Effects of Structural changes on the intertemporal relationship between Government revenue & Government expenditure: A Case study of Malaysia.

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Abstract

Objectives: The relationship between government expenditure & government revenue has been an important topic in public finance. The purpose of this paper is to investigate causal relationship between these two important macroeconomic variables over the period of study 1963-2007 and to examine whether the dataset exhibit any structural breaks during the whole time span and such breaks have an impact on the direction of relationship between government expenditure & government revenue.

Methods: The present study involves use of battery of test for stationarity like ADF, PP and KPSS. The Engel-Granger cointegration method is used to test the long-run relationship between the variables concerned. The Vector Error Correction Model (VECM) is applied to examine whether the long-run relationship is stable along with causality test in the short run. Unresticted Vector Autoregressive Model (UVAR) is used for Granger Causality between the variables concerned in the long run. In order to test for a structural break in the data set we use the Chow test.

Results: The empirical results suggest that for Malaysia, fiscal neutrality hypothesis exists over the period of study 1963-2007 and government revenue & government expenditure have no long run equilibrium relationship. The dataset exhibits that possible structural changes have been occurred in the year 1983 and 1997 during the whole time span and consequently the relationship between revenue and expenditure has been undergoing a significant changes under different sub-periods i.e 1963-1980 and 1981-1997 & 1998-2007. The statistical results reveal an important fact that unidirectional causality is observed in the short-run during the sub-period 1963-1980. In the long-run during this sub-period, fiscal neutrality principle is observed. During the second sub-period 1981-1997, a long-run relationship exists in Malaysia but no-way causal relationship exists in the short-run during this sub-period. This sub-period 1981-1997 is marked by the presence of unidirectional causality running from expenditure to revenue in the long-run. The sub-period 1998-2007 is witnessed by the presence of unidirectional causality running from expenditure to revenue in the long-run.

Conclusion: The estimated causal relationship with historical dataset may not provide reliable guideline for making policy decisions. On the other hand, the estimated causal relationships under different sub-periods may provide reliable guidelines for decision making process.

Keywords: Government Revenue; Government Expenditure; Unit Root Test; Engel-Granger Cointgration Method; VECM ; VAR; Chow Test.
JEL Classification: E62; C22; H61; H62.

1. Introduction

In economics, fiscal policy is the use of government revenue and government expenditure to influence the economy. The two main instrument of fiscal policy are government expenditure and government revenue. Government uses fiscal policy to influence the level of aggregate demand in the economy, in an effort to achieve economic objectives of price stability, full-employment and economic growth. Keynesian economics suggest that increasing government expenditure and decreasing tax rates are the best ways to stimulate aggregate demand. Classical and neo-classical economists argue that crowding out completely negates any fiscal stimulus. The nexus between government revenue and government expenditure has attracted significant interest. This is due to the fact that the nexus between government revenue and government expenditure has an impact on the budget deficit. Persistent budget deficit can be prevented by higher taxes or lowering expenditure. But the central to this issue is the question as to the causal relationship between government expenditure and government revenue. Budget deficit has been one of the economic problems for Malaysia. The country was running budget deficit from 1963 to 1992 & then from 1998 to 2007. The country achieved remarkable growth in spite of budget deficits. Malaysia had budget surplus from 1993 to 1997.

Empirical study of revenue and expenditure nexus has attracted significant importance in Malaysia in recent years. D.M. Mithani and Goh Soo Khon [1] (1999) observed the unidirectional causality from expenditure to revenue Malaysia over the period 1970.1- 1994.1. Abdul Aziz, Marium and shah Habibullah [2] (2000) found the bi-directional causality between government revenue and government expenditure for the period 1960-1997. Wong Hock Tsen and Lim Kian Ping [3] (2005) found the evidence of Tax-Spend Principle in Malaysia over the period 1965-2002. Tan Jaut Hong (2009) [4] discovered that the variables are cointegrated and empirical results do support the spend-and-tax hypothesis from the period 1970-2007. All these empirical studies are concerned with the historical dataset which have provided an important impulse to the empirical testing of the revenue and expenditure relationship where no structural changes are considered. But there might be a possibility of structural change [5] in the economy over the long period of time. In general, structural breaks are a problem for the analysis of economic series, since they are usually affected by either internal or external shocks [6]. The empirical issue of revenue and expenditure nexus is important for Southeast Asian countries because these countries have been badly affected several times by Asian financial crisis or world recession. Revenue and expenditure relationship may be expected to undergo changes following such structural changes. The assumption of stability in the long-run relationship between revenue and expenditure would seem too restrictive, so that not allowing for structural change would be an important potential shortcoming of the past research. Thus we pay particular attention to the structural change in the relationship between government revenue and government expenditure in Malaysia. For effective policy formulation, the relationship between government revenue and government expenditure needs to be examined in presence of structural change in the economy of Malaysia. On this topic few studies have been done in developed and developing countries [7]. But no study has been carried out in Malaysia so far which justify the need of more research in this area.

1.2 Objectives- This paper seeks to enquire into the following issues;

(1) Short-run & long-run causal (Grager) relationship between government revenue and government expenditure in Malaysia during the whole time span 1963-2007.

(2) Whether the dataset exhibits any significant structural break during the whole time span and such breaks have an impact on the direction of causality in the short-run as well as in the long-run.

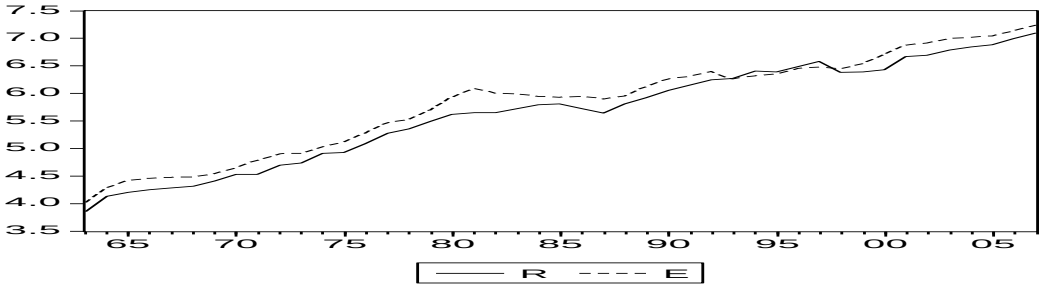
1.3 Time Period

The study takes the use of annual dataset for government revenue and government expenditure in Malaysia covering the period from 1963 to 2007.The time series data have been collected from different issues of IFS (International Financial Statistics) where the base period is the year 2000. To convert government revenue and government expenditure in real terms, the fiscal variables are deflated by consumer price index (CPI) respectively. we have used natural log values of real government revenue and real government expenditure as denoted by R_t and E_t respectively in the study.

1.4 Time Plot of R_t and E_t in Malaysia

Time plot of government revenue (R_t) and government expenditure (E_t) are given by the figure 1. It is observed from the following figure (1) that both the series are highly trended the period concerned .This feature of the series is pointers to their non–stationarity. This leads us to examine the nature of stationarity of R_t and E_t series.

Figure 1. Time plot of E_t and R_t (At level)



Source: International Financial Statistics

The paper is organized as follows: section 2 deals with Unit Root Test of the dataset, section 3 describes long-run relationship of the government revenue & government expenditure, section 4 provides causal (Granger) relationship in the long-run, section 5 deals with stability analysis and the causal (Granger) relationships between two fiscal variables in different sub-periods, section 6 presents overall empirical findings and section 7 concludes.

2. Unit root test

Macroeconomic time series data basically contain unit root and stochastic trends. The first step is to detect the presence of non-stationarity among the variables. The Augmented Dickey-Fuller test [8] (ADF 1981) and Phillips-Perron [9] (PP 1988) unit root test with intercept and with intercept and trend are applied to examine stationarity or non-stationarity of both the series concerned. In this test, the minimizing of Akaike Information Criteria (AIC) determines the optimal lags and specification. The results of ADF and PP test are reported in the table1 for the level data and differenced data of each of the variable.

2.1. Augmented dickey fuller (ADF) test

Stationarity of government expenditure and revenue can be studied with the Augmented Dickey Fuller (ADF) test. The relevant ADF test equations are

$$\Delta E_t = \alpha_1 + \beta_1 t + \gamma_1 E_{t-1} + \delta_{1t} \sum_1^m \Delta E_{t-1} + \mu_{1t} \quad (1)$$

$$\Delta R_t = \alpha_2 + \beta_2 t + \gamma_2 R_{t-1} + \delta_{2t} \sum_1^m \Delta R_{t-1} + \mu_{2t} \quad (2)$$

Where μ_{1t} & μ_{2t} are white noise error terms and

$\Delta R_t = R_t - R_{t-1}$

$\Delta E_t = E_t - E_{t-1}$

The optimum lag may be determined through Akiaike information criterion, Schwartz information criterion, Hannan–Qinn information criterion etc.

Again the estimable ADF test equations for the differenced series of R_t & E_t are

$$\Delta^2 E_t = \alpha_3 + \gamma_3 \Delta E_{t-1} + \delta_{3t} \sum_1^r \Delta^2 E_{t-1} + \mu_{3t} \quad (3)$$

$$\Delta^2 R_t = \alpha_4 + \gamma_4 \Delta R_{t-1} + \delta_{4t} \sum_1^r \Delta^2 R_{t-1} + \mu_{4t} \quad (4)$$

Where μ_{3t} & μ_{4t} are white noise error term and

$\Delta^2 R_t = \Delta R_t - \Delta R_{t-1}$

$$\Delta^2 E_t = \Delta E_t - \Delta E_{t-1}$$

2.2. Stationarity

Stationarity of government revenue series (R_t) and government expenditure series (E_t) can be studied with the Augmented Dickey Fuller (ADF) & Pillips-Perron Test. The results of unit roots tests are

Table 1. ADF and PP unit root results

variable	Model specification	ADF Statistics	PP statistics	Critical values at 5%	Degrees of freedom
E_t	Intercept	-1.59	-1.47	-2.92	I(1)
	Intercept & trend	-2.05	-2.25	-3.51	I(1)
ΔE_t	Intercept	-4.93*	-4.90*	-2.92	I(0)
	Intercept & trend	-4.81*	-4.77*	-3.51	I(0)
R_t	Intercept	-1.46	-1.51	-2.92	I(1)
	Intercept & trend	-2.42	-2.42	-3.51	I(1)
ΔR_t	Intercept	-6.75*	-6.73*	-2.92	I(0)
	Intercept & trend	-6.63*	-6.63*	-3.51	I(0)

*denotes significance at 5% level. Lag length automatic based on modified AIC, Max lag=9 in ADF test.
Neway-West using Bartlett Karnel in PP test.
Δ represents first difference.
Note - results obtained by using E-Views 4 econometric software.

Based on these statistics, we can infer that
(1) the null hypothesis of unit roots for the level data can't be rejected at 5% level for both fiscal variables. Therefore both R_t & E_t series follow random walks.
(2) the null hypothesis of unit roots for ΔE_t & ΔR_t are rejected at 5% level which implies that these series are integrated of order one i.e I(1).Hence E_t & R_t series are difference-stationary (DS).

2.3. Summary of findings on stationarity

(1) Both E_t and R_t series are non stationary at levels.
(2) Both E_t and R_t series are stationary upon first differencing. So ΔE_t and ΔR_t are I(0).
(3) The non-stationary in R_t and E_t series is not due to structural shift.

3. Long-run relationship of the government revenue & government expenditure

3.1. Engel-granger cointegration: The model

According to Engel-Granger [10] (1997), the variables will be cointegrated when the linear combination of the non -stationary variables is stationary. In this study E_t and R_t are found to be integrated of order 1i.e I(1).Now the linear combinations of these variables are

$$R_t = \alpha + \beta E_t + v_t \quad (5)$$
$$E_t = \gamma + \delta R_t + \omega_t \quad (6)$$

Where

$$\vartheta_t = R_t - \alpha - \beta E_t$$
$$\omega_t = E_t - \gamma - \delta R_t$$

Now if $\hat{v}_t$ and $\widehat{w_t}$ are stationary i.e.I(0) then E_t and R_t are cointegrated at levels i.e.CI(1,1).consequently, the cointegation between E_t and R_t is being examined through the estimation of equtations (5) and (6)
Results of estimation of equation (5) and equation (6) are shown below.

R_t = -0.25+ 1.01E_t
(0.10) (0.01)
(-2.47) (58.62)
R^2=.98, Adjusted R^2=.98,F-statistic=3437.380,$D.W$=0.50

E_t= .31+ .97R_t
(0.09) (0.01)
(3.33) (58.62)
R^2 =.98, Adjusted R^2=.98,F-statistic=3437.380,$D.W$=.50

3.2. Stationarity of Residuals-

Stationarity of the corresponding residuals $\hat{\vartheta}_t$ and $\hat{\omega}_t$ has been examined for stationarity through the ADF and PP tests .The results of the tests are given by the table (2).

Table 2. ADF & PP unit Root tests on residuals ($\widehat{\vartheta_t}$ & $\widehat{\omega_t}$)

Variable	Null Hypothesis	ADF Test statistic	PP Test statistic	Critical values at 5%
ϑ_t	$\widehat{\vartheta_t}$ has a unit root(intercept)	-2.46	-2.67	-2.92
$\omega\hat{}_t$	$\widehat{\omega_t}$ has a unit root(intercept)	-2.48	-2.70	-2.92

Lag length automatic based on modified AIC,Max lag=9 in ADF test.
†Neway-West using Bartlett Karnel in PP test.
$\widehat{v_t}$ residual estimated from revenue equation.
$\widehat{w}_t$ residual estimated from expenditure equation.

It is observed from the table (2) that
(1) the null hypothesis of unit roots with intercept for the residual $\widehat{v_t}$ *and* $\widehat{w}_t$ is accepted by the ADF test at 5% level .So the residual $\widehat{v_t}$ is non-stationary.
(2) the null hypothesis of unit roots with intercept for the residuals $\widehat{v_t}$ & $\widehat{w}_t$ accepted by the PP test at 5% level . So the residuals $\widehat{v_t}$ & $\widehat{w}_t$ are non-stationary.
Both the tests confirm that the residuals $\hat{\vartheta}_t$ and $\hat{\omega}_t$ are non- stationary. This means that both revenue & expenditure series are not cointegrated. There is no long-run co-movement between these two fiscal variables during the period of study. As E_t and R_t are not cointegrated, the Error Correction Mechanism is not applied to investigate the causal relationship between the concerned variables in the short-run.

4. Vector autoregression model

We have sought to enquire into the interrelationship between government expenditure & government revenue in long-run by establishing a structural model of revenue & expenditure. For this purpose , we have applied the Vector Autoregressive Model.
The model of VAR for government expenditure & government revenue in Malaysia consists of the following equations.

$$R_t = c_1 + \sum_{i=1}^{k} a_{1i}\, R_{t-i} + \sum_{i=1}^{k} b_{1i}\, E_{t-i} + e_1 \qquad (9)$$

$$E_t = c_2 + \sum_{i=1}^{k} a_{2i}\, E_{t-i} + \sum_{i=1}^{k} b_{2i} R_{t-i} + e_2 \qquad (10)$$

Where a_{1i},b_{1i} and c_i are the parameters to be estimated. Here, E_t and R_t represent government expenditure and government revenue at time t respectively .E_{t-i} and R_{t-i} represent government expenditure and government revenue at time t-i,i=1,2,3,…,respectively. e_1 and e_2 are the stochastic error terms, called impulse or innovations or shocks in the VAR model. We have performed the VAR Model with varying lags from one to three in order to capture the dynamic relationship between revenue and expenditure. In this study, we have estimated the model with two period lags following own intuitive reasoning. The Results of the estimation of the VAR Model are being presented through the tables (3) & (4)

Table 3. Results of VAR Estimation (Equation 9)

Dependable variable	Explanatory variable	coefficients	S.E	t-statistic
ΔR_t	constant	0.05	0.02	2.92
	ΔR_{t-1}	-0.06	0.19	-0.33
	ΔR_{t-2}	-0.18	0.19	-0.55
	ΔE_{t-1}	0.12	0.21	0.56
	ΔE_{t-2}	0.17	0.20	0.86

R^2= 0.13, Adjusted R^2=-0.01, F-statistic= 1.15,D-W = 1.98

*denotes significance at 5% level.

Table 4. Results of VAR Estimation (Equation 10)

Dependable variable	Explanatory variable	coefficients	S.E	t-statistic
ΔE_t	constant	0.52	0.01	2.70
	ΔR_{t-1}	-0.09	0.18	-0.53
	ΔR_{t-2}	0.01	0.18	0.09
	ΔE_{t-1}	0.42	0.19	2.10*
	ΔE_{t-2}	-0.11	0.19	-0.58

R^2= 0.13, Adjusted R^2=-0.017, F-statistic= 1.15, D-W=1.95

*denotes significance at 5% level.

4.1 Findings from the table (3) and (4)

(1) All the lags of expenditures in revenue equation are insignificant at conventional level of significance.
(2) All the lags of revenues in expenditure equation are insignificant at conventional level of significance.
(3) The JB Statistic shows normality of the residuals.
(4) LM and Portmanteau test depict no serial correlation problem.

4.2 Overall findings- These findings testify that

(1) the expenditure did fail to granger cause revenue.
(2) the revenue was failed to Granger cause expenditure in the country of Malaysia during the period of study.

(3) As all the coefficients of equations (9) & (10) are less than unity so all the lag structures are consistent in the VAR Model.
(4) Since F-statistics of equations (9) & (10) are significant at 5% level. Hence the estimated equations are good fit.
(5) As the values of D-W statistics of both the estimated equations are close to 2, so the system is free from auto-correlation.

VAR Stability Condition Check

Roots	Modulas
0.178908-0.334371i	0.379651
0.178908+0.334371i	0.379651
-0.002120- 0.252142i	0.252151
-0.002120- 0.252142i	0.252151

Joint residual tests & stability condition show the adequacy and robustness of the model used.

4.3. Overall finding & Economic interpretation-
(1) There is no causal link one-way or two-way between government revenue and government expenditure in Malaysia. This implies that both revenue and expenditure decisions are made independently during 1963-2007.
(2) Empirical findings support neutrality of fiscal reaction in Malaysia.

5. Stability analysis

It is observed that Engel-Grager Cointegration method does confirm that both government expenditure and government revenue series are not cointegrated suggesting no long-run relationship between revenue & expenditure in the long-run. Granger causality through unrestricted VAR approach fails to detect any causality link between revenue and expenditure in the long-run. we can infer that both expenditure and revenue decisions are taken independently from each other over the entire time period. Fiscal neutrality principle was the prevalent feature of Malaysia for the entire time span 1963-2007 while dealing with the historical dataset.

So far we have examined the relationship between government revenue and government expenditure on the historical data for the entire sample period 1963-2007.The above results will be biased if there is a structural change in the time series data. During the entire sample period 1963-2007, there might be a possibility of structural change in the relationship because of policy changes, institutional changes, external shocks, change in social attitudes and motivation etc. We have made an attempt to find out if any structural change in the existing relationship observed for entire sample period was in fact occurred.

We break up the entire sample period into different sub-periods through the 'Chow Break-Point Test [11] which is basically a 'Recursive Estimation Procedure' with the historical data in order to trace any possible structural change in the relationship between these two fiscal variables. Second and third column of Table 5 report the observed values of F-Statistic and probability obtained from the recursive estimations of the relationship between revenue & expenditure during entire time span. Fourth and fifth column of the same table show the observed values of F-Statistic & probability obtained from the recursive estimations of the relationship between revenue & expenditure during the period 1981-2007. The results of recursive estimations of the relationship between revenue & expenditure against each iteration is reported in the sixth and seventh column of table 5 during the period 1998-2007.The cointegration and Error Correction Mechanism and VAR approach are used for each sub-periods separately to detect the direction of causality between government revenue and government expenditure.
Table 5 presents the values of F- statistic & probability on recursive residual estimation of the following equation.

$$E_t = \alpha + \beta R_t + \vartheta_t \quad (11)$$

Table 5. Results of Chow Break-Point Test (1963-2007)

During 1963-2007			**During 1981-2007**		**During 1998-2007**	
Year	F-statistic	probability	F-statistic	probability	F-statistic	probability
1972	.896403	.415851	--	--	--	--
1973	.921688	.405932	--	--	--	--
1974	1.091372	.345210	--	--	--	--
1975	1.665739	.201590	--	--	--	--
1976	1.927674	.158445	--	--	--	--
1977	2.195346	.124237	--	--	--	--
1978	2.357918	.107325	--	--	--	--
1979	2.752215	.075585	--	--	--	--
1980	2.815292	0.71502	--	--	--	--
1981	2.528622	0.092143	--	--	--	--
1982	3.484940	0.040014	--	--	--	--
1983	5.087925*	.010623	--	--	--	--
1984	5.885193	.005663	4.018228	.031867	--	--
1985	4.665319	.014945	4.013985	.031967	--	--
1986	3.540347	.038164	4.049719	.031133	--	--
1987	3.931582	.027412	4.315907	.025612	--	--
1988	5.138080	.010205	4.445148	.023324	--	--
1989	4.489675	.017253	4.533856	.021882	--	--
1990	5.398056	.008298	4.053519	.031045	--	--
1991	7.116686	.002223	4.314514	.025638	--	--
1992	7.831464	.001317	5.022182	.015497	--	--
1993	8.745532	.000687	5.929740	.008379	--	--
1994	4.744113	.014018	5.334709	.012493	--	--
1995	1.612135	.211848	6.621818	.005354	--	--
1996	0.509143	.604760	7.968331	.002348	--	--
1997	0.371777	.691808	10.51415*	.000571	--	--
1998	1.589586	.216326	23.82357	.000000	--	--

1999	2.562497	0.089408	28.76647	.00000	--	--
2000	3.030990	.059201	24.54006	.00000	120.0972	.00000
2001	1.478377	.239908	10.96669	.00000	34.40883	.0005
2002	0.990562	.380080	5.830536	.0089	1.064605	.402077
2003	0.503560	.608064	3.42342	.062159	1.049524	.406586
2004	0.200432	.819174	1.629278	.217899	.94748	.438938
2005	0.077284	.925761	.892235	.423452	0.664048	.548884
2006	0.27666	.972731	.489175	.619367	.399595	.687199
2007	--	--	--	--	--	--

*indicates Chow break point.

5.1 Findings from the Table 5

It is observed from the table 5 that

(1) there exists two possible structural changes in the relationship between government revenue & government expenditure during the whole period 1963-2007.

(2) the first possible structural change occurred in 1981-82 due the worldwide recession and consequently depressed the prices of Malaysia's traditional commodity exports, growth slackened and investment fell. The year 1981-82 was witnessed as commodity shocks. The first sub-period covers the time period 1963-1980.

(4) the second possible structural change occurred in the year 1997-98 due to falling currency values in the wake of the financial crisis of 1997-98 which pushed the Malaysia's economy to further external shocks. The second sub-periods ranges over 1981-1997.

(5) the next sub-period extends from 1998 to 2007.

During the first sub-period 1963-1980, the causality link between government revenue & government expenditure is examined by using Error Correction Mechanism (ECM) for short-run & VAR approach for long-run. The results of ECM & VAR are presented in the tables 6 & 7.

Table 6. Estimates of Vector Error Correction Model (ECM): Sub-Period 1963-1980

Equations	coefficients	ECM estimate of revenue(ΔR_t)	ECM estimate of expenditure (ΔE_t)
Z_{1t-1} Z_{2t-1}	π_1 π_2	-0.60 (-1.29)	-1.44 (-3.90*)
ΔR_{t-1}	θ_1	0.65 (-2.03*)	1.07 (3.39*)
ΔE_{t-1}	γ_1	-0.85 (1.63)	-1.03 (-3.11*)
Constant	β	0.11 (4.02*)	0.09 (4.39*)

π_1 represents the coefficient of the error correction term Z_{1t-1} of expenditure equation and

π_2 represents coefficient of the error correction term Z_{2t-1} of revenue equation.

Figures in the parentheses (.) denotes t-statistics

*denotes significance at 5% level. Δ denotes first difference

Joint Test of residuals of ECM

JB Test=4.09 (0.40)Portmanteau test: lag=2,Q-Stat.=6.13 (.18), lag = 6,Q =15.55(0.74), lag =10,Q stat.= 25.48(0.90), lag t=12, Q stat.= 30.52 (0.93)
LM Test: lag =1, LM Stat. = 7.51 (0.11), lag =5, LM Stat. = 4.44 (0.22), lag =10, LM Stat. = 4.12 (0.44) lag t= 12, LM stat. = 10.44 (0.05)
Figures in the parentheses (.) denote p-values.

5.2 Findings from the Table 6

(1) The error-correction term (z_{1t-1}) in expenditure equation is significant at 5% levels.
(2) In expenditure equation, first period lagged expenditure (E_{t-1}) and revenue (R_{t-1}) are significant at 5% levels.
(3) In revenue equation, first period lagged revenue (R_{t-1}) is significant at 5% level and first period lagged expenditure (E_{t-1}) is insignificant at 5% level.
(4) The JB Statistic shows normality of the residuals.
(5) LM and Portmanteau tests depict no serial correlation problem.

5.3 Economic Interpretations - All these findings indicate that
(1) there is a long-run equilibrium relationship between government revenue (R_{t-1}) and government expenditure (E_{t-1}) in Malaysia during the sub-period 1963-1980.
(2) revenue Granger caused expenditure but expenditure did not caused (Granger) revenue in the short-run during the sub-period 1963-1980.
As the ECM is described as short-run dynamics, therefore, we have sought to enquire into the interrelationship between government expenditure & government revenue in long-run by establishing a structural model of revenue & expenditure. For this purpose, we have performed the VAR Model with one period lagged in order to capture the dynamic relationship between revenue and expenditure. The lag period one (t=1) is chosen on the basis of lowest value of AIC & SBC.

Table 7. Results of VAR Estimation: Sub-Period 1963-1980

	Dependable variable	Explantory variable	Coefficents	t-statistic
VAR (1)	ΔR_t	ΔE_{t-1}	0.40	1.12
		ΔR_{t-1}	-0.52	-1.52
		R^2=0.15,Adj.R^2=0.02,F-Statistic=1.18, D.W=1.97		
	ΔE_t	ΔR_{t-1}	-0.23	-0.62
		ΔE_{t-1}	0.48	1.19
		R^2=0.11,Adj.R^2=0.01, F-Statistic= 0.87, D.W=1.72		

Δ represents first-difference series.
Figure in the bracket (.) denotes lag length of the model.

Joint Test of residuals of VAR

JB Test=3.39 (0.49)
Portmanteau test: lag=2,Q-Stat.= 6.35 (0.17), lag = 6, Q =16.28 (0.69), lag =10,Q stat.= 24.35 (0.93)
LM Test: lag =2, LM Stat. = 6.57 (0.16), lag =6, LM Stat. = 4.24 (0.37), lag =10, LM Stat. = 6.78 (0.14)
Figures in the parentheses (.) denote p-values.

5.4 Findings – All the results from table 7 & joint tests of residual testify that

(1) in revenue equation, first period lagged revenue (R_{t-1}) & expenditure (E_{t-1}) are insignificant at 5% level.
(2) in expenditure equation, the first period lagged revenue & expenditure are insignificant at 5% level.
(3) the JB Statistic shows normality of the residuals.
(4) LM and Portmanteau test depict no serial correlation problem.
(5) VAR satisfies the stability condition because all the roots lie inside the circle (not reported here but available on demand).

5.5 Economic Interpretations -All these findings indicate that
(1) there is no causality (Granger) link between government revenue (ΔR_t) & government expenditure (ΔE_t) in the long-run during the sub-period1963-1980.
(2) the empirical findings do confirm fiscal neutrality principle in the long-run in Malaysia during the sub-period1963-1980.

5.6 Summary & Conclusion (1963-1980)

The statistical results reveal an important fact that unidirectional causality was observed in the short-run in this sub-period 1963-1980. This important fact did not observe in the short-run while dealing with the historical dataset. In the long-run during this sub-period, fiscal neutrality principle was observed & this was also in conformity with the findings from the econometric study of historical dataset 1963-2007.

During the Second Sub-Period 1981-1997, the estimations of ECM and VAR are reported in the tables 8, 9 & 10.

Table 8. Estimates of Vector Error Correction Model (ECM):Sub-Period 1981-1997

Equations	coefficients	ECM estimate of revenue(ΔR_t)	ECM estimate of expenditure (ΔE_t)
Z_{1t-1} Z_{2t-1}	π_1 π_2	0.01 (0.02)	-1.36 (-2.99*)
ΔR_{t-1}	θ_1	0.31 (0.94)	0.31 (1.12)
ΔR_{t-2}	θ_2	-0.44 (-1.34)	-0.16 (-0.58)
ΔE_{t-1}	γ_1	-0.16 (-0.44)	0.45 (1.42)
ΔE_{t-2}	γ_2	0.69 (1.75)	0.84 (2.51*)
Constant	β	0.05 (1.86)	0.01 (0.51)

π_1 represents the coefficient of the error correction term Z_{1t-1} of expenditure equation.

π_2 represents coefficient of the error correction term Z_{2t-1} of revenue equation.

Δ denotes first difference.
Figures in the parentheses (.) denote t-statistics
*denotes significance at 5% level

Joint Test of residuals of ECM

JB Test=4.39 (0.35)
Portmanteau test: lag=2,Q-Stat.=8.19 (.08), lag = 6, Q =18.68 (0.54), lag =10,Q stat.= 24.18 (0.93), lag t=12, Q stat.= 25.16 (0.98)
LM Test: lag =1, LM Stat. = 5.91 (0.20), lag =5, LM Stat. = 5.01 (0.28), lag =10, LM Stat. = .97 (0.91) lag t= 12, LM stat. = 1.90 (0.75)
Figures in the parentheses (.) denote p-values.

5.7 Findings from the Table 8

(1) the error-correction term(Z_{1t-1}) in expenditure equation is significant at 5% levels.
(2) In expenditure equation, second period lagged expenditure (E_{t-2}) is significant at 5% levels.
(3) In revenue equation, first period lagged & second period lagged revenues & expenditures are insignificant at 5% level.
(4) The JB Statistic shows normality of the residuals.
(5) LM and Portmanteau tests depict no serial correlation problem.

All these findings indicate that long run relationship exists but there is no causal relationship between government revenue (R_t) and government expenditure (E_t) in the short-run in Malaysia during the sub-period 1981-1997.

We move to VAR approach in order to examine the causality between revenue and expenditure in the long-run during the period 1981-1997. For this purpose, we have performed the VAR Model with lag order of two. The lag period two (t=2) is chosen on the basis of lowest value of AIC, SC and

Table 9. Results of VAR Estimation: Sub-Period 1981-1997

Dependable variable	Explantory variable	Coefficents	S.E	t- Statistics
ΔR_t	Constant	0.05	0.02	2.10
	ΔE_{t-1}	-0.16	0.30	-0.52
	ΔE_{t-2}	0.69	0.29	2.39*
	ΔR_{t-1}	0.31	0.30	1.00
	ΔR_{t-2}	-0.44	0.31	-1.42

R^2= 0.40, Adj.R^2= 0.14, F-Statistic= 1.54, D.W=-2.01
Δ represents first-difference series.
* denotes significance at 5% level.

Table 10. Results of VAR Estimation: Sub-Period 1981-1997

Dependable variable	Explantory variable	Coefficents	S.E	t-Statistics
ΔE_t	Constant	0.02	0.03	0.65
	ΔR_{t-1}	0.26	0.38	0.68
	ΔR_{t-2}	-0.14	0.38	-0.38
	ΔE_{t-1}	0.007	0.39	0.02
	ΔE_{t-2}	0.22	0.36	0.61

R^2= 0.09, Adj.R^2= -0.30, F-Statistic= 0.29, D.W= 1.96
Δ represents first-difference series.
* denotes significance at 5% level.

Joint Test of Residual of VAR

JB Test=6.82 (0.14)
Portmanteau test: lag=4,Q-Stat.=7.64 (.0.10), lag = 6, Q =11.01 (0.52), lag =10,Q stat.= 17.50(0.93).
LM Test: lag =1, LM Stat. = 3.45 (0.48), lag =4, LM Stat. = 1.01 (0.90), lag =08, LM Stat. = 7.64 (0.10) lag t= 10, LM stat. = 4.58 (0.33)
Figures in the parentheses (.) denote p-values.

5.8 Findings from the Table 10

It is observed from the table that

(1) in expenditure equation, all lagged independent variables are insignificant at 5% levels.

(2) in revenue equation, second period lagged expenditure (ΔE_{t-2}) is significant at 5% level.

(3) the JB Statistic shows normality of the residuals.

(4) LM and Portmanteau tests depict no serial correlation problem.

5.9 Economic Interpretations— All these findings indicate that

(1) the expenditure causes revenue but revenue does not cause expenditure in Malaysia during the sub-period 1981`-1997.

(2) the government revenue with respect to government expenditure, the elasticity is estimated at 0.69, implying increase in government expenditure (E_{t-2}) in t-2 period led to an increase in current government revenue by 69%.

(3) the empirical findings support spend-and-tax principle in Malaysia during the second sub-period 1981-1997.

5.10 Summary & Conclusion (1980-1997)

During the second sub-period 1981-1997, a long-run relationship exists in Malaysia but no-way causal relationship runs from spend to revenue & revenue to spend in the short-run during this sub-period. This result is consistent with the findings of no-way causal relationship with the historical dataset. This sub-period 1981-1997 is marked by the presence of unidirectional causality running from expenditure to revenue in the long-run.

Now we perform the same exercise for the next sub-period 1998-2007. The estimated results are reported in the following table 11 & 12.

The structures of correlogram of the revenue & expenditure series during the sub-period indicate that both the series are stationary. KPSS Test also confirms the stationarity of the data during the period 1998-2007. But ADF test and PP test can't be used here for insufficient number of observations. . Since the data are stationary, there is a coingrating relationship between government revenue (R_t) and government expenditure (E_t) in Malaysia during the sub-period 1998-2007. Since the series of government revenue & government expenditure are cointegrated, but ECM is not performed here because of insufficient number of observations. This might pose a limitation to the study but with more data documentation we believe that similar studies could be undertaken. We report the Granger causality test results below obtained by VAR approach with one period lagged. The lagged period is chosen on the basis of lowest value of AIC by the lag selection criteria.

Table 11. Results of VAR Estimation: Sub-Period 1998-2007

Dependable variable	Explantory variable	Coefficents	S.E	t-Statistics
R_t	Constant	0.04	0.61	0.06
	R_{t-1}	0.19	0.36	0.51
	E_{t-1}	0.79	0.35	2.26*

R^2= 0.95, Adj.R^2= 0.93, F-Statistic= 62.04, D.W= 2.22

*denotes significance at 5% level.

Table 12. Results of VAR Estimation: Sub-Period 1998-2007

Dependable variable	Explantory variable	Coefficents	S.E	t-Statistics
E_t	Constant	0.97	0.51	1.88
	R_{t-1}	-0.21	0.31	0.68
	E_{t-1}	1.07	0.29	3.61*

R^2= 0.95, AdjR^2= 0.94, F-Statistic= 70.92, D.W= 1.76

*denotes significance at 5% level

5.11 Findings from the Table 11 and 12

It is observed from the table that

(1) in revenue equation, E_{t-1} is significant at 5% level.

(2) in expenditure equation, E_{t-1} is significant at 5% level.

(3) the elasticity of revenue with respect to expenditure is estimated at 0.79 implying as expenditure increases at any period revenue increases in the following period by 79%.

(4) the JB Statistic shows normality of the residuals.

(5) LM and Portmanteau tests depict no serial correlation problem.

5.12 Economic interpretations— All these findings indicate that

(1) there exists a causal relationship between revenue and expenditure running from expenditure to revenue in the economy of Malaysia during the sub-period 1998-2007.

(2) this sub-period is marked by the presence of spend-and-tax principle.

5.13 Summary & Conclusion (1998-2007)

The sub-period 1998-2007 was witnessed by the presence of unidirectional causality between revenue & expenditure. This causal relationship was not observed to be present in the historical dataset. During this sub-period 1998-2007, expenditure does cause revenue & no evidence of reverse.

6. Overall empirical findings

Some of the main findings emerging from the study of different sub-periods are as follows.

(1) During the entire time span 1963-2007, the study reveals that both revenue and expenditure can't move together in the long-run and there is no-way causal relationship between revenue and expenditure in the short-run and even in the long-run. The empirical findings accept the evidence of fiscal neutrality hypothesis in Malaysia during the whole span 1963-2007.

(2) During the sub-period 1963-1980, an econometric study exhibits that there is a cointegrating relationship between government revenue & government expenditure and revenue causes expenditure in the short-run but the study fails to detect any causality link between revenue & expenditure in the long-run memory. This is an indicative of the fact that the short-run causal (Granger) relationship between revenue and expenditure differs significantly with the findings as evidenced by historical dataset but the relationship in the long-run does support the finding of historical dataset.

(3) During the second sub-period 1981-1997, the statistical results indicate that there is no long-run relationship between government revenue and government expenditure. Using unrestricted VAR approach, the empirical results do support the Spend-and tax principle in Malaysia in the long-run. The relationships both in the short-run and long-run differ significantly between the first sub period & whole sample period.

(4) During the third sub-period 1998-2007, both the fiscal variables are moving together in the long-run but a very important fact comes to light that the relationship between revenue and expenditure appears to have shifted to run from expenditure to revenue. This fiscal principle was not observed in the entire time span.

7. Conclusion

In view of the empirical findings observed in different sub-periods, we can conclude that the relationship between government revenue and government expenditure has been undergoing a change before and after structural break. The budgetary process in Malaysia is driven very much by the revenue consideration over the period 1963-1980 and then by the expenditure consideration during the period 1981-1997 and 1998-2007. The relationship is not stable; rather it varies from time to time with structural adjustment. Consequently, the causal relationship between government revenue and government expenditure with historical dataset & different time periods in Malaysia may not provide reliable guideline for preparing fiscal policy. Therefore it is recommended that the fiscal policy should not be static over a long period of time; rather it should link with the structural changes over time.

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