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# FISCAL PERFORMANCE IN KENYA: A THREE-GAP ANALYSIS

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***Abstract:*** **In investigating fiscal performance in Kenya for the period 1985 to 2017, we find that, in the long run, openness to the economy, GDP per capita growth, total debt service, and Treasury bill rate do not affect the fiscal deficit. However, openness has an effect, while investment was negative and insignificant in determining fiscal deficit. The results also indicated that variance in fiscal deficit was mostly attributed to shock in total debt service and openness to the economy and least by Treasury bill rate.**

## 1. INTRODUCTION

Fiscal performance is critical in maintaining macroeconomic stability of an economy and it's a dream of many developed, developing and underdeveloped economies. It is a framework within which policy is effectively employed in open economies to promote internal and external equilibrium in the economy. Many governments strive to improve fiscal performance by reducing fiscal deficit[1], which arises as a result of the anticipation of additional revenue translated from increased business activity to cover the shortage and hence more money is invested in the economy than it's collected through taxation.

Reliance on budget to finance election activities, increases in recurrent expenditure and unbudgeted spending has resulted to high budget deficit in developing countries particularly Africa. Fiscal management dialogue is vital to economies for the reason that fiscal policy impacts on aggregate demand, wealth sharing and capability of an economy to produce goods and services. Thus volume of demand for goods and services in the economy in the short run, can change due to changes in spending or taxation (Zuze, 2016). In Africa, particularly East Africa, Kenya is evolving as one of the key growth centers and is also poised to become one of the fastest growing economies. The drive for growth is predicted to be sustained by a steady macroeconomic environment supported by both fiscal and monetary policy.

Fiscal deficit has become an outstanding feature of the Kenyan economy, occupying recent policy discussions with other fiscal dimensions such as high public debt burden, inadequate savings and investment, and inadequate revenue to finance increasing public expenditure. Deficit is incurred to fund revenue and expenditure mismatch and also investments. However, it becomes problematic when the deficit levels become too high and prolonged, forcing the government to reduce spending on relevant sectors of the economy as a result of high government borrowing and debt servicing. Thus reduction in growth in both human and physical capital, which have a long-term influence on economic growth. Furthermore, crowding out of private investment, variations in inflation and exchange rate can caused by large public borrowing (Mohanty, 2012).

Kenya's fiscal framework involves a considered effort to contain fiscal risks by lowering fiscal deficit and containing increase in recurrent expenditure in favor of capital spending that is productive by exercising caution in public expenditure management, as aligned to the second Medium Term Plan (GOK, 2016). Kenya's widening deficit is attributed to an upward trend in public expenditures matched by unequal growth in revenues resulting in deficits over the years. The government depends on taxes as the main source of revenue and does not provide opportunity to increase revenue generation through tax adjustments, since tax rates are high. On the other hand, there is high proportion of non-discretionary government expenditure and hence there is little the government can do to contain the widening of fiscal deficit (Sirengo, 2008). This has led to unstable fiscal balance that continues to be experienced over the years.

[1] Defined as excess government expenditure over its income.

Fiscal performance of an economy can be measured through various variables including government revenue, expenditure and public debt. In this study, fiscal performance will be captured by the trend and magnitude of fiscal balance. Tuluji and Wolswijk (2014) argue that government budgetary targets are usually defined terms of flow (deficit) rather than stock terms (debt), because they are hard to target or monitor. In this regard, this study will identify the underlying factors that determine fiscal deficit in Kenya from 1985 to 2017 and the overall fiscal performance of the economy.

## 2. EMPIRICAL REVIEW

Using two stage least squares method, Diokno (2007) estimated fiscal balance using both the narrow and broader measure that is, the national government account balance and consolidated public sector fiscal position respectively. The period 1981 to 2005, in Philippine the author established that NGAB was statistically influenced by tax effort, inflation, capital outlay and domestic liquidity. While inflation, capital outlays and tax effort were positive, domestic liquidity was found to be negative.

In the West African Economic and Monetary Union (WAEMU) and the Central African Economic and Monetary Community (CEMAC), Adedeji and Williams (2007) using panel data for the period 1990 to 2006, analyzed fiscal performance. Empirical results revealed that fiscal stance is strongly and positively influenced by the previous period fiscal effort, therefore underscoring the risks of a pro cyclical fiscal policy stance. They found economic growth and per capita GDP, and openness being positive and significant in explaining fiscal performance in both CEMAC and WAEMU. Terms of trade was found to be significant though positive in CEMAC and negative in WAEMU, and time dummy was significant in both. In addition, lagged debt stock was found to be positive and significant in impacting fiscal performance.

The study by Sirengo (2008) set to investigate the determinants of fiscal balance in Kenya using a three-gap analysis. Using yearly data for the period 1975 to 2006 and GDP per capita growth rate, treasury bill rate, total debt service as proportion of total exports and degree of openness as variables. The study found treasury bill rate to positively affect fiscal balance, while total debt and trade openness negatively affect fiscal balance in the long run. All the three variables were found to be significant. Real GDP per capita was found be positive and insignificant in determining fiscal balance. In applying the error correction model, real GDP per capita was found to have a positive and significant effect on fiscal balance, while trade openness and total debt service were negative and significant. The study indicated that the trade liberalization policies of 1993 negatively impacted on fiscal balance.

In Pakistan 1976 to 2009 Anwar and Ahmad (2012) in both the short run and long run, examined the political factors that define budget deficit. The study used bounds testing approach and the error correction model (ECM) within an Autoregressive Distribution Lag model (ARDL). Empirical results showed that in the long run, government size was positive and highly significant, while democracy and GDP were positive and insignificant to budget deficit. In the short run, the ECM coefficient was negative and significant indicating adjustment of budget deficit dynamics to equilibrium in the long run. Also, government size was found to be positive and significant, democracy and GDP were positive and insignificant in determining fiscal deficit.

Ndungu (2014) used yearly data for the period 1963 to 2012 to analyze the determinants of fiscal performance in Kenya. The study measured fiscal balance using total revenue and grants minus total expenditure, excluding interest payment. The results obtained showed that all the variables were jointly significant determinants of fiscal performance in Kenya. The results indicated in the short run that, the first and second lag of GDP per capita, total debt service and current account as being positive in influencing fiscal balance. Whereas the first and second lag of treasury bill rate, inflation and tax revenue had a positive and negative impact on fiscal balance respectively. Board money first and second lag were found to have a negative effect, while gross government investment was found to have a negative and positive effect on fiscal balance in its first and second lag respectively.

In using panel approach and covering 1991 to 2011, Maltritz and Wuste (2015) analyzed the factors contributing to budget balance for 27 EU countries. They focused on effectiveness of fiscal rules, fiscal councils, effect of EMU affiliation and creative accounting. In estimating the model without interaction terms, they found outstanding debt to be significant and positive, unemployment rate and election dummy to be significant and negative. While political orientation, GDP growth, bond yield and the federalism dummy were found to have no significant influence.

Employing unrestricted Vector Autoregressive (VAR) model, Nyang'au and Orayo in 2016 analyzed factors behind fiscal performance in Kenya for the period 1963 to 2013. The study found that in the short run fiscal balance is influenced positively and negatively by the first and second lag of treasury bill, tax revenue and inflation, with inflation being insignificant. Empirical results also showed that, real GDP per capita growth rate first and second lag was positive and insignificant in determining fiscal balance. Total debt service, gross government investment and current account first lags were positive and significant, while the second lags were negative and insignificant in influence fiscal balance. Broad money was found to be negative in the first and second lag, influencing fiscal balance significantly and insignificantly respectively.

## 3. THEORETICAL MODEL

The study will follow the Keynesian perspective and use the simple Keynesian model which articulates the role of consumption and savings and then explains the accounting identity. The study borrows from the work of Sirengo (2008) and the analytical framework applied stems from the national income identity of an open economy in the context of a three-gap analysis, consisting of the fiscal gap, investment- savings gap and export-import gap. The fiscal gap derived from the income identity as presented in equation 1 below, which is the sum of the investment-savings gap and export-imports gap.

$$Y = C + I + G + X - M \quad (1)$$

Where:

Y is national income

C is private consumption

I is investment

G is government expenditure

X is exports

M is imports

Assuming that national income is disposable income plus taxes, disposable income being money available for consumption and saving after taxes have been accounted, we get:

$$Y = Y_d + T \quad (2)$$

Substituting equation 2 into 1 we get:

$$Y_d + T = C + I + G + X - M \quad (3)$$

Subtracting consumption from income we get:

$$Y_d + T - C = I + G + X - M \quad (4)$$

Savings is what remains from the disposable income after consumption and rearranging equation 4 we get:

$$S + T = I + G + X - M \quad (5)$$

Hence from equation 5, fiscal gap is given as:

$$T - G = I - S + X - M \quad (6)$$

Fiscal gap equation 6 also referred to as budget balance, indicate that fiscal budget revenue shortfalls are financed through domestic savings and export earnings. Nevertheless, the government can borrow from external sources to finance shortfalls in export earnings and or domestic savings.

The savings gap is equal to the sum of domestic savings and foreign transfers. It shows that investment financing can be achieved through current account surplus, government net foreign capital inflows and private savings. This is when we assume that government budget is financed by all foreign capital inflows and gross government income is used to pay all factor service leakages. Savings constraint level of investment is when private consumption is determined outside the

model and income is at its potential level. Foreign transfers on the other hand is the difference between net capital inflows and net factor to abroad and thus net exports and foreign transfers determine foreign exchange level of investment.

Breaking down investment into private and government gives budget constraint, government investment being a function of the differences of private savings and private investment, government gross income and expenditure and net capital flows and net factor service to abroad (Sirengo, 2008). The Keynesian expansionary effect of budget deficit leads to crowding-in effect, in that rise in budget deficit as a result of increase in public sector investment encourages private sector investment and thus we get a fiscally constraint level of investment. The rate of inflation, differences in money holdings, current account surplus and foreign transfers determine fiscal constraint.

Thus the fiscal balance is determined by factors that affect both the investment-savings gap and exports-imports gap. In this study, equation 6 will be model and fiscal balance will be measured using fiscal deficit as a percentage of GDP (excluding grants) and it will be a function of GDP per capita growth, interest rates, total debt servicing, trade openness and investment.

**3.1 Model Specification**

Equation (6) above indicate that fiscal balance is equal to the investment-savings gap and the exports-imports gap. The paper relied on the theoretical framework and past studies, where the model adopted provides key variables determining budget deficit. The general model adopted from equation 6 can be written as:

$$FD_t = f(GDPPCG_t, Int_t, TDE_t, Opn_t, Inv_t,) \quad (7)$$

Where $FD$ is fiscal deficit, $GDPPCG$ is growth rate of real GDP per capita; $Int$ is interest rate; $TDE$ is total debt servicing over exports, $Opn$ is the openness of the economy, $Inv$ is investment proxied by gross capital formation and t is time index.

The model is articulated in an econometric form as follows:

$$FD_t = \beta_0 + \beta_1 GDPPCG_t + \beta_2 Int_t + \beta_3 TDE_t + \beta_4 Opn_t + \beta_5 Inv_t + \mu_t \quad (8)$$

Where $\beta_0$ is the intercept predicting fiscal balance when all other variables are kept constant, $\beta_1$ to $\beta_6$ are independent variables coefficients and $\mu_t$ is the error term at time t. The priori expectations are as follows and some studies have found fiscal balance determinants to positive, while others found negative relationship.

$\beta_1, \beta_5 > 0$ and $\beta_2, \beta_3, \beta_4 < 0$

**3.2 Definition of Variables**

Fiscal deficit in the study is defined as total revenue excluding grants minus total expenditure less foreign financed capital expenditure, being a primary convergence criteria for attainment of EAC monetary union and desired to preserve fiscal sustainability. It is used as a dependent variable, because policy makers are interested in flow variables instead of stock variables. In addition the government can set fiscal balance target which is easy to monitor than debt to GDP ratio (Sirengo, 2008).

Real GDP per Capita growth rate measures the effect of the state of the economy to fiscal performance. It is expected that rise in the growth rate in real GDP per capita will increase revenue and hence improve fiscal balance, indicating a positive relationship for the variable. However, Tujula and Wolswijk in 2004 articulate that the variable is a measure of welfare level and in less developed countries, low welfare levels would lead to higher fiscal deficit, as the countries revenue catch up with expenditure. They argue that the variable would have a negative sign because of high investment needs facing the countries.

Interest rate measured by treasury bill rate is the cost domestic borrowing by the government. Higher fiscal deficit will result to government borrowing to finance the deficit and the higher the cost of borrowing, the higher would be the interest on borrowed funds, increasing government expenditure and hence worsening the fiscal balance. This would limit government borrowing and hence operating within the set budget constraint. In the study, the coefficient is anticipated to have a negative sign.

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Total debt service to exports ratio measures the influence of debt and sustainability on fiscal policy. Increase in total debt servicing to exports ratio is expected to worsen fiscal balance in that an increase in the ratio would mean high interest payment and hence a negative sign is predicted.

Opn measures the trade openness of the economy and its exposure and vulnerability to external shocks, including impact on fiscal performance. It could lower revenue and at the same time, could be favorable to growth, thereby enhancing revenue performance. The variable is expected to be have a negative sign and calculated as the sum of value of imports and exports, divided by the GDP at current market price. On the hand, investment will be proxied by gross capital formation and is expected to have a positive sign, as increase in productive investment as articulated by Keynesians will increase productive capacity of the economy improving the fiscal balance.

The summary of variables description and sources are presented in table 3.1 below:

**Table 3.1: Summary Description, Measurement and Source**

| Variable Name | Description and measurement | Source |
|---|---|---|
| Dependent variable: Annual fiscal deficit as a percentage of GDP (excluding grants) | | KNBS |
| Other variables | | |
| GDPPCG | Annual real GDP per capita growth rate | KNBS |
| Int | This is an annual nominal principal 91 day treasury bill rate | KNBS |
| TDE | Total debt service as a proportion of exports of goods and services at current market price. | World bank |
| Opn | This measures the degree of openness to the economy and is calculated as the sum of value of imports and exports, divided by the GDP at current market price. | KNBS |
| GCF | Annual gross capital formation used as proxy for investment and includes gross fixed capital formation plus changes in inventories as percentage of GDP at current market prices | KNBS |

### 4.1 Descriptive Statistics

The summary (table 4.1) indicate that most of the variables p values are higher than the conventional p value of 0.05 except for INT. This implies that all the variables are normally distributed except for INT and thus leads to the acceptance of the Jarque-Bera statistics that, the variables distribution is not statistically different from normal.

The period 1985 to 2017 Kenya's average fiscal deficit is approximately 3.78 per cent, with a maximum of 2.94 per cent in 1989 and a minimum of -10.42 per cent in 2014. The standard deviation of 3.28 per cent shows that fiscal deficit has a wide variation from the average mean. In the same period, the mean of GDPPCG is 1.22 per cent with a maximum of 9.73 per cent to a minimum of -7.69 per cent in 1989 and 1991 respectively. GFCF, INT, OPN and TDE had a mean of 18.56 per cent, 12.94 per cent, 50.42 per cent and 17.93 per cent, with standard deviations of 3.42 per cent, 2.49 per cent, 7.42 per cent, 6.65 per cent and 11.85 per cent respectively showing that they all have a wide variation from the average mean.

**Table 4.1: Descriptive Statistics**

**Observations: 33**

| Variable | Mean | Std. Dev. | Max | Min | Probability |
|---|---|---|---|---|---|
| FD | -3.782613 | 3.279066 | 2.93699 | -10.4162 | 0.866775 |
| GDPPCG | 1.219289 | 3.420199 | 9.734719 | -7.68504 | 0.29296 |
| GCF | 18.55774 | 2.499841 | 22.43266 | 14.44226 | 0.371765 |
| INT | 12.93939 | 7.415385 | 39.34000 | 1.41000 | 0.000004 |
| OPN | 50.41827 | 6.645089 | 60.44867 | 36.75137 | 0.259831 |
| TDE | 17.92771 | 11.84643 | 39.76611 | 4.319411 | 0.175945 |

*Source: Author's compilation from E-views*

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### 4.2 Unit Root Tests

Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were used to test for stationarity of the variables. This is prudent for time series data because it is associated with non-stationary problems and hence unit root test provides a basis for assessing for elimination of spurious results. Table 4.2 below indicate that five variables were non stationary at level and leading to first differencing. The first difference of FD, GCFC, INT, OPN and TDE showed that they were integrated of order one and significant at 1 per cent in both ADF and PP tests. However, GDPPCG was found to be stationary in level or integrated of order zero and significant at 1 per cent in both tests.

**Table 4.2: Augmented Dickey-Fuller and Phillips-Peron Tests**

| | **Augmented Dickey-Fuller Test** | | | | |
|---|---|---|---|---|---|
| **Variable Name** | Levels | | First Difference | | Order of Integration |
| | Intercept | Trend and Intercept | Intercept | Trend and Intercept | |
| **FD** | -0.98084 | -1.76345 | -13.8059* | -4.82974* | I (1) |
| **GDPPCG** | -4.28238* | -4.39271* | | | I (0) |
| **GCF** | -2.48314 | -2.58834 | -5.22976* | -5.18372* | I (1) |
| **INT** | -1.6787 | -2.45202 | -10.4585* | -4.41944* | I (1) |
| **OPN** | -1.85938 | -1.52832 | -5.92602* | -6.12866* | I (1) |
| **TDE** | -1.68827 | -1.72289 | -6.38452* | -5.37073* | I (1) |
| | **Phillips- Peron Test** | | | | |
| **Variable Name** | Levels | | First Difference | | Order of Integration |
| | Intercept | Trend and Intercept | Intercept | Trend and Intercept | |
| **FD** | -2.24782 | -2.43406 | -9.27894* | -17.3912* | I (1) |
| **GDPPCG** | -4.29366* | -4.33987* | | | I (0) |
| **GCF** | -2.50643 | -2.5447 | -6.55073* | -6.44009* | I (1) |
| **INT** | -2.36935 | -3.18746 | -8.4585* | -8.3166* | I (1) |
| **OPN** | -1.82829 | -1.53602 | -5.92602* | -6.44471* | I (1) |
| **TDE** | -1.80194 | -1.56404 | -6.52743* | -9.02927* | I (1) |

Significant levels: *(1%); ** (5%) and *** (10%)

*Source: Source: Author's compilation from E-views*

### 4.3 Correlation

Linear relationship between explanatory variables is examined using a correlation matrix. The results in table 4.3 show that GFCF is positively correlated with GDPPCG, and INT being negatively correlated with GDPPCG and INT. OPN is positively correlated with GDPPCG and INT and negatively correlated with GFCF. In addition, TDE was found to be negatively correlated with GDPPCG, GFCF and OPN, but positively correlated with INT. The highest correlation is between gross fixed capital formation and gross domestic product per capita growth of 0.366551.

**Table 4.3: Correlation Matrix**

| | **GDPPCG** | **GFCF** | **INT** | **OPN** | **TDE** |
|---|---|---|---|---|---|
| **GDPPCG** | 1.000000 | | | | |
| **GCF** | 0.366551 | 1.000000 | | | |
| **INT** | -0.26199 | -0.40291 | 1.000000 | | |
| **OPN** | 0.007661 | -0.18645 | 0.101636 | 1.000000 | |
| **TDE** | -0.11161 | -0.02840 | 0.347023 | -0.56384 | 1.000000 |

*Source: Author's compilation from E-views*

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### 4.4 Optimal Lag Length

The Akaike Information Criterion (AIC) and the Schwartz Bayesian Information Criterion (SBIC) were used to determine optimal lag length for the model, to ensure that it is well specified. Three lags were employed to the model and the guiding principal is to choose the one with the lowest AIC and SBIC. The results in table 4.4 shows lag three with the lowest AIC and SBIC, compared to one and two. Hence lag three was identified fit for the model.

**Table 4.4: Lag Length Selection**

| Lags | Akaike Information Criterion (AIC) | Schwartz Bayesian Information Criterion (SBIC) |
|---|---|---|
| **1** | 5.08993 | 5.69128 |
| **2** | 4.646781 | 5.534206 |
| **3** | 2.969987 | 4.148691 |

*Source: Author's compilation from E-views*

### 4.5 Diagnostic Checks

The residual and stability tests were subjected to the general model in appendix 2 to ensure the model is stable and well specified and the results are shown below:

#### 4.5.1 Residual Tests

The behavior of the error term is tested using residual tests and Histogram- Normality test, Serial Correlation LM test and Breuch-Pagan-Godfrey, Heteroscedasticity test were employed. Hisogram- Normality tests whether the variables are normally distributed or not and the test uses the Jacque-Bera statistics under the null hypothesis of normality. Results in table 4.5 indicate that the *p* value of the Jacque-Bera statistics is 0.708004 which is insignificant and hence fail to reject the null hypothesis and conclude that the residuals are normally distributed (see appendix 3).

Serial correlation LM test null hypothesis is that residuals are not correlated and the *p* value is 0.206532 which is higher than the conventional *p* value of 0.05, hence insignificant. We agree with the null hypothesis and conclude that there is no serial correlation or no autocorrelation. In addition, the equation estimated had no presence of heteroscedasticity with an insignificant *p* value of 0.386055, leading to acceptance of the null hypothesis of homoscedasticity or the variance of the error term is zero.

**Table 4.5: Residual Tests**

| Test | Statistic | Value | Probability | Conclusion |
|---|---|---|---|---|
| Normality | Jarque-Bera test | 0.690611 | 0.708004 | Residuals are normally distributed |
| Serial Correlation LM test | Obs*R-squared | 3.154598 | 0.206532 | No serial correlation |
| Heteroskedasticity test: Breuch-Pagan- Godfrey) | Obs*R-squared | 22.23540 | 0.386055 | No heteroscedasticity |

*Source: Author's compilation from E-views*

#### 4.5.2 Stability Tests

Ramsey Rest test, Cusum test and Recursive coefficients test were used to confirm the stability of the model. The results indicated an insignificant F-statistic probability value of 0.899055, in the null hypothesis that the model is well specified. Thus we accept the null hypothesis and conclude that the model is well specified. The cusum test (see appendix 4) at 5 per cent level of significance indicate that the model is stable and thus not sensitive to changes in the size of the sample. In looking at all the coefficients, all the variables are within the boundaries and thus indicating stability. C(1) shows the stability of the constant and C(2) to C(22) show the stability of the explanatory variables.

### 4.6 Co-integration

Co-integration is suggested as remedy to loss of log run relationship between variables after differencing of time series data to achieve stationarity. The variables in the model were tested for stationarity and FD, GCFC, INT, OPN and TDE were found to be integrated of order one, while GDPPCG was found to be stationary in level or integrated of order zero.

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Thus the Auto Regressive Distributed Lag (ARDL) or the bounds testing approach proposed by pesaran et al. (2001) was identified as suitable for the model. The results of the bound test for co-integration shown in the 4.6 indicate that the F-statistics value 6.327971 surpasses the upper bounds critical values at 90 per cent and 95 per cent level of significance, using unrestricted intercept and no trend. Hence we reject the null hypothesis that the variables jointly are not equal to zero and conclude that there is a long run association among variables.

**Table 4.6: Bound Testing**

**Significance: 95%**

| Test | Statistic | Value | Lower Bound | Upper Bound | Conclusion |
|---|---|---|---|---|---|
| Bound Test | F-Statistic | 3.426775682 | 2.62 | 3.79 | Co-integration |

**Significance: 90%**

| Test | Statistic | Value | Lower Bound | Upper Bound | Conclusion |
|---|---|---|---|---|---|
| Bound Test | F-Statistic | 6.327971 | 2.26 | 3.35 | Co-integration |

*Source: Author's compilation from E-views*

### 4.7 Long Run Model

The estimated long run coefficients using the ARDL approach as shown in table 4.7 indicate that the independent variables can only explain 41.76 per cent variation in fiscal deficit. The F-statistic of 3.87168 *(p value 0.00896)* shows a good joint explanatory power among the independent variables. The constant term was found to be negative and insignificant, in that if all the variables in the model were held constant a 1 unit change in the constant term would lead to -11.86875 units change in fiscal deficit. Openness to the economy was found to be positive and significant at 5 per cent, meaning a 1 unit change would result to 0.22807 change in fiscal deficit in the long run. The same results were established by Adebeji and Williams (2007) for both CEMAC and WAEMU and differing findings by Sirengo (2008).

The coefficient of real GDP per capita growth rate was found to be positive though insignificant, a 1 unit change would result to 0.04216 change in fiscal deficit. In the long run, improved welfare level would result to increased revenues and hence improve fiscal balance. These results concur with the priori expectation and finding of sirengo (2008) and Tujula and Wolswijk (2004). Gross capital formation a measure of investment was negative and insignificant, meaning that a 1 unit change would lead to -0.34085 units change in fiscal deficit. The results were similar to those of Murwirapachena et al (2013) in South Africa though investment was found to significant.

In addition, empirical results indicated that a 1 unit change in treasury bill rate would lead to 0.09788 units change in fiscal deficit in the long run. The results are contrary to the priori expectation and similar to those of Sirengo (2008). Total debt service was found to be positive and insignificant in that a 1 unit change would lead to 0.08897 units change in fiscal deficit. Kalim and Hassan (2012) in Pakistan established the same results, though total debt service was found to be significant.

**Table 4.7: Estimated Long Run Model**

| Dependent Variable: FD | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample: 1985 2017 | | | | |
| Included observations: 33 | | | | |
| Variable | Coefficient | Std. Error | t-statistic | Prob. |
| C | -11.86875 | 7.16267 | -1.65703 | 0.10909 |
| GDPPCG | 0.04216 | 0.15333 | 0.27495 | 0.78545 |
| GCF | -0.34085 | 0.22408 | -1.52109 | 0.13986 |
| INT | 0.09788 | 0.08104 | 1.20783 | 0.23759 |
| OPN | 0.22807 | 0.09569 | 2.38327 | 0.02446 |
| TDE | 0.08897 | 0.05659 | 1.57223 | 0.12754 |
| R-squared | 0.41758 | | | |

| | |
|---|---|
| Adjusted R-squared | 0.30973 |
| Durbin-Watson Stat | 2.13211 |
| Sum squared resid | 200.39433 |
| F-statistic | 3.87168 |
| Prob(F-statistic) | 0.00896 |

*Source: Author's compilation from E-views*

**4.8 Short Run Model**

The Error correction estimation is shown in table 4.8 and the overall fitness of the model is satisfactory as depicted by the adjusted R-Squared of 0.519571. The independent variables have a good joint explanatory power as evident by the significant F-statistic of 3.16295 *(P-value 0.01957)*. The estimation was general to an agreeable fit by including a dummy variable to capture the short run structural break. The error correction term lagged once was found to be negative and highly significant at 5 per cent level. The magnitude of the error correction term is -0.60088 indicating the speed of adjustment to the long run and stable equilibrium fiscal deficit in Kenya for the period covered is 60 per cent in each time period. This implies that instabilities in fiscal deficit would be corrected within a period of six years.

The coefficient of GDP per capita growth first and second lag is positive and significant in explaining fiscal deficit in the short run. When GDP per capita growth increases by 1 unit, fiscal deficit increase by 0.26754 and 0.37548 units change respectively. This is in support of the priori expectation in that the increase in welfare level is expected to result to improved state of the economy, improving living conditions, increasing income and thus improving the fiscal balance. This is possible through the multiplier effect as articulated by the Keynesian theory and the results were comparable with the findings of Adebeje and Williams (2007), Sirengo (2008), Ndungu (2014) and Nyang'au and Orayo (2016).

The coefficient of the first and the third lag of interest rate was found to be negative and significant, indicating that a 1 unit change would lead to -0.26698 and -0.15909 units change in fiscal deficit respectively. This is in line with the priori expectation that interest on borrowed funds would be higher as a result of higher cost of borrowing, leading to increased government expenditure and thus worsening fiscal balance. The same results were established by Tujula and Wolswijk (2004) and Nyang'au and Orayo (2006) in their second lag of treasury bill rate, though insignificant. The study by Ndungu (2014) found first and second lag of treasury bill rate to be positive and significant in determining fiscal deficit.

All the lags of total debt service were found to be negative and significant in explaining fiscal balance. This is in support of priori expectation and a one unit change in total debt service would lead to -0.65865, -0.40438 and -0.55854 units change in fiscal deficit in its first, second and third lag respectively. The higher the ratio, the higher the interest payment, resulting to increased government expending and hence worsening fiscal balance. Sirengo (2008), Kalim and Hassn (2012) and Nyang'au and Orayo (2016) in their first lag found similar results. On the other hand, Ndungu (2014) in their first and second lag and Nyang'au and Orayo (2016) in their second lag found total debt service to be negative and significant in explaining fiscal deficit.

Openness of the economy was found to be negative and significant, in that in its second lag a1 unit change would result to -0.27672 units change in fiscal deficit. The results are consistent with those obtained by Sirengo (2008) and different from those established by Adebeje and Williams (2007) in both CEMAC and WAEMU, and Kalim and Hassan (2012). Investment was found to be positive and significant, except for the first lag which was not significant. 1 unit change in the first, second and third lag would contribute to 0.68079, 1.08619 and 0.98419 units change in fiscal deficit respectively. This implies that investment remains the engine of growth in Kenya, as it will increase the productive capacity of the economy through capital accumulation as envisaged by the Keynesian's and thus improving the fiscal balance. The results are supported by the first lag of investment in the works of Ndungu (2014) and Nyang'au and Orayo (2016) and was found as expected. However, the study by Murwirapachena et al (2013), and second lag in Ndungu (2014) and Nyang'au and Orayo (2016) found investment to negatively explain fiscal deficit.

The dummy D2009 had a negative and significant impact on fiscal deficit, as a result of combined spill over effects from the post-election crisis, the global financial crisis and high international crude fuel prices which resulted to decline in most of the sectors of the economy in 2008 (CBK, 2010). The constant term was found negative and significant indicating that if all the variables in the model were held constant, a 1 unit change would lead to -1.37118 units change in fiscal deficit.

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**Table 4.8: Estimated Error Correction Model**

| Dependent Variable: D(FD) | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1989 2017 | | | | |
| Included observations: 29 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-statistic | Prob. |
| C | -1.37118 | 0.73385 | -1.86848 | 0.08276 |
| D(GDPPCG(-1)) | 0.26754 | 0.14896 | 1.79600 | 0.09410 |
| D(GDPPCG(-2)) | 0.37548 | 0.19844 | 1.89216 | 0.07934 |
| D(GDPPCG(-3)) | -0.39588 | 0.19653 | -2.01433 | 0.06360 |
| D(INT(-1)) | -0.26698 | 0.12247 | -2.17990 | 0.04683 |
| D(INT(-3)) | -0.15909 | 0.07832 | -2.03118 | 0.06167 |
| D(TDE(-1)) | -0.65865 | 0.26137 | -2.52002 | 0.02450 |
| D(TDE(-2)) | -0.40438 | 0.20127 | -2.00915 | 0.06421 |
| D(TDE(-3)) | -0.55854 | 0.21720 | -2.57152 | 0.02217 |
| D(OPN(-2)) | -0.27672 | 0.14614 | -1.89357 | 0.07913 |
| D(GCF(-1)) | 0.68079 | 0.41111 | 1.65597 | 0.11996 |
| D(GCF(-2)) | 1.08619 | 0.42128 | 2.57834 | 0.02188 |
| D(GCF(-3)) | 0.98419 | 0.48266 | 2.03911 | 0.06078 |
| ECM(-1) | -0.60088 | 0.32161 | -1.86835 | 0.00020 |
| D2009 | -6.12000 | 3.27869 | -1.86660 | 0.08304 |
| R-squared | 0.759786 | | | |
| Adjusted R-squared | 0.519571 | | | |
| Durbin-Watson Stat | 1.934908 | | | |
| Sum squared resid | 102.0044 | | | |
| F-statistic | 3.16295 | | | |
| Prob(F-statistic) | 0.01957 | | | |

*Source: Author's compilation from E-views*

### 4.9 Short-Run Model Diagnostic Checks

The short run model was subjected to residual and stability test and the results are as shown below:

#### 4.9.1 Short-Run Residual Tests

The short run model residuals were found to be normally distributed as indicated by the insignificant Jarque-Bera probability of 0.789360, resulting to acceptance of the null hypothesis of normality. The equation residuals was also found to have no serial correlation and no heteroscedasticity as shown by their insignificant *p* values, which is higher than the conventional p value of 0.05.

**Table 4.9: Short-Run Residual Tests**

| Test | Statistic | Value | Probability | Conclusion |
|---|---|---|---|---|
| Normality | Jarque-Bera test | 0.473065 | 0.789360 | Residuals are normally distributed |
| Serial Correlation LM test | Obs*R-squared | 2.360259 | 0.307239 | No serial correlation |
| Heteroskedasticity test: Breuch-Pagan- Godfrey) | Obs*R-squared | 8.126647 | 0.882634 | No heteroscedasticity |

*Source: Author's compilation from E-views*

#### 4.9.2 Short-Run Stability Test

The short run model was tested for stability and the Ramsey Rest test showed that the model is well specified with a probability of the F-statistic being 0.28809. The model and its coefficients was also found to be stable as they were within the boundaries as shown in the Cusum test at 5 per cent level and recursive coefficient test (see appendix 6 and 7)

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### 4.10 Variance Decomposition Analysis

The effects of shock to the dependent variables was examined using variance decomposition and it validates the significant role played by GDPPCG, INT, TDE, OPN, INT and GCF in determining fluctuations in Kenya's fiscal deficit. Over a series of time horizon, it determines the magnitude of the forecast error variance for any variable in the model, elucidated by innovations to each explanatory variable. The study used Cholesky ordering and table 4.10.1 indicate that in the short-run at year five, FD own shock account for 46.38 per cent of its fluctuation and shock to GDPPCG, INT, TDE, OPN, INT and GCF causes 14.06 per cent, 3.17 per cent, 2.45 per cent, 8.82 per cent and 7.40 per cent fluctuation in fiscal deficit. In year ten, 34.47 per cent of fluctuation in fiscal deficit is explained by 12.04 per cent variance in GDPPCG, 8.70 per cent in INT, 13.99 per cent in TDE, 21.26 per cent in OPN and 9.54 per cent in GCF. The results indicate that in the long run the variance in fiscal deficit is explained more by shock to openness to the economy.

**Table 4.10.1: Variance Decomposition of FD**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 2.166 | 100.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **2** | 2.653 | 70.728 | 14.123 | 3.474 | 0.029 | 10.780 | 0.865 |
| **3** | 3.017 | 64.101 | 14.062 | 3.169 | 2.452 | 8.820 | 7.395 |
| **4** | 3.555 | 51.408 | 12.247 | 2.371 | 15.172 | 6.369 | 12.433 |
| **5** | 3.762 | 46.379 | 11.462 | 2.484 | 16.391 | 11.328 | 11.956 |
| **6** | 4.090 | 43.803 | 10.167 | 2.530 | 16.157 | 15.262 | 12.081 |
| **7** | 4.337 | 39.592 | 9.256 | 2.939 | 15.036 | 22.427 | 10.750 |
| **8** | 4.557 | 40.253 | 9.196 | 5.138 | 13.630 | 22.035 | 9.750 |
| **9** | 4.710 | 37.707 | 9.487 | 7.899 | 13.428 | 22.170 | 9.308 |
| **10** | 4.942 | 34.468 | 12.044 | 8.699 | 13.991 | 21.258 | 9.541 |

*Source: compilation from E-views*

In year five, shock to GDPPCG account for 58.73 per cent variance in GDPPCG, with the highest variance being contributed by shock to FD at 19.44 per cent, followed by TDE at 8.96 per cent, INT at 4.69 per cent and lastly by GCF at 3.32 per cent. At year ten, 50.41 per cent variance in GDPPCG is explained by 21.56 per cent variance in FD, 8.52 per cent of variance in TDE, 7.08 per cent variance in OPN, 5.19 per cent variance in INT and 3 per cent variance in GCF. Table 4.10.2 indicate that as we move towards the long run, fluctuation caused by GDPPCG own shock is reducing, while other variables shock exhibits presence of a fluctuating trend to GDPPCG.

**Table 4.10.2: Variance Decomposition of GDPPCG**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 3.888 | 17.973 | 82.027 | 0.000 | 0.000 | 0.000 | 0.000 |
| **2** | 4.279 | 14.928 | 67.792 | 2.807 | 8.454 | 3.615 | 2.404 |
| **3** | 4.490 | 19.905 | 61.741 | 2.578 | 8.806 | 3.441 | 3.529 |
| **4** | 4.554 | 19.406 | 61.223 | 3.360 | 9.182 | 3.374 | 3.455 |
| **5** | 4.652 | 19.440 | 58.734 | 4.689 | 8.960 | 4.861 | 3.316 |
| **6** | 4.755 | 20.439 | 56.486 | 4.595 | 8.799 | 6.480 | 3.202 |
| **7** | 4.894 | 20.100 | 56.383 | 4.661 | 8.310 | 7.491 | 3.055 |
| **8** | 4.998 | 22.254 | 54.225 | 5.186 | 8.103 | 7.230 | 3.002 |
| **9** | 5.082 | 21.556 | 53.197 | 5.897 | 8.523 | 7.079 | 3.747 |
| **10** | 5.231 | 20.493 | 50.410 | 6.297 | 9.996 | 8.496 | 4.309 |

*Source: E-views*

Treasury bill rate's own shock at year five contributes to its fluctuation by 47.87 per cent and its variance is highly attributed by shock to GDPPCG by 35.03 per cent, while shock to GCF contributes least to its fluctuation by 2.64 per cent. In the long run 34.25 per cent contributes to fluctuation to INT attributed to its own shock, with the highest variance being caused by GDPPCG shock 29.07 per cent, followed by FD 12.04 per cent, TDE 9.75 per cent, OPN 8.24 per cent and GCF 6.66 per cent.

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**Table 4.10.3: Variance Decomposition of INT**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 4.461 | 0.035 | 0.117 | 99.848 | 0.000 | 0.000 | 0.000 |
| **2** | 6.434 | 0.026 | 20.469 | 73.074 | 0.023 | 5.472 | 0.936 |
| **3** | 7.368 | 0.125 | 34.228 | 56.888 | 0.031 | 5.927 | 2.801 |
| **4** | 7.981 | 5.072 | 31.062 | 52.457 | 2.687 | 5.818 | 2.905 |
| **5** | 8.417 | 6.378 | 35.029 | 47.873 | 2.614 | 5.463 | 2.643 |
| **6** | 8.775 | 11.041 | 32.433 | 45.892 | 2.578 | 5.622 | 2.434 |
| **7** | 9.085 | 11.078 | 32.116 | 43.402 | 3.198 | 6.390 | 3.816 |
| **8** | 9.701 | 15.371 | 29.571 | 41.714 | 3.919 | 5.704 | 3.721 |
| **9** | 10.299 | 13.647 | 31.595 | 39.652 | 5.421 | 5.062 | 4.623 |
| **10** | 11.183 | 12.042 | 29.069 | 34.248 | 9.746 | 8.241 | 6.655 |

*Source: E-views*

Table 4.10.4 shows that in the fifth year 61.29 per cent variance in total debt service is explained by 18.49 per cent variance in GCF, 4.41 per cent variance in FD, 2.86 per cent variance in GDPPCG and only 2.54 per cent variance in OPN. In the tenth year, variance in total debt service is mostly explained by OPN 15.42 per cent and least attributed by FD 4.12 per cent. Its own shock account for 55.34 per cent fluctuation in TDE.

**Table 4.10.4: Variance Decomposition of TDE**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 2.443 | 18.744 | 0.682 | 2.758 | 77.816 | 0.000 | 0.000 |
| **2** | 3.969 | 8.167 | 5.242 | 13.565 | 62.950 | 0.626 | 9.450 |
| **3** | 5.343 | 4.767 | 4.819 | 8.460 | 58.760 | 0.425 | 22.769 |
| **4** | 6.359 | 3.662 | 3.415 | 9.298 | 62.569 | 1.132 | 19.924 |
| **5** | 6.966 | 4.414 | 2.861 | 10.402 | 61.293 | 2.543 | 18.487 |
| **6** | 7.782 | 3.661 | 2.485 | 8.344 | 59.577 | 7.984 | 17.948 |
| **7** | 8.353 | 3.414 | 2.704 | 7.616 | 58.769 | 11.061 | 16.436 |
| **8** | 8.976 | 4.697 | 2.637 | 6.598 | 56.678 | 13.689 | 15.702 |
| **9** | 9.515 | 4.209 | 3.776 | 5.973 | 55.628 | 15.552 | 14.862 |
| **10** | 9.617 | 4.121 | 4.718 | 5.858 | 55.336 | 15.418 | 14.549 |

*Source: E-views*

The shock to OPN account for 25.81 per cent and 36.25 per cent in its variance in year five and ten respectively. Shock to GDPPCG contributes highest to the variance by 29.39 per cent in year five and TDE by 20.77 per cent in the tenth year. The least contributor to the variance in OPN was shock to treasury bill rate in both the fifth and tenth year by 5.25 per cent and 5.74 per cent.

**Table 4.10.5: Variance Decomposition of OPN**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 3.467 | 0.921 | 26.635 | 18.766 | 0.766 | 52.913 | 0.000 |
| **2** | 4.830 | 12.291 | 21.388 | 13.030 | 0.589 | 52.674 | 0.028 |
| **3** | 6.165 | 15.182 | 29.870 | 8.712 | 1.371 | 41.949 | 2.915 |
| **4** | 7.341 | 11.111 | 37.232 | 6.226 | 8.751 | 30.998 | 5.681 |
| **5** | 8.309 | 9.442 | 29.388 | 5.250 | 18.436 | 25.805 | 11.679 |
| **6** | 9.521 | 7.655 | 24.357 | 4.430 | 24.400 | 25.046 | 14.112 |
| **7** | 10.353 | 7.418 | 20.603 | 4.192 | 25.344 | 29.770 | 12.673 |
| **8** | 11.152 | 8.544 | 17.781 | 3.762 | 23.517 | 35.113 | 11.283 |
| **9** | 11.769 | 8.715 | 17.040 | 4.723 | 21.701 | 37.690 | 10.131 |
| **10** | 12.093 | 8.996 | 18.107 | 5.740 | 20.769 | 36.251 | 10.138 |

Table 4.10.6 indicate that GCF own shock account for 23.2 per cent to its fluctuation in year five, with shock to TDE causing 44.98 per cent variance, followed by 13.52 per cent OPN and least 4.69 per cent GDPPCG. In the tenth year, 17.74 per cent variance in GCF is mostly attributed to shock to TDE, followed by OPN, GDPPCG, INT and lastly FD. 33.85 per cent, 15.55 per cent, 12.91 per cent, 12.6 per cent and 7.36 per cent respectively.

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**Table 4.10.6: Variance Decomposition of GCF**

| Period | S.E. | FD | GDPPCG | INT | TDE | OPN | GCF |
|---|---|---|---|---|---|---|---|
| **1** | 1.881 | 0.246 | 6.046 | 6.908 | 44.769 | 15.070 | 26.960 |
| **2** | 2.498 | 2.936 | 5.599 | 8.453 | 50.698 | 9.092 | 23.221 |
| **3** | 2.752 | 6.205 | 5.448 | 8.414 | 47.320 | 8.122 | 24.491 |
| **4** | 3.023 | 6.215 | 4.829 | 7.423 | 45.317 | 12.255 | 23.961 |
| **5** | 3.072 | 6.109 | 4.689 | 7.491 | 44.984 | 13.525 | 23.201 |
| **6** | 3.194 | 5.889 | 4.475 | 8.561 | 41.685 | 17.792 | 21.598 |
| **7** | 3.365 | 6.977 | 4.738 | 10.679 | 38.362 | 19.318 | 19.926 |
| **8** | 3.504 | 7.826 | 9.014 | 10.713 | 35.544 | 17.925 | 18.979 |
| **9** | 3.661 | 8.025 | 11.251 | 11.832 | 34.568 | 16.422 | 17.903 |
| **10** | 3.827 | 7.358 | 12.909 | 12.600 | 33.849 | 15.547 | 17.736 |

*Source: E-views*

### 4.11 Impulse Response Function

The impulse response function ascertains the responsiveness of the dependent variable when a shock is applies to the error term. The assumption is that all the variables are endogenous and the residuals in the model are normally distributed, no serial correlation, no heteroscedasticity and it is stable. The study applied a one standard deviation positive shock to all endogenous variables over a ten year period with ordering as: fiscal deficit, GDP per capita growth, treasury bill rate, total debt service, openness to the economy and gross capital formation. One standard deviation positive shock in FD results to a fluctuating trend over the ten year period sometimes positive and sometimes negative. A one standard deviation innovation to GDPPCG, FD is negative up to five years with an increasing trend and becomes positive after eight years. This is consistent with ECM model results that improvement in welfare levels improves fiscal balance overtime.

Fiscal deficit becomes positive for two years, declines and stabilizes at zero for three years and thereafter becomes positive into future unit ten years. This is as result of a one standard deviation positive shock to treasury bill rate. As for total debt service, fiscal deficit was zero for the first two years and became negative after three years up to the eight year and thereafter a positive trend. This confirms that higher debt ratio resulting to higher interest payment, leading to increased government expenditure and thus worsens fiscal balance. The figure also shows that fiscal deficit responses to shock in openness to the economy positively for two years, then resides to zero and thereafter negative up to ten years. This shows that as external shock to the economy worsens trade balance as established in the ECM estimation. Positive shock in investment on the other hand, fiscal deficit is negative for seven year, resides to zero for two years and becomes positive after. This indicates that investment in the long run will expand the economy and hence improve fiscal balance.

## 5. CONCLUSION AND SUMMARY

The general model was found to be normally distributed, no serial correlation, no heteroscedasticity, stable and well specified. Bound testing approach was used to establish Co integration and there was long run association among the variables revealed by F-statistic value exceeding the upper bound critical values at 90 per cent and 95 per cent significance. In the long run, Openness of the economy, GDPPCG, treasury bill rate and total debt service were found to be positive, with only openness of the economy being significant in determining fiscal deficit for the period covered. In addition, gross capital formation was found to be negative in explaining fiscal deficit and insignificant.

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# APPENDIX

## Appendix 1: Descriptive Statistics

**Sample: 1985-2017**

| | FD | GDPPCG | GFCF | INT | OPN | TDE |
|---|---|---|---|---|---|---|
| **Mean** | -3.78261 | 1.219289 | 18.55774 | 12.93939 | 50.41827 | 17.92771 |
| **Median** | -3.79380 | 1.825495 | 18.79616 | 11.07000 | 53.1324 | 15.82524 |
| **Maximum** | 2.93699 | 9.734719 | 22.43266 | 39.34000 | 60.44867 | 39.76611 |
| **Minimum** | -10.4162 | -7.68504 | 14.44226 | 1.41000 | 36.75137 | 4.319411 |
| **Std. Dev.** | 3.279066 | 3.420199 | 2.499841 | 7.415385 | 6.645089 | 11.84643 |
| **Skewness** | 0.01660 | 0.093391 | -0.11370 | 1.442155 | -0.53818 | 0.625536 |
| **Kurtosis** | 2.545179 | 4.32321 | 1.822055 | 6.125017 | 2.104572 | 2.019076 |
| **Jarque-Bera** | 0.285951 | 2.455436 | 1.978989 | 24.86684 | 2.695447 | 3.475165 |
| **Probability** | 0.866775 | 0.29296 | 0.371765 | 0.000004 | 0.259831 | 0.175945 |
| **Sum** | -124.8260 | 40.23655 | 612.4053 | 427.0000 | 1663.803 | 591.6146 |
| **Sum Sq. Dev.** | 344.0728 | 374.3284 | 199.9745 | 1759.614 | 1413.031 | 4490.816 |
| **Observations** | 33 | 33 | 33 | 33 | 33 | 33 |

## Appendix 2: General Model

| Dependent Variable: D(FD) | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1989 2017 | | | | |
| Included observations: 29 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 24.82785 | 28.80277 | 0.86200 | 0.41724 |
| D(GDPPCG(-1)) | -0.58881 | 0.50602 | -1.16360 | 0.28271 |
| D(GDPPCG(-2)) | -0.62764 | 0.33362 | -1.88129 | 0.10197 |
| D(GDPPCG(-3)) | -0.50380 | 0.26141 | -1.92726 | 0.09531 |
| D(INT(-1)) | 0.16302 | 0.26320 | 0.61936 | 0.55530 |
| D(INT(-2)) | 0.14604 | 0.27509 | 0.53089 | 0.61192 |
| D(INT(-3)) | -0.08051 | 0.21908 | -0.36749 | 0.72411 |
| D(TDE(-1)) | -0.29312 | 0.37522 | -0.78119 | 0.46029 |
| D(TDE(-2)) | -0.15532 | 0.29279 | -0.53047 | 0.61219 |
| D(TDE(-3)) | -0.16456 | 0.27287 | -0.60309 | 0.56547 |
| D(OPN(-1)) | 0.09411 | 0.34780 | 0.27058 | 0.79452 |
| D(OPN(-2)) | 0.13925 | 0.36563 | 0.38085 | 0.71461 |
| D(OPN(-3)) | 0.12710 | 0.25232 | 0.50373 | 0.62991 |
| D(GFCF(-1)) | 1.95280 | 0.68400 | 2.85495 | 0.02451 |
| D(GFCF(-2)) | 1.03051 | 0.48027 | 2.14566 | 0.06905 |
| D(GFCF(-3)) | 0.43604 | 0.68487 | 0.63667 | 0.54459 |
| FD(-1) | -1.58383 | 0.36984 | -4.28252 | 0.00364 |
| GDPPCG(-1) | 0.54596 | 0.57486 | 0.94973 | 0.37388 |
| INT(-1) | -0.16159 | 0.24103 | -0.67043 | 0.52408 |
| TDE(-1) | 0.24770 | 0.20849 | 1.18805 | 0.27356 |
| OPN(-1) | -0.01807 | 0.42940 | -0.04209 | 0.96760 |
| GFCF(-1) | -1.75335 | 0.72962 | -2.40309 | 0.04725 |
| R-squared | 0.90552 | | | |
| Adjusted R-squared | 0.62208 | | | |
| Durbin-Watson stat | 1.49793 | | | |
| Sum squared resid | 40.120201 | | | |
| Log likelihood | -45.85569 | | | |
| F-statistic | 3.19473 | | | |
| Prob(F-statistic) | 0.06013 | | | |

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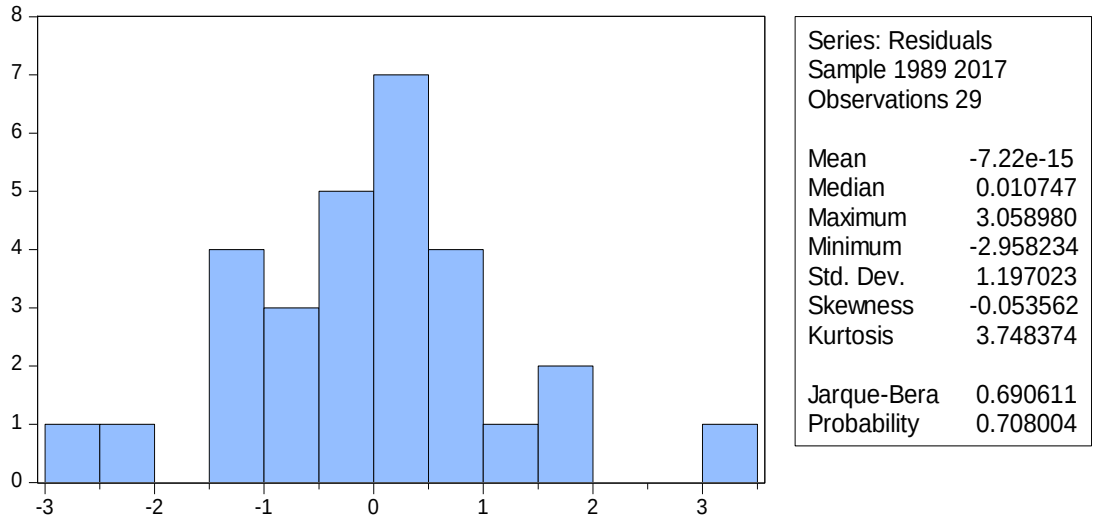
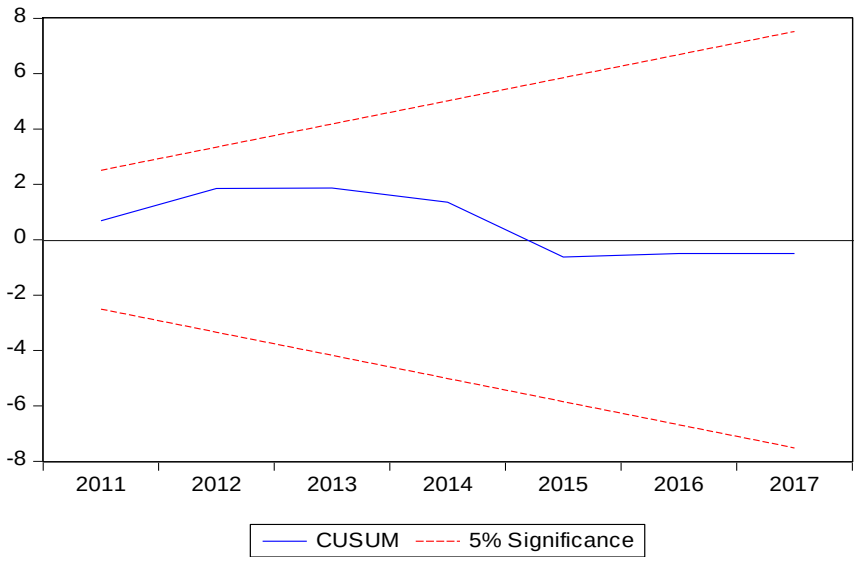
**Appendix 3: Histogram Normality Test**




**Appendix 4: Cusum Test Graph**




**Appendix 5: Short-Run Model Cusum Graph**