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Testing for Causality Between Taxation and Government Spending: An Application of Toda-Yamamoto Approach

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ABSTRAK

Kajian ini bertujuan menyelidik hubungan penyebab antara hasil cukai kerajaan dengan perbelanjaan kerajaan. Kaedah jangka panjang bukan penyebab Granger yang dicadangkan oleh Toda dan Yamamoto (1995) digunakan untuk menguji hubungan penyebab tersebut untuk tempoh masa 1960 hingga 1997. Hasil kajian menunjukkan kewujudan hubungan penyebab dua hala di antara perbelanjaan kerajaan dengan hasil cukai kerajaan.

ABSTRACT

The purpose of the present study is to investigate the causal relationship between the government tax revenues and government expenditures in Malaysia. We employ the Granger long run non-causality test as proposed by Toda and Yamamoto (1995) to test the causal relationships between government spending and tax revenues for the period 1960 to 1997. The evidence generally supports the existence of bi-directional casuality between government spending and tax revenues.

INTRODUCTION

Government expenditures in Malaysia have almost consistently exceeded government revenues throughout most of the past decades since 1959 except for the 1959-61 and 1993-97 periods. The government's commitment in pursuing rapid economic development programmes as embodied in the various five year Malaysian develoment plans largely accounts for the fiscal deficits incurred. The expanded role of the public sector resulted in rapid growth of government expenditures.

Government budget deficits have significant impact on the economy. Such fiscal imbalance tends to reduce national savings which in turn has the effect of impeding rapid economic growth. The options available to stimulate economic growth in a budget deficit economy include reducing government expenditures and/or raising tax revenues. Both options serve the objective of reducing the fiscal deficit.

One of the most researched topics in macroeconomics is the empirical testing of the relationship between government expenditures and tax revenues. Establishing the direction of interdependence between the two macro-economic variables, namely, government expenditures and tax revenues would assist policy makers in identifying the source of any fiscal imbalances that might exist. Consequently this would facilitate efforts to develop a suitable fiscal reform strategy.

The purpose of this study is to investigate the causal relationship between the government tax revenues and government expenditures for the period 1959 to 1997. We have utilised the more recent technique proposed by Toda and Yamamoto (1995) in the attempt to determine the interdependence between the two variables mentioned. According to Toda and Yamamoto, their Granger long-run non-causality analysis, provide a simplistic approach in determining the association between integrated variables without having to worry about the order of integration and/or the cointegrating rank in a Vector Autoregression (VAR) system.

LITERATURE REVIEW

The relationship between government revenue and expenditure can be categorized into three main competing hypotheses. First, the fiscal synchronization hypothesis implies that taxation

and spending decisions are simultaneously made by the fiscal authorities. In the Granger sense, this is known as a bi-directional relationship between tax revenue and government spending. Second, a unidirectional causality that runs from revenue to expenditure supports the so-called tax-and-spend hypothesis. The hypothesis indicates that, since government revenue causes changes in government expenditure, the control of tax revenue should represent a good policy to reduce the size of the government expenditure. On the other hand, the spend-and-tax hypothesis implies that government expenditure leads to changes in tax revenue. In other words, the chain of causality is running from government spending to tax revenue.

Empirical evidences with respect to the above three competing hypotheses are at best mixed. Musgrave (1966), Meltzer and Richard (1981), Miller and Russek (1990), Bohn (1991) and Bhat *et al.* (1993) supported the fiscal synchronization hypothesis. Studies by Friedman (1972, 1978), Buchanan and Wagner (1977, 1978), Darrat (1998), Blackley (1986), Marlow and Manage (1987) and Joulfaian and Mookerjee (1990); all indicated that government tax revenues lead expenditures. On the other hand, the spend-and-tax hypothesis is supported by studies done by Peacock and Wiseman (1961, 1979), Jones and Joulfaian (1991), Anderson *et al.* (1986), von Furstenberg *et al.* (1986) and Provopoulos and Zambaras (1991). Conversely, apart from those studies, Baghestani and McNown (1994) found that government expenditure and revenue are not interdependent.

Other studies on the government revenue-expenditure nexus found a diversity of results, depending on the time period used, lag length and also between different levels of government. For instance, Manage and Marlow (1986) found out that using different lag lengths gave different sets of results. Varying the lag length between two and five, the result indicates that in all cases the lower and most upper lag lengths suggest unidirectional relationship; a causal relation that runs from expenditures to revenues. On the other hand, the intermediate lag length provides support for bi-directional causal relationship between the two variables. Ram (1988) used both annual and quarterly data to examine the expenditures-revenues nexus for both Federal government and State and Local government. The study arrived at conflicting results too. For example, using annual data, the results support the fiscal synchronization hypothesis at the federal government level. However, when quarterly data was used, the results suggest that causality runs from revenues to expenditures, thus, supporting the tax-and-spend hypothesis. But, at the state and local level, both annual and quarterly data indicate results that support the spend-and-tax hypothesis. In another study, Owoye (1995) studied the causal relationship between taxes and expenditures in the G7 countries. Despite the similarities in terms of the economic settings of the sample countries, Owoye found that the results of the causality relationships are not similar. The empirical results obtained from the error-correction models support the fiscal synchronization hypothesis for the U.S, Germany, U.K, France and Canada. This implies that the fiscal authorities in these countries make tax and spending decisions jointly. On the other hand, causality runs from revenues to expenditures in Japan and Italy, thus, supporting the tax-and-spend hypothesis.

METHOD OF ESTIMATIONS

It has been noted that the traditional Granger (1969) causality test for inferring leads and lags among integrated variables will end up in spurious regression results, and the F-test is not valid unless the variables in levels are cointegrated. New development in econometric offers the error-correction model (Engle and Granger 1987) and the vector autoregression error-correction model (Johansen and Juselius 1990) as alternatives for testing of non-causality between economic time series. Unfortunately, these tests are cumbersome and sensitive to the values of the parameters in finite samples and therefore their results are unreliable (Toda and Yamamoto 1995; Zapata and Rambaldi 1997). Furthermore, pretests are necessary to determine the number of unit roots and the cointegrating ranks before proceeding to estimate the Vector Error-Correction Model (VECM).

Toda and Yamamoto (1995) propose a simple procedure requiring the estimation of an 'augmented' VAR, which guarantees the asymptotic distribution of the MWald statistic even when there is cointegration. The Toda-Yamamoto causality procedure has been labelled as the long-run causality tests. One needs to determine the maximal order of integration d_{max}

which is expected in the model and construct a VAR in their levels with a total of $p = (k + d_{max})$ lags. Toda and Yamamoto point out that for d=1 the lag selection procedure is always valid since k(1=d. If d=2, then the procedure is also valid unless k=1. Moreover, according to Toda and Yamamoto, the MWald statistic is valid regardless whether a series is I(0), I(1) or I(2), non-cointegrated or cointegrated of any arbitrary order.

To examine the causality between government expenditure and government revenue our structural VAR model consist of three (p=3) variables; government revenues (GR), government expenditures (GE) and national output (Q).[1] Using Akaike's Information Criteria (AIC) as the lag selection criteria, say, the lag length chosen k=2. If d_{max}=1, then we must estimate a VAR(3). Suppose we want to test that GE does not Granger cause GR, we then test that GE_{t-1} and GE_{t-2} do not appear in the GR_t equation. The estimated system is:

$$\begin{bmatrix} GR_t \\ GE_t \\ Q_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} GR_{t-1} \\ GE_{t-1} \\ Q_{t-2} \end{bmatrix} + A_2 \begin{bmatrix} GR_{t-2} \\ GE_{t-2} \\ Q_{t-2} \end{bmatrix} + A_3 \begin{bmatrix} GR_{t-3} \\ GE_{t-3} \\ Q_{t-3} \end{bmatrix} + \begin{bmatrix} e_{GR} \\ e_{GE} \\ e_Q \end{bmatrix} \qquad (1.1)$$

where A's are three by three matrices of coefficients with A_0 as an identity matrix. The null hypothesis is $H_0 : \alpha_{12}^{(1)} = \alpha_{12}^{(2)} = 0$, where $\alpha_{12}^{(i)}$ are the coefficients of GE_{t-i}, i=1, 2, in the first equation of the system. The existence of a causality from government expenditure to government revenue can be established through rejecting the above null hypothesis which requires finding the significance of the MWald statistic[2] for the group of the lagged independent variables identified above. A similar testing procedure can be applied to the alternative hypothesis that government revenue does not Granger cause government expenditure, is to test $H_0 : \alpha_{12}^{(1)} = \alpha_{12}^{(2)} = 0$, where $\alpha_{12}^{(i)}$ are the coefficients of GRt-i, i=1,2, in the second equation of system equation (1.1) where the system is being estimated as a VAR(3).

Sources and Description of Data Used

The study utilised annual data series for all three variables, namely government revenues, government expenditures and output for the period 1960 to 1990. The real GDP series were utilised to proxy for national real output. All variables were compiled from various issues of the *Quarterly Bulletin* published by Bank Negara Malaysia.

THE EMPIRICAL RESULTS

The application of the Toda-Yamamoto approach requires information about the lag length (k) and the maximum order of integration (d) of the variables. The order of integration of each variable is not examined as a pretest. This is because in most cases, the order of the integration of macroeconomic variables are at most two. The causality test for both d_{max}=1 and d_{max}=2 is done after selecting the lag length.

In this study, the optimal lag length was determined using the AIC. Although the AIC chose k=1 as the optimal lag, we have presented k=2 and k=3 to show the robustness of the results at various lag lengths. We therefore estimated a system of VARs (p) where ($p=d_{max}+k=2$, $p=d_{max}+k=3$, $p=d_{max}+k=4$; $p=d_{max}+k=3$, $p=d_{max}+k=4$, $p=d_{max}+k=5$) and then calibrated the MWald test statistics The result for d_{max}=1 and d_{max}=2 are presented in Tables 1 and 2 respectively. In each table we have also presented the respective p-values.

The test results in Table 1 clearly suggest that government revenue and government expenditure are bi-directional in nature. The results are robust irrespective of the number of lag length estimated. For all lag length chosen, lag 1, 2 and 3, indicate that the null hypothesis of Granger non-causality from government revenues to government expenditures is rejected

1. Output is included in the analysis as a third variable because both government expenditures and government revenues are related to the overall conditions in the economy (see Payne, 1997). Furthermore, the inclusion of output is to alleviate the problem of spurious causal effects due to omitted important variable from the investigated relationship.
2. With the degree of freedom equal to the number of restriction imposed.

at the five percent significance level. At the same time, the null hypothesis of Granger non-causality from government expenditures to government revenues can be rejected at the five percent significance level for all lag length. These results support the fiscal synchronization hypothesis for Malaysia.

Our results in Table 2 suggest similar bi-directional causality that runs from government expenditures to government revenues and from government revenues to government expenditures in the case of d_{max}=2. The null hypothesis of Granger non-causality running from government revenues to government expenditures and from government expenditures to government revenues is rejected at the five percent significance level. The robustness of the results of both the d_{max}=1 and d_{max}=2 supports the existence of a two-way causal relationship between government expenditure and tax revenues in Malaysia.

CONCLUSION

Most of the empirical studies addressing the debate about the causal relationships between government expenditures and revenues have focused on developed nations. In addition, the procedures employed were based on the testing for unit root, cointegration, error-correction modeling and the vector error-correction modeling and Granger causality.

This study, however, adopts the methodology

TABLE 1
Results of long-run non-causality test due to Toda-Yamamoto (1995) for d_{max} =1

Null hypothesis	Test statistics MWald statistics	*p*-values
k=1:		
Government revenue does not Granger cause government expenditure	18.484	0.000**
Government expenditure does not Granger cause government revenue	8.161	0.004**
k=2:		
Government revenue does not Granger cause government expenditure	33.110	0.000**
Government expenditure does not Granger cause government revenue	18.453	0.000**
k=3:		
Government revenue does not Granger cause government expenditure	36.663	0.000**
Government expenditure does not Granger cause government revenue	13.312	0.004**

Notes: Asterisk (**) denotes statistically significant at one and five percent level respectively.

TABLE 2
Results of long-run non-causality test due to Toda-Yamamoto (1995) for d_{max}=2

Null hypothesis	Test statistics MWald statistics	*p*-values
k=1:		
Government revenue does not Granger cause government expenditure	18.960	0.000**
Government expenditure does not Granger cause government revenue	18.430	0.000**
k=2:		
Government revenue does not Granger cause government expenditure	31.962	0.000**
Government expenditure does not Granger cause government revenue	13.264	0.001**
k=3:		
Government revenue does not Granger cause government expenditure	53.645	0.000**
Government expenditure does not Granger cause government revenue	18.093	0.000**

Notes: Asterisk (**) denotes statistically significant at one and five percent level respectively.

of Granger non-causality recently proposed by Toda and Yamamoto (1995) to test the causal relationship between government expenditures and government revenues for Malaysia. The evidence, based on MWald-tests, generally supports the existence of the bi-directional causality between government spending and government revenues. The results are robust with respect to our assumption that the variables are I(1) and I(2).

The empirical evidence of bi-directional causal relationship implies fiscal synchronization in Malaysia. This suggests that the government compares the marginal benefits and marginal costs of any balanced budget change when formulating a decision in terms of the appropriate levels of government revenues and expenditures.

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