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**Article**

## The determinants of tax revenue: A study of Southeast Asia

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# The determinants of tax revenue: A study of Southeast Asia

Nguyen Minh Ha<sup>1\*</sup>, Pham Tan Minh<sup>2</sup> and Quan Minh Quoc Binh<sup>1</sup>

**Abstract:** This study identifies the determinants of tax revenue in Southeast Asia based on a balanced dataset of eight countries. By employing static (pooled Ordinary Least Squares (OLS), fixed effects (FE) model, random effects (RE) model and Driscoll-Kraay standard error) as well as dynamic panel data (system-generalized method of moments) regression techniques, we show that the openness of the economy, foreign direct investment (FDI), the ratio of foreign debt to the gross domestic product (GDP), the share of value added in industry to GDP have positive impacts on tax revenue, and official development assistance has a negative impact. We suggest that Southeast Asian countries design better policies in international trade as well as attract FDI, speed up the process of economic restructuring, and enhance the capacity to mobilize, manage, and use foreign debt and assistance in order to collect more taxes.

**Subjects:** Economics and Development; Economics; Public Finance

**Keywords:** Driscoll-Kraay; determinants of tax revenue; Southeast Asia; system-GMM  
**JEL Classifications:** H2; O1; O2

## ABOUT THE AUTHORS

Nguyen Minh Ha is a Professor of Economics at Ho Chi Minh City Open University, Vietnam. He holds a Doctor of Philosophy in Economic at the Aberdeen University, United Kingdom. His research interest includes economics, development economics, entrepreneurship, corporate finance, investment project analysis, applied economics. He published over 100 articles in domestic and international journals.

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## PUBLIC INTEREST STATEMENT

This study identifies the determinants of tax revenue in Southeast Asia based on a balanced dataset of eight countries. We show that the openness of the economy, foreign direct investment (FDI), the ratio of foreign debt to the gross domestic product (GDP), the share of value added in industry to GDP have positive impacts on tax revenue, and official development assistance has a negative impact. Our paper differs from past research in two respects. First, it is the first to focus on a sample of Southeast Asia countries employing panel data. Second, our paper uses an advanced econometrics approach with a sample of eight ASEAN countries. We suggest that Southeast Asian countries design better policies in international trade as well as attract FDI, speed up the process of economic restructuring, and enhance the capacity to mobilize, manage, and use foreign debt and assistance in order to collect more taxes.

## 1. Introduction

The history of human development has shown that taxes are essential, as they are related to the birth, existence, and development of the state. Taxes are not just an important source of revenue for the state budget but also related to economic growth, equitable distribution, and social stability. Because of the importance of taxation, determining factors with a potential impact on tax revenue are necessary and thus of interest to economists, such as Chelliah et al. (1975), Stotsky and WoldeMariam (1997), Bird et al. (2008), Profeta and Scabrosetti (2010), and Castro and Camarillo (2014). Using various methods, researchers have conducted studies on different countries and regions and identified factors that affect tax revenue. Their results depend on the characteristics of a country or region, the study period, and analytical method. However, these studies did not reach a consensus.

Stotsky and WoldeMariam (1997) conducted research on the tax collection efforts in 43 sub-Saharan African countries from 1990 to 1995. They conclude that the share of exports and the gross domestic product (GDP) per capita have positive impacts on tax revenue; and the share of agriculture and mining have a negative impact. Meanwhile, the share of manufacturing and import density do not affect tax revenue. Tanzi (1992) uses data on developing countries to study the factors that go into tax revenue, finding that per capita income does not affect tax revenue, but the share of imports and foreign debt have a positive impact on tax revenue. In other empirical work, Teera and Hudson (2004) analyze tax performance across the sample low-, middle-, and high-income countries. They find that their results have low significance when they run the regression with the full sample. However, the results are better when subsamples with countries have the same geographic location and development are employed (as cited in Castro & Camarillo, 2014).

Castro and Camarillo (2014) investigated the factors that influence tax revenue in 34 member countries in the Organization for Economic Cooperation and Development (OECD) from 2001 to 2011. They indicate that GDP per capita and manufacturing have a positive influence on tax revenue, but the rate of foreign direct investment (FDI), agriculture, civil liberties indexes, and life expectancy have a negative impact on tax revenue. Furthermore, Imam and Jacobs (2014) investigated the factors that influence tax revenue in 12 Middle Eastern countries from 1990 to 2003. According to the study, inflation has a positive influence on tax income, whereas GDP per capita has a negative effect.

Castañeda Rodríguez (2018) examines an unbalanced panel dataset with a large sample of developed and developing countries over a 40-year period (1976–2015), in order to discover which long-term variables (economic, social, political, and cultural aspects) affect taxes and explain disparities in tax performance. The results show that taxation follows a path dependent process based on the importance of the lags, taking into consideration the total tax burden and revenue from consumption and income taxes, as well as a progressiveness index. The findings imply that taxes are heavily influenced by both historical and structural variables, such as the economic climate and the dynamics in other public income sources (e.g., inflation).

In this paper, we study the determinants of tax revenue in a sample of eight Southeast Asian countries (Indonesia, Cambodia, Laos, Myanmar, Malaysia, the Philippines, Thailand, and Vietnam) from 2000 to 2016, employing static and dynamic panel data techniques. This study aims to help countries design better policies for mobilizing local resources and targeting them for economic development. Using a research sample of countries that are homogeneous in terms of geographic location and development level, we expect our results to be more reliable and significant. In addition, to date almost no research has been conducted on tax revenue in Southeast Asia. This study aims to contribute a small part to the theory on this subject.

Our paper differs from past research in two respects. First, it is the first to focus on a sample of Southeast Asia countries employing panel data. In the past several decades, the Southeast Asian region has experienced a significant surge in economic growth, which it hopes will continue for many years to come, and tax administration is a complex and important issue for countries in Southeast Asia. However, the Association for Southeast Asian Nations (ASEAN) region has received little attention from scholars. The empirical results from our study provide new insights into the determinants of tax revenue. Second, our paper uses an advanced econometrics approach with a sample of eight ASEAN countries. Various tests, including tests of stationarity and cointegration, are used to address cross-sectional dependence and homogeneity among countries. In addition, we use panel Driscoll-Kraay standard error together with the system-generalized method of moments (GMM) to overcome the potential issue of endogeneity.

The structure of the paper is as follows. In section 2 we present a brief review of the literature. We then present our methodology in section 3, followed by a discussion of the results in section 4. Section 5 concludes.

## 2. Literature review

### 2.1. Theoretical foundations of tax revenue analysis

Three main theories are used to study tax revenue: the cost of service theory, the benefit theory, and the social-political theories on taxation (see, Ojong et al., 2016). The theory of service costs states that the costs paid by the government for delivering certain services to people must be shared by the people who are the final recipients of the service (Jhingan, 2004). According to this view, tax rates are comparable to prices. So, if someone does not use state services, he should not be taxed. This theory is subject to several critiques. The cost of service theory, according to Jhingan (2004), imposes some constraints on government services. The goal of government is to offer assistance to the needy. According to this notion, the state does not engage in welfare activities, such as medical treatment, education, and social services (Ojong et al., 2016). In addition, calculating the cost per head of the many services offered by the state is extremely difficult; once again, the theory has broken the right definition and fundamentals of taxes; and lastly, the theory's base of taxation is deceptive.

Because of the constraints inherent in the cost of service theory, it has been modernized. This change gave rise to the benefit theory of taxation (Ojong et al., 2016). According to this view, people should be required to pay taxes in proportion to the benefits they receive from government services. This notion posits that taxpayers and the government have an exchange relationship. The government provides certain benefits to taxpayers by providing social goods for which taxpayers pay in the form of taxes (Ojong et al., 2016). Because it is impossible to quantify the benefits obtained by someone from government services, the theory is no longer valid (Ahuja, 2012).

According to the sociopolitical philosophy of taxation, the primary considerations in taxing should be social and political purposes (Ojong et al., 2016). This argument holds that a tax system should not be designed to benefit individuals but, rather, to address the ills of society as a whole.

### 2.2. Objectives of taxation

The primary goal of taxation is to generate income to cover government expenditures as well as to redistribute wealth and control economic activities (Jhingan, 2004). According to Anyanwu (1993), taxes have three primary goals: raising money for the government, regulating the economy and economic activity, and controlling income and employment. According to Nzotta (2007), taxes play a role in allocation, distribution, and stabilization. The allocation function of taxes consists of determining the pattern of production, the items that should be produced, who produces them, the connection between the private and public sectors, and the social balance between the two sectors

(Ojong et al., 2016). The distribution function of taxes refers to how the effective demand for economic products is distributed across people in society. The stabilization function of taxes tries to achieve a high level of employment, a tolerable degree of price stability, and an adequate pace of economic growth, while accounting for trade and balance-of-payments consequences (Ojong et al., 2016). According to Nwezeaku (2005), the extent of these tasks is determined by the people's political and economic orientation, their wants and ambitions, and their willingness to pay taxes. Therefore, the amount to which a government can carry out its responsibilities is mainly determined by its capacity to establish and administer a tax system, as well as the desire and patriotism of the governed.

### **2.3. Overview of previous empirical studies**

In most countries, especially middle-income countries, taxes account for a high proportion of a government's budgetary revenue. Considerations of the impact of tax revenue is a topic that interests many scholars. Researchers have conducted studies on different countries or regions using various methods.

In a study of tax collection trends in 30 developing countries from 1953–1955 to 1966–1968, Chelliah (1971) analyzed statistics for tax system in more than 30 countries in the 1966–1968 periods. The results show that (1) the proportion of mining in gdp and the proportion of exports without mining had a positive impact on tax revenue; (2) the proportion of agriculture had a negative impact; (3) higher per capita income resulted in a higher level of development and a higher ability to pay taxes. However, this study does not find a statistically significant effect of per capita income on tax revenue.

In a study of tax indexes and tax development efforts in 47 developing countries in 1969–1971, Chelliah et al. (1975) used regression analysis to quantify the impact of various factors on tax revenue. The results indicate that (1) the proportion of mining in GDP had a positive impact on tax revenue; (2) the proportion of agriculture had a negative impact; (3) the share of trade, per capita income (without exports), and exports (without mining) do not affect tax revenue.

Baunsgaard and Keen (2010) studied the impact of globalization on tax revenue. Employing panel data for 117 countries over a period of 32 years, the results show that trade has a positive impact on tax revenue because of taxes on imports. Moreover, as trade expands, the credibility and competitiveness of the economy increases, which makes tax collection easier.

Profeta and Scabrosetti (2010) analyzed the determinants of tax revenue in the period 1990–2004 in 39 countries: 11 Asian countries, 19 Latin American countries, and 9 members of the European Union. Their research shows that GDP per capita and the debt-to-GDP ratio were not significant in determining tax revenues in Asian economies but had a positive impact in Latin American countries. The share of agriculture in GDP negatively affected tax revenue in Latin America but was not significant in Asia; the openness of the economy had a positive impact on tax revenue in Asia and Europe but a negative impact in Latin America. The higher the indexes of democratic rights, civil liberties, and political rights were, the greater the increase in efficiency in the tax system. The education level in Latin American countries, the proportion of the over-65 population, the percentage of female labor, and the size of the underground economy had a positive and significant impact on tax revenue whereas population density did not have any impact. In Asia, the variables for the high school graduation rate and the proportion of the urban population had no impact, but the proportion of the over-65 population had a significantly negative impact on tax revenue.

Dioda (2012) used a panel data regression method to determine the determinants of tax revenue in 32 countries in Latin America and the Caribbean in the period 1990–2009. The research results indicate that civil liberties, the number of female workers, political stability, the education

level, population density, and the scale of the underground economy have significant impacts on tax revenue.

Castro and Camarillo (2014) investigated the factors that influence tax revenue in 34 OECD member countries from 2001 to 2011. They indicate that GDP per capita and the size of the manufacturing sector have a positive influence on tax revenue, but the rate of FDI, agriculture, civil liberties indices, and life expectancy have a negative impact on tax revenue. Imam and Jacobs (2014) investigated the factors that affect tax revenue in 12 Middle Eastern countries from 1990 to 2003. According to their study, inflation has a positive influence on tax income, whereas GDP per capita has a negative influence.

Ayenew (2016) investigated the factors influencing Ethiopian tax revenue from 1975 to 2013. According to the study's findings, manufacturing, GDP growth, and foreign aid have a positive influence on tax income, however, the inflation rate has a negative impact on tax revenue.

Castañeda Rodríguez (2018) examined an unbalanced panel dataset with a large sample of developed and developing countries over a 40-year period (1976–2015) to determine which long-term variables (economic, social, political, and cultural aspects) affect taxes and explain disparities in tax performance. The results show that taxation demonstrates path dependence based on the importance of lags, taking into consideration the total tax burden and revenue from consumption and income taxes, as well as a progressiveness index. The findings imply that tax is heavily influenced by both historical and structural variables, such as the economic climate and the dynamics of other public income sources (e.g., inflation).

This literature review demonstrates the absence of consensus in existing studies. Their results depend on the characteristics of a country or region, the study period, and the analytical method. In addition, almost no research on tax revenue has been conducted on Southeast Asia until now. This study employs both static and dynamic panel data techniques, which are the most advanced econometric techniques, and the study sample is homogeneous. Therefore, the results are more reliable and consistent.

### 3. Methodology

#### 3.1. Model specification

Castro and Camarillo (2014) fully explored the impacts of economic, structural, institutional, and social factors on tax revenue in 34 OECD countries in 2001–2011. Following the model in Castro and Camarillo (2014) and other studies, we propose the following static and dynamic regression models.

##### 3.1.1. Static regression model

$$\begin{aligned} TAXREV_{it} = & \alpha + \beta_1 * GDPPC_{it} + \beta_2 * TRADE_{it} + \beta_3 * FDI_{it} + \beta_4 * ARG_{it} + \beta_5 * IDN_{it} + \beta_6 * POLRIG_{it} \\ & + \beta_7 * CIVLIB_{it} + \beta_8 * SCHTER_{it} + \beta_9 * LIFEEXP_{it} + \beta_{10} * INF MOR_{it} + \beta_{11} * EXDEBT_{it} \\ & + \beta_{12} * ODA_{it} + \beta_{13} * INF_{it} + T_t + c_i + \varepsilon_{it} \end{aligned} \quad (1)$$

##### 3.1.2. Dynamic regression model

$$\begin{aligned} TAXREV_{it} = & \alpha + \beta_0 * TAXREV_{it-1} + \beta_1 * GDPPC_{it} + \beta_2 * TRADE_{it} + \beta_3 * FDI_{it} + \beta_4 * ARG_{it} + \beta_5 * IDN_{it} \\ & + \beta_6 * POLRIG_{it} + \beta_7 * CIVLIB_{it} + \beta_8 * SCHTER_{it} + \beta_9 * LIFEEXP_{it} + \beta_{10} * INF MOR_{it} \\ & + \beta_{11} * EXDEBT_{it} + \beta_{12} * ODA_{it} + \beta_{13} * INF_{it} + T_t + c_i + \varepsilon_{it} \end{aligned} \quad (2)$$

where  $\alpha, \beta_k$  ( $k = 0, \dots, 13$ ) is the vector of coefficients to estimate.

$i$  is the country ( $i = 1, \dots, 8$  is for the eight ASEAN countries).



$t$  is the year ( $t = 1, \dots, 17$  is for the 17 years from 2000 to 2016).

$\mu_i$  is unobservable individual effects, specific to each country.

$T_t$  is the time dummy.

TAXREV (tax revenue) is the most important concept in this research and is the dependent variable in the model. TAXREV (%) is measured by the ratio of total tax revenue to GDP. Data for this variable was obtained from the World Bank WDI.

TAXREV <sub>$t-1$</sub>  is a lagged dependent variable. It represents the potential impact of past tax revenue on current tax revenue. This variable may have a positive effect on the dependent variable because high tax revenue in the past will stimulate public spending and lead to higher economic growth and thus increase current tax revenue. However, according to neoclassical growth theory, high tax rates can prevent economic activities, and thus it has negative effects on tax revenue (Castro & Camarillo, 2014).

GDPPC, measured by the growth rate of GDP per capita, represents a country's level of economic development. We expect this variable to have positive impacts on tax revenue. This is because when a country has higher economic growth, the government will have a greater ability to collect taxes. GDPPC is widely used in many papers (see, Chelliah, 1971; Eltony, 2002; Gupta, 2007; Piancastelli, Stotsky & WoldeMariam, 1997; Tanzi, 1992). The data can be collected from the WDI.

TRADE is trade volume measured as the sum of exports and imports as a percentage of GDP. Taxes on international trade activities are among the most important sources of tax revenue in many countries. When a country opens up to international trade, it will be exposed to many external influences, so its government might increase protection of domestic production through measures such as raising taxes or applying quotas (Rodrik, 1998). Therefore, we expect trade openness to have a positive impact on tax revenue. This data is collected from the World Bank.

FDI is foreign direct investment, one of the important sources of capital in many developing countries. FDI contributes to job creation, technology transfer, economic growth, and sustainable development. FDI inflows have the potential to affect tax revenue, but their impact is not clear, as they depend on the policy of the host country. If the recipient country has preferential policies to attract FDI, including tax incentives, FDI inflows are expected to have a negative impact on tax revenue (Cassou, 1997; Castro & Camarillo, 2014; Martín-Mayoral & Uribe, 2010). However, FDI can promote national competitiveness and increase the country's tax revenue (Gugler & Brunner, 2007). The FDI variable is calculated by the contribution of net FDI inflows to GDP (% of GDP). FDI data can be obtained from the WDI.

ARG is the proportion of value added in agriculture (%). The data come from the World Bank. Most agricultural activities are small in scale, and the products are sold in informal markets, so it is difficult to collect taxes (Stotsky & WoldeMariam, 1997). In addition, countries often have create incentives in agriculture, such as not taxing agricultural products or reducing taxes to a minimum level (Castro & Camarillo, 2014; Gupta, 2007). Therefore, the proportion of the agricultural sector is expected to have a negative effect on tax revenue.

IND is the proportion of value added in manufacturing (%). This data comes from the World Bank. In contrast to agriculture, manufacturing is highly specialized and dynamic, with large businesses that can generate huge profits. Thus, the government can collect more direct taxes through corporate income tax and indirect taxes through sales tax and special consumption taxes



on domestic products. In addition, it is easier to collect taxes in manufacturing than in agriculture (Eltony, 2002; Gupta, 2007).

We also include institutional factors in the regression. POLRIG (political rights) and CIVLIB (civil liberties) measure the level of democracy and the freedom of expression, freedom of assembly, and religious freedom. Both indicators are calculated on a scale of 1 to 7, in which 7 represents the lowest level of freedom and 1 the highest. We obtain them from Freedom House (2017). Empirical studies show a positive correlation between democracy and tax revenue; when democratic freedoms and political rights are fully and strongly expressed, tax revenues are higher (Dioda, 2012). In countries with high levels of democracy and freedom, taxpayers have greater awareness of government and tax regulations, and they become more willing to address tax issues. In other words, people will voluntarily pay their taxes and appear to engage in less tax evasion. In addition, political stability and social security create a better environment for the functioning of the economy. Thus, tax revenue is higher (Castro & Camarillo, 2014).

SCHER represents the education level. A highly educated population has high-quality human resources, thus increasing production efficiency, which enables the government to increase tax revenue. Being well educated makes people more aware of the benefits from paying taxes, as well as their responsibilities and obligations to the state. Therefore, education can have a positive impact on tax revenue. The education level in a country can be measured with various proxy variables. Castro and Camarillo (2014) use the proportion of the labor force that has a secondary education, and Hoài and Hùng (2016) use the university enrollment rate. However, their data do not fully cover ASEAN countries, and secondary or university education levels differ significantly between countries. Therefore, this study uses the ratio of public expenditure on education as a percentage of GDP to represent a country's level of education. The data are obtained from the WDI. We can expect the education level and tax revenue to have a positive correlation.

LIFEEXP is average life expectancy of the population. When life expectancy is high, the government faces pressure to increase pension payments and welfare policies for the elderly. This can only be funded by raising taxes, so life expectancy will have a positive effect on tax revenue (Castro & Camarillo, 2014; Svejnar, 2002). However, life expectancy can also adversely affect tax revenue because when the population is older, the retirement rate is higher, and the number of people who pay taxes will decline (Svejnar, 2002). Data on life expectancy come from the WDI.

INFMOR is the infant mortality rate, which is measured by the number of deaths per 1,000 live births of children under the age of one. Developed countries tend to have a lower infant mortality rate, so we expect to see a negative correlation between this variable and tax revenue (Castro & Camarillo, 2014; Svejnar, 2002). Data on infant mortality come from the WDI.

EXDEBT represents foreign debt, which is calculated as cumulative external public debt as a percentage of GDP. A country's debt level can actually affect tax revenue. When foreign debt is large and a country's economic growth is insufficient to repay debt, the government needs to raise taxes to make these debt payments (Eltony, 2002; Tanzi, 1977). However, high external public debt can also cause macroeconomic imbalance and increase the trade deficit because of import restrictions. This reduces tax revenue from imported goods. Public debt can have a negative impact on tax revenue (Tanzi, 1992). The data come from the WDI.

ODA (official development assistance) represents foreign aid. An increase in foreign aid inflows leads governments to reduce their efforts to mobilize domestic resources, such as taxes, to serve their spending needs. Therefore, foreign aid is considered to have a negative effect on tax revenue. Among the forms of aid, the highest proportion is made up of ODA. Therefore, many studies use this indicator

to represent the influence of foreign aid (Ayenew, 2016; Gupta, 2007). This variable is calculated as the percentage of net ODA inflows in comparison to GDP (%). The data come from the WDI.

INF is inflation, considered a proxy for macroeconomic stability. When inflation increases, it reduces purchasing power and the ability of taxpayers to pay taxes. Taxpayers respond to “tax increases” due to inflation through informal economic activities, underground economies, and tax evasion (Amin et al., 2014). The inflation variable is calculated according to the consumer price index (CPI) with data obtained from the WDI.

### 3.2. Method of Estimation and Data Sources

We employ static (pooled OLS, FE model, RE model and Driscoll-Kraay) as well as dynamic panel data regression techniques (system-GMM) to explore the possible determinants of tax revenue. The sample consists of eight countries in Southeast Asia (Indonesia, Cambodia, Laos, Myanmar, Malaysia, the Philippines, Thailand, and Vietnam). Tax revenue data on Brunei Darussalam is not available, so we exclude this country from the sample. There is also a shortage of data on Singapore, which is a developed country and has higher income per capita than the other countries in Southeast Asia. To ensure that our sample is homogeneous in terms of geographic location and level of development, we also exclude Singapore from the sample. The research data mainly come from the World Bank’s WDI in 2017 and *Freedom in the World 2017* (Freedom House, 2017). Information about variables in the model can be found in Table 1.

## 4. Results and analysis

### 4.1. Descriptive statistics

Table 2 shows the descriptive statistic. The research sample varies widely in tax revenue. TAXREV has a mean of 12.5% and a standard deviation of 4.63%. The minimum is 2% for Myanmar in 2002, and the maximum is 22.4% for Vietnam in 2008. The other variables also differ significantly between countries. TRADE has a standard deviation of 53.2%, a minimum of 0.17% (Myanmar in 2010), and a maximum of 220.41% (Malaysia in 2000). EXDEBT has a standard deviation of 24.52%, a minimum of 9.06% for Myanmar in 2014, and a maximum of 155.18% for Laos in 2002. AGR has a standard deviation of 12.60%, a minimum of 8.01% (Malaysia in 2001), and a maximum of 57.24% (Myanmar in 2000).

INF in Vietnam in 2000 and GDPPC in Malaysia in 2009 are negative because of the negative impact of the Asian financial crises in 1998 and the global financial crisis in 2008.

### 4.2. Tests of stationarity and cointegration

Stationarity is an important issue in panel data, especially panels with long time series. We need to check for stationarity first to avoid spurious results. The study performs panel unit-root tests using the techniques by Levin-Lin-Chu (Levin et al., 2002) and Im-Pesaran-Shin (Im et al., 2003) designated as hypothesis  $H_0$ : the time-series data are not stationary. The results show that TAXREV, GDPPC, FDI, SCHTER, INFMOR, ODA, and INF are stationary at level ( $I(0)$  variables).

The other variables—TRADE, AGR, IND, POLRIG, CIVLIB, LIFEEXP, and EXDEBT—are stationary in only some tests. Therefore, the unit-root test for the first differences of these variables is carried out. The results in Table 3 show that all variables are stationary at  $I(1)$ . Hence, the variables in the study are not stationary at  $I(0)$ . To avoid spurious regressions, it is necessary to conduct a cointegration test of the dependent variable TAXREV and the independent variables.

To check for the existence of a cointegration relationship among the variables, we perform the tests proposed by Westerlund (2007) as well as Persyn and Westerlund (2008). Cointegration tests of panel

**Table 1. Definitions of the variables**

Variable	Definition	Source
<i>TAXREV</i>	The ratio of total tax revenue to GDP	WDI
<i>GDPPC</i>	Growth in GDP per capita	WDI
<i>TRADE</i>	Sum of exports and imports as a percentage of GDP	WDI
<i>FDI</i>	Net FDI inflows in GDP (% of GDP)	WDI
<i>ARG</i>	Proportion of value added in agriculture (%)	WDI
<i>IDN</i>	Proportion of value added in manufacturing (%)	WDI
<i>POLRIG</i>	Political rights index	Freedom House
<i>CIVLIB</i>	Civil liberties index	Freedom House
<i>SCHTER</i>	The ratio of public expenditure on education as a percentage of GDP	WDI
<i>LIFEEXP</i>	Average life expectancy of the population	WDI
<i>INFMOR</i>	The number of deaths per 1,000 live births	WDI
<i>EXDEBT</i>	Cumulative external public debt as a percentage of GDP	WDI
<i>ODA</i>	Percentage of net ODA inflows in comparison with GDP (%)	WDI
<i>INF</i>	Inflation (% of CPI)	WDI

**Table 2. Descriptive statistics**

Variable	Mean	SD	Min.	Max.	Obs.
<i>TAXREV</i>	12.50	4.63	2.00	22.40	136
<i>GDPPC</i>	5.02	2.80	-4.27	12.69	136
<i>TRADE</i>	99.81	53.02	0.17	220.41	136
<i>FDI</i>	3.62	2.83	-2.59	13.07	136
<i>AGR</i>	21.59	12.60	8.01	57.24	136
<i>IND</i>	34.04	8.63	9.69	48.53	136
<i>POLRIG</i>	5.03	1.90	2.00	7.00	136
<i>CIVLIB</i>	4.66	1.24	3.00	7.00	136
<i>SCHTER</i>	2.66	1.39	0.30	5.89	136
<i>LIFEEXP</i>	68.76	4.67	58.43	76.25	136
<i>INFMOR</i>	3.26	0.71	1.90	4.41	136
<i>EXDEBT</i>	38.44	24.52	9.06	155.18	136
<i>ODA</i>	2.79	3.96	-0.64	16.92	136
<i>INF</i>	6.17	7.70	-1.71	57.07	136

data detect the existence of a long-run equilibrium relationship, but they do not estimate long-run elasticity. When the conditions of the variables indicate cointegration, the use of the pooled mean

**Table 3. Stationarity test results**

Variable	Levin-Lin-Chu		Im-Pesaran-Shin		Result
	Without time trend	With time trend	Without time trend	With time trend	
TAXREV	0.0440	0.0000	0.1106	0.0267	Stationary
GDPPC	0.0001	0.0000	0.0007	0.0028	Stationary
TRADE	0.1510	0.0040	0.7838	0.1355	Nonstationary
FDI	0.0013	0.0000	0.0276	0.0541	Stationary
AGR	0.1399	0.1267	0.6419	0.8371	Nonstationary
IND	0.2539	0.0352	0.9506	0.5973	Nonstationary
POLRIG	0.7079	0.6332			Nonstationary
CIVLIB	0.5355	0.2375			Nonstationary
SCHTER	0.0000	0.0011	0.0000	0.0082	Stationary
LIFEEXP	0.9999	0.0000	0.9779	0.0000	Nonstationary
INFMOR	0.0000	0.0080	0.0000	0.8951	Stationary
EXDEBT	0.0009	0.0026	0.1649	0.6403	Nonstationary
ODA	0.0213	0.0000	0.2304	0.0000	Stationary
INF	0.0000	0.0000	0.0000	0.0000	Stationary
$\Delta$ TRADE	0.0000	0.0000	0.0000	0.0000	Stationary
$\Delta$ IND	0.0000	0.0000	0.0000	0.0000	Stationary
$\Delta$ AGR	0.0000	0.0000	0.0000	0.0000	Stationary
$\Delta$ POLRIG	0.0000	0.0000			Stationary
$\Delta$ CIVLIB	0.0000	0.0000			Stationary
$\Delta$ LIFEEXP	0.0000	0.0000	0.0000	0.0000	Stationary
$\Delta$ EXDEBT	0.0000	0.0000	0.0000	0.0000	Stationary

Lag length selected using Akaike information criterion.

group (PMG) estimation technique proposed by Pesaran and Smith (1995) and Pesaran et al. (1999) is employed to estimate the long-run equilibrium relationships.

Westerlund (2007) developed four statistical standards for testing cointegration in panel data:  $G_a$  and  $G_t$  test the statistical significance of each cross-sectional unit, and  $P_a$  and  $P_t$  test the statistical significance of the entire panel. The test results presented in Table 4 show a cointegration relationship between the dependent variable TAXREV and the independent variables TRADE, FDI, ARG, IND, CIVLIB, SCHTER, EXDEBT, ODA, and INF. The independent variables GDPPC, POLRIG, LIFEEXP, and INFMOR do not show cointegration with the dependent variable. Therefore, we need to remove these variables from the model to avoid spurious regression.

#### 4.3. Multicollinearity test

The results of multicollinearity analysis presented in Table 5 show that the VIF of AGR is quite large (> 10). We need to exclude this variable from the model to avoid multicollinearity.

#### 4.4. Results of the regression model

Table 7 reports the results of the econometric exercise conducted to estimate the determinants of tax revenue with a static regression model (pooled OLS, FE, and RE models). The estimated coefficients in the pooled OLS and RE models yield the same results. The F test ( $u_i = 0$ ,  $p$ -value)

**Table 4. Panel cointegration test (Dependent variable: TAXREV)**

Variable	Gt(p-value)	Ga(p-value)	Pt(p-value)	Pa(p-value)	Result
GDPPC	0.000	0.693	0.965	0.783	No cointegration
TRADE	0.013	0.000	0.893	0.605	Cointegration
FDI	0.000	0.000	0.008	0.003	Cointegration
AGR	0.000	0.011	0.000	0.001	Cointegration
IND	0.000	0.002	0.000	0.000	Cointegration
POLRIG	0.000	1.000	0.929	0.149	No cointegration
CIVLIB	0.000	0.000	0.526	0.000	Cointegration
SCHTER	0.000	0.004	0.004	0.073	Cointegration
LIFEEXP	0.000	0.995	0.000	0.941	No cointegration
INFMOR	0.000	0.844	0.851	0.512	No cointegration
EXDEBT	0.000	0.007	0.072	0.056	Cointegration
ODA	0.000	0.065	0.002	0.000	Cointegration
INF	0.000	0.008	0.072	0.000	Cointegration

**Table 5. Multicollinearity test**

Variable	VIF	SQRT (VIF)	Tolerance	R-Squared
TRADE	4.23	2.060	0.237	0.763
FDI	1.97	1.400	0.507	0.493
AGR	14.65	3.830	0.068	0.932
IND	4.38	2.090	0.228	0.772
CIVLIB	3.57	1.890	0.280	0.720
SCHTER	5.75	2.400	0.174	0.826
EXDEBT	3.03	1.740	0.330	0.671
ODA	3.85	1.960	0.260	0.740
INF	1.56	1.250	0.640	0.360
Mean VIF	4.78			

The results of VIF analysis after removing AGR variable are presented in [Table 6](#). All variables have VIF less than 10. Therefore, there is no multicollinearity in the model.

rejects the null hypothesis that pooled OLS is more suitable than FE model. Hence, the FE model is more appropriate than the pooled OLS model. In addition, the Hausman test results show that the FE model is more suitable than the RE model (see Appendix 1).

We also employ a modified Wald test to check for heteroskedasticity and the Wooldridge test of autocorrelation (see Appendixes 2 and 3). The results confirm the existence of heteroskedasticity and autocorrelation in the model. To overcome the problems, we use the Driscoll and Kraay (1998) estimation method, which is based on Driscoll-Kraay standard errors to address heteroskedasticity, autocorrelation, and cross-sectional independence in a FEM (see, [Table 8](#)).

**Table 6. Multicollinearity test**

Variable	VIF	SQRT (VIF)	Tolerance	R-Squared
TRADE	4.10	2.030	0.244	0.756
FDI	1.82	1.350	0.549	0.452
IND	3.03	1.740	0.330	0.670
CIVLIB	1.86	1.360	0.537	0.463
SCHTER	5.05	2.250	0.198	0.802
EXDEBT	3.00	1.730	0.333	0.667
ODA	3.60	1.900	0.278	0.722
INF	1.41	1.190	0.707	0.293
Mean VIF	2.98			

**Table 7. Static model regression results**

Variable	Pooled OLS	FEM	REM
TRADE	0.0148* (0.00881)	−0.00649 (0.00771)	0.0148* (0.00881)
FDI	0.230** (0.110)	0.256*** (0.0696)	0.230** (0.110)
IND	0.154*** (0.0466)	0.186*** (0.0491)	0.154*** (0.0466)
CIVLIB	−0.0306 (0.253)	0.286 (0.266)	−0.0306 (0.253)
SCHTER	1.818*** (0.373)	−0.0252 (0.264)	1.818*** (0.373)
EXDEBT	0.00438 (0.0163)	0.0107 (0.0111)	0.00438 (0.0163)
ODA	0.209* (0.110)	−0.176** (0.0818)	0.209* (0.110)
INF	0.0216 (0.0356)	0.0276 (0.0176)	0.0216 (0.0356)
Constant	−0.616 (2.259)	4.524 (2.791)	−0.616 (2.259)
Observation	136	136	136
R-squared	0.685	0.421	
F test (p-value)	0.000	0.000	
F test (ui = 0, p-value)		0.000	
Wald chi2 (p-value)			0.000
Number of countries		8	8

Standard errors in parentheses. \*\*\*, \*\*, and \* statistically significant at 1%, 5%, and 10%.

**Table 8. Regression results with the Driscoll-Kraay method**

Variable	FEM	Driscoll-Kraay
TRADE	−0.00649 (0.00771)	−0.00649 (0.0148)
FDI	0.256*** (0.0696)	0.256*** (0.0800)
IND	0.186*** (0.0491)	0.186* (0.0966)
CIVLIB	0.286 (0.266)	0.286 (0.348)
SCHTER	−0.0252 (0.264)	−0.0252 (0.229)
EXDEBT	0.0107 (0.0111)	0.0107 (0.0125)
ODA	−0.176** (0.0818)	−0.176** (0.0816)
INF	0.0276 (0.0176)	0.0276 (0.0190)
Constant	4.524 (2.791)	4.524 (3.548)
Observations	136	136
R-squared	0.4210	0.4207
F test (p-value)	0.000	0.0000
Number of countries	8	8

Standard errors in parentheses. \*\*\*, \*\*, and \* statistically significant at 1%, 5%, and 10%.

The results of the Driscoll-Kraay regression method are not very different from those with the FE method. The variables are still significant, only with a change in the level.

In terms of a dynamic model, the study employs a generalized method of moments (GMM) model. The two popular estimation methods using GMM are first difference-GMM (diff-GMM), developed by Arellano and Bond (1991), and system-GMM, proposed by Arellano and Bover (1995) and then enhanced by Blundell and Bond (1998). However, the diff-GMM estimator suffers weak instrument bias when series are persistent. The sys-GMM estimator is less biased, combining various levels of information (Blundell & Bond, 1998). In addition, the small sample size does not lead to significant effects on the characteristics of the sys-GMM estimator, even for those that are cross sectional, such as the number of countries. Because of the small sample size (136 observations), we use the system-GMM method to conduct the dynamic model estimation.

The Arellano-Bond test of first-order autocorrelation (AR (1)) and second-order autocorrelation (AR (2)) of GMM model shows that AR(1) has a p-value < 0.01, and AR(2) has a p-value > 0.1 (see, Table 9). Therefore, the model has first-order autocorrelation but no second-order autocorrelation, which is consistent with the requirements of GMM estimation. The regression model gives consistent estimation results. The Sargan test is performed to check for the validity of the instruments. The results in Table 9 show that the Sargan test has a p-value > 0.1, which demonstrate that the models are



**Table 9. Regression results with the system-GMM model**

Variable	Sys-GMM
<i>L.TAXREV</i>	0.865*** (0.06468)
<i>TRADE</i>	0.0113* (0.00634)
<i>FDI</i>	0.0747 (0.06764)
<i>IND</i>	0.0729** (0.03428)
<i>CIVLIB</i>	0.116 (0.1619)
<i>SCHTER</i>	−0.134 (0.25867)
<i>EXDEBT</i>	0.0138* (0.00774)
<i>ODA</i>	−0.0448 (0.053643)
<i>INF</i>	0.00273 (0.014143)
Constant	−2.647 (1.665)
Observations	128
Countries	8
F test (p-value)	0.000
Sargan test (p-value)	0.182
AR (1) (p-value)	0.001
AR (2) (p-value)	0.354
Difference-in-Sargan tests of exogeneity of GMM instrument subsets (p-value)	
Sargan test excluding group	0.384
Difference (null H = exogenous)	0.159

Standard errors in parentheses. \*\*\*, \*\*, and \* statistically significant at 1%, 5%, and 10%.

correctly determined and have valid instruments. Therefore, we can analyze the results of the model (see, [table 10](#)).

#### Variables with Statistical Significance

In the dynamic model, *TRADE* has a positive coefficient, which represents a positive impact of trade openness on tax revenues in Southeast Asian. The coefficient of *TRADE* is 0.0113, with a 10% significance level, indicating that a 1% increase in the ratio of trade to GDP increases the average rate of tax revenue in Southeast Asian countries by 0.0113%. The sign of the *TRADE* coefficient is similar to our initial expectations and consistent with the results by Piancastelli, Gupta (2007), Baunsgaard and Keen (2010), and Profeta and Scabrosetti (2010). An increase in international trade openness expands exposure to external influences; governments might have to increase

**Table 10. Summary of the estimated results**

Variable	Driscoll-Kraay	Sys-GMM
<i>L.TAXREV</i>		0.865*** (0.06468)
<i>TRADE</i>	−0.00649 (0.0148)	0.0113* (0.00634)
<i>FDI</i>	0.256*** (0.0800)	0.0747 (0.06764)
<i>IND</i>	0.186* (0.0966)	0.0729** (0.03428)
<i>CIVLIB</i>	0.286 (0.348)	0.116 (0.1619)
<i>SCHTER</i>	−0.0252 (0.229)	−0.134 (0.25867)
<i>EXDEBT</i>	0.0107 (0.0125)	0.0138* (0.00774)
<i>ODA</i>	−0.176** (0.0816)	−0.0448 (0.053643)
<i>INF</i>	0.0276 (0.0190)	0.00273 (0.014143)
Constant	4.524 (3.548)	−2.647 (1.665)
Observations	136	128
Countries	8	8
F test (p-value)	0.000	0.000
R-squared	0.421	
Sargan test (p-value)		0.182
AR (1) (p-value)		0.001
AR (2) (p-value)		0.354
Difference-in-Sargan tests of exogeneity of GMM instrument subsets (p-value)		
Sargan test excluding group		0.384
Difference (null H = exogenous)		0.159

Standard errors in parentheses. \*\*\*, \*\*, and \* statistically significant at 1%, 5%, and 10%.

measures to protect their citizens and domestic production, such as increasing taxes and imposing quotas. Moreover, when trade expands, economic formalization and competitiveness increase, so tax collection and, thereby, tax revenue also increase.

FDI has a significant and positive relation with tax revenue in Southeast Asian countries. All things being equal, a 1% increase in net FDI inflows raise the tax revenue ratio by 0.256%. The sign of the coefficient is similar to the initial expectations because FDI is an important source of capital that compensates for a shortage in investment capital, contributes to growth, and increases a country's tax revenue. This result contradicts the findings of Castro and Camarillo (2014), who

believe that host countries have preferential policies to attract more FDI, such as tax incentives, and FDI has negative impacts on tax revenue.

Manufacturing and tax revenue have a significantly positive correlation. The results indicate that, everything else being equal, in the dynamic model, a 1% increase in the value added of an industry increases tax revenue in Southeast Asian countries by 0.0729%. In the static model, the regression coefficient of IND is 0.186, with 10% significance, which indicates that a 1% increase in the value added of industry increases tax revenue in Southeast Asian countries by 0.186%. This is broadly consistent with findings obtained by Castro and Camarillo (2014) and Ayenew (2016). An industry in a highly specialized and dynamic economic sector with large enterprises could earn profits; therefore, it has higher taxable income, making it easier to collect taxes than in agriculture—therefore, the higher the value-added of an industry, the higher the tax revenue.

EXDEBT has a positive regression coefficient, which represents the positive impact of foreign public debt on tax revenue in Southeast Asian countries. The regression coefficient of EXDEBT in the dynamic model is 0.0138, with a 10% significance level, which shows that when foreign debt increases by 1%, it makes the tax revenue increase by 0.0138%. The sign of the regression coefficient of EXDEBT is similar to our initial expectations and consistent with the results of Tanzi (1992) and Profeta and Scabrosetti (2010). The increase in external debt leads to an increase in principal and interest. If the rate of economic growth is not high enough to compensate for large debt, governments under pressure of debt repayment need to raise taxes. Therefore, high debt rates require higher tax revenue in Southeast Asian countries.

ODA has a significant and negative correlation between foreign aid and tax revenue, *Ceteris paribus*, a 1% increase in ODA decreases tax revenue in Southeast Asian countries by 0.176% in the Driscoll-Kraay static model. The sign of the ODA coefficient is similar to our initial expectations, which indicates that the increase in foreign aid inflows led governments to reduce their efforts at mobilizing domestic resources (including taxes) to meet their spending needs. This result contrasts with that of Gupta (2007) and Ayenew (2016), which suggest that aid in the form of loans increases the burden of debt repayment in the future. Therefore, it encourages the mobilization of domestic capital through an increase in tax collection efforts.

#### **4.5. Variables with statistical insignificance**

The index of civil liberties, a country's education level, and the inflation rate did not have any impact on tax revenue in Southeast Asian countries.

CIVLIB was statistically insignificant in both the static and dynamic models, showing that it did not affect tax revenue in Southeast Asian countries. However, Bird et al. (2008), Dioda (2012), and Castro and Camarillo (2014) find a positive impact on tax revenue whereas Hoài and Hùng (2016) find a negative impact. These results highly depend on the specific research field, as well as the estimation method.

A well-educated country with good-quality human resources has higher production efficiency and tax revenue. Good education makes people more aware of the benefits from taxes, as well as their responsibilities and obligations to the state. However, SCHTER is not statistically significant, which shows that the education level in Southeast Asian countries does not yet have a significant effect on tax revenue. This result is consistent with that of Castro and Camarillo (2014), who study Europe, and Hoài and Hùng (2016), who study low-income countries.

Inflation demonstrates macroeconomic stability. When inflation increases, it reduces purchasing power and taxpayers' ability to pay taxes. Therefore, they respond to "tax increases" caused by

inflation by engaging in informal economic activities and tax evasion, and inflation is expected to have a negative impact on tax revenue. However, the estimated results of INF are not statistically significant, which indicates that inflation does not affect tax revenue in Southeast Asian countries. This result contrasts with that of Ayenew (2016) and Amin et al. (2014), who find that inflation has a negative impact on tax revenue.

## 5. Conclusion

Taxation is a crucial aspect of a modern economy, as the government of each country tries to maximize tax revenue collection to finance its spending needs. Taxes are also associated with a country's economic growth, equity in distribution, and social stability. Because of the importance of taxation, the goal of this study is to investigate the determinants of tax revenue performance in eight Southeast Asian countries from 2000 to 2016 using static panel (Driscoll-Kraay) and dynamic panel (system-GMM) regressions. The results show that the openness of the economy, foreign direct investment, the ratio of foreign debt to GDP, the share of value added in industry to GDP have positive impacts on tax revenue, whereas ODA has a negative impact.

Our results lead to some practical policy implications for Southeast Asian governments that wish to increase tax revenue effectively. First, the analytical results show a positive impact from trade openness and FDI on tax revenues in Southeast Asian countries, which are representative factors of international economic integration. Countries should concentrate on trade openness policies because favorable trade positively affects trade flows. They not only help countries collect taxes through import and export activities but also contribute to economic growth and infrastructure development, thereby indirectly increasing tax revenue. Second, with respect to FDI, governments should pay more attention to policies for attracting investment, rather than offering tax incentives for foreign businesses and to transfer pricing activities that drive enterprises to evade taxes. Third, Southeast Asian countries should accelerate economic restructuring to achieve industrialization and modernization and to increase the contribution share of industry in GDP. Fourth, the role of foreign debt in economic growth—such as supplementing the shortage of capital in development, contributing to technology transfer, enhancing management capacity through the imports of modern machinery, advanced technology, and accessing the transfer of management skills of foreign experts—is undeniable; therefore, it increases production capacity in the economy. However, the higher the ratio of external public debt to GDP is, the greater the debt repayment pressure faced by governments; therefore, governments need to increase revenue to repay these debts. Therefore, they need to complete policy institutions and debt management tools and to improve their efficiency in mobilizing and using loans. Last but not least, although foreign aid negatively affects tax collection, governments need to reduce the tax collection burden in investment activities. However, it is the cause of weak responsibility in public spending, the possibility of government's reckless public spending; thus, as with foreign debt, governments need to improve their foreign aid management policies, allocate and use investment funds appropriately, and frequently monitor the implementation process in investment projects.

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## Appendix 1

### Hausman test results

Chi2	60.37
Prob>chi2	0.0000

## Appendix 2

### Wald Modified test for heteroskedasticity

Chi2	71.58
Prob>chi2	0.0000

## Appendix 3

### Wooldridge test for autocorrelation

F	95.671
Prob>F	0.0000



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