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The Relationship Between State's Revenues and Expenditures in Malaysia: Some Robust Results

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ABSTRACT

This study focuses on the intertemporal dynamics between revenues and expenditures, as well as the strategies used by state governments in managing their public deficits. This study provides an opportunity to explore several hypotheses to investigate the Malaysian government's tax collection and spending behavior. The tax-spend hypothesis posits that governments generate tax revenues prior to initiating new expenditures. In contrast, the spend-tax hypothesis posits that governments first engage in spending activities and afterwards augment tax receipts in order to fund their expenditures. Another concept that exists is the fiscal synchronization hypothesis, which posits that governments make choices about both revenues and spending concurrently. Choices pertaining to expenditure and the generation of income may allow for autonomy. Based on an empirical investigation conducted on yearly data including revenue and expenditure in 13 Malaysian states from 1990 to 2018, the findings derived from our Granger long-run causality, as corrected by the error-correction framework provide consistent results that support the fiscal synchronization hypothesis.

JEL Classification: H50
Keywords: Tax-spend; Spend-tax; Fiscal synchronization

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INTRODUCTION

The empirical examination of the link between government expenditures and tax receipts is a well-investigated subject within the field of macroeconomics. Determining the causal relationship between government expenditures and tax receipts at the macroeconomic level will aid policymakers in discerning the underlying causes of any fiscal imbalances that may be present. As a result, this would enhance endeavors to formulate an appropriate fiscal reform approach.

The examination of the causal relationship between revenues and expenditures has led to the emergence of several opposing theories. The fiscal synchronization concept posits that the fiscal authorities make tax and expenditure choices concurrently. According to the Granger concept, the link between tax income and government expenditure may be characterized as a bi-directional association. Furthermore, a unidirectional connection means that income influences spending, thus providing support for the tax-and-spend concept. The hypothesis asserts that there is a relationship between government income and expenditure, suggesting that controlling tax revenue might serve as an effective strategy to decrease the magnitude of government expenditure. Conversely, the spend-and-tax theory posits that there exists a relationship between government spending and subsequent fluctuations in tax collections. To clarify, the direction of causation may be seen as flowing from government expenditure towards tax income. Lastly, the concept of institutional separation between government spending and taxing choices posits that revenues and expenditures are mutually exclusive.

One of the earlier works on the tax-spend nexus in Malaysia was conducted by Aziz et al. (2000) first examined the tax-spend nexus in Malaysia. Malaysia's government expenditures have continuously surpassed government earnings during most of the decades since 1959, except for the years between 1959-1961 and 1993-1997. Budget deficits may primarily be attributed to the government's dedication to pursuing fast economic growth programs, as seen in the several five-year Malaysian development plans. However, the increased involvement of the public sector has led to a significant increase in government spending. In their study, Aziz et al. (2000) found that the annual data on Malaysia's tax revenue and expenditures provided support for the fiscal synchronization hypothesis during the testing of the previously mentioned hypotheses. The statement suggests the presence of a reciprocal causal link, as defined by Granger, between government income and expenditure. Findings by Taha and Loganathan (2008), who discovered bidirectional Granger causation extending from government spending to both direct and indirect tax receipts for the years 1970–2006, provided more support for this conclusion.

Nevertheless, unidirectional Granger causality between tax spending and tax revenue was also found in several studies on Malaysia. For example, the work of Wong and Lim (2005) shows that government revenue leads government expenditure for the period 1965–2002, supporting the tax-spend hypothesis. On the other hand, recent work by Khan et al. (2021) also supported the tax-spend hypothesis for Malaysia. Using data for the period 1990–2019 and by employing the vector error-correction model framework, the Granger causality showed a one-way relation between government revenues and expenditures; expenditures are supported by tax revenues, indicating that the tax-spend hypothesis is validated.

Nonetheless, the spend-tax hypothesis is not without support in Malaysia. Karim et al. (2006) investigate the tax-spend behavior of five ASEAN economies, including Malaysia, for the period 1972–2000. They found that Malaysia, Indonesia, and the Philippines supported the spend-tax hypotheses, while Thailand and Singapore supported the tax-spend hypotheses. The tax-spend hypothesis for Malaysia was also supported by the work of Tan (2009) using annual data from 1970–2007; Sanusi et al. (2012) using data spanning from 1975–2006; and Mele et al. (2020) for the period 1985–2016. As an alternative, utilizing quarterly data covering 1970:1–1990:4, Mithani and Goh (1999) found a one-way Granger causality running from government expenditure to government revenue, thus supporting the spend-and-tax hypothesis implying higher government spending leads to higher taxes.

Saha and Mukhopadhyay (2014) investigated the correlation that existed in Malaysia between government revenue and spending from 1963 till 2007.They discovered that Malaysia exhibits evidence in favor of the fiscal neutrality hypothesis, which postulates the independence of tax collection and tax spending, over the years 1963 to 2007. This finding indicates that changes in tax collection had no immediate impact on government spending over the years 1963 to 2007 in Malaysia. However, when the periods of the study were divided into three sub-periods of 1963–1980, 1981–1997, and 1998–2007, the directions of the causality gave

mixed results. For the sub-period 1963–1980, the annual data support the fiscal neutrality hypothesis, while for both sub-periods 1981–1997 and 1998–2007, they support the spend-and-tax hypotheses.

At the state level, Asri et al. (2015) investigated the tax and spending nexus using annual data for the period 1970–2008 for 11 states, namely, Negeri Sembilan, Selangor, Perlis, Kedah, Kelantan, Terengganu, Pahang, Johor, Melaka, Perak, and Penang. Using the popular autoregressive distributed lag (ARDL) model approach, their findings suggest that the tax-spend hypothesis was supported, implying that the state's government determines the level of tax revenue before deciding to spend. However, the work of Jalil and Harun (2012) found that using data from 1980–2009, the spend-and-tax hypothesis was supported in Kelantan, while Penang supported the fiscal neutrality hypothesis.

Dayang-Affizzah et al. (2006) examined annual data on revenues and expenditures for 16 municipalities in Sabah over the period 1965–2003 by employing the vector error correction model procedure. The results were at best mixed. Municipalities in Papar, Sandakan, Tambunan, Tawau, Tenom, and Tuaran support the tax-and-spend hypothesis. This implies that these municipalities decided first on the amount of tax collections and then decided on how much to spend. Conversely, municipalities in Keningau, Lubuk, Sugut, Lahad Datu, and Ranau supported the spend-and-tax hypothesis.

This would suggest that to pay for expenses, these towns' fiscal authorities choose to spend money first and then raise taxes. While municipalities in Beaufort and Kuala Penyu suggest that revenues and expenditures are not related in the long run, Kota Kinabalu is the only local government that endorses the fiscal synchronization hypothesis and suggests that, in this scenario, the fiscal authority of Kota Kinabalu should try to raise revenues and cut spending simultaneously to control budget deficits. This analysis of revenues and expenditure indicates a lack of coordination at the local government level.

The primary objective of this study is to examine the causative relationship between revenue and expenditure at the state level in Malaysia for the time frame spanning from 1990 to 2018. The use of cointegration and causality models allows for the analysis and evaluation of the proposed hypotheses. In this section, a concise summary of the hypotheses will be presented, along with an examination of pertinent scholarly works pertaining to the tax-spend issue. Section 3 provides an in-depth examination of the technique used and the data utilized in the study. The empirical results are presented in Section 4, and the conclusion is provided in Section 5.

REVIEW OF LITERATURE

In developed countries, the relationship between government income and spending may be classified into four primary conflicting hypotheses. The fiscal synchronization concept posits that the fiscal authorities make tax and expenditure choices in a synchronized manner. According to the Granger concept, the link between tax income and government expenditure is characterized as a bi-directional association. Musgrave (1966) posits that voters engage in a comparative analysis of the incremental advantages and disadvantages associated with government services in order to make informed decisions on the optimal levels of government income and expenditures. Therefore, according to the fiscal synchronization concept, choices about income and spending are concurrently decided. Several studies have provided support for the fiscal synchronization concept, including the works of Musgrave (1966), Meltzer and Richard (1981), Miller and Russek (1990), Bohn (1991), Bhat et al. (1993), Payne (1998), Koren and Stiassny (1998), Kollias and Makrydakis (2000), Kollias and Paleologou (2006), Chang and Chiang (2009), Vamvoukas (2011), Mutascu (2016), Irandourst (2017), Jaen-Garcia (2019), Karakas and Turan (2019), and Tashevska et al. (2020).

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Conversely, the spend-and-tax theory posits that government spending has a causal effect on alterations in tax income. To clarify, the direction of causation may be seen as flowing from government expenditure towards tax income. According to Peacock and Wiseman (1979), it is posited that transient surges in government spending triggered by crises have the potential to result in enduring augmentations in government revenues. The spend-and-tax theory finds support in many research studies conducted by Peacock and Wiseman (1961, 1979), Jones and Joulfaian (1991), Anderson et al. (1986), von Furstenberg et al. (1986), Provopoulos and Zambaras (1991), Joulfaian and Mookerjee (1991), Hondroyiannis and Papapetrou (1996), Darrat (1998), Koren and Stiassny (1998), Almasri and Shukur (2003), Konstantinou (2004), Richter and Dimitrios (2013), Mutascu (2016, 2017), Karakas and Turan (2019), and Kirikkaleli and Ozbeser (2023).

According to Wildavsky (1988) and Baghestani and McNown (1994), in cases in which there is no causal relationship between revenue and expenditure, the collection of tax income and spending are independent of each other. A non-causal relationship between revenue and expenditure is known as fiscal neutrality, institutional separation, or fiscal independence hypotheses. Kollias and Paleologou (2006) found that Austria, Belgium, and Germany support the institutional separation hypothesis. Other studies by Ewing et al. (2006) have also found the fiscal neutrality hypothesis for the United States; for Estonia, Latvia, Lithuania, Poland, and Romania by Mutascu (2016); and Karakas and Turan (2019) for Romania and Poland.

As shown above, even in developed nations, the empirical data pertaining to the aforementioned conflicting hypotheses is, at best, mixed and inconclusive. Various studies examining the relationship between government income and spending have shown diverse outcomes, which may be attributed to variations in the time frame considered, the duration of lag, and disparities among various tiers of government. For example, the study conducted by Manage and Marlow (1986) revealed that using varying lag durations had distinct outcomes. By manipulating the lag length within the range of two to five, the findings consistently demonstrate a unidirectional link in all instances. Specifically, the lower and higher lag lengths consistently reveal a causative relationship, where expenditures have a significant impact on revenues. Conversely, the utilization of an intermediate lag time offers substantiation for a bidirectional causal association between the two variables. In their study, Ram (1988) investigated the link between expenditures and revenues in the federal governments as well as state and local governments, using a combination of quarterly and annual data.

The investigation yielded contradictory findings as well. For instance, when examining yearly data, the findings provide empirical support for the fiscal synchronization theory within the context of the federal government. However, the use of quarterly data yielded findings indicating a causal relationship from revenues to expenditures, hence providing support for the tax-and-spend theory. However, when examining data at the state and municipal levels, both yearly and quarterly figures show outcomes that align with the spend-and-tax theory. In a separate investigation, Owoye (1995) conducted an examination of the causal association between taxes and expenditures among the G7 nations. Owoye observed that while the sample nations have comparable economic environments, the outcomes of the causal linkages differ. The findings derived from the error-correction models provide empirical evidence that supports the fiscal synchronization theory in the context of the United States, Germany, the United Kingdom, Canada and France. This suggests that these countries' fiscal authorities engage in collaborative decision-making processes about taxation and expenditure. In contrast, it can be seen that the direction of causation in Japan and Italy is from revenues to expenditures, providing support for the tax-and-spend theory.

There have also been contradictory findings on the link between government tax revenue and government expenditures in developing countries. A significant amount of study has been conducted on the tax-spend relationship in developing economies. Notable studies, among others, include Chang and Ho (2002a) for China, Fuess et al. (2003) and Chang and Ho (2002b) for Taiwan, Al-Foul and Baghestani (2004) for Egypt and Jordan, Ewing and Payne (1998) for Latin America, and Carneiro et al. (2004) for Guinea-Bissau. Chang and Ho (2002a) conducted a study using annual time series data for China from 1977 to 1999. They employed multivariate error correction models to scrutinize the relationship between government revenues and government expenditures. Their findings revealed the presence of bi-directional Granger causality, providing support for the fiscal synchronization hypothesis in the context of China. Regarding Taiwan, the tax-and-spend hypothesis, which posits a unidirectional causal relationship from government

revenues to expenditures, is supported by the research conducted by Chang and Ho (2002b) as well as Fuess et al. (2003).

According to Ewing and Payne's (1998) research, it was determined that Chile and Paraguay provide support for the fiscal synchronization concept among Latin American nations. There exists empirical data in the cases of Colombia, Ecuador, and Guatemala that suggests a causal link between revenues and expenditures, hence providing support for the tax-and-spend theory. According to the research conducted by Al-Foul and Baghestani (2004) on the countries of Egypt and Jordan, the findings reveal that the data pertaining to Egypt demonstrate unidirectional causation from income to expenditure. Specifically, it was seen that an increase in revenue is associated with a corresponding increase in spending. The findings pertaining to Jordan demonstrate a reciprocal relationship between revenue and expenditure, hence providing empirical support for the fiscal synchronization concept. On the other hand, a study by Alagidede and Tweneboah (2015) examined the fiscal synchronization hypothesis for Latin America for the period 1990–2012. Cheng (1999) shows that Chile, Panama, Brazil, and Peru have bidirectional causality between taxes and expenditure, supporting the institutional separation hypothesis. Studies by Gounder et al. (2007) support the fiscal neutrality hypothesis for Fiji, while for Nigeria by Shuaibu and Ibrahim (2013), Ghana by Takumah (2014), South Africa by Moyo et al. (2021) and Nyamongo et al. (2007), India by Akram and Rath (2019), China by Chang and Ho (2002a), Ho and Huang (2009), Li (2001), and Karlsson (2019), and Pakistan by Raza et al. (2019).

Carneiro et al. (2004) discovered the presence of a durable equilibrium between government spending and income in Guinea-Bissau. The spend-and-tax theory posits that the government exhibits a tendency to first allocate cash towards expenditures and thereafter seek to generate tax revenues and/or get grants to finance these outlays, as opposed to adopting a strategy of acquiring funds to support spending first. Similar spend-and-tax hypotheses can be found in the work by Narayan and Narayan (2006) for Haiti; Diky et al. (2023) for Indonesia; Hayat et al. (2017) for Pakistan; Sanusi (2020) for South Africa; and Nzimande and Ngalawa (2021) for Mauritius and Mozambique.

A study conducted by Chang et al. (2002) examined the tax-and-spend hypothesis in three newly industrialized countries in Asia (South Korea, Taiwan, and Thailand) as well as seven industrialized countries (Australia, Canada, Japan, New Zealand, South Africa, the UK, and the USA). The findings of this study revealed that the data supported the tax-and-spend hypothesis for Japan, South Korea, Taiwan, the UK, and the USA. However, the spend-and-tax hypothesis was found to be applicable only to Australia and South Africa. Canada, in the context being discussed, aligns with and provides evidence for the fiscal synchronization concept. Moreover, the study conducted by Chang et al. (2002) revealed that there is no significant correlation between revenues and expenditures in both New Zealand and Thailand.

In another study, the tax-and-spend hypothesis was also found by Nzimande and Ngalawa (2021) for Botswana; Narayan and Narayan (2006) for Mauritius, El Salvador, Haiti, Chile, and Venezuela; Sriyana (2009), and Solikin and Nizar (2023) for Indonesia; Mohanty and Mishra (2017) for India; Rahman and Wadud (2014) for Bangladesh; Al-Khulaifi (2012) for Qatar; Rezael (2014) for Iran; Yinusa and Adedokun (2017), and Obioma and Ozughalu (2010) for Nigeria; Craigwell et al. (1994) for Barbados; Masenyetse and Motelle (2012) for Lesotho; and Cheng (1999) for Columbia, the Dominican Republic, Honduras, and Paraguay.

Several studies have also found a fiscally independent relationship between government tax revenue and government expenditure. Works by Babarinde (2022) for the fiscal independent hypothesis hold for Nigeria; Sere and Choga (2017) for South Africa; and Narayan and Narayan (2006) for Peru, South Africa, Guatemala, Uruguay, and Ecuador.

Testing for Long-Run Relationship between Revenue and Expenditure

Following the existing literature and preserving a suitable degree of flexibility, we construct the long-term model for state revenue and spending in this study as follows:

$$\exp_t = \theta_0 + \theta_1 rev_t + \omega_t \quad (1)$$

where $\omega_t \sim NID(0, \sigma^2)$; $\exp_t$ is the total states' expenditure to states' GDP ratio; rev_t is states' total tax revenue to states' GDP. The error term ω_t is assumed to have mean zero and constant variance.

To estimate Equations (1), we employ the Ordinary Least Square (OLS) with robust standard error due to the Newey-West (1987) procedure. The Newey-West standard error method is a robust method or estimator that is highly accurate when there is a presence of heteroskedasticity and autocorrelation. As the time series variables are nonstationary and, most likely, the regression results will be spurious, we test the model for the presence of cointegration. To test cointegration, we employ the conventional cointegration test that was suggested by Granger and Engle in 1987. The two-step Engle-Granger cointegration test is done by estimating Equation (1) using OLS first. In the second step, the residuals are saved and then tested for the presence of a unit root. The rejection of a unit root in the residuals will suggest cointegration. If the variables are found to be cointegrated in Equations (1), the estimated long-run models are said to be valid, the OLS estimation is efficient, and the results are nonspurious.

We also employ the Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), Canonical Cointegrating Regression (CCR) procedure, and robust regression using the M-estimator to estimate the long-run models as per Equations (1). The FMOLS, DOLS, and CCR are robust and more efficient than the OLS, particularly for small samples, to work with models with heteroscedasticity, autocorrelation, and non-normality of errors (Phillips and Hansen, 1990; Stock and Watson, 1993; Park, 1992). For the long-run models estimated using FMOLS, DOLS, and CCR, the test for cointegration is performed using Hansen statistics (Hansen, 1992), with a null hypothesis that there is cointegration and the alternative hypothesis that there is no cointegration.

We also use robust regression for further robustness testing. Regression that is robust is effective when there are outliers. When applying parametric or non-parametric tests, the presence of outliers can result in inflated error rates and significant distortions of parameters and statistical estimations (Barnett and Lewis, 1994). According to Perez et al. (2013), an increase in error variance will statistically weaken statistical test power, disrupt normalcy, and significantly skew or affect parameter estimations. Robust regression is the most effective technique for identifying outliers and producing findings that are resistant to outliers (Rousseeuw, 1984). The M-estimation approach is the most widely used generic technique for robust regression (Huber, 1964).

The present analysis employs an error-correction model that is used to determine the tax-spend hypothesis (Granger, 1986; Engle and Granger, 1987).

$$\Delta \exp_t = \gamma_0 + \sum_{i=1}^{m} \gamma_{1i} \Delta \exp_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta rev_{t-i} + \lambda_1 ECM_{t-1} + \eta_t \quad (2)$$

$$\Delta rev_t = \delta_0 + \sum_{i=1}^{m} \delta_{1i} \Delta \exp_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta rev_{t-i} + \lambda_2 ECM_{t-1} + \mu_t \quad (3)$$

where $\exp_t$ and rev_t are expenditure and revenue respectively, and Δ is the difference operator. The ECM term was derived from the residual lagged one period of the long-run Equation (1) above,

$$ECM_{t-1} = \omega_{t-1} = \exp_{t-1} - [\theta_0 + \theta_1 rev_{t-1}] \quad (4)$$

The Granger long-run causality between revenue and expenditure is tested using the statistically significant parameter lambda (λ) in Equations (2) and (3). A negative and significant of the estimated coefficient of λ_1 in Equation (2) and a negative and non-significant of λ_2 in Equation (3) would suggest the tax-and-spend hypothesis; while a negative and non-significant of the estimated coefficient of λ_1 in Equation (2) and a negative and significant value of λ_2 in Equation (3) would suggest the spend-and-tax hypothesis. A bi-directional causal relationship between revenue and expenditure, or a fiscal synchronization hypothesis, is supported when λ_1 in Equation (2) and λ_2 in Equation (3) are both negative and significant. On the other hand, the negative and non-significant of both λ_1 in Equation (2) and λ_2 in Equation (3) would suggest the fiscal neutrality hypothesis of the institutional separation hypothesis. The estimated value for λ's usually lies between 0 and -2 (Fromentin and Leon, 2019; Loayza and Rancière, 2006; Samargandi et al., 2015).

Sources of Data

The data pertaining to the total tax revenue and expenditures of thirteen Malaysian states from 1990 to 2018 were gathered from various editions of the State Financial Yearbook, which is produced by the Department of Statistics Malaysia. The series variables were converted into ratios to the state's gross domestic product and into natural logarithms for the purpose of the analysis in this study. Figure 1 demonstrates the trends in real gross domestic product (GDP) for the 13 states in Malaysia, while Figure 2 illustrates the trend in the ratios of tax revenue and expenditure to GDP for all thirteen states in Malaysia for the period 1990–2018. Both figures clearly suggest that the revenue and expenditure series are integrated economic variables.

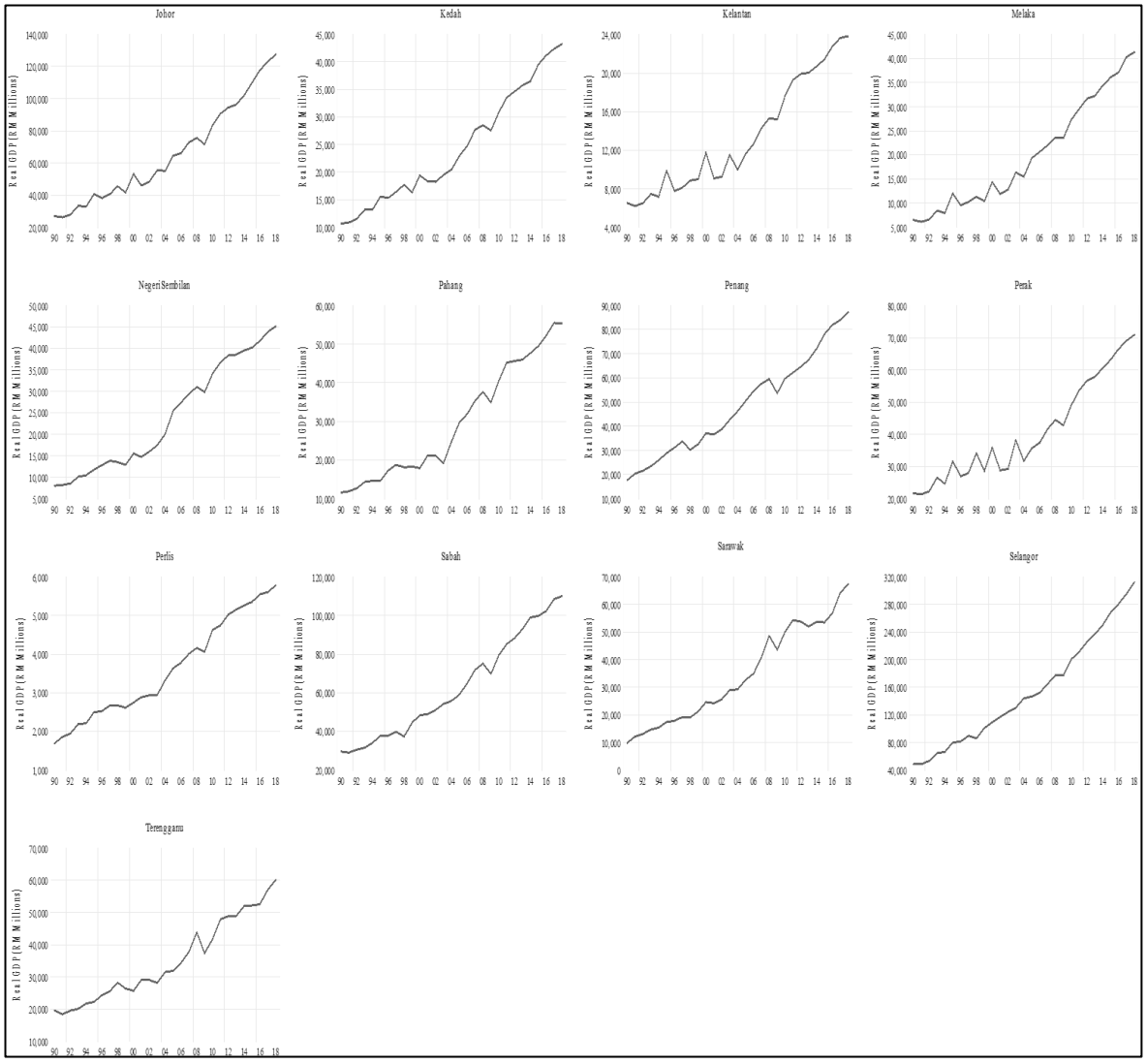

Figure 1 Trend in states' Real GDP, 1990-2018

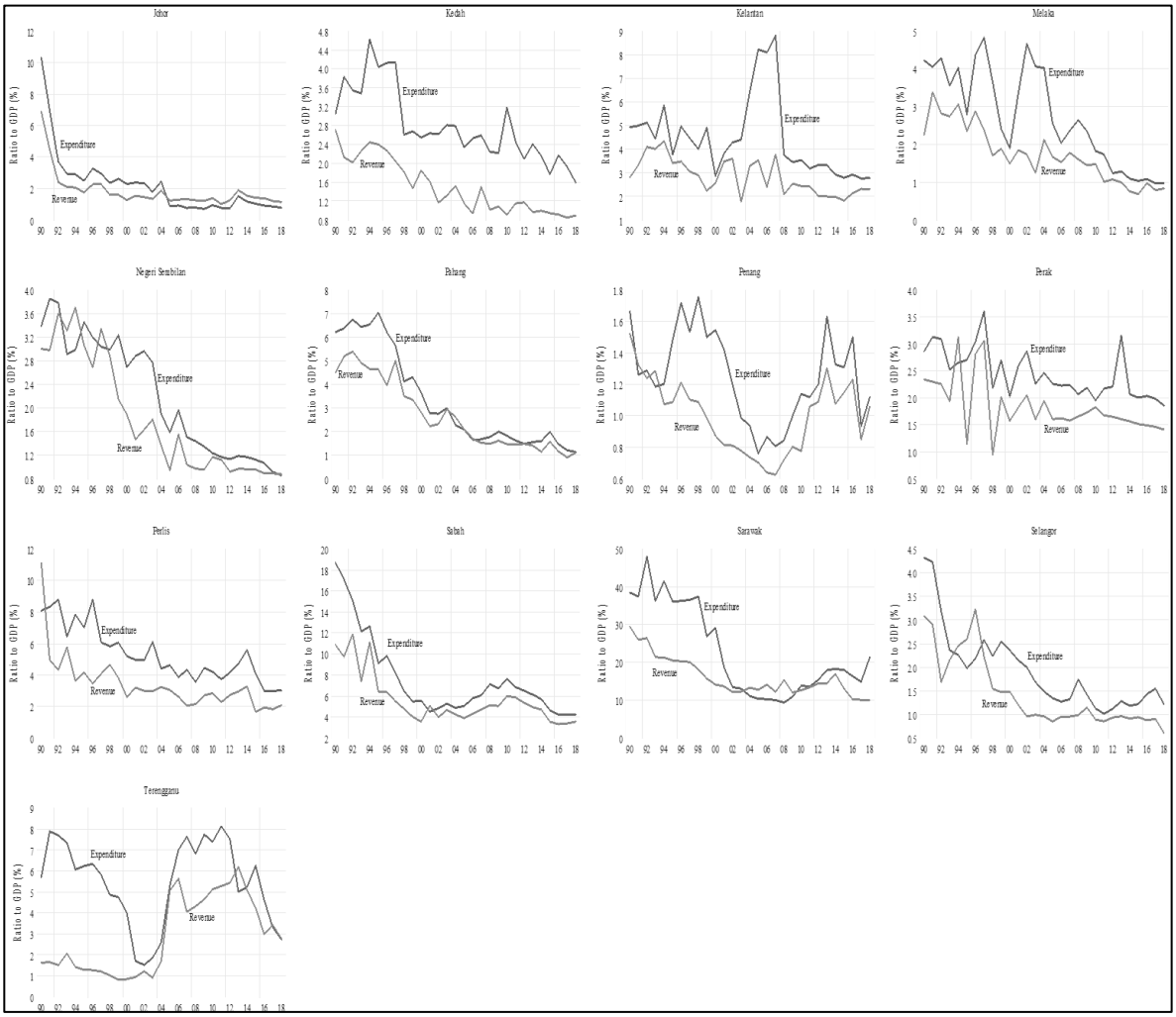

Figure 2 Trends in ratio of states' total tax revenue and expenditure to state's GDP, 1990-2018

RESULTS AND DISCUSSION

Descriptive Statistics and Correlation Matrix

The descriptive statistics of each of the study's variables are presented in Table 1. In general, the means for all series are positive. States with a mean expenditure ratio to GDP of more than 5% include Perlis, Sabah, Sarawak, and Terengganu, while the states with a mean tax revenue ratio to GDP of more than 5% include Sabah and Sarawak. At the mean level, all states experienced deficits, implying that mean expenditure is greater than mean revenue.

As shown in Figure 2, most of the time, the state-to-GDP ratios of spending are larger than the state-to-GDP ratio of revenue, suggesting that the states are typically running fiscal deficits. More importantly, most variables demonstrate substantial standard deviations, skewness, and kurtosis. All twenty-six variables are skewed, showing asymmetry. As for kurtosis, the variables that show a size greater than 3 include expenditure for Johor, Kelantan, Sabah, and Selangor, and revenue for Johor, Perak, Perlis, Sabah, and Sarawak. On the right side of the distribution, this suggests that the variables display a longer or fatter tail. Stated differently, the series' kurtosis indicates a leptokurtic distribution type. However, for Johor (expenditure and revenue), Kelantan (expenditure), Perak (revenue), Perlis (revenue), Sabah (expenditure and revenue), Sarawak (revenue), and Selangor (expenditure and revenue), the Jarque-Bera tests for the normality of the series are rejected. As a result, many of the variables in our analysis have non-normal distributions and exhibit high skewness and kurtosis. Transforming all variables into logarithms is a common solution to these issues (McKinney et al., 2009; Naidoo and Adamowicz, 2001; Ehrhardt-Martinez et al., 2002).

In Table 2, we present the correlation matrix between the ratios of expenditure to GDP and ratios of tax revenue to GDP for each state. In all cases, data from all thirteen states suggest that the correlation between revenue and expenditure is favorable and, at the 1% level, statistically significant. In other words, an increase in states' tax revenue is correlated with an increase in states' expenditure.

Table 1 Descriptive statistics

Variables	Unit	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	J-B test	Obs
Expenditure:									
Johor	% GDP	2.22	10.32	0.69	2.05	2.56	10.13	93.17***	29
Kedah	% GDP	2.80	4.62	1.59	0.77	0.75	2.70	2.85	29
Kelantan	% GDP	4.45	8.83	2.75	1.66	1.30	3.95	9.28***	29
Melaka	% GDP	2.74	4.83	0.97	1.29	0.06	1.59	2.43	29
Neg.Sembilan	% GDP	2.20	3.85	0.86	1.00	0.12	1.44	3.01	29
Pahang	% GDP	3.35	7.03	1.13	2.08	0.66	1.78	3.91	29
Perak	% GDP	2.45	3.61	1.86	0.45	0.77	2.67	2.97	29
Perlis	% GDP	5.34	8.79	2.99	1.74	0.62	2.36	2.37	29
Penang	% GDP	1.25	1.75	0.76	0.29	0.04	1.97	1.30	29
Sabah	% GDP	7.60	18.69	4.19	3.91	1.58	4.50	14.71***	29
Sarawak	% GDP	22.77	47.99	9.31	11.92	0.57	1.84	3.19	29
Selangor	% GDP	1.92	4.31	1.01	0.85	1.45	4.73	13.74***	29
Terengganu	% GDP	5.48	8.14	1.53	2.01	-0.58	2.24	2.35	29
Revenue									
Johor	% GDP	1.84	6.89	1.01	1.17	3.26	13.74	190.7***	29
Kedah	% GDP	1.50	2.70	0.85	0.57	0.58	1.98	2.89	29
Kelantan	% GDP	2.83	4.34	1.77	0.75	0.36	1.91	2.08	29
Melaka	% GDP	1.74	3.38	0.69	0.75	0.49	2.34	1.69	29
Neg.Sembilan	% GDP	1.83	3.70	0.87	0.99	0.64	1.83	3.64	29
Pahang	% GDP	2.69	5.40	0.91	1.48	0.56	1.82	3.23	29
Perak	% GDP	1.84	3.13	0.94	0.51	1.06	3.92	6.44**	29
Perlis	% GDP	3.41	11.13	1.64	1.78	2.93	13.26	168.5***	29
Penang	% GDP	1.00	1.52	0.63	0.23	0.15	2.15	0.99	29
Sabah	% GDP	5.62	11.91	3.30	2.38	1.50	4.21	12.67***	29
Sarawak	% GDP	16.07	29.48	9.99	5.13	1.06	3.29	5.58*	29
Selangor	% GDP	1.43	3.22	0.60	0.76	1.15	2.94	6.36**	29
Terengganu	% GDP	2.89	6.19	0.81	1.82	0.38	1.54	3.27	29

Notes: Asterisks ***, **, and * denote statistically significant at the 1%, 5% and 10% level, respectively. All variables were in percentage to state's gross domestic product. J-B test denotes Jacque-Bera test on normality of the variables.

Table 2 Correlation matrix

States' Expenditure	States' Revenue	Correlation coefficients
Johor	Johor	0.88***
Kedah	Kedah	0.81***
Kelantan	Kelantan	0.57***
Melaka	Melaka	0.87***
Negeri Sembilan	Negeri Sembilan	0.91***
Pahang	Pahang	0.97***
Perak	Perak	0.64***
Perlis	Perlis	0.78***
Penang	Penang	0.75***
Sabah	Sabah	0.94***
Sarawak	Sarawak	0.78***
Selangor	Selangor	0.82***
Terengganu	Terengganu	0.45**

Notes: Asterisks ***, and ** denote statistically significant at the 1%, and 5% level, respectively. All variables were in logarithm.

Results of Unit Root Tests

Before conducting the cointegration test on Equations (1), it is necessary to ascertain each variable's integration order. To test for integration, we employ the standard Augmented Dickey-Fuller (Dickey and Fuller, 1981) unit root test. The test is conducted for both variables in terms of level as well as their first differences. For each unit root test, we include the intercept and/or trend as the deterministic components when conducting a unit root test. The results of the unit root test are presented in Table 3. The unit root test results suggest that all variables in their levels are integrated of order one, that is, I (1). No unit root is found after the first difference, indicating that their log changes are stationary. Each series is I (0), meaning they are all stationary in first differences.

Table 3 Results of unit root tests

Series	Series in level:		Series in difference:	
	Intercept	Intercept+trend	Intercept	Intercept+trend
Johor:				
Revenue	-1.5619 (0)	-2.2837 (1)	-3.2233***(1)	-5.7665***(0)
Expenditure	-1.1148 (0)	-2.7391 (0)	-5.9847***(0)	-6.8376***(0)
Kedah:				
Revenue	-0.3303 (1)	-2.2779 (2)	-7.0877***(0)	-4.3960***(2)
Expenditure	-1.2729 (0)	-3.0635 (3)	-4.3672***(1)	-5.3138***(1)
Kelantan:				
Revenue	-1.9056 (1)	-2.4592 (2)	-8.0647***(0)	-6.1719***(1)
Expenditure	-1.4813 (1)	-1.9533 (1)	-6.7080***(0)	-6.7637***(0)
Melaka:				
Revenue	-1.1122 (3)	-1.6148 (2)	-5.7435***(0)	-8.1506***(0)
Expenditure	-0.6680 (0)	-2.5938 (2)	-4.4412***(1)	-4.9347***(3)
Negeri Sembilan:				
Revenue	-0.6905 (0)	-1.4863 (2)	-7.0830***(0)	-5.9864***(1)
Expenditure	0.2228 (0)	-2.7986 (0)	-5.0987***(0)	-5.8911***(0)
Pahang:				
Revenue	-0.3230 (0)	-2.3047 (2)	-5.2880***(0)	-6.4114***(0)
Expenditure	0.1344 (0)	-2.0854 (0)	-4.9867***(0)	-5.1155***(0)
Penang:				
Revenue	-1.5862 (0)	-1.6945 (0)	-6.2178***(0)	-6.5048***(0)
Expenditure	-1.4740 (2)	-1.9644 (2)	-5.5077***(0)	-5.9272***(0)
Perak:				
Revenue	-1.2086 (2)	-2.3068 (4)	-5.1458***(3)	-5.1707***(3)
Expenditure	-1.8027 (1)	-2.3966 (4)	-8.7673***(0)	-8.9855***(0)
Perlis:				
Revenue	-1.7029 (0)	-2.6187 (1)	-4.1177***(0)	-5.8757***(0)
Expenditure	-1.1374 (0)	-2.0199 (3)	-7.5927***(0)	-7.7659***(0)
Sabah:				
Revenue	-1.4026 (0)	-2.4102 (0)	-9.2936***(0)	-9.5000***(0)
Expenditure	-0.7392 (0)	-1.5192 (0)	-5.1496***(0)	-5.5407***(0)
Sarawak:				
Revenue	-0.7965 (0)	-2.2331 (0)	-6.2286***(0)	-6.5522***(0)
Expenditure	-1.0411 (0)	-0.8250 (0)	-4.7773***(0)	-5.1993***(0)
Selangor:				
Revenue	-0.6390 (0)	-2.4205 (0)	-5.0511***(0)	-5.0488***(0)
Expenditure	-1.0031 (0)	-2.2472 (0)	-4.1757***(0)	-4.2874***(0)
Terengganu:				
Revenue	-1.3569 (0)	-2.5561 (1)	-3.1298**(0)	-3.3270**(0)
Expenditure	-1.7473 (6)	-1.6372 (6)	-5.2519***(0)	-5.4862***(0)

Notes: Asterisks ***, ** denote statistically significant at the 1% and 5% level, respectively. Critical values for the series with Intercept, refer to MacKinnon (1996); while critical values for series with Intercept and Trend, refer to Elliot et al. (1996, Table 1).

Results of the Long-run Models

The results for estimated long-run spend-tax equations for the thirteen states in Malaysia are exhibited in Table 4 demonstrate that the OLS-robust estimates of Equation (1) are cointegrated, rejecting the null hypothesis that the residuals have a unit root at least at the 10% level (Johor, Negeri Sembilan, and Sarawak), the 5% level (Kelantan, Penang, and Terengganu), and the 1% level (Kedah, Melaka, Pahang, Perak, Perlis, Sabah, and Selangor). Statistics for the FMOLS, DOLS, and CCR estimates imply that there are long-term correlations between state revenue and expenditure for the years 1990–2018 and that the cointegration null hypothesis cannot be rejected. In all estimated equations, the revenue variable is statistically significant at least at the 10% level and shows a positive sign. This implies that a rise in state tax collections will eventually result in a rise in state spending

Table 4 Results on long-run models

States/Independent variables	OLS-robust	FMOLS	DOLS	CCR
Johor:				
constant	-0.2588	-0.5108	-0.5153**	-0.4306
	(-1.4717)	(-1.2355)	(-2.1382)	(-1.2962)
revenue	1.5487***	1.9028**	2.1914***	1.7082***
	(8.3941)	(2.4999)	(3.9863)	(3.5591)
R^2	0.777	0.702	0.712	0.701
Cointegration tests:				
$DF_{t-statistic}$	-1.7096*			
$L_{c-statistic}$		0.2581	0.0197	0.1405
Kedah:				
constant	0.5857***	0.7768***	0.8081***	0.7745***
	(18.864)	(20.752)	(20.405)	(19.890)
revenue	0.7970***	0.7241***	0.6600***	0.7203***
	(5.6651)	(9.0698)	(8.3373)	(8.9822)
R^2	0.663	0.686	0.777	0.688
Cointegration tests:				
$DF_{t-statistic}$	-5.3466***			
$L_{c-statistic}$		0.2713	0.0684	0.1560
Kelantan:				
constant	0.7031***	0.5620	0.5258	0.5167
	(3.6754)	(1.1933)	(1.2569)	(0.9559)
revenue	0.7280***	0.8611*	0.9014**	0.9054*
	(3.8672)	(1.9007)	(2.2172)	(1.7334)
R^2	0.334	0.324	0.367	0.315
Cointegration tests:				
$DF_{t-statistic}$	-2.4816**			
$L_{c-statistic}$		0.1227	0.0262	0.1371
Melaka:				
constant	0.3900***	0.4093***	0.3639***	0.4109**
	(4.8695)	(2.8058)	(2.9549)	(2.6587)
revenue	1.0586***	1.0518***	1.1192***	1.0487***
	(10.719)	(4.5545)	(6.1965)	(4.2991)
R^2	0.772	0.766	0.771	0.766
Cointegration tests:				
$DF_{t-statistic}$	-3.1998***			
$L_{c-statistic}$		0.2058	0.0266	0.2094
Negeri Sembilan:				
constant	0.2732***	0.1563	0.2238***	0.1595
	(3.4648)	(1.3460)	(3.0898)	(1.3930)
revenue	0.8597***	0.9701***	0.8635***	0.95928***
	(9.8848)	(5.6648)	(8.6575)	(6.0158)
R^2	0.838	0.797	0.876	0.798
Cointegration tests:				
$DF_{t-statistic}$	-1.9728*			
$L_{c-statistic}$		0.1211	0.0285	0.0783
Pahang:				
constant	0.1218**	0.1273	0.1244	0.1297
	(2.3467)	(1.6278)	(1.5193)	(1.5811)
revenue	1.9732***	1.1036***	1.0899***	1.0992***
	(23.374)	(13.852)	(14.421)	(13.656)
R^2	0.954	0.947	0.956	0.948
Cointegration tests:				
$DF_{t-statistic}$	-2.9035***			
$L_{c-statistic}$		0.1582	0.0257	0.1229
Penang:				
constant	0.2160***	0.2017***	0.2278***	0.2027***
	(4.5793)	(3.2756)	(4.7728)	(3.3201)
revenue	0.7502***	0.6859**	0.8149***	0.6937***
	(5.1818)	(2.5455)	(3.6522)	(2.6938)
R^2	0.570	0.533	0.612	0.534
Cointegration tests:				
$DF_{t-statistic}$	-2.2836**			
$L_{c-statistic}$		0.2168	0.0305	0.1421

Notes: Asterisks ***, ** and * denote statistically significant at the 1%, 5% and 10% level, respectively. The two-step cointegration test ($DF_{t-statistic}$) with null hypothesis of non-cointegration; while the Hansen cointegration test ($L_{c-statistic}$) with null hypothesis of cointegration. Prewhitening lag 1 was used for FMOLS and CCR; while for DOLS, lead equals 1, and lag equals 1.

Table 4 Cont.

States/Independent variables	OLS-robust	FMOLS	DOLS	CCR
Perak:				
constant	0.6332***	0.5533***	0.3782***	0.4584***
	(7.7897)	(7.3071)	(3.3129)	(4.2145)
revenue	0.4321***	0.5657***	0.8662***	0.7287***
	(3.9318)	(4.6330)	(4.4208)	(4.0148)
R^2	0.413	0.351	0.535	0.190
Cointegration tests:				
$DF_{t-statistic}$	-4.2245***			
$L_{c-statistic}$		0.3620	0.0743	0.2100
Perlis:				
constant	0.8946***	0.5674***	0.5169***	0.6153***
	(6.9332)	(3.6307)	(4.8466)	(4.1983)
revenue	0.6416***	0.9365***	0.9837***	0.8864***
	(6.0124)	(6.8178)	(10.387)	(7.0975)
R^2	0.623	0.652	0.830	0.659
Cointegration tests:				
$DF_{t-statistic}$	-5.0747***			
$L_{c-statistic}$		0.0761	0.0572	0.0850
Sabah:				
constant	0.0717	-0.0488	-0.0472	-0.0519
	(0.5956)	(-0.4560)	(-0.4125)	(-0.4848)
revenue	1.1210***	1.1866***	1.1777***	1.1876***
	(14.785)	(18.439)	(16.694)	(18.702)
R^2	0.899	0.874	0.957	0.874
Cointegration tests:				
$DF_{t-statistic}$	-5.9550***			
$L_{c-statistic}$		0.1327	0.0316	0.1232
Sarawak:				
constant	-0.8187	-1.4852	-2.2995***	-1.2406
	(-0.9788)	(-0.8991)	(-3.2448)	(-1.3071)
revenue	1.3946***	1.5451***	1.8942***	1.4547***
	(4.8418)	(2.5469)	(7.2315)	(4.2297)
R^2	0.609	0.319	0.867	0.318
Cointegration tests:				
$DF_{t-statistic}$	-1.8306*			
$L_{c-statistic}$		0.1220	0.0286	0.0479
Selangor:				
constant	0.4050***	0.2920***	0.3360***	0.2913***
	(6.7847)	(3.6247)	(6.4218)	(3.6541)
revenue	0.6878***	0.7133***	0.6180***	0.7144***
	(4.3368)	(4.3098)	(5.7551)	(4.8961)
R^2	0.682	0.549	0.761	0.548
Cointegration tests:				
$DF_{t-statistic}$	-2.4068***			
$L_{c-statistic}$		0.0996	0.0358	0.1112
Terengganu:				
constant	1.3444***	1.4510***	1.3180***	1.4381***
	(5.3201)	(3.6437)	(6.8041)	(3.8654)
revenue	0.3150*	0.2449	0.3607*	0.2583
	(1.9093)	(0.6763)	(2.0003)	(0.7809)
R^2	0.206	0.188	0.368	0.193
Cointegration tests:				
$DF_{t-statistic}$	-2.4461**			
$L_{c-statistic}$		0.1787	0.0296	0.1305

Notes: Asterisks ***, ** and * denote statistically significant at the 1%, 5% and 10% level, respectively. The two-step cointegration test ($DF_{t-statistic}$) with null hypothesis of non-cointegration; while the Hansen cointegration test ($L_{c-statistic}$) with null hypothesis of cointegration. Prewhitening lag 1 was used for FMOLS and CCR; while for DOLS, lead equals 1, and lag equals 1.

Finally, the elasticity of revenue of more than one is registered for the states of Johor, Melaka, Pahang, Sabah, and Sarawak, which thus implies that with a 1% increase in the state's tax revenue, the state's expenditure will increase by more than 1%. On the other hand, states that have a lower elasticity of revenue include Kedah, Kelantan, Negeri Sembilan, Perak, Perlis, Penang, Selangor, and Terengganu. A 1% increase in the state's tax revenue will increase the state's expenditure by less than 1%.

Table 5 presents the estimated long-run model for all thirteen states in Malaysia employing robust regression using the M-estimator. The state's revenue variable is statistically significant at the 1% level in all

cases and shows a positive relationship with the state's expenditure. The expenditure in the states of Johor, Melaka, Pahang, Sabah, and Sarawak is more responsive to the changes in the state's tax revenue, while the expenditure in the states of Kelantan, Kedah, Perak, Negeri Sembilan, Perlis, Penang, Selangor, and Terengganu were less responsive to the changes in the state's tax revenue during the period 1990–2018. These results were consistent with the earlier results indicated by OLS-Robust, FMOLS, DOLS, and CCR.

Table 5 Results on long-run models with Robust regressions

Independent variables	**Johor**	**Kedah**	**Kelantan**	**Melaka**	**Negeri Sembilan**	**Pahang**	**Penang**
constant	-0.2862***	0.7714***	0.6615***	0.3399***	0.2624***	0.1287***	0.2090***
	(-2.5533)	(19.294)	(3.5933)	(5.3597)	(4.7958)	(2.6468)	(6.5267)
revenue	1.5760***	0.6442***	0.7039***	1.0815***	0.8635***	1.0738***	0.7635***
	(9.0383)	(7.9967)	(3.9732)	(10.894)	(10.999)	(22.183)	(5.6692)
R^2	0.687	0.548	0.292	0.682	0.734	0.744	0.520
	Perak	**Perlis**	**Sabah**	**Sarawak**	**Selangor**	**Terengganu**	
constant	0.6332***	0.8728***	0.0548	-0.9131	0.4030***	1.6246***	
	(7.7897)	(7.2409)	(0.4596)	(-1.4722)	(7.9552)	(14.771)	
revenue	0.4321***	0.6498***	1.1384***	1.4306***	0.7019***	0.1449***	
	(3.9318)	(6.4906)	(16.162)	(6.3384)	(7.2291)	(1.4291)	
R^2	0.413	0.564	0.672	0.584	0.603	0.043	

Notes: Asterisk *** denotes statistically significant at the 1% level. Figures in brackets are z-statistics.

Results of Granger Long-run Causality

In estimating the error-correction framework as per Equations (2) and (3), we follow the work of Pesaran et al. (2001). According to Pesaran et al. (2001), the optimal lag structure of the error-correction models can be estimated by estimating the autoregressive distributed lag (ARDL) model with its optimal lag structure. In Table 6, the optimal lag structure of the ARDL(p,q) model, where p is the lag period for the dependent variable and q is the lag period for the independent variable, is shown for each state. It varies from ARDL (1,0) for Sarawak to ARDL (3,3) for Terengganu. The Akaike Information Criterion, or AC, was used to determine the optimal lag length.

Table 6 Results of Granger long-run causality

Dependent variable	**Johor**	**Kedah**	**Kelantan**	**Melaka**	**Negeri Sembilan**	**Pahang**	**Penang**
Expenditure	ARDL (1,1)	ARDL (4,4)	ARDL (1,0)	ARDL (4,1)	ARDL (1,4)	ARDL (2,2)	ARDL (1,1)
λ_1, ECM_{t-1}	-0.1465**	-1.4661***	-0.4209***	-0.3415**	-0.4527***	-0.4014***	-0.3339**
	(-2.0744)	(-4.1335)	(-3.8097)	(-2.6758)	(-3.8525)	(-3.0980)	(-2.2535)
Revenue:	ARDL (1,1)	ARDL (4,1)	ARDL (3,1)	ARDL (2,4)	ARDL (1,1)	ARDL (1,0)	ARDL (2,4)
λ_2, ECM_{t-1}	-0.3453***	-0.5200***	-0.3782*	-0.3876**	-0.3161**	-0.7022***	-0.2544***
	(-3.9542)	(-4.7760)	(-1.7612)	(-2.1613)	(-2.1958)	(-6.8427)	(-3.6900)
	Perak	**Perlis**	**Sabah**	**Sarawak**	**Selangor**	**Terengganu**	
Expenditure	ARDL (1,3)	ARDL (3,4)	ARDL (1,0)	ARDL (4.0)	ARDL (1,0)	ARDL (2,0)	
λ_1, ECM_{t-1}	-1.0360***	-1.5597***	-0.4779***	-0.2085**	-0.3298***	-0.3028***	
	(-5.0231)	(-4.9871)	(-6.1022)	(-2.3312)	(-4.3825)	(-3.3426)	
Revenue	ARDL (2,0)	ARDL (1,0)	ARDL (1.0)	ARDL (1,0)	ARDL (1,4)	ARDL (3,3)	
λ_2, ECM_{t-1}	-1.5618***	-0.8923***	-1.0955***	-0.2145***	-0.1983***	-0.0286***	
	(-7.1206)	(-6.1585)	(-8.2171)	(-2.7066)	(-3.0264)	(-3.6899)	

Notes: Asterisks ***, ** and * denote statistically significant at the 1%, 5% and 10% level, respectively. Figures in brackets are t-statistics.

In this study, we are interested in testing the long-run tax-spending hypothesis (as shown by the significant of the lambda) for Malaysia rather than the short-run tax-spending hypothesis (as shown by the significant of the 's operator). In Table 6, we present the estimated coefficients of the parameter, namely, the term's coefficient. If the expenditure equation's term is significant and negative but not in the revenue equation, we have unidirectional Granger long-run causality running from revenue to expenditure, thus supporting the tax-and-spend hypothesis, while a unidirectional Granger long-run causality running from expenditure to revenue is established if the term in the revenue equation is negative and significant but not in the expenditure equation, thus supporting the spend-and-tax hypothesis. Conversely, if the terms in both the revenue and expenditure equations are negative and significant, this indicates bidirectional Granger long-run causality running between revenue and expenditure, thus supporting the fiscal synchronization hypothesis. Finally, the data are consistent with either the fiscal neutrality hypothesis or the institutional separation hypothesis if the term is not significant in both the revenue and spending equations.

In the expenditure equation, as indicated in Table 6, the terms are negative and statistically significant at least at the 5% level in all thirteen states; likewise, in the revenue equation, the terms are negative and statistically significant at least at the 10% level in all thirteen states. These results suggest bidirectional Granger long-run causality running in both directions between revenue and expenditure. It therefore supports the fiscal synchronization hypothesis. Therefore, according to the fiscal synchronization hypothesis, Malaysian state governments make decisions about the state's consumption expenditure and the state's tax collection simultaneously, and the public is aware of the advantages of state government services compared to their expenses. However, the best course of action for reducing fiscal deficits is to simultaneously implement steps to raise revenue and reduce spending.

CONCLUSION

The purpose of the present study is to test the revenue and expenditure, or tax and spend, nexus in the thirteen states in Malaysia for the periods 1990 to 2018. The thirteen states included in the study are Johor, Kedah, Kelantan, Melaka, Negeri Sembilan, Pahang, Perak, Perlis, Penang, Sabah, Sarawak, Selangor, and Terengganu. Four tax-spending hypotheses were tested, namely the spend-and-tax hypothesis, the tax-and-spend hypothesis, the fiscal synchronization hypothesis, and the institutional separation or fiscal neutrality hypothesis.

We used the ratio of states' tax revenue and expenditure to states' GDP and transformed them into logarithms. In this study, the revenue and expenditure variables were tested for unit root, and we employed several estimators to test for cointegration to establish whether there is a long-run relationship between expenditure and revenue in the thirteen states. The estimators are Ordinary Least Square (OLS) with robust standard error, Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), Canonical Cointegrating Regression (CCR), and Robust Regression with M-estimator. On the other hand, the tax-spending hypotheses were tested using the error-correction model framework following Pesaran et al. (2001). Within the error-correction framework, we employed the ECM term-lag one period to ascertain the Granger long-run causality between revenue and expenditure.

Our results suggest that, first, both ratios of states' revenue and expenditure to states' GDP are non-stationary in levels, but they are stationary in first difference. Second, in all thirteen states, revenue and expenditure are cointegrated, implying that there is a long-term link between states' expenditure and states' revenue over the time periods 1990–2018, and all five different estimators give consistent results. Third, the long-run tax-spending models indicate that 5 states respond more to 1% changes in revenue, while 8 states respond less to 1% changes in revenue. And fourthly, our study supports the fiscal synchronization hypothesis between states' expenditure and states' revenue for all thirteen states in Malaysia for the period 1990–2018. The most important policy implication is that cutting state government spending while enacting concurrent tax restrictions would be one way to reduce the state budget.

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