International Journal of Business and Economics, 2002, Vol. 1, No. 2, 157-165

Tax or Spend, What Causes What: Taiwan's Experience

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Abstract

In this paper we tested the hypothesis of tax-and-spend, spend-and-tax, or fiscal synchronization for Taiwan using annual data covering the 1967 to 1999 period. Granger causality test results based on the corresponding vector error-correction models (ECM) suggest unidirectional causality running from government revenues to government expenditures, thus supporting the tax-and-spend hypothesis for Taiwan.

Key words: tax-and-spend; spend-and-tax; fiscal synchronization; Taiwan

JEL classification: C32; H62

1. Introduction

Owing to the great concern over the growing budget deficits world-wide, numerous studies have been devoted to testing the hypothesis of tax-and-spend, spend-and-tax, or fiscal synchronization. The determination of this hypothesis determines the characteristics of an economy as more than just an intellectual exercise for it also carries implications as to solutions to the problem of budget deficit. Although previous empirical work has led to contradictory test results for the U.S. and the U.K., still, very limited testing has been done for developing countries. Thus, there is a pressing need for further research in developing countries, so that the relationship between government revenues and expenditures can be investigated more fully and comparisons with other countries at different levels of economic development can be made. This study makes some contributions to this line of research by using recent time-series econometric techniques to test the hypothesis of tax-and-spend, spend-and-tax, or fiscal synchronization in the case of Taiwan over the 1967 to 1999 period.

Received August 1, 2001, accepted December 13, 2001.

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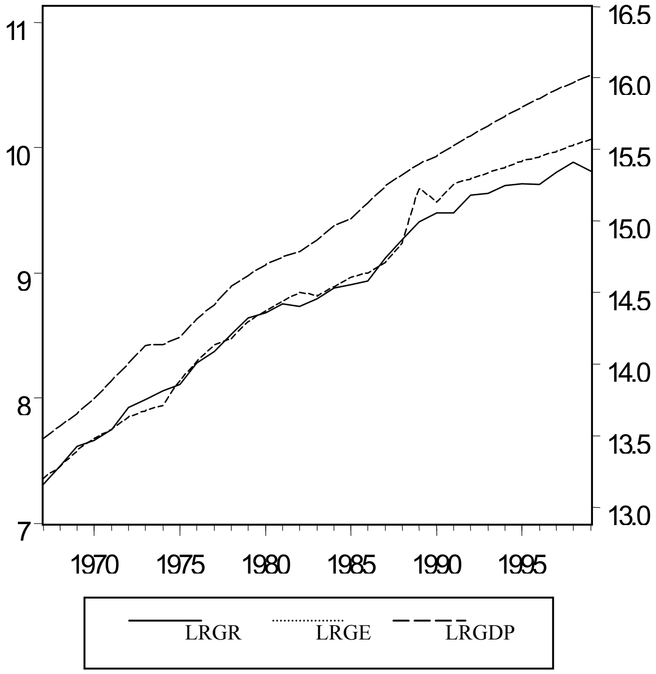
Though Taiwan had a balanced government budget from 1955 to 1988, it has had a growing deficit since then. To balance this budget deficit, the government has had to sell public properties, issue debts, and borrow from banks. In the meantime, a previous six-year plan for national economical development (adopted in 1990 and abandoned in 1993 to maintain macroeconomic stability) further aggravated the situation by producing an additional budget deficit amounting to trillions of NT dollars, which was financed by issuing bonds [Wu (1998)]. Since 1989, the reality of the budget deficit and its increasing size have sparked heated debates as to the possible consequences. The year 2000 introduced a new era for Taiwan with a change in political party leadership. The fifty-year reign of the National Party (KMT) as the ruling party ended with a loss to the Democratic Progress Party (DPP), thereby giving rise to a currently somewhat unstable political situation. Being highly volatile, the stock markets fluctuated throughout the year 2000. All the while, increased labor costs have forced some enterprises to leave Taiwan for mainland China, taking huge sums of investment dollars with them; simply put, the overall economic downtown has worsened. In response, the new Administration has decided to spend NT$810 billion in an attempt to stimulate the domestic demand and, hopefully, give a boost to the economy of Taiwan in the near future and, as a consequence, put an end to the current slump. Whether this budget deficit policy will be sustainable and how this ambitious development can be financed remain two fundamental, unanswered questions. Accordingly, it was deemed critical to see what causes what — that is, the direction of causality between government revenues and government expenditures in this small island-economy.

This paper organized as follows. Section 2 presents the data used. Section 3 describes the methodology employed, while Section 4 discusses the empirical findings. Finally, Section 5 presents the conclusions.

2. Data

Our empirical analysis employed annual data on real GDP (rgdp), real government revenues (rgr), and real government expenditures (rge) for Taiwan over the 1967 to 1999 period (deflated by GDP deflator, 1996 =100). All data were obtained from the AREMOS database of the Ministry of Education of Taiwan. Examination of the individual data series makes it clear that logarithmic transformations were required to achieve stationarity in variance; therefore, all the data series were transformed to logarithmic form. A cursory review of the data reveals that government budget deficits have continuously increased in Taiwan since 1989. Upon closer examination, Figure 1 clearly shows that Taiwan had a roughly balanced budget during the 1967 to 1988 period, but the government budget first ran a deficit in 1989, and, subsequently, the slumping state of the economy significantly worsened and has tended to persist ever since.

Figure 1. Log(RGR), Log(RGE) and Log(RGDP) Plots for Taiwan, 1967-1999



3. Methodology

3.1 Unit Root Test

A number of authors have pointed out that the standard ADF tests are not appropriate for variables that may have undergone structural changes. For example, Perron (1989, 1990) has shown that the existence of structural changes tends to bias the standard ADF tests towards nonrejection of the null of a unit root. Hence, it might be misleading to conclude that the variables are non-stationary just on the basis of the results from the standard ADF tests. Perron (1990) developed a procedure to test the hypothesis that a given series $\{Y_t\}$ has a unit root with an exogenous structural break which occurs at time T_B. Zivot and Andrews (1992) (hereafter ZA) rejected the assumption of an exogenous break point and developed a unit root test procedure that allows an estimated break in the trend function under an alternative hypothesis. In this study, therefore, it seemed most reasonable to treat the structural break as endogenous and test the order of integration by the ZA procedure. The ZA tests are represented by the following augmented regression equations:

$$\text{Model A:} \quad \Delta Y_t = \mu_1^A + \beta_1^A t + \mu_2^A DU_t + \alpha^A Y_{t-1} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + \varepsilon_t,$$

$$\text{Model B:} \quad \Delta Y_t = \mu_1^B + \beta_1^B t + \gamma^B DT_t^* + \alpha^B Y_{t-1} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + \varepsilon_t, \tag{1}$$

$$\text{Model C:} \quad \Delta Y_t = \mu_1^C + \beta_1^C t + \mu_2^C DU_t + \gamma^c DT_t^* + \alpha^C Y_{t-1} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + \varepsilon_t,$$

where DU_t is 1 and $DT_t^* = t - T_B$ if $t > T_B$ and 0 otherwise. Here T_B represents a possible break point. Model A allows for a change in the level of the series, Model B allows for a change in the slope of the trend function, while Model C combines changes in the level and the slope of the trend function of the series. The sequential ADF test procedure estimates a regression equation for every possible break point within the sample and calculates the t-statistic for the estimated coefficients. This tests the null hypothesis of a unit root against the alternative hypothesis of a trend stationarity with a one-time break (T_B) in the intercept and slope of the trend function at an unknown point in time. The null of a unit root is rejected if the coefficient of Y_{t-1} is significantly different from zero. The selected break point for each data series is that T_B for which the t-statistic for the null is minimized. Since the choice of lag length *k* may affect the test results, the lag length was selected according to the procedure suggested by Perron (1989).

3.2 Cointegration Test

Following Johansen and Juselius (1990), we constructed a *p*-dimensional (3 x 1) vector autoregressive model with Gaussian errors that can be expressed by its first-differenced error correction form as

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} - \Pi Y_{t-1} + \mu + \lambda\, Ac + \varepsilon_t, \tag{2}$$

where Y_t are the data series studied, ε_t is i.i.d. N(0, Σ), $\Gamma_i = -I + A_1 + A_2 + A_3 + \ldots + A_i$ for *i*=1,2,...,*k*-1, $\Pi = I - A_1 - A_2 - \ldots - A_k$, and *Ac* is a dummy variable which takes into account previous Asian financial crises. The Π matrix conveys information about the long-term relationship among the Y_t variables, and the rank of Π is the number of linearly independent and stationary linear combinations of variables studied. Thus, testing for cointegration involves testing for the rank *r* of matrix Π by examining whether the eigenvalues of Π are significantly different from zero.

Johansen and Juselius (1990) proposed two test statistics to determine the number of cointegrating vectors (or the rank of Π), namely, the trace (T_r) and the maximum eigenvalue (L-max) statistics. Cheung and Lai (1993) demonstrated that these two statistics are subject to size distortions depending on the chosen data generating process (DGP) and sample size. To correct for such a possibility, here we followed Reimers's (1992) suggestion and made an adjustment for the degree of freedom by replacing T with T-np, where T is the sample size, n is the number of variables, and p is the lag-length. In so doing, the over-rejection of the null when the hypothesis is true is corrected.

3.3 Granger Causality Results Based on the Error-Correction Model (ECM)

Granger (1988) demonstrated that if there is indeed a cointegrating vector among variables, there must be causality among them at least in one direction. Engle and Granger (1987) provided a test of causality that incorporates information provided by the cointegrated properties of variables. The model can be expressed as an error-correction model (ECM) as follows [see Engle and Granger (1987)]:

$$\Delta Y_{it} = \mu_{it} + \beta' Z_{t-1} + \sum_{i=1}^{m} a_i \Delta Y_{1,t-i} + \sum_{i=1}^{m} b_i \Delta Y_{2,t-i} + \sum_{i=1}^{m} c_i \Delta Y_{3,t-i} + \gamma \, Ac + \varepsilon_{it} \,, \qquad (3)$$

where Y_{it} denotes real GDP, real government revenues, or real government expenditures, $\beta' Z_{t-1}$ contains r cointegrating terms, reflecting the long-term equilibrium relationship among variables, and Ac is a dummy variable taking into account the previous Asian financial crises. From the system, the Granger causality tests were examined by testing whether all the coefficients of $\Delta Y_{2,t-i}$ or $\Delta Y_{3,t-i}$ are statistically different from zero as a group based on a standard F-test and/or whether the β s coefficient of the error-correction is significant. Since the Granger causality tests are very sensitive to the selection of the lag length, in this paper, the lag lengths were determined using Hsiao's (1979) sequential procedure which is based on the Granger definition of causality and Akaike's (1974) minimum final prediction error (FPE) criterion.

4. Empirical Results

For the purpose of comparison, Panels A and B in Table 1 report the results of the non-stationary tests for real GDP (lrgdp), real government revenues (lrgr), and real government expenditures (lrge) using both ADF and KPSS tests.

Table 1. ADF and KPSS Unit Root Tests

	Panel A: ADF		Panel B: KPSS (η_μ)	
	Level	Difference	Level	Difference
lrgdp	-2.167 (1)	-3.553* (1)	1.722* [1]	0.035 [1]
lrgr	-2.144 (1)	-3.436* (1)	1.707* [1]	0.059 [1]
lrge	-1.354 (1)	-3.714* (1)	1.713* [1]	0.054 [1]

Note: Numbers in parentheses indicate the selected lag order of the ADF model. Lags were chosen based on Perron's (1989) method. Numbers in brackets were chosen following Andrews (1991). * and ** indicate significance at the 5% level. Critical values for KPSS are taken from Kwiatkowski et al. (1992).

It is obvious that each data series is non-stationary in terms of levels but stationary with respect to first differences, suggesting that all of the data series are integrated of order one.

Table 2 presents the minimum t-statistics which correspond to Model C. The test results summarized in Table 2 provide further evidence of the existence of a unit root when breaks are allowed. The plausible breaks in the series occur for 1989, 1992, and 1989, respectively, for real GDP, real government revenues, and real government expenditures. On the basis of these results, we proceeded to test whether these three variables are cointegrated, and we used the Johansen method.

Table 2. Zivot-Andrews Unit Root Tests for One Break

	Model	Break	$t(\hat{\lambda}_{inf})$
lrgdp	C	1989	-3.293
lrgr	C	1992	-2.335
lrge	C	1989	-3.642

Note: Model selection (i.e., the appropriateness of Model A, B, or C) is based on the initial estimation of the most general specification possible, which is Model C, and subsequent elimination of the shifting mean or segmented trend dummies included in the associated ADF auxiliary regression subject to their statistical significance. Critical values are taken from Zivot and Andrew (1992).

It is well known that Johansen's cointegration tests are very sensitive with regard to the choice of lag length. The Schwartz Information Criterion (SIC) was used to select the number of lags required in the cointegration test, and a VAR model was first fit to the data to find an appropriate lag structure. The Schwartz Information Criterion (SIC) suggests 4 lags for our VAR model. Table 3 presents the results from the Johansen and Juselius (1990) cointegration tests.

Table 3. Cointegration Tests Based on the Johansen and Juselius (1990) Approach (VAR lag = 4)

	Trace test	Trace test (*T-np*)	10% critical value
$H_0: \gamma = 0$	36.29**	27.22**	26.79
$H_0: \gamma \leq 1$	11.22	08.42	13.33
$H_0: \gamma \leq 2$	02.13	01.59	02.69

Note: Critical values are taken from Osterwald-Lenum (1992). *r* denotes the number of cointegrating vectors. Schwartz Information Criteria (SIC) were used to select the number of lags required in the cointegrating test. ** indicates significance at the 10% level. *T-np* is the Trace test adjusted for the number of degrees of freedom. Estimates of cointegrating relation: (Asymptotic standard errors in brackets)

lrgdp – 0.796 lrgr – 0.176 lrge ~ I (0)
(0.171) (0.155)

According to Cheung and Lai (1993), the trace test shows more robustness to both skewness and excess kurtosis in the residuals than does the L-max test; therefore, we only used trace statistics in this study. As shown in this table, trace statistics and adjusted trace statistics both indicate that there is one cointegrating vector among these three variables. This result suggests that these three variables could not have moved too far away from each other, thereby displaying a co-movement phenomenon for real GDP, real government revenues, and real government expenditures in Taiwan over this sample period. Figure 2 shows the plot of cointegrating vector 1, further confirming this finding. The major policy implications of our results are that if the gap between government revenues and government expenditures is large in terms of their long-term relationship, then the gap can be reduced by either (1) an increase in government revenues or a decrease in government expenditures, (2) a rise in government revenues which exceeds that in government expenditures, or (3) a decrease in government expenditures which is less than that in government revenues.

Figure 2. Plot of Cointegrating Vectors 1

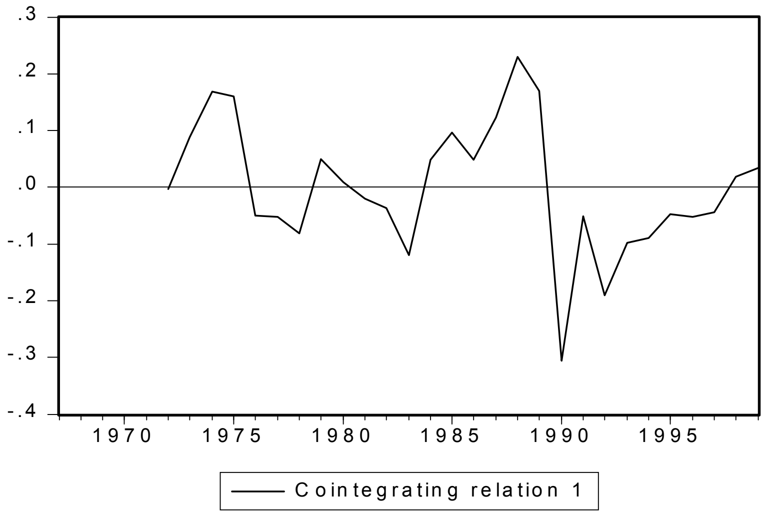


Table 4 shows the results from the Granger causality tests based on the vector error-correction models (ECM), and it is clearly indicative of unidirectional causality running from government revenues to government expenditures. This result supports the tax-and-spend hypothesis for Taiwan over this sample period. Further, we find the ECT (error-correction term) is only significant for the equation concerning government expenditure. The interpretation of this is that, over time, whenever there is a deviation from the equilibrium cointegrating relationship, as measured by the ECT, it is government expenditure that must bear the brunt of adjustment rather than government revenues or GDP to restore the long-term relationship within the system. In other words, the results here indicate that reductions in spending are essential to decrease budget deficits, while any increase in government revenues would only lead to more government spending. As previously stated, since the government budget deficit in Taiwan has been rising significantly and the economic slump has persisted since 1989, and as a solution, the new government has decided to spend NT$810 billion to increase domestic demand in an attempt to boost the economy, fundamental questions have arisen as to how this budget deficit policy can be sustained and financed. Some have proposed that the government draw on tax revenues (which will increase as the economy picks up). However, our findings indicate raising taxes to deal with the increasing deficits in Taiwan would not be completely effective since higher tax revenues would only lead to higher government spending.

Table 4. Granger Causality Results Based on Multivariate Error-Correction Models (ECM)

Explanatory variables	dlrgdp	dlrgr	dlrge
Short-run: F-statistic			
dlrgdp(-4)	-	1.57(-4)	3.04**(-2)
dlrgr(-3)	0.07(-3)	-	4.25*(-3)
dlrge(-1)	0.00(-1)	1.27(-2)	-
Ac: t-statistic	-0.36	0.72	-0.13
ECT: t-statistic	0.13	1.31	-1.99**
Joint (Short-run/ECT): F-statistic			
dlrgdp/ECT	-	2.44*(-4)	2.31**(-2)
dlrgr/ECT	0.05(-3)	-	3,43*(-3)
dlrge/ECT	0.01(-1)	1.19(-2)	-

Note: * and ** indicate significance at the 5% and 10% levels, respectively. Numbers in parentheses indicate lags selected on the basis of Akaike's (1974) minimum FPE.

4. Conclusion

In this paper we tested the hypothesis of tax-and-spend, spend-and-tax, or fiscal synchronization for Taiwan over the 1967 to 1999 period. Our application of the Johansen and Juselius (1990) cointegration test indicates that one cointegrating vector among real GDP, real government revenues, and real government expenditures was at play in Taiwan over this sample period. The results from the Granger causality test based on the corresponding vector error-correction (ECM) models suggest unidirectional causality running from government revenues to government expenditures, which lends support to the tax-and-spend hypothesis for Taiwan. The major conclusion that we draw from this study is that to attack the problem of persistent budget deficits, the government of Taiwan should focus more on spending cuts rather than look for ways to raise revenues from taxes or from any other means.

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