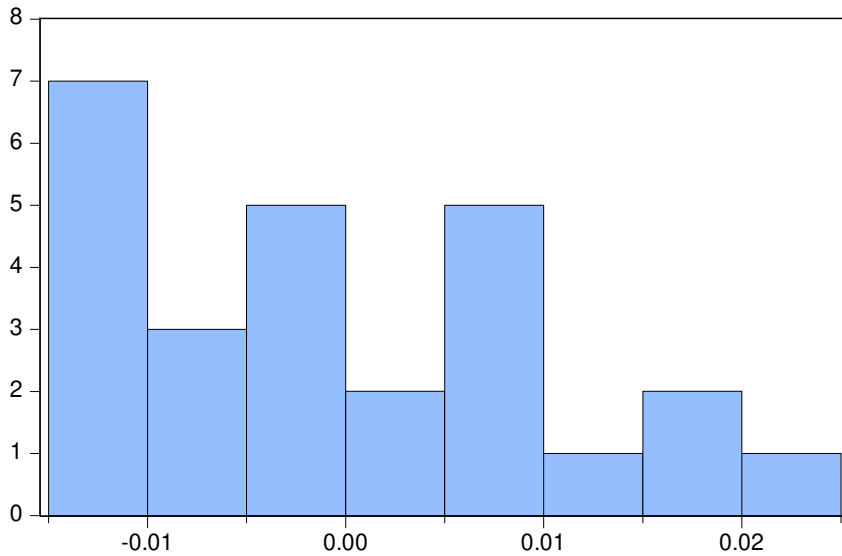
Appendix 10: Distribution of error for the final model



Appendix 11. Correlation coefficients between Vt and explanatory variables

	RESID04	LNCONS	LNCONS(-1)	LNFDI(-4)	LNSAVR(-2)	LNGDP(-1)
RESID04	1	4.586478796661696e-12	1.181957594574793e-12	1.701491175931449e-12	5.310946694311226e-12	5.475514299610888e-12

Appendix 12: Histogram and Descriptive statistics for residual of the model



Series: RESID09	
Sample 1984 2013	
Observations 26	
Mean	-8.88e-16
Median	-0.001458
Maximum	0.022217
Minimum	-0.014554
Std. Dev.	0.010374
Skewness	0.473535
Kurtosis	2.264084
Jarque-Bera	1.558390
Probability	0.458775

Appendix 13: Unit root tests output (for the first difference)

Null Hypothesis: D(LCONS) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.138691	0.0034
Test critical values:		
1% level	-3.689194	
5% level	-2.971853	
10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LCONS,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:41
 Sample (adjusted): 1986 2013
 Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCONS(-1))	-0.745907	0.180228	-4.138691	0.0003
C	0.037394	0.010016	3.733308	0.0009
R-squared	0.397154	Mean dependent var		0.001020
Adjusted R-squared	0.373968	S.D. dependent var		0.032131
S.E. of regression	0.025423	Akaike info criterion		-4.437573
Sum squared resid	0.016805	Schwarz criterion		-4.342415
Log likelihood	64.12602	Hannan-Quinn criter.		-4.408482
F-statistic	17.12876	Durbin-Watson stat		2.058869
Prob(F-statistic)	0.000325			

Null Hypothesis: D(LCONS) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.486431	0.0069
Test critical values:		
1% level	-4.323979	
5% level	-3.580623	
10% level	-3.225334	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LCONS,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:41
 Sample (adjusted): 1986 2013
 Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCONS(-1))	-0.919295	0.204906	-4.486431	0.0001
C	0.028844	0.011053	2.609651	0.0151
@TREND("1984")	0.001097	0.000676	1.622320	0.1173
R-squared	0.454575	Mean dependent var		0.001020
Adjusted R-squared	0.410941	S.D. dependent var		0.032131
S.E. of regression	0.024661	Akaike info criterion		-4.466240
Sum squared resid	0.015204	Schwarz criterion		-4.323504
Log likelihood	65.52736	Hannan-Quinn criter.		-4.422604
F-statistic	10.41790	Durbin-Watson stat		1.936451
Prob(F-statistic)	0.000512			

Null Hypothesis: D(LCONS) has a unit root
 Exogenous: None
 Lag Length: 2 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.050354	0.6567
Test critical values:		
1% level	-2.656915	
5% level	-1.954414	
10% level	-1.609329	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LCONS,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:42
 Sample (adjusted): 1988 2013
 Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCONS(-1))	-0.005439	0.108008	-0.050354	0.9603
D(LCONS(-1),2)	-0.616267	0.215797	-2.855769	0.0089
D(LCONS(-2),2)	-0.553887	0.227188	-2.438019	0.0229
R-squared	0.339882	Mean dependent var		0.000546
Adjusted R-squared	0.282481	S.D. dependent var		0.033200
S.E. of regression	0.028123	Akaike info criterion		-4.196326
Sum squared resid	0.018190	Schwarz criterion		-4.051161
Log likelihood	57.55223	Hannan-Quinn criter.		-4.154523
Durbin-Watson stat	2.110043			

Null Hypothesis: D(LFDI) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.460009	0.0000
Test critical values: 1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LFDI,2)
Method: Least Squares
Date: 10/29/15 Time: 15:45
Sample (adjusted): 1987 2013
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI(-1))	-1.685490	0.260911	-6.460009	0.0000
D(LFDI(-1),2)	0.515257	0.174498	2.952790	0.0069
C	0.057848	0.094056	0.615039	0.5443
R-squared	0.673656	Mean dependent var		-0.006029
Adjusted R-squared	0.646460	S.D. dependent var		0.817605
S.E. of regression	0.486142	Akaike info criterion		1.499806
Sum squared resid	5.672012	Schwarz criterion		1.643788
Log likelihood	-17.24738	Hannan-Quinn criter.		1.542620
F-statistic	24.77097	Durbin-Watson stat		2.227174
Prob(F-statistic)	0.000001			

Null Hypothesis: D(LFDI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.322181	0.0001

Test critical values:	1% level	-4.339330
	5% level	-3.587527
	10% level	-3.229230

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LFDI,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:45
 Sample (adjusted): 1987 2013
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI(-1))	-1.685479	0.266598	-6.322181	0.0000
D(LFDI(-1),2)	0.515245	0.178387	2.888356	0.0083
C	0.058172	0.218517	0.266211	0.7924
@TREND("1984")	-2.02E-05	0.012280	-0.001648	0.9987
R-squared	0.673656	Mean dependent var		-0.006029
Adjusted R-squared	0.631089	S.D. dependent var		0.817605
S.E. of regression	0.496598	Akaike info criterion		1.573880
Sum squared resid	5.672011	Schwarz criterion		1.765856
Log likelihood	-17.24738	Hannan-Quinn criter.		1.630965
F-statistic	15.82590	Durbin-Watson stat		2.227163
Prob(F-statistic)	0.000008			

Null Hypothesis: D(LFDI) has a unit root
 Exogenous: None
 Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.512333	0.0000
Test critical values:	1% level	-2.653401
	5% level	-1.953858
	10% level	-1.609571

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LFDI,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:46
 Sample (adjusted): 1987 2013
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI(-1))	-1.669018	0.256286	-6.512333	0.0000
D(LFDI(-1),2)	0.507456	0.171859	2.952744	0.0068
R-squared	0.668512	Mean dependent var		-0.006029
Adjusted R-squared	0.655252	S.D. dependent var		0.817605
S.E. of regression	0.480059	Akaike info criterion		1.441371

Sum squared resid	5.761410	Schwarz criterion	1.537359
Log likelihood	-17.45850	Hannan-Quinn criter.	1.469913
Durbin-Watson stat	2.206321		

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.822893	0.0073
Test critical values: 1% level	-3.689194	
5% level	-2.971853	
10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:46
 Sample (adjusted): 1986 2013
 Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.738662	0.193221	-3.822893	0.0007
C	0.036920	0.010201	3.619395	0.0013
R-squared	0.359835	Mean dependent var		0.000757
Adjusted R-squared	0.335213	S.D. dependent var		0.024771
S.E. of regression	0.020197	Akaike info criterion		-4.897795
Sum squared resid	0.010606	Schwarz criterion		-4.802638
Log likelihood	70.56914	Hannan-Quinn criter.		-4.868705
F-statistic	14.61451	Durbin-Watson stat		2.011542
Prob(F-statistic)	0.000741			

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.701695	0.0042
Test critical values: 1% level	-4.323979	
5% level	-3.580623	
10% level	-3.225334	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:47

Sample (adjusted): 1986 2013
 Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.927698	0.197311	-4.701695	0.0001
C	0.029063	0.010063	2.887971	0.0079
@TREND("1984")	0.001104	0.000483	2.287937	0.0309
R-squared	0.470669	Mean dependent var		0.000757
Adjusted R-squared	0.428323	S.D. dependent var		0.024771
S.E. of regression	0.018729	Akaike info criterion		-5.016480
Sum squared resid	0.008770	Schwarz criterion		-4.873744
Log likelihood	73.23072	Hannan-Quinn criter.		-4.972844
F-statistic	11.11472	Durbin-Watson stat		2.009126
Prob(F-statistic)	0.000352			

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: None
 Lag Length: 2 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.136214	0.7170
Test critical values:		
1% level	-2.656915	
5% level	-1.954414	
10% level	-1.609329	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:47
 Sample (adjusted): 1988 2013
 Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	0.011798	0.086611	0.136214	0.8928
D(LGDP(-1),2)	-0.586188	0.201144	-2.914271	0.0078
D(LGDP(-2),2)	-0.348249	0.196484	-1.772401	0.0896
R-squared	0.289849	Mean dependent var		0.002034
Adjusted R-squared	0.228096	S.D. dependent var		0.025129
S.E. of regression	0.022078	Akaike info criterion		-4.680299
Sum squared resid	0.011211	Schwarz criterion		-4.535134
Log likelihood	63.84389	Hannan-Quinn criter.		-4.638497
Durbin-Watson stat	2.114261			

Null Hypothesis: D(LSAVR) has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
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Augmented Dickey-Fuller test statistic		-6.157323	0.0000
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LSAVR,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:48
 Sample (adjusted): 1987 2013
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAVR(-1))	-1.661824	0.269894	-6.157323	0.0000
D(LSAVR(-1),2)	0.281865	0.145044	1.943300	0.0638
C	0.021176	0.020820	1.017135	0.3192
R-squared	0.676720	Mean dependent var		0.005716
Adjusted R-squared	0.649780	S.D. dependent var		0.181381
S.E. of regression	0.107340	Akaike info criterion		-1.521186
Sum squared resid	0.276527	Schwarz criterion		-1.377204
Log likelihood	23.53600	Hannan-Quinn criter.		-1.478372
F-statistic	25.11950	Durbin-Watson stat		1.971599
Prob(F-statistic)	0.000001			

Null Hypothesis: D(LSAVR) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.030099	0.0002
Test critical values:	1% level	-4.339330
	5% level	-3.587527
	10% level	-3.229230

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(LSAVR,2)
 Method: Least Squares
 Date: 10/29/15 Time: 15:48
 Sample (adjusted): 1987 2013
 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAVR(-1))	-1.662355	0.275676	-6.030099	0.0000
D(LSAVR(-1),2)	0.280578	0.148621	1.887880	0.0717
C	0.025864	0.048938	0.528500	0.6022
@TREND("1984")	-0.000291	0.002734	-0.106347	0.9162
R-squared	0.676879	Mean dependent var		0.005716

Adjusted R-squared	0.634732	S.D. dependent var	0.181381
S.E. of regression	0.109622	Akaike info criterion	-1.447603
Sum squared resid	0.276391	Schwarz criterion	-1.255627
Log likelihood	23.54264	Hannan-Quinn criter.	-1.390519
F-statistic	16.06023	Durbin-Watson stat	1.970727
Prob(F-statistic)	0.000008		

Null Hypothesis: D(LSAVR) has a unit root

Exogenous: None

Lag Length: 1 (Automatic - based on SIC, maxlag=7)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.104584	0.0000
Test critical values:		
1% level	-2.653401	
5% level	-1.953858	
10% level	-1.609571	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LSAVR,2)

Method: Least Squares

Date: 10/29/15 Time: 15:49

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSAVR(-1))	-1.645981	0.269630	-6.104584	0.0000
D(LSAVR(-1),2)	0.287165	0.145051	1.979752	0.0588
R-squared	0.662784	Mean dependent var		0.005716
Adjusted R-squared	0.649296	S.D. dependent var		0.181381
S.E. of regression	0.107414	Akaike info criterion		-1.553056
Sum squared resid	0.288447	Schwarz criterion		-1.457068
Log likelihood	22.96626	Hannan-Quinn criter.		-1.524514
Durbin-Watson stat	1.921470			

Appendix 14: Unit root test for Vt

Null Hypothesis: RESID03 has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.441786	0.0002
Test critical values:		
1% level	-3.724070	
5% level	-2.986225	
10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(RESID03)
 Method: Least Squares
 Date: 11/03/15 Time: 13:01
 Sample (adjusted): 1989 2013
 Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID03(-1)	-1.096753	0.201543	-5.441786	0.0000
C	0.000487	0.002087	0.233371	0.8175
R-squared	0.562846	Mean dependent var		0.000631
Adjusted R-squared	0.543839	S.D. dependent var		0.015446
S.E. of regression	0.010432	Akaike info criterion		-6.211220
Sum squared resid	0.002503	Schwarz criterion		-6.113710
Log likelihood	79.64025	Hannan-Quinn criter.		-6.184175
F-statistic	29.61304	Durbin-Watson stat		2.081990
Prob(F-statistic)	0.000016			

Null Hypothesis: RESID03 has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.345960	0.0011
Test critical values:		
1% level	-4.374307	
5% level	-3.603202	
10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(RESID03)
 Method: Least Squares
 Date: 11/03/15 Time: 13:02
 Sample (adjusted): 1989 2013
 Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID03(-1)	-1.097950	0.205379	-5.345960	0.0000
C	0.002451	0.005444	0.450268	0.6569
@TREND("1984")	-0.000116	0.000295	-0.391947	0.6989
R-squared	0.565877	Mean dependent var		0.000631
Adjusted R-squared	0.526412	S.D. dependent var		0.015446
S.E. of regression	0.010630	Akaike info criterion		-6.138178
Sum squared resid	0.002486	Schwarz criterion		-5.991913
Log likelihood	79.72723	Hannan-Quinn criter.		-6.097611
F-statistic	14.33847	Durbin-Watson stat		2.095840
Prob(F-statistic)	0.000103			

Null Hypothesis: RESID03 has a unit root

Exogenous: None
 Lag Length: 0 (Automatic - based on SIC, maxlag=5)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.555720	0.0000
Test critical values:		
1% level	-2.660720	
5% level	-1.955020	
10% level	-1.609070	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(RESID03)
 Method: Least Squares
 Date: 11/03/15 Time: 13:03
 Sample (adjusted): 1989 2013
 Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID03(-1)	-1.097348	0.197517	-5.555720	0.0000
R-squared	0.561811	Mean dependent var		0.000631
Adjusted R-squared	0.561811	S.D. dependent var		0.015446
S.E. of regression	0.010225	Akaike info criterion		-6.288855
Sum squared resid	0.002509	Schwarz criterion		-6.240100
Log likelihood	79.61068	Hannan-Quinn criter.		-6.275332
Durbin-Watson stat	2.075922			