TAX SMOOTHING: TESTS ON INDONESIAN DATA

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─Abstract ─

This paper contributes to the literature of public debt management by testing for tax smoothing behaviour in Indonesia. Tax smoothing means that the government smooths the tax rate across all future time periods to minimize the distortionary costs of taxation over time for a given path of government spending. In a stochastic economy with an incomplete bond market, tax smoothing implies that the tax rate approximates a random walk and changes in the tax rate are nearly unpredictable. For that purpose, two tests were performed. First, random walk behaviour of the tax rate was examined by undertaking unit root tests. The null hypothesis of unit root cannot be rejected, indicating that the tax rate is nonstationary and, hence, it follows a random walk. Second, the predictability of the tax rate was examined by regressing changes in the tax rate on its own lagged values and also on lagged values of changes in the goverment expenditure ratio, and growth of real output. They are found to be not significant in predicting changes in the tax rate. Taken together, the present evidence seems to be consistent with the tax smoothing, therefore provides support to this theory.

Key Words: Tax smoothing, tax rate, public debt management, Indonesia

JEL Classification: H21 - Efficiency; Optimal Taxation

1. INTRODUCTION

This paper tests for tax smoothing behaviour in Indonesia. In their seminal contributions, Kydland and Prescott (1977) and Barro (1979, 1980, and 1981) argue that tax smoothing is both a positive and normative theory of public debt management. Tax smoothing means that the government smooths tax rate across

all future time periods to minimize the excess burden of taxation for a given path of government spending. Temporary changes in government spending and output will result in budget imbalances (surplus or deficit), but there will be no change in the tax rate. To smooth the tax rate, public debt levels are permitted to vary over time.

In a stochastic economy with an incomplete bond market, this means that the tax rate approximates a random walk and, hence, changes in the tax rate are nearly unpredictable. We examine two implications of tax smoothing hypothesis for the case of Indonesia. First, we examine the random walk implication for the tax rate by testing the unit root in the tax rate. For this purpose, we use two methods of unit root test; the Augmented Dickey-Fuller (ADF) test and the Phillip-Perron (PP) test. We find that the tax rate is nonstationary, consistent with a random walk. This result is line with, among others, Barro (1979) for US and Kingston (1986) for Australia. Second, we test whether changes in tax rate are predictable. For this purpose, changes in the tax rate are regressed on a vector of lagged variables, including changes in government expenditure and growth of real output. The results reveal that the tax rate is unpredictable. This suggests tax smoothing by the government.

2. LITERATURE REVIEW

There have been many attempts to test the implication of the tax smoothing hypothesis by using different approaches, and the results are relatively mixed. Some studies test the hypothesis by checking time series behaviour of the tax rate; whether the tax rate follows a random walk and whether changes in the tax rate can be predicted. For instance, Barro (1981) examines the time series behaviour of average tax rate in the United States over the period of 1884 – 1979. He finds that both U.S. federal and total government average tax rate do follow a random walk. There is little explanatory power for tax-rate changes from changes in government spending and growth of real output. In contrast, Sahasakul (1986) finds evidence against the tax smoothing hypotheses for United States. He tests the hypothesis for the United States between 1937 – 1982 by relating the current marginal tax rate to his measures of permanent and transitory components of the government expenditure rate and some other variables. He finds evidence that tax rate responds significantly not only to the permanent government expenditure rate but also to the transitory component and the general price level, and a time trend.

Kingston and Layton (1986) test the tax smoothing hypothesis for Australia between 1949/50 – 1980/81. They use similar approach as in Barro (1981), but they build a tax smoothing model that combines simplicity, explicit microeconomic underpinnings, and applicability to an open economy. They find that marginal rate of income tax on average male weekly earnings is a random walk, and that its changes cannot be predicted by a vector of forcing variables which includes changes in government spending and growth of real output. These results confirm tax smoothing hypothesis. Moreover, since they also some evidence against random-walk behaviour of average tax rates, public sector outlays and receipts as percentage of GDP, and average male weekly earnings, they that their failure to reject the tax smoothing hypothesis is probably not just a statistical artifact.

More recent studies use a different approach to test the tax smoothing hypothesis. Rather than examining the random walk behaviour and the predictability of tax rate, they test the hypothesis by examining whether the fiscal deficit is informative about future changes in government expenditures. The government sets the budget surplus equal to expected changes in government expenditure. When expenditure is expected to increase, the government runs a budget surplus, and when expenditure is expected to fall, the government runs a budget deficit. For examples, Huang and Lin (1993) and Ghosh (1995) examine the time series properties of North American data using vector autoregression technique, and find that increases in the budget surplus signal future increases in government expenditure, which is evidence in favour of tax smoothing. In contrast, Olekalns (1997) finds for Australian post-World War II data that the budget surplus has been too volatile to be fully consistent with tax smoothing. Olekalns and Crosby (1998) examine long-run data, covering all of the twentieth and some of the nineteenth centuries for Australia, the United Kingdom, and the United States. They found that tax smoothing is accepted only for the United States.

3. THEORETICAL FRAMEWORK

The model used in this paper is based on Kingston and Layton (1983, 1986). In the domestic economy, the representative private domestic agent chooses values of consumption c_t, labour n_t, and asset a_t that maximize welfare subject to resource constraint:

$$Max \sum_{t=0}^{1} \left(c_t - \tfrac{1}{2} n_t^2 \right) \tag{1}$$

subject to

$$h_t + (1-\tau_t)\theta_t n_t + (1+r_t)a_t - (c_t + a_{t+1}) = 0 \tag{2}$$

Assets are claims on the domestic government and/or on foreign entities with real interest rate of r_t. Using λ_t as the multiplier for the constraints (2), the first-order-necessary conditions for interior optimum are:

$$\lambda_t = 1 \tag{3}$$

$$n_t = \theta_t (1-\tau_t) \tag{4}$$

$$r_1 = 0 \tag{5}$$

From equation (1) and (5) it follows that output is positively related to productivity and negatively to taxes

$$y_t = \theta_t^2 (1-\tau_t) \tag{6}$$

Lifetime private consumption is given by inherited assets plus lifetime disposable income:

$$\sum_{t=0}^{1} c_t = a_0 + \sum_{t=0}^{1} \left[\theta^2 (1-\tau_t)^2 + h_t \right] \tag{7}$$

The government seeks benevolent finance of its exogenous purchases of goods and service, g_t, plus exogenous transfer h_t. Although debt finance is available, lump-sum taxation is not, so that tax policy must settle for second best. Beginning-of-period public debt, b_t, is such that initial debt, b_0, is predetermined and terminal debt, b_2, is zero. Holders are domestic and/or foreign residents. Public and private debt instruments are perfect substitutes, so the government borrows at the prevailing real interest rate of zero.

The government's problem is to choose values of τ_t and b_1 that solve

$$Max \left\{ a_0 + \sum_{t=0}^{1} \left[\tfrac{1}{2} \theta_t^2 (1-\tau_t)^2 + h_t \right] \right\} \tag{8}$$

subject to

$$\tau_t \theta_t^2 (1-\tau_t) + b_{t+1} - (b_t + g_t + h_t) = 0 \quad (9)$$

According to equation (10), the government's objective function is the private agent's indirect lifetime utility function.

Let μ_t be the multipliers to the constraints (11). The first-order necessary conditions for an interior optimum are

$$\mu_t = 1 + \frac{\tau_t}{1-2\tau_t} \quad (10)$$

$$\mu_0 = \mu_1 \quad (11)$$

From (10) and (11) we get

$$\tau_0 = \tau_1 \qquad [= \tau^*] \quad (12)$$

According to (12), the tax rate in current period is an unbiased predictor of future tax rates, in other words, the tax rate is expected to remain constant. This implies that the tax rate behaves as a random walk. The random walk condition for the tax rate series can be written in an empirical form as follows:

$$\Delta\tau_t = \varepsilon_t, \quad \varepsilon_t \sim (0, \sigma^2) \quad (13)$$

where $\Delta\tau_t = \tau_t - \tau_{t-1}$ and ε_t is a white noise error term that is independent and identically distributed. The random walk hypothesis implies that none of the autocorrelations in the residual from the first differenced tax rate is significantly different from zero. Noted that under the null hypothesis of random walk, given τ_{t-1}, no other lagged information should be helpful to predict τ_t. Accordingly, evidence of lagged information that can predict $\Delta\tau_t$ would reject tax smoothing (Barro, 1981).

4. DATA AND METHODOLOGY

Data on the tax rate (τ_t), government expenditure rate (Δg_t), and real output growth (Δy_t) are examined for the period of 1969 – 2008. The tax rate and government expenditure rate are respectively calculated as central government tax revenue and expenditure divided by Gross Domestic Product (GDP). The real output growth is the growth of real GDP, that is nominal GDP adjusted by

Consumer Price Index (CPI) with year 2000 as the base year. Data are drawn from the *Economic Key Indicators* published on-line by the Asian Development Bank, IMF's Government Financial Statistics and Ministry of Finance, Indonesia.

We examine the random walk implication of tax smoothing by testing the null hypothesis of a unit root in the tax rate variable. Two unit root tests are used: the Augmented Dickey-Fuller (ADF) test and the Phillips-Peron (PP) tests.

Based on model, changes in the tax rate cannot be predicted either by its own lagged values or by lagged values of other variables; the ratio of government expenditure Δg_t and growth of real output θ_t. To begin with, we test whether the tax rate can be predicted by its own lagged values by estimating the following autoregressive equation:

$$\Delta \tau_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta \tau_{t-i} + u_t \tag{14}$$

The test is carried out by employing *F* test with null hypothesis $\alpha_0 = \alpha_1 = ... = \alpha_k = 0$. The optimal lag length is determined by using the AIC model selection criterion (Stock, 1994).

To further examine the null hypothesis of tax smoothing, changes in the tax rate variable is regressed on lagged values of itself together with lagged values of changes in government expenditure ratio Δg_t and the growth of real output θ_t. Therefore, the following vector autoregression (VAR) model is estimated:

$$Y_t = \delta + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + ...\Phi_p Y_{t-p} + u_t \tag{15}$$

where $Y_t = \left[\Delta \tau_t, \Delta g_t, \theta_t\right]'$ is a vector of endogenous variables. The Φ_i (*i*= 1,2,..., *p*) are *k*-dimensional quadratic coefficients matrices, and u_t represents the *k*-dimensional vector of residual. Analysis is based on the *F*-statistics and Chi-squared of the Wald coefficient tests. As noted by Barro (1981), test for the unpredictability of tax rate changes are most interesting in an environment where some future changes in real government spending, real output, etc., are forecastable. It would be less interesting to find that tax rate shifts were unpredictable if changes in the government spending ratio to output were also unpredictable.

5. ESTIMATION AND RESULT

Table 1 we present the results of the ADF and PP tests for unit root in the tax rate variable. All *t*-statistics obtained from both tests, either only with constant or with constant and trend, are not significant at 5 per cent level (or lower). Therefore, the null hypothesis of a unit root cannot be rejected. Accordingly, we conclude that the tax rate satisfies one condition for a random walk.

Table 1: The ADF and PP Test Results for the Tax Rate

	Intercept Only			Intercept and Trend		
Unit Root Test	Lag	*t*-stat.	*p*-value	Lag	*t*-stat.	*p*-value
ADF	0	-0.5556	*0.8687*	4	-2.7823	*0.2130*
PP	0	-0.4868	*0.8829*	0	-2.0877	*0.5358*

Table 2 reports autoregression results which provide evidence on whether changes in tax rate are predictable by its own previous values. A comparison furnished on the basis of Akaike Information Criteria (AIC) statistics for different orders of autoregressive equations suggests that the first order autoregressive model is the best predictive model. However, rather than just reporting results from model with one lag, Table 2 also reports results from model with up to four lags so we have richer information on predictability of changes in tax rate. The *F*-statistics obtained from all equations are not significant at 5% or lower. Accordingly, the null of zero coefficients for all lagged variables cannot be rejected, and we conclude that changes in tax rate cannot be predicted significantly by changes in previous periods.

Table 2: Tax Rate Autoregression: 1970 – 2008

	Number of Lags in the Model			
Coefficient	Lag 4	Lag 3	Lag 2	Lag 1
α_0	0.1661	0.1480	0.1729	0.1775
	(1.1501)	(1.0173)	(1.2591)	(1.3630)
α_1	-0.0705	-0.0831	-0.0805	-0.0702
	(-0.4010)	(-0.4602)	(-0.4616)	(-0.4116)
α_2	-0.0079	-0.0589	-0.0634	
	(-0.0451)	(-0.3282)	(-0.3636)	
α_3	0.1302	0.1047		
	(0.7476)	(0.5831)		

α_4	0.0891			
	(0.5108)			
AIC	2.4845	2.5252	2.4494	2.3833
F-stat.	0.2329	0.2308	0.1615	0.1694
Prob. (F-stat.)	(0.9176)	(0.8742)	(0.8515)	(0.6831)

Note: Figures in parentheses are *t*-statistics

Table 3 reports the results from vector autoregression (VAR), providing evidence on whether changes in tax rate are predictable not only by its own past values but also by past changes in government expenditure ratio and growth of real GDP. Moreover, Table 3 also provides evidence on the predictability of changes in government expenditure and output growth. The VAR model is estimated for one up to four lags, and the AIC statistic indicates that the model with two lags is the best model specification. However, Table 3 also presents the results from all lag structures. The results for the tax rate changes $\Delta\tau_t$ suggest low predictive power as indicated by insignificant *F*-statistics obtained from all model at 5% level. Accordingly, the null of zero coefficients for all lagged variables cannot be rejected. Meanwhile, the results from the Wald coefficient restriction tests for individual variables are quite mixed. While the lagged values of changes in the tax rate and government expenditure ratio are not significant, the lagged values of real output growth are significant at 5 per cent level. This indicates that changes in tax base, as proxied by output growth, might be important for changes in tax rate. However, based on the overall *F*-statistics, and in accordance with the results from random walk tests, we conclude that changes in the tax rate are unpredictable by the lagged values for the variables considered in the model.

Table 3: Vector Autoregression

Dependent		Complete VAR		Wald Coefficient Restriction Test					
				$\Delta\tau_t$		Δg_t		Δy_t	
Variable	Lag	*F*-Stat.	Prob.	Chi-Sqr	Prob.	Chi-Sqr.	Prob.	Chi-Sqr.	Prob.
$\Delta\tau_t$	Lag 1	2.032	0.129	0.030	0.863	0.008	0.930	5.874	0.015
	Lag 2	1.207	0.331	0.156	0.925	0.176	0.916	6.854	0.033
	Lag 3	1.201	0.338	1.562	0.668	1.019	0.797	8.470	0.037
	Lag 4	1.178	0.358	5.635	0.228	2.925	0.570	11.099	0.026

Δg_t	Lag 1	2.954	0.047	0.027	0.870	8.475	0.004	0.673	0.412
	Lag 2	5.786	0.001	14.935	0.001	15.442	0.000	0.257	0.879
	Lag 3	4.609	0.001	7.905	0.048	18.310	0.000	2.989	0.393
	Lag 4	4.144	0.002	10.323	0.035	17.756	0.001	7.043	0.134
Δy_t	Lag 1	2.119	0.117	1.612	0.204	0.048	0.827	4.150	0.042
	Lag 2	1.319	0.280	2.417	0.299	1.447	0.485	3.441	0.179
	Lag 3	1.304	0.284	6.198	0.102	3.221	0.359	2.927	0.403
	Lag 4	1.048	0.445	7.481	0.113	4.899	0.298	1.898	0.755
VAR AIC	Lag 1=	12.0325	Lag 2= 11.8705		Lag 3= 11.9954		Lag 4= 12.0447		

Note: In the Wald test, the coefficients of lagged variables are restricted to zero.

The results for changes in government expenditure Δg_t suggest some predictive power as indicated by significant *F*-statistics at 5% level. Therefore, the null of unpredictable changes in government expenditure can be rejected. In particular, the Wald coefficient tests indicate that historical values of changes in tax rate and government expenditure ratio have significant predictable effect on changes in government expenditure. Meanwhile, the Wald coefficient test statistics for output growth are not significant at 5% level, indicating that changes in rate of government expenditure is not necessarily depends on changes in tax base. Possible explanation for this is that the government in the matter of fact needs to continuously increase its expenditure over time in order to stimulate the economy, regardless of the economic condition. In the case of Indonesia, this was made possible by the support of foreign aid and large revenue from oil (during the New Order regime), and, later on, by rapid increase in tax revenue and larger access to debt market, both domestic and international. The government, then, can always finance increasing expenditure without heavily relying on the growth of tax base.

The results for output growth Δy_t indicate low predictive power. In Table 3, the *F*-statistics are not significant at 5% level and the null of unpredictable output growth cannot be rejected. The Wald coefficient tests confirm that none of the lagged endogenous variables is significant individually. The output growth, then, is unpredictable either by its own historical values or by past values of changes in tax rate and government expenditure. Related to these findings, the relationship between government expenditure and economic growth has actually been a

continued debate among scholars. It is possible that different components of expenditure affect real income in different ways, and vary considerably across the nations. A cross country study by Landau (1983) reveals a negative effect of government consumption expenditure on growth of real output. Bose, Haque and Osborn (2007) find that the share of government capital expenditure in GDP is positively and significantly correlated with economic growth, but current expenditure is insignificant. They also find that, at the disaggregated level, government investment in education and total expenditures in education are the only outlays that are significantly associated with growth once. For the case of Indonesia, a number of studies find that government expenditures do not play a significant role in promoting economic growth (Dogan and Tang 2006). A study by Ramayandi (2003) for the period of 1969-1999 even finds that both the share of government unproductive spending and productive spending show negative effect on growth. This result suggests an existence of inefficiencies in the overall management of government budget in Indonesia during the period under consideration.

6. CONCLUSION

This paper examined Indonesian tax rate data to ascertain whether there is an evidence of tax smoothing. For that purpose, two tests were performed. First, random walk behaviour of the tax rate was examined by undertaking unit root tests. The null hypothesis of unit root cannot be rejected, indicating that the tax rate is nonstationary and, hence, it follows a random walk. Second, the predictability of the tax rate is examined by regressing changes in the tax rate on its own lagged values and also lagged changes in the tax rate, changes in the government expenditure ratio to GDP, and growth of real output. They are found to be not significant in predicting changes in the tax rate. Taken together the present evidence seems to be consistent with the tax smoothing hypothesis since the tax rate series displays random walk behaviour and is unpredictable. Therefore, the present empirical study provides support to this theory.

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