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Leading Indicators of Tax Revenue: Does Government Spending Matter?

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Abstract. Indonesia's tax ratio has shown a declining trend over the past fifteen years. Tax revenue is an essential component in the provision of public goods and services. Therefore, it is vital to empirically examine the leading indicators that determine tax revenues. One of the concepts underlying the determination of tax revenue is the spend-tax hypothesis. This hypothesis states that the fiscal authority will determine the level of government spending and tax revenues will be targeted accordingly. The objective of this study is to empirically examine the leading indicators of aggregate tax revenues and its components and whether government spending is a determinant. In developing the estimated model, this study utilizes existing literature and the results of focused group discussions conducted with the Directorate General of Budget, Indonesian Ministry of Finance. This study utilizes monthly data to be more accurate in identifying trend changes and to get better estimates for strategic long-term forecasting, as required by fiscal authorities. To capture information affecting tax revenue and to overcome spurious regression, this study uses Partial Adjustment and Autoregressive Models. Those models are consistent with the nature of determination of government budget in Indonesia which considers the values of past variables. The estimates show that government expenditure is an essential variable affecting tax revenue and its components, implying that government spending encourages economic activity. Since government spending is the dominant variable in affecting tax revenue and its components, expansionary fiscal policy can be implemented to increase total tax revenue and its components.

Keywords: expansionary fiscal policy, government expenditures, leading indicators, spend-tax hypothesis, tax revenues

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Introduction

The most important component of state revenue is tax revenue. Taxes are the largest contributor to state revenue in developing countries. In developing countries, the components of tax revenue generally come from value added tax, personal income tax, corporate income tax, other taxes on goods and services, social security contribution and other taxes (OECD, 2022). The magnitude of tax revenue contribution to state revenues in Indonesia as shown in the Central Government Financial Report (Laporan Keuangan Pemerintah Pusat—LKPP) reached almost 80 percent of total state revenues and grants (Badan Pemeriksa Keuangan, 2022) in 2019. Tax revenue is a vital element of state revenues, especially for developing countries, to finance investment and public expenditure in education, health, infrastructure, and the provision of other services to the society. However, the ratio of tax revenue to gross domestic product (GDP) or often referred to as the tax ratio in developing countries is still relatively small compared to the tax ratio in developed countries. Tax revenue in low- and middle-income countries only accounted to 10.9 percent of GDP in 2021. This figure is lower than the tax ratio in developed countries, which averages 16.2 percent. Indonesia as a developing country urgently needs tax revenue to support the government's capacity to provide public facilities; however, the tax ratio has shown a declining trend over the past decade (Figure 1). The graph shows that Indonesia's average tax ratio over the period 2008-2021 was only 10.57 percent. Therefore, it is important for policy makers to understand the determinants of tax revenue to increase government revenue. One of the key variables determining tax revenue is government spending.

According to the spend-and-tax hypothesis, the government first decides on the level of spending and then adjusts tax policy to match this spending level. Therefore, government spending will determine tax revenue (Aisha & Khatoon, 2009). Wagner's Law states that as gross domestic product increases, there is a long-term tendency for government spending to increase. In addition, Peacock and Wiseman in 1979 hypothesized that a temporary increase in government spending in times of crisis (e.g. war or pandemic) could lead to a permanent increase in government revenue (Payne, 1998).

Numerous previous studies have examined the factors determining total tax revenue, such as Ewing et al. (2006); Aisha & Khatoon (2009); Ishak & Farzanegan (2020); Kirikkaleli & Ozbeser (2023); however, studies that analyze tax revenue more specifically using monthly data are still limited. The contribution of this study is to analyze the role of government spending on Indonesia's total tax revenue and its components, which consist of revenues from Oil and Gas Income Tax which then is decomposed into Oil Income Tax and Gas Income Tax. This study also estimates the role of government spending on the government revenues of Value Added Tax (VAT), Property Tax (Pajak Bumi dan Bangunan—PBB), International Trade Tax, Import Duty, Export Duty, and Tobacco Excise Tax.

In addition, this study empirically examines the leading indicators of the determinants of aggregate tax revenue and its components. This study utilizes monthly data to identify trend changes more accurately, resulting in better estimation and improved strategic long-term forecasting, which is essential for fiscal authorities. To capture the information that affects tax revenue, as well as to overcome the autocorrelation problem that commonly occurs in time series estimation, this study uses Partial Adjustment Model (PAM) and Autoregressive (AR) Model. All information that influences tax revenue is contained in the lagged dependent variable used in the Partial Adjustment Model. The development of the estimated model was conducted through literature review and focused group discussion (FGD) with the Directorate General of Budget (Direktorat Jenderal Anggaran—DJA) of the Ministry of Finance. The estimation results are expected by the DJA of the Ministry of Finance to be one of the references in determining the leading indicators that affect tax revenue in Indonesia.

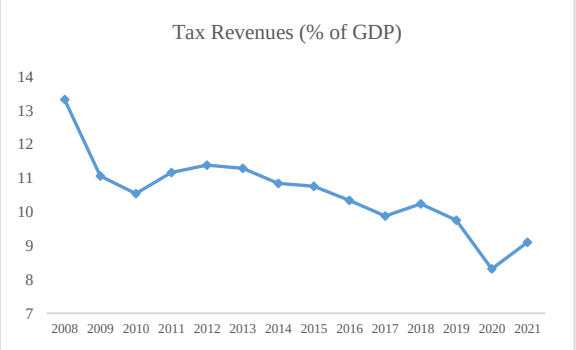

Fig. 1. Trend of Tax Ratio in Indonesia, 2008-2021

Previous Literature

Existing literature has identified important factors that determine tax revenue in an economy. Government expenditure is a variable that has an important effect on tax revenue (Lojanica, 2015). Based on data from the United States, Payne (1998) shows that some states demonstrate the applicability of the spend-and-tax hypothesis, in other words, government revenues will adjust to changes in government spending.

According to the spend-and-tax hypothesis, the government will determine the level of government spending beforehand and then the tax policy will be adjusted to the level of government spending. Therefore, government spending will determine tax revenue (Aisha & Khatoon, 2009; Ewing et al., 2006). Ewing et al. (2006) examined the relationship between government spending and tax revenue in the United States using quarterly data over the period 1958-2003. The estimation results show that government expenditure and tax revenue are cointegrated. The adjustment process of the budget imbalance is asymmetric; the speed of adjustment when the budget deteriorates is faster than when the budget improves.

In the Ricardian equivalence perspective, Barro (1979) asserts that higher government spending, funded through borrowing, will result in greater future tax obligations. Meanwhile, Peacock & Wiseman (1979) also argued that government spending is constrained by the tolerable level of taxation. Such tax levels tend to stabilize in times of peace. As national income grows, tax revenue will grow at a tolerable level, allowing government spending to grow gradually. However, during crises such as wars and other economic disruptions, the level of taxation that people can tolerate increases, as the government requires higher tax revenue to cover unexpected expenditures. The increase in government spending during the crisis replaces the previous level of government spending. After the crisis has passed, this level of government spending does not fall to pre-crisis levels since people recognize and accept the need for increased social spending to address social needs during a crisis. They understand that they must bear the burden of new, higher taxes, leading to greater tax tolerance. Therefore, the level of government spending determines tax revenue.

Kirikkaleli & Ozbeser (2023) utilizes quarterly US data from the second quarter of 1960 to the third quarter of 2019 to test the spend-and-tax hypothesis. The results show that the US government determines government spending and then decides the level of tax revenue to finance the budget deficit.

Previous studies indicate a relationship between tax revenue and output, suggesting that output or income is a key factor in determining the amount of tax revenue (Brückner, 2012; Fricke & Süssmuth, 2014; Ishak & Farzanegan, 2020). In the literature, income is approximated using real gross domestic product (GDP) (Fricke & Süssmuth, 2014), GDP per capita (Castro & Camarillo, 2014; Oz-Yalaman, 2019), and transformation of GDP into logarithms or other non-linear functions (Brückner, 2012; Mawejje & Sebudde, 2019). GDP is utilized to measure the level of economic development, which in turn influences the amount of tax revenue (Mawejje & Sebudde, 2019).

Tax revenue was also found to be procyclical (Fricke & Süssmuth, 2014). They discovered that half of the economies in the sample display a trade-off between economic growth and tax revenue volatility, with tax revenues having high growth potential tending to be volatile in the short and medium term. Additionally, more than half of the countries show an asymmetric response to macroeconomic conditions in the short term: tax revenue reacts strongly when above equilibrium and weakly when below equilibrium. Estimates for personal income tax (PIT), corporate income tax (CIT), value added tax (VAT) revenues show that if revenue is above (below) the long-run equilibrium it will react more strongly (weakly) to the business cycle. Therefore, a myopic strategy of increasing revenue by raising GDP has two consequences: positive (in an upturn) and risky (in a downturn). The long-run elasticity is found to be larger than the short-run elasticity when income is below the equilibrium level and smaller when it is above equilibrium.

Other studies incorporate variables that directly reflect international trade into the regression analysis. These variables include exports, imports, or a combination of both, indicating a country's openness to foreign trade (Keen & Lockwood, 2010; Morrow et al., 2022). Openness and corporate tax revenues are generally expected to have a positive relationship, as it allows foreign corporations to enter the domestic country and expand its tax base (Slemrod, 2004), however, analysis using data from the European Union found otherwise (Cozmei, 2015). The negative relationship between openness and value-added tax revenues was also found by Keen & Lockwood (2010).

Oil prices also may impact on tax revenues, as seen in Pakistan, where oil is imported and the tax rate on

oil-derived products is 40% (Ishak & Farzanegan, 2020). Ishak & Farzanegan (2020) concluded that a drop in oil prices, which reduces oil rents, positively impacts tax revenue in countries with a relatively small shadow economy. However, in countries with a large shadow economy, the decline in oil rents does not increase tax revenue, as the shadow economy allows businesses to conceal activities from tax authorities.

This study aims to analyze the leading indicators that affect tax revenue. In the government budget (Anggaran Pendapatan dan Belanja Negara—APBN) preparation process in Indonesia, variables such as gross domestic product, oil lifting, exports and imports, crude oil prices are factors that policy makers focus on. The magnitude of those variables are predicted as assumptions in arranging the government budget. The study utilizes the results of a focused group discussion (FGD) with the Directorate General of Budget (DJA) of the Ministry of Finance to develop the estimation model. The FGD indicated that the value of variables from the previous period is a key factor considered in budget setting. Institutional variables are often unavailable on a monthly basis. To account for variables influencing tax revenue that are not included as independent variables, this study employs the Partial Adjustment Model and the Autoregressive Model. The Partial Adjustment Model captures all information not included as independent variables in the lagged dependent variable—which is included as one of the regressors.

Research Method

Methodology

Aligned with Indonesia's budgeting process, which considers the previous year's budget, this study employs the Partial Adjustment Model (PAM). This model includes the lagged dependent variable as an explanatory variable. The lagged dependent variable also captures information that affects the dependent variable, other than that represented by the independent variables in the estimated model. In the estimation of this model, the dependent variable adjusts gradually to changes in the independent variables.

The components of tax revenues estimated as dependent variables in this study include total tax revenue, value-added tax (VAT), oil and gas income tax, gas income tax, oil income tax, international trade tax, central government property tax (PBB), import duty, export duty, and tobacco excise tax.

Partial Adjustment Model (PAM)

The dynamic specification of the partial adjustment model is derived from the general principle of the nature of time. The partial adjustment model consists of two parts: a static part that describes the process of determining the desired level and a dynamic part that describes the partial adjustment process:

Static part: $y_t^* = \alpha_0 + \alpha_1 x_t + u_t$
Dynamic part: $y_t - y_{t-1} = \lambda(y_t^* - y_{t-1})$

where y^* is the expected or desired level of y. By substituting y^*, the following equation is derived:

$$y_t = \alpha_0\lambda + (1-\lambda)y_{t-1} + \lambda\alpha_1 x_t + \lambda u_t$$

The autoregressive distributed lag (ARDL) estimation is obtained as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_t + \beta_3 x_{t-1} + v_t$$

The following restrictions are imposed when partial adjustments occur:

$$\beta_3 = 0$$

Parameter estimates in the initial equation containing the expected level y, and adjustment parameter λ can be obtained as follows:

$$\beta_1 = (1-\lambda) \Rightarrow \lambda = (1-\beta_1)$$

$$\beta_2 = \alpha_1\lambda$$

$$\beta_0 = \alpha_0\lambda$$

The parameter λ measures the adjustment speed and is between 0 and 1. The closer the value is to 1, the faster the adjustment speed.

In line with Indonesia's budgeting process, this study utilizes the time series properties of budget data. The budgeting process considers not only basic macroeconomic assumptions such as Gross Domestic Product (GDP), economic growth, oil and gas liftings, and oil prices, the trade price index, fiscal capacity, but also taking into account the size of the prior year's budget.

Time Series Properties

Estimates in this study relies on data that shows trends over time, i.e. time series data. In analyzing this type of data, it is usually assumed that the data are stationary for the analysis to be reliable. Granger & Newbold (1974) warns that using data with trends non-stationary data) in regression analysis can produce unreliable results when performing standard tests for significance. Conventional linear regression,

which ignoring serial correlation, produces a significant relationship even when the data is uncorrelated. Spurious regression can arise due to the inclusion of non-stationary data in the regression. When analyzing data with long-term trends, either upward or downward movements, a misleading relationship can appear between variables. It happens because the trends themselves, not a true connection between the variables, lead to a high R-squared value (a measure of fit). Therefore, it is essential to test the stationarity of the data to ensure that the data does not exhibit long-term trends.

A stochastic process is said to be covariance stationary if its mean is independent of time and the covariance between two observations is a finite function of the distance between the two observations but not a function of the observations themselves. The unit root tests are applied to test the stationarity of the data, for example, for the data Y (Evans & Savin, 1981; Greene, 2000; Gujarati, 2004):

$$Y_t = \rho Y_{t-1} + u_t \quad (1)$$

where u is white noise error term, stochastic and uncorrelated residuals with zero mean and constant variance σ^2. The null hypothesis for the presence of a unit root is $\rho = 1$. If the null hypothesis is failed to reject, then Y is a random walk time series. Subtracting Y_{t-1} from Equation (1) results in:

$$\Delta Y_t = (\rho - 1)Y_{t-1} + u_t = \delta Y_{t-1} + u_t \quad (2)$$

where

$$\delta = (\rho - 1)$$

$$\Delta Y_t = Y_t - Y_{t-1}$$

The null hypothesis is $\delta = 0$. The null hypothesis cannot be rejected if the absolute value of the t-statistic, called the Dickey-Fuller (DF) statistic, exceeds the DF or MacKinnon critical value. If the null hypothesis cannot be rejected, then Equation (2) becomes:

$$\Delta Y_t = Y_t - Y_{t-1} = u_t \quad (3)$$

The first differential of non-stationary time series data is therefore stationary, since the random error term (u_t) is integrated of order one, denoted as I(1). If the data requires d differencing steps to become stationary, then it is said to be integrated of order d, or I(d). Another form of the DF test is specified as follows:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \quad (4)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t \quad (5)$$

where t is time trend. The null hypothesis of a unit root is $\delta = 0$. In the case of autocorrelated residuals, the above equation can be generalized to the Augmented Dickey-Fuller (ADF) test:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (6)$$

The null hypothesis of a unit root remains unchanged i.e. $\delta = 0$ or $\rho = 1$.

If first order integrated time series Y and X form a stationary linear combination, they are said to be cointegrated. Suppose Y is regressed against X:

$$Y_t = \beta_1 + \beta_2 X_t + u_t \quad (7)$$

Two variables, denoted as Y and X, are said to be cointegrated if a linear combination of them, u_t, exhibits stationarity, I(0), without the need for differencing. This statistical property implies a long-run equilibrium relationship between Y and X. Even in general cases where both Y and X are integrated of order d, I(d), and exhibit trends, cointegration can still occur. Importantly, regressions involving cointegrated variables produce reliable estimates that capture this long-term equilibrium relationship, thereby avoiding spurious results (Engle & Granger, 1987; Gujarati, 2004).

Disequilibrium may occur in the short term. The residual, u_t, in the above equation can be viewed as equilibrium error and can be utilized to relate the short-run behavior of Y to its long-run equilibrium. The adjustment mechanism from the short-run disequilibrium to the long-run solution occurs because each variable is assumed to recognize the deviation between its current position and the desired long-run position.

Autoregressive (AR) Model

The AR(1) model is an autoregressive process. In a first-order AR process, the outcome variable is only related to a time period that is one period away or the value of the variable at t-1. The AR(p) model is defined by the following:

$$y_t = \delta + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \cdots + \varphi_p y_{t-p} + A_t$$

where y_{t-1}, y_{t-2}…y_{t-p} are the value of the series of previous periods (lags) and A_t is white noise.

The autoregressive model is based on the assumption that the value of the previous period affects the value of the current period. This study utilizes an autoregressive model to identify the factors influencing the primary budgetary components. This approach aligns with Indonesian budgetary practices,

which incorporate the preceding year's budget allocation.

Data on Tax Revenues in Indonesia

This study examines various tax categories that contribute to total tax revenue in Indonesia. These categories include Value Added Tax (VAT), Central Government Property Tax (PBB), Oil Income Tax, Gas Income Tax, Non-Oil and Gas Income Tax, Import Duty, Export Duty, and Tobacco Excise Tax. This study analyzes data spanning over a decade, from January 2011 to December 2021. The data consists of 133 monthly observations. Meanwhile, the independent or explanatory variables that may influence the tax revenues are government expenditure, gross domestic product (GDP), openness (open), oil lifting (oillift), gas lifting (gaslift), oil price measured by Indonesia Crude Price (ICP), trade price index (tradeindex), import, export, and crude palm oil (CPO) reference price. Since GDP data was only available quarterly, interpolation technique is used to estimate monthly values. All the data were obtained from the Directorate General of Budget (DJA), Ministry of Finance of Indonesia.

Results and Discussions

In general, government spending appears to be the main determinant of tax revenues collection. Government spending grows at 2.53 percent per month during period of observation. Our regression results show that government spending positively and significantly affect total tax revenues and its components such as oil and gas income tax, value added tax, land and building tax, international trade tax, export duty, import duty, and tobacco excise tax. The positive and significant nature of government spending in affecting tax revenues indicate that government spending promotes economic activities, which in turn, expands tax base and hence, increase tax revenues.

During period of observation, total tax revenues grow at on average 2.6 percent per month. Among the components of tax revenues, land and building tax grow at the fastest rate, i.e. 4.39 percent per month. Meanwhile, value added tax grow at 2,8 percent per month; tobacco tax grow at 2.93 percent per month; international trade tax grow at 2.2 percent per month; import and export duties grow at 2.04 percent and 2.4 percent per month, respectively. Oil and gas income tax grow at the slowest rate, i.e. 1.93 percent per month. Among the components of tax revenues, value added tax comprises the largest portion, i.e. 33.44 percent of total tax revenues. In addition, all tax revenue components experience positive growth; and so does government spending. This upward trend in both tax revenues and government spending is consistent with regression results which show significant and positive relationships between them.

Unit Root Tests

Unit root test results of the variables used in the estimation show that most of the variables are either integrated of the first order, I(1), or reach stationarity after being differenced once. Only the variables current income index (incindex), log gas lifting (lgaslift), and log import duty revenue (lbeain), are stationary at level (undifferenced) or integrated at zero order, I(0).

In a regression involving variables with the same integration, Ordinary Least Squares (OLS) is a reliable method. OLS regression of variables that are integrated of order zero and order one can produce stationary residuals. The regression is a cointegrating regression, which produces long-run equilibrium. In keeping with the nature of budgeting in Indonesia, which considers the value of variables in the previous period, this study estimates a Partial Adjustment Model (PAM) and an Autoregressive model (AR).

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This section presents the estimation results and discussion. The dependent variables are total tax revenues (log tax revenue or ltr), oil and gas income tax revenues (log oil and gas income tax or lpphmigas), oil income tax revenues (log oil income tax or lpphoil), gas income tax revenues (log gas income tax or lpphgas), Value Added Tax revenues (log VAT or lvat), central government land and building tax revenues (log property tax revenue or lpbb), international trade tax revenues (log international trade tax or linttradetax), import duty revenues (log duty in or lbeain), export duty revenues (log duty out or lbeaout), and tobacco excise tax revenues (log tobacco excise tax or ltobtax). The letter l in front of the variable name indicates natural logarithm transformation. This natural logarithm

transformation is applied to derive elasticity for sensitivity analysis, and to smooth-out the data, which helps reducing the risk of violating the classical assumptions of heteroscedasticity and multicollinearity. In displaying the estimation results, ***, **, and * indicate significance at 1 percent, 5 percent, and 10 percent, respectively. In the estimation process, if the results show autocorrelation or the Durbin-Watson (DW) statistic falls in the inconclusive range, this study adjusts the standard errors to ensure robust and efficient results.

Tax revenue in Indonesia shows a seasonality pattern. To take into account the seasonality factor, the estimation includes seasonality dummy variables, such as semester dummy variables (equal to 1 if Semester I, 0 otherwise), quarter dummy variables (equal to 1 for Q1, 0 otherwise; equal to 1 for Q2, 0 otherwise; equal to 1 for Q3, 0 otherwise). In other words, the baseline dummy variables are Semester II and Quarter 4.

Total Tax Revenues

The following is the estimated model for total tax revenue:

$$ltr_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lgdp_t + \alpha_3 lopen_t + \alpha_4 loillift_t + \alpha_5 ltr_{t-1} + \alpha_6 semester + \alpha_7 Q_1 + \alpha_8 Q_2 + \alpha_9 Q_3 + \alpha_{10} AR(1) + u_t$$

Table 1
Estimation Results for Total Tax Revenues

Independent Variable	Model 1	Model 2	Model 3	Model 4
	Dependent Variables			
	ltr	ltr	ltr	ltr
lspending	1,1029***	1,0168***	0,7029***	0,2963***
	(0.2286)	(0,1682)	(0,1320)	(0,0964)
lgdp	0,7067*	1,1402**	0,9547***	0,9874***
	(0.4123)	(0,4545)	(0,3484)	(0,1614)
lopen	0,7606*	0,5253	-	-
	(0,4341)	(0,4209)		
loillift	3,8696***	3,8899***	3,3412***	2,2130***
	(0,7226)	(0,5626)	(0,4919)	(0,3451)
ltr(-1)	0,2464***	-	-	-
	(0,0742)			
Semester I	-	-	-0,9323***	-
			(0,1225)	
Q1	-	-	-	-1,7395***
				(0,1036)
Q2	-	-	-	-0,7900***
				(0,1144)
Q3	-	-	-	-0,2932**
				(0,1214)
AR(1)	-	0,5016***	0,5233***	0,2005***
		(0,1002)	(0,0679)	(0,1038)
C	-34,5909***	-36,7684***	-26,4918***	-17,2105***
	(9,8880)	(8,7993)	(7,0065)	(4,0611)
F-statistic	33,4117	37,3027	72,9961	192,0407
Adjusted R-squared	0,5549	0,6244	0,7780	0,9210
Observations	131	132	132	132
Model	LS	ARMA	ARMA	ARMA

Standard errors are in parentheses
* p < ,1, ** p < ,05, *** p < ,01

The regression results using the Partial Adjustment Model and the Autoregressive Model indicate that nearly all variables—government spending, GDP, economic openness, and lagged oil lifting and tax revenue—significantly impact tax revenues at the 1 percent level. Additionally, all quarter dummies are significant in Model 4. The four models consistently demonstrate the same directional relationships between the dependent and independent variables.

The estimation results indicate that, all else being equal, a one percent increase in government spending leads to an average increase in tax revenue of 0.3 to

1.11 percent. Similarly, a one percent increase in economic openness (exports plus imports) results in an average increase in tax revenue of 0.76 percent. A one percent rise in GDP leads to an average tax revenue increase of 0.7 to 0.99 percent, while a one percent increase in oil lifting results in an average tax revenue increase of 2.2 to 3.87 percent. The impact of these independent variables diminishes when seasonality dummy variables are included in the estimation. Seasonality dummy variables, including both quarter and semester dummies, have a significant impact on total tax revenue. Tax revenues in Quarters 1, 2, and 3 are significantly lower than in Quarter 4, which aligns with Semester I tax revenues being significantly lower than those in Semester II.

Income Tax Revenues (PPh) on Oil and Gas, Oil Income Tax, and Gas Income Tax

The following are the estimated models for oil and gas income tax, oil income tax, and gas income tax revenues, respectively:

$$lpphmigas_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lgdp_t + \alpha_3 licp_t + \alpha_4 loillift_t + \alpha_5 lgaslift_t + u_t$$

$$lpphoil_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lgdp_t + \alpha_3 licp_t + \alpha_4 loillift_t + \alpha_5 AR(1) + u_t$$

$$lpphgas_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lgdp_t + \alpha_3 licp_t + \alpha_4 lgaslift_t + \alpha_5 AR(1) + u_t$$

Table 2
Estimation Results for Revenues from Oil and Gas Income Tax, Oil Income Tax, and Gas Income Tax

Independent Variable	Model 1	Model 2	Model 3
	Dependent Variables		
	lpphmigas	lpphoil	lpphgas
lspending	2,0050***	1,1730***	1,2861***
	(0,3461)	(0,1499)	(0,1810)
lgdp	0,8122	0,6783	-0,6392
	(1,2691)	(0,5514)	(0,5495)
licp	0,5034	1,0549***	0,4935**
	(0,3079)	(0,2220)	(0,2431)
loillift	10,1049**	2,9047***	-
	(4,2073)	(0,5467)	
lgaslift	-3,8880	-	0,4811***
	(2,9064)		(0,8475)
AR(1)	-	0,5940***	0,5218***
		(0,0796)	(0,0967)
C	-54,4496	-30,8864***	7,2257
	(37,231)	(10,1281)	(11,8902)
F-statistic	9,7728	46,7378	24,9271
Adjusted R-squared	0,2508	0,6802	0,5267
Observations	132	130	130
Model	LS	ARMA	ARMA

Standard errors are in parentheses
* p < ,1, ** p < ,05, *** p < ,01

well as for oil income tax and gas income tax, reveal that GDP is the only variable that does not significantly affect income tax revenue. According to the least squares model, a one percent increase in government spending results in an average 2 percent increase in oil and gas income tax revenue, all else being equal. A one percent rise in the price of

The estimation results for oil and gas income tax, as Indonesian crude oil leads to an average 0.5 percent increase in oil and gas income tax revenue, and a one percent increase in oil lifting results in an average 10.11 percent increase in oil and gas income tax revenue, ceteris paribus. Additionally, oil and gas income tax revenue can be broken down into separate components for oil and gas income tax revenue.

Estimation using the Autoregressive Model indicates that a one percent increase in government spending leads to an average increase of 1.17 percent in Oil Income Tax revenue, all else being equal. A one percent rise in the price of Indonesian crude oil results in an average increase of 1.06 percent in oil and gas income tax revenue. In addition, a one percent increase in oil lifting leads to an average increase of 2.91 percent in Oil Income Tax, ceteris paribus. For Gas Income Tax revenue, a one percent increase in government spending results in an average increase of 1.29 percent, while a one percent rise in the price of Indonesian crude oil leads to an average increase of 0.94 percent, ceteris paribus.

Table 3
Estimation Results for Value Added Tax Revenues

Independent Variable	**Model 1**	**Model 2**	**Model 3**
	Dependent Variables		
	lvat	**lvat**	**lvat**
lspending	1,2615***	1,3752***	0,9359***
	(0,2364)	(0,1622)	(0,1438)
tradeindex	0,0062***	0,0058**	0,0021
	(0,0021)	(0,0026)	(0,0022)
lvat(-1)	0,2390***	-	-
	(0,0913)		
Semester I	-	-	-0,9310***
			(0,1292)
AR(1)	-	0,3877***	0,318009***
		(0,1008)	(0,0809)
C	1,8321***	4,1479***	7,4417***
	(0,6857)	(0,9119)	(0,8947)
F-statistic	38,8585	35,1448	57,0495
Adjusted R-squared	0,46821	0,51234	0,683118
Observations	130	131	131
Model	LS	ARMA	ARMA

Standard errors are in parentheses
* p < ,1, ** p < ,05, *** p < ,01

Value Added Tax (VAT) Revenues

The variables which significantly affect VAT revenue are government spending, the wholesale trade price index, and semester dummy variables. When the Semester I dummy variable (1 for Semester I, 0 otherwise) is included, the significance of the wholesale price index diminishes. This indicates that the wholesale price index's significance is primarily due to seasonality, represented by the semester dummy variable. A one percent increase in government spending results in an average 0.94 percent increase in VAT revenue, all else being equal. VAT revenue in Semester I is significantly lower than in Semester II. Although the wholesale price index is statistically significant in affecting VAT revenue, its impact is so minimal that it can be considered negligible.

Property Tax (PBB) Revenues

The following is the estimated model for Property Tax (PBB) revenue:

$$lpbb_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lgrowth_t + \alpha_3 lpbb_{t-1} + \alpha_4 lgdp_t + \alpha_5 semester + \alpha_6 AR(1) + u_t$$

Table 4

Estimation Results for Total Land and Building Tax Revenues

Independent Variable	Model 1	Model 2	Model 3
	Dependent Variables		
	lpbb	lpbb	lpbb
lspending	1,5210***	1,4264***	1,2698***
	(0,1736)	(0,1966)	(0,2197)
growth	0,0258*	0,0109	-
	(0,0150)	(0,0431)	
lpbb(-1)	0,1961**	-	-
	(0,0851)		
lgdp	-	-	0,6883
			(0,4387)
Semester I	-1,2473***	-1,4866***	-1,4974***
	(0,2132)	(0,1380)	(0,1360)
AR(1)	-	0,4317***	0,4309***
		(0,0665)	(0,0621)
C	-1,9728**	-0,0739	-9,4994
	(0,7763)	(1,0543)	(6,1758)
F-statistic	98,8958	89,1308	91,3361
Adjusted R-squared	0,7508	0,7708	0,7752
Observations	131	132	132
Model	LS	ARMA	ARMA

Standard errors are in parentheses

The variables which significantly affect PBB revenue are government spending, economic growth, and the Semester I dummy variables. The estimation shows that a 1 percent increase in government spending leads to an average increase in PBB revenue of 1.26 to 1.52 percent, all else being equal. Although the coefficient for economic growth is significant, it is highly inelastic and negligible; a one percent increase in economic growth results in only a 0.03 percent average increase in PBB revenue, ceteris paribus. Additionally, PBB revenue in the first semester is significantly lower on average than in the second semester.

International Trade Tax Revenues, Import Duty, Export Duty, and Tobacco Excise Tax

The following is the estimated International Trade Tax revenues model:

$$linttradetax_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 lcpo_t + \alpha_3 tradeindex_t + \alpha_4 semester + + \alpha_8 AR(1) + u_t$$

Table 5
Estimation Results for International Trade Tax, Import Duty, Export Duty, and Tobacco Excise Revenues

	Model 1	Model 2	Model 3	Model 4
Independent Variable	Dependent Variables			
	linttradetax	lbeain	lbeaout	ltobtax
lspending	0,9409***	0,4974***	0,3780***	0,9744**
	(0,2134)	(0,0761)	(0,1427)	(0,4250)
limport	-	0,2208	-	-
		(0,2103)		
lexport	-	-0,1766	-	-
		(0,2401)		
tradeindex	0,0063**	0,0015*	0,0074***	-
	(0,0028)	(0,0009)	(0,0022)	
lbeain(-1)	-	0,1274	-	-
		(0,0305)		
incindex	-	-	-	-0,0001
				(0,0129)
lcpo	0,8658***	-	-	-
	(0,3136)			
Semester I	-0,9778***	-	-	-1,6367***
	(0,1617)			(0,3716)
Q1	-	-1,5169***	-1,8501***	-
		(0,0813)	(0,1288)	
Q2	-	-0,7113***	-1,1284***	-
		(0,0380)	(0,1339)	
Q3	-	-0,3035***	-0,5345***	-
		(0,0352)	(0,1114)	
AR(1)	0,2818**	-	0,9020***	0,4657***
	(0,1154)		(0,0413)	(0,0698)
C	-1,2401	6,0796***	6,1194***	6,5073**
	(2,4581)	(0,5616)	(0,8418)	(2,7864)
F-statistic	32,1684	1,3287	129,4557	26,7500
Adjusted R-squared	0,7276	0,8910	0,8737	0,4957
Observations	71	130	131	132
Model	ARMA	LS	ARMA	ARMA

Standard errors are parentheses
* p < ,1, ** p < ,05, *** p <

The variables which are significant in influencing international trade tax revenue are government spending, crude palm oil (CPO) reference price, wholesale price index, and seasonality dummy variable (semester). The estimation of international trade tax revenue implies that if government spending increases by 1 percent, international trade tax on average increases by 0.94 percent on average, ceteris paribus. If the CPO reference price rises by 1 percent, international trade tax rises by 0.87 percent on average, ceteris paribus. Although the wholesale price index is significant in affecting international trade tax revenue, the magnitude of the effect is negligible, as it is close to zero. International trade tax revenue in Semester I was significantly lower than in Semester II.

The following are the estimated models for import duty revenues, export duty revenues, and tobacco excise revenues, respectively:

$$lbeain_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 limport_t + \alpha_3 lexport_t + \alpha_4 ltradeindex_t + \alpha_5 lbeain_{t-1} + \alpha_6 Q_1 + \alpha_7 Q_2 + \alpha_8 Q_3 + \alpha_9 AR(1) + u_t$$

$$lbeaout_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 ltradeindex_t + \alpha_3 Q_1 + \alpha_4 Q_2 + \alpha_5 Q_3 + \alpha_6 AR(1) + u_t$$

$$ltobtax_t = \alpha_0 + \alpha_1 lspending_t + \alpha_2 incindex_t + \alpha_3 semester1 + \alpha_4 AR(1) + u_t$$

The variables that affect import duty receipts are government spending, the wholesale price index, quarterly dummy variables, and the previous month's import duty receipts. The estimation of import duty revenue implies that if government spending increases by 1 percent, then import duty revenue increases by 0.5 percent on average, ceteris paribus. Although the wholesale price index is statistically significant in influencing import duty revenue, its magnitude is negligible as it is close to zero. Import duty receipts in Quarter 1, Quarter 2, and Quarter 3 are significantly lower than import duty receipts in Quarter 4. Meanwhile, the variables that are statistically significant in influencing export duty revenue are government spending, the wholesale price index, and the seasonality dummy variable. The estimation of export duty revenue shows that if government spending increases by 1 percent, export duty revenue increases by 0.38 percent, on average, ceteris paribus. If the wholesale price index increases by 1 percent, export duty revenue increases by 0.01 percent, ceteris paribus. Variables that are significant in influencing tobacco excise revenue are government spending and Semester I dummy. The estimation of Tobacco Excise Revenue implies that if government spending increases by 1 percent, tobacco excise revenue increases by 0.97 percent on average, ceteris paribus. Semester I tobacco excise revenue is significantly lower than Semester II tobacco excise tax revenues.

Conclusions

Robust regression estimation is utilized to identify variables that significantly influence tax revenue. Government spending emerges as the primary significant variable, with a considerable impact on tax revenue. These significant results hold true for aggregate tax revenue as well as for major components, including oil and gas income tax revenue, VAT, property tax, international trade tax, import duty, export duty, and tobacco excise tax. Other variables consistently showing significant effects on tax revenue are GDP, economic growth, economic openness, oil lifting, the price of Indonesian crude oil, the wholesale price index, and the CPO reference price.

Government spending is a crucial factor in influencing tax revenue. In Indonesia, it stimulates economic activity, and during the pandemic, it has been proven to protect both the community and the business sector. During normal times, estimation results suggest that government spending can help the business sector thrive. An increase in government spending boosts tax revenue through a ripple effect mechanism, as heightened economic activity expands the tax base. Thus, to increase tax revenue, the government should consider increasing its spending. Empirical evidence shows that government spending positively affects state revenue. This study does not examine the effect of government spending by sectors to tax revenues. Further detailed study is needed to understand government spending's effectiveness by sector. In addition, the limitation of this research is it does not take into account the institutional factors such as political stability, accountability and corruption perception index which may explain the aggregate tax collection. This study does not take into account those factors since this study utilizes monthly data and there is no monthly data availability on factors such as corruption and accountability. Further study may consider those factors.

Various estimates consistently show that government spending is the dominant variable affecting aggregate tax revenue and its components, such as oil and gas income tax revenue, VAT, central government property tax, import duties, export duties, international trade taxes, and tobacco excise tax. Therefore, expansionary fiscal policy can be employed to enhance total tax revenues and its components.

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