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Budget Deficit and Interest Rate: Evidence from Malaysia 1965-2005

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ABSTRACT

This study aims to analyze the impact of the budget deficit on interest rates in Malaysia for 40 years from 1965 to 2005. Towards the achievement of the objective, the study uses Granger causality and co-integration analysis. The primary results of the study shows that there is no significant short-term relationship between deficit budget and the interest rate. However, by using of co-integration test and error correction model test (ECM), it has found a significant long-term relationship between the budget deficit and interest rates. The present study also recommends for policy guidelines for the selection of national budget strategies to ensure sufficient options to take care of burdened with debt and inflation also a tolerable tax option in Malaysia.

Keywords: Budget Deficit, Interest Rate, Granger Causality, Co-integration and Error Correction Model

1. INTRODUCTION

The budget deficit is an issue that is frequently discussed by economists from time to time. The budget deficit is the effect of economic conditions that influenced the design of policies pursued by the government. Budget deficit occurs are caused by government expenditure exceeds its revenue. The expenses incurred need a source of funding to enable the implementation of the national budget and to boost the economic growth. Generally, in order to get more funding, the government will issue more government bonds and certificates. As a result, it will increase the national debts. Malaysia national budget over a period

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of 40 years from 1965 to 2005 shows Malaysia is experiencing a budget deficit almost every year on average. Based on the above circumstances, the question arises of whether there is an effect of budget deficits on interest rates in Malaysia?

In view of the importance issues of the linkage between the budget deficit and interest rate some research has been addressed in a large and growing number of publications. According to previous researchers like (Cebula, 1988, 1991, 2000, 2013), (Knot & de Haan, 1999), (Al-Saji, 1993) and (Aisen & Hauner, 2013) stated that the budget deficit and interest rates are positively correlated. While (Plosser, 1987), the increase in the deficit will lead to an increase in interest rates as a result of the outflow of capital accumulation. However, according to (Hassan & Nassar, 2015), there is no positive effect of budget deficit on long-term interest rate.

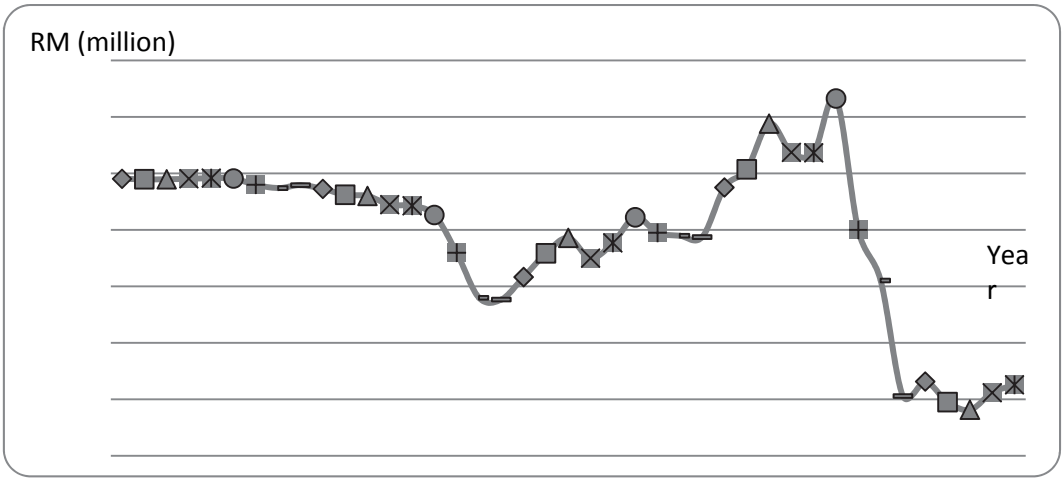

Figure 1: Growth of Malaysia Federal Government deficit (1965-2005)
Source: Malaysia Economic Report 1965-2005

Due to the importance of the issue of the relationship between budget deficit and interest rate and a mixed result from the previous study, this research is to examine the relationship between budget deficits and interest rates in Malaysia by using a longer time period from 1965 to 2005. The relationship between budget deficits and interest rates are important as guidelines to governments and policy makers in formulating the policy to be conducted for the purpose of economic development. The interest rate is an important factor because of high interest rates led to an increase in the national debt. This research will add a support to the discussion on the budget deficit and interest rate.

2. LITERATURE REVIEW

2.1 *Relationship of Budget Deficit and Interest Rate*

According to (Cebula, 1988), the government deficit has a positive effect on long-term nominal interest rates, the slope of the yield curve due to increased and long-term capital outflows. Based on the studies of Al-Saji (1993) it identifies the impact of the government's budget deficit on interest rates and nominal long-term interest rates in the UK for 1960 to 1990. The study found that increasing the government budget deficit contributed to an increase in nominal interest rates and long-term interest rate significantly. The increase in nominal interest rates and long-term interest rate effects of high government budget deficits would lead to an outflow of private investment in turn prevents the formation of capital and economic growth in the long term.

(Correia-Nunes & Stemitsiotis, 1995) conducted an empirical study on the relationship between interest rates and budget deficits of the 10 countries of the Organization for Economic Cooperation and Development (OECD), the US, Japan, the Netherlands, Denmark, Germany, France, United Kingdom, Canada, Belgium and Ireland for the period 1970 to 1993. The results showed that long-term interest rates rose by a huge budget deficit. (Belton & Cebula, 1995) also conducted a study to identify the impact of budget deficits in the US on short-term nominal interest rates and long-term framework based on the open economy. The study found that short-term nominal interest rate, consistently not affected by the budget deficit. The long-term nominal interest rates showed a positive and significant impact on the budget deficit. High interest rates will cause a decrease in sensitivity to interest rate component of private spending such as investment and thus would reduce the accumulation of capital.

(Ewing & Yanochik, 1999) has been studying the impact of the government's budget deficit over the term structure of interest rates in Italy for the period 1977 to 1999. The study was conducted using co-integration test to examine the long term relationship between budget deficit and interest rate. The study found that the budget deficit increases the yield on long-term government bonds and the rate of three-month treasury bills. The budget deficit will prevent the growth of the Italian economy in the long term, the impact of capital outflows. The findings also supported by (Cebula, 1991) which found that the US deficit showed a significant effect on the interest rate term structure. Also provides a similar opinion is (Knot & de Haan, 1999). He stated that the budget deficit and interest rates are positively correlated. These statements are based on studies conducted in Germany for the period 1987 to 1993. The higher interest rate due to the large budget deficits will impact negatively on growth potential and also lowering the standard of living in the future.
According to a survey conducted (Wachtel & Young, 1987) on interest rates and the impact of government deficit budget planning. The results showed that there

was a relationship between interest rates and government deficit in the future. The announcement of the government's budget deficit affects the government securities of all maturities, although the effect is significant to the acquisition of the long-term. The statement was supported by (Plosser, 1987), where he found an increased deficit will lead to an increase in interest rates as a result of the outflow of capital accumulation right. The fall in interest rates is due to concerns over government debt will lead to an outflow of private investment.

(Cebula, 2000) also conducted a study to determine the effect of budget deficits on long-term real interest rates in the US for the period 1973 to 1995. The study found that the government's budget deficit and long-term real interest rates showed a positive and significant relationship. Government budget deficit financing through the sale of government bonds and treasury bills directly will lead to a rise in interest rates. An increase in interest rates will lead to slowing private investment activity in the country and had a negative effect on economic growth. To the extent of this research done by (Cebula, 2013) using a longer time period from 1975 to 2012 on the impact of US budget deficits on the nominal interest rate yield on Moody's Aaa-rated corporate bonds using autoregressive two-stage least squares. The extended research finding shows the federal budget deficit has a statistically significant impact on the nominal interest rate yield on Moody's Aaa-rated long-term corporate bonds.

Recent research done by (Hassan & Nassar, 2015) on the relationship between long term interest rate and government debt and deficit spending on US, England, France, Germany and Japan. However, the results show that there was no positive effect of deficit spending on long term interest rate in any of the five countries. The study found that government borrowing has no crowding effect. Meaning the deficit spending does not affect the availability of funds for lending and its result of higher long term interest rate.

3. METHODOLOGY

This research used yearly time series data for a period of 40 years, starting from 1965 to 2005 for the budget deficit and short-term real interest rates. Information from the data obtained from the Economic Report, published annually by the Malaysia Ministry of Finance, the annual report of the Bank Negara Malaysia (BNM) and statistical data from the *International Monetary Fund (IMF)*. This study uses the Granger Causality test, Additional Dickey-Fuller test (ADF), Co-integration Engle-Granger (EG) test and Error Correction Model (ECM) test.

3.1 *Model Specifications*

The model used in the research is the multiple regression model. In this model, the budget deficit was used as dependent variables and variable interest rates were used as independent variables.

DEF= F (IR)
Where:
DEF= Budget deficit
IR = Short-term real interest rate
INF = Inflation
This particular model of interest rate can be written as follows:

$$DEF = a_0 + \beta_1 IR + \mu_i$$

In equation (2) above, μ_i representing the error term while β is the parameter for variable.

3.1.1 Granger Causality Test

To test the relationships that exist between the budget deficit and interest rates, Granger Causality Test (1969) will be used in research.

$$\ln DEF_t = \delta + \sum_{i=1}^{a} \alpha_i \ln DEF_{t-i} + \sum_{j=1}^{b} \beta_j \ln IR_{t-j} + \mu_t \quad (1)$$

$$\ln IR_t = \rho + \sum_{i=1}^{m} \gamma_i \ln IR_{t-i} + \sum_{j=1}^{n} \lambda_j \ln DEF_{t-j} + \tau_t \quad (2)$$

Where,
DEF_t = Budget deficit
IR_t = Interest rate
μ_t and τ_t = uncorrelated error terms
$\delta, \alpha_i, \beta_j, \rho, \gamma_i, \lambda_j$ = Coefficient estimated

Equations (1) and (2) can be estimated using the method of least squares (OLS).The null hypothesis of the equation (1) is $H_0 = \beta_1 = 0$ while the null hypothesis of the equation (2) is $H_0 = \lambda_1 = 0$. If the null hypothesis is accepted based on F-Test, the IR_t (DEF_t) does not cause DEF_t (IR_t) in the form of Granger.If the null hypothesis is rejected, then there is a one-way relationship between IR_t (DEF_t) with DEF_t (IR_t). An inverse relationship will exist when there is a bilateral cause-and-effect which the IR_t lead to DEF and $DEF_{t\ lead}$ to IR. If the above equation takes the form of Autoregressive Distributed Lag involving the distribution of different lag, the determination of the relationship between DEF_t and IR is by looking at the Joint Hypothesis through the F - test.

$$\mathbf{F} = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)}$$

Where,
m= The number of intervals for DEF and IR
n= Number of observations
k = Number of the regression coefficients estimated without constraints

If the calculated F value which is a reference to the F statistic exceeds the critical value of F at a certain level of significance, the hypothesis is null (H_0) will be rejected. This means that the equation (1), the lagged IR should be in regression. Therefore, IR Granger causality to DEF

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3.1.2 Unit root test - Additional Dickey-Fuller test (ADF)

Additional Dicky-Fuller test (ADF) is a stationary test introduced by Dickey and Fuller in 1979. This test is a t-statistic test for the α parameter of the equation as follows:

$$\Delta \ln DEF_t = \alpha_0 + \sum_{i=1}^{a} \varphi_i \ln DEF_{t-1} + \sum_{j=1}^{b} \theta_j \Delta \ln DEF_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta \ln IR = \beta_0 + \sum_{i=1}^{a} \lambda \ln IR_{t-1} + \sum_{j=1}^{b} \rho \Delta \ln IR_{t-1} + v_t \quad (4)$$

Using equation (3) and (4) above. Δ was the first differentiation while ε_t and v_t is a stationary error. The null hypothesis (H_0) is $\vartheta = \rho = 0$ where the time series data is not stationary. If stationary time series data on the first degree, it is known as I (1) and if the stationary time series in the second degree, it is also known as the I (2). The same situation will occur if the time-series data down to the next level.

3.1.3 Co-Integration Test: Engle-Granger (EG)

When the data from two time series such as the equation (3) and (4) still at the same degree as the level integrated at s otherwise known as I (s), then it can be said that the two time series has been co-integration with each other will be able to create a balance in the long term between the two variables. The false regression problem can be solved when two time series are co-integrated with each other. Co-integration can be explained by looking at the following equation:

$$\mathrm{DEF_t} = \alpha + \beta IR_t + \mu_t \quad (5)$$

$$\mu_t = \mathrm{DEF_t} - \alpha - \beta IR_t \quad (6)$$

According to equation (6), it indicates that the error variable is a linear combination of variables DEF and IR. The same concept also applies to the independent variable INF. Both variables DEF and IR are expected to have the unit root and stationary which also shows the error terms are not stationary. Thus, the unit root in error term is said to be the cause of the existence of the problem of false regression. However, it is likely that there is a case where the unit root of X and Ycancel each other out and this will generate a stationary error. This special case is known as co-integrated and false regression problem will be eliminated and equation (5) will be able to continue to run the research. In economics, the two variables are said to be co-integrated with one another if there is a long-term relationship and balance between the two. Engle-Granger (EG) test are used to carry out tests on Co-integration between variables budget deficit (DEF) and short-term real interest rates (IR).In addition, Engle-Granger test was performed on independent variables INF.

Time series regression of the DEF and IR as below:

$$\ln \mathrm{DEF_t} = \alpha_0 + \sum \alpha_1 \ln IR + \mu_t \tag{7}$$

In addition, time-series error variables (μ_t) acquired and subsequently the unit root test μ_t will be generated as the following equation:

$$\Delta\mu_t = \mu_{t-1} + \varphi_t \tag{8}$$

Time series of DEF and IR co-integration between each other when the unit root test of the error term indicates it is stationary at I (0) ie equivalent to the equation DEF as independent variables or IR as independent variables. This test shows that the DEF and IR for the equation (7) individually are not stationary and this will result in a high probability of false regression. However, when the unit root test of time series as equation (8) is carried out, is likely to be a stationary of I (0).Thus, equation (7) is known as the co-integration regression and it is not fake. The problem of false regression erased when the two co-integration of time series with each other.

3.1.4 Error Correction Model (ECM) Test

Error Correction Model (ECM) involves estimating the model in first differences and add an error correction term as other variables. Thus, the Granger causality test need to be modified by adding the error correction term derived from long-term relationship that is used to ensure that the long term impact. The test of additional Engle-Granger causality (AEG) is formulated as follows.

$$\Delta \ln IR_t = \alpha_0 + \sum_{i=1}^{g} \beta_i \Delta \ln IR_{t-1} + \sum_{j=1}^{k} \lambda_j \Delta \ln DEF_{t-1} + \delta\eta_{t-1} + \varepsilon_t \tag{9}$$

$$\Delta \ln DEF_t = \gamma_0 + \sum_{i=1}^{m} \varphi_i \Delta \ln DEF_{t-1} + \sum_{j=1}^{n} \varphi_j \Delta IR_{t-1} + \sigma\tau_{t-1} + \mu_t \tag{10}$$

Where,

ε_t and μ_t = Assumed *White Noise* with mean zero, constant variance and not autocorrelated

Δ = First differentiation

η_{t-1} and τ_{t-1} = Correction of error which existed in the long-term co-integration regression

Equation (9), causality refers to Granger causality of Δ DEF to Δ IR that either λ_j or δ must not zero. Similar to the equation (10), Granger causality of Δ DEF to Δ IR if φ_i and σ must not zero. Granger causality can be shown in two ways: first, the F-statistic calculated under the null hypothesis in equation (5) and (6) showed that all coefficients λ_j and φ_i = 0.Second, the dependent variable is the cause of the independent variable if error correction in equation (9) and (10) are statistically significant.

4. FINDINGS

4.1 Granger Causality Test

Granger causality test results show that the DEF has no significant relationship with IR for one-way or two-way in the short term. The result is consistent with a study conducted by (Belton & Cebula, 1995) found that short-term nominal interest rates not affected by the budget deficit.

Table 1: Results of Granger Causality Test between DEF and IR

No. of Lag	[a] null hypothesis (H_0)	Statistics-f [b]	Probability
1	DEF not Granger Cause-IR	0.48818	0.48911
	IR does not Granger Cause-DEF	2.11372	0.15441
2	DEF not Granger Cause-IR	0.57255	0.56943
	IR does not Granger Cause-DEF	1.14143	0.33129
3	DEF not Granger Cause-IR	1.86358	0.15633
	IR does not Granger Cause-DEF	0.97466	0.41723

4	DEF not Granger Cause-IR	1.31987	0.28690
	IR does not Granger Cause-DEF	0.73485	0.57599

Note: Statistics-F refers to the Wald statistic for the hypothesis with , Rejection of the null hypothesis (H_0) at the significance level of 1% , ** The rejection of the null hypothesis (H_0)at the significance level of 5% , *** The rejection of the null hypothesis (H_0)at the significance level of 10%*

4.2 *Unit Root Test*

According to Table 3 above, ADF tests carried out on the level *(Level)* for the budget deficit (DEF), the interest rate (IR) is the period lag 0. ADF test which was carried out on all the variables in the form of a level *(level)* show time series is not stationary.

In the first stage of differentiation, a result of the ADF test shows that all of the variable time series is stationary at a certain level of 1 percent of the budget deficit (DEF) and the real interest rate (IR) using lag 0. It shows the regression estimation using a series of levels for variable regression deficit is likely false and unusable. Based on the results of a series that has been tested, the series is still in the first stages of differentiation and integration at 0 degrees where each has its source unit.

Table 3: Test Series ADF stationary

Variables	Level		First Differentiation	
	Lag	ADF Test Statistic	Lag	ADF Test Statistic
DEF	0	-1.619849	0	-4.708953 *
IR	2	-2.414974	0	-6.265131 *

*Note: * = Significant at 1%significance level*

4.3 *Co-Integration Test: Engle-Granger*

Table 4 refers to the findings of Co-Integration Test Engle-Granger (EG) between DEF and IR. The results of the ADF test for the variable time series and IR DEF in equation 1 shows the time series are not stationary in which the value of the t-statistic for the test is not significant at the significance level of at least 10%. This shows that there is a long-term relationship or co-integration between the DEF and IR

For equation 2, the variable DEF and IR have established two co-integrated vector, which clearly shows that there is a relationship between long-term IR and DEF. Stationary of time series variables DEF- IR and showed that the estimation of the equation is true.

Table 4: Results of Co-Integration Test Engle-Granger between DEF and IR

	EQUATION	ADF TEST	INTEGRATION OF THE EQUATION [KO-a]
KO-INTEGRATION	1	-2.210442	2
DEF-IR	2	-4.301542 *	

*Note: a. Long term relationship exists between DEF and IR, if it exists at least one vector of co-integration of the four above equations. * = Significant at 1% significance level*

4.4 Error Correction Model (ECM) Test

Table 6 shows the results of a study of the error correction model (ECM) between the DEF and IR. Based on the results, it was found that DEF is significant in affecting IR at significance levels of 5 percent. It shows in the long-term, a country's deficit in either high or low deficits have an impact on interest rates. Changes in IR also affect the change DEF where it shows the significant value of the significance level of 1 percent. Therefore, in the long-term interest rates affect the deficit in the case of Malaysia. The results of the test show the long-term IR is a more powerful influence to the DEF rather than DEF affecting the IR. The results of this research are consistent with the results of previous research, researchers like (Cebula, 1991, 2013; Knot & de Haan, 1999), stated that the budget deficit and interest rates are positively correlated.

Table 6: Results of the error correction model (ECM) in the DEF and IR

$\Delta DEF_t \rightarrow \Delta IR_t$	$\Delta IR_t \rightarrow \Delta DEF_t$
-0.206776	-0.631828
(-2.338518)**	(-3.848238)*

*Note: The figures refer to the enclosed t statistics, * Significant at the 1% level of significance,** Significant at the 5% significance level*

5. CONCLUSION

This study was conducted to measure the impact of the federal government budget deficits on interest rates in Malaysia. The output of the study provides compelling evidence for co-integration analysis for the 1965-2005 periods that there is a significant relationship in the long run between the budget deficit and interest rates. Budgetary developments have shown that Malaysia, adopt the budget deficit approach.

Moreover, the finding shows that there are no significant relationship between the deficit budget and interest rate in the short-term. Meanwhile, in the long-term, it shows that there is a significant relationship between deficit budget and

interest rate. From a policy perspective, a clear conclusion emerged from the empirical study. A massive budget deficits result in high interest rates in the long-term as the government's requirement for fund conflict with private financing requirements; eventually, high interest rates will deter the individual investment.

Therefore, the selection of national budget policies is essential to ensure the country is not burdened with debt and the public is not burden with increased high prices for essential items and a high tax burden. However, Malaysia in the present year is seen as trying to improve the situation of the budget deficit in the annual budget every year. The Islamic financing instruments (i.e Sukuk) could help the government overcome the immediate consequences of the impact of the interest rate charged and thus can assist the government in policy planning and overcome a budget deficit. Absence of quarterly information on the two variables required the analyst to fall on annual time series data. Perhaps the utilization of quarterly data with numerous data points could enhance the conclusions of this study. Further research in this field can be done by including more macroeconomic variables (money supply, inflation, private investment, income, etc.) to test the relationship with the budget deficit as it will show the impact of deficit budgets of other macroeconomic variables.

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