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Determinants of Public Debt in ASEAN-4 Countries: Evidence from Panel Data Analysis (2002–2021)

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Abstract
Public debt is one of the key methods used by governments to finance their expenditure to ensure the continued development of their country, primarily when it is impossible to increase taxes and/or to lower public spending. Growing public debt has become a worrying factor in many emerging countries. In recent decades, a huge number of countries have been adding to the numerical value of public debt due to the expanding size of public debt as well as thoughtless fiscal and budgetary policies. This is a concerning trend, especially when it can result in unsustainable debt that requires monetary financing. The objective of this research is to investigate the factors influencing the public debt level. The empirical analysis uses panel data from 4 ASEAN countries for the period 2002–2021. Furthermore, this research applies the Feasible Generalised Least Squares (FGLS) method. The empirical findings report that public debt responds positively to an increase in the size of expenditure. While an increase in investment and tax revenue will contribute to a decrease in public debt. The government should look into ensuring the sustainability of public debt level growth by making it a mission to reduce government consumption as well as increase tax revenue, and lastly, manage its government investment, as these contribute to the increase and decrease of public debt. However, the task of balancing these three contributing factors is challenging. In general, governments may enhance and strengthen the quality of governance and public institutions by reducing and restructuring government consumption as well as improving tax collection by having a clear approach and strategy on how to execute it.

Keywords: Public Debt, Corruption, Government Investment, Government Consumption, Tax Revenue

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INTRODUCTION

Public debt is one of the key methods used by governments to finance their expenditure, to ensure the advancement of their country (Adewunmi, 2022), primarily when it is impossible to increase taxes and/or to lower public spending (Gnegne & Jawadi, 2013). Public debt is also known as the total outstanding debt of a country, which consists of bonds and other securities (Adewunmi, 2022). Some key areas where public expenditure is utilised are public investment, such as the development of education and healthcare facilities. In some advanced economies, in order to manage unemployment, the government may introduce social safety nets, which are partly funded by public debt (Pirtea et al., 2013).

Growing public debt has become a worrying factor in many emerging countries. In recent decades, a huge number of countries have been adding to the numerical value of public debt due to the expanding size of public debt as well as thoughtless fiscal and budgetary policies. This is a concerning trend, especially when it can result in unsustainable debt that requires monetary financing. Consequently, inflation, an increase in tax and/or a reduction in public expenditure, including in severe cases a default in public debt (Pirtea et al., 2013). Moreover, this is also a concern to investors as it can unfavourably impact the capital market and may, in the course of time, lessen productive investment and

employment (Coccia, 2013, 2017). In addition, it is a very demanding task for governments to sustain public debt in a condition of huge pre-existing debt, high interest rates, lack of substantial productive investment, as well as modest economic growth (Checherita-Westphal & Rother, 2012).

Post Global Financial Crisis, public debt has accelerated due to decreasing revenue and higher government expenditure to manage recession. This has heightened further public debt level in various economies. (Makin & Layton, 2021). In 2018, global debt stock, which consists of private, public and household debt, recorded 225 per cent of the world's GDP, which is approximately 12 per cent higher than after the Global Financial Crisis (International Monetary Fund, 2022). A bulk of the increase was from developing countries in Asia, where nearly half of the gain is from China. While the majority of the global debt stock is from advanced economies, which were incurred during the Global Financial Crisis. Thus, the post-COVID-19 pandemic public debt level around the world has increased further (Makin & Layton, 2021).

Approximately 60% of the poorest countries are experiencing debt distress or are at risk of falling. Moreover, debt service charges are currently at a 30-year high for medium-income countries. A global economic crisis could occur again based on history, with one small surprise, since now there is Russia's invasion, a rise in oil prices, as well as an increasing interest rate across the world (Estevao, 2022). For a first example, Romania had to devalue its currency because of the Euro Zone crisis, and its public debt has reached an all-time high. This had pushed its Government to implement inflexible measures as well as accept a loan from the International Monetary Fund (Pirtea et al., 2013). In addition to this, Jamaica in 2013 recorded a public debt of 147% of GDP due to obstacles after the Global Financial Crisis, such as policy failure, which led to a larger public debt to a weak economy, to natural catastrophe (IMF Lending Case Study: Jamaica, 2019). This has led Jamaica to request additional financial support from the International Monetary Fund worth 750 million US dollars ("Jamaica Agrees $750m IMF Loan Terms - BBC News," 2013). Jamaica's public debt in 2019 stood at 94% of gross domestic product (GDP) (Jamaica Works to Maintain Its Hard-Won Economic Stability, 2022).

Additionally, another example of a country experiencing a public debt crisis from 2009 until 2016 is Greece (Economides & Philippopoulos, 2022). Greece was already experiencing shortcomings when the Global Financial Crisis occurred in 2007 until 2008. In the past, Greece had economic expansion and a low unemployment rate, which was driven by a huge increase in private demand as well as pro-cyclical fiscal measures. These measures were financed using debt from banks in Greece and Northern Europe. This demand motivated interest led to a build-up of debt, which contributed to a hike in salary, prices and unit labour costs. Subsequently, this reduces Greece's competitiveness. 2009 was an exceptionally bad year for Greece as various adverse events, such as riots, led to lowered confidence in the government, collapse of the GDP and a drastic increase in debt. Thus, Greece had to be bailed out by the European Union and the International Monetary Fund (IMF) in 2010 and continue to receive assistance in 2012 and 2015 (Economides et al., 2021). At the end of 2019, Greece public debt stood at 180% of GDP (Economides & Philippopoulos, 2022).

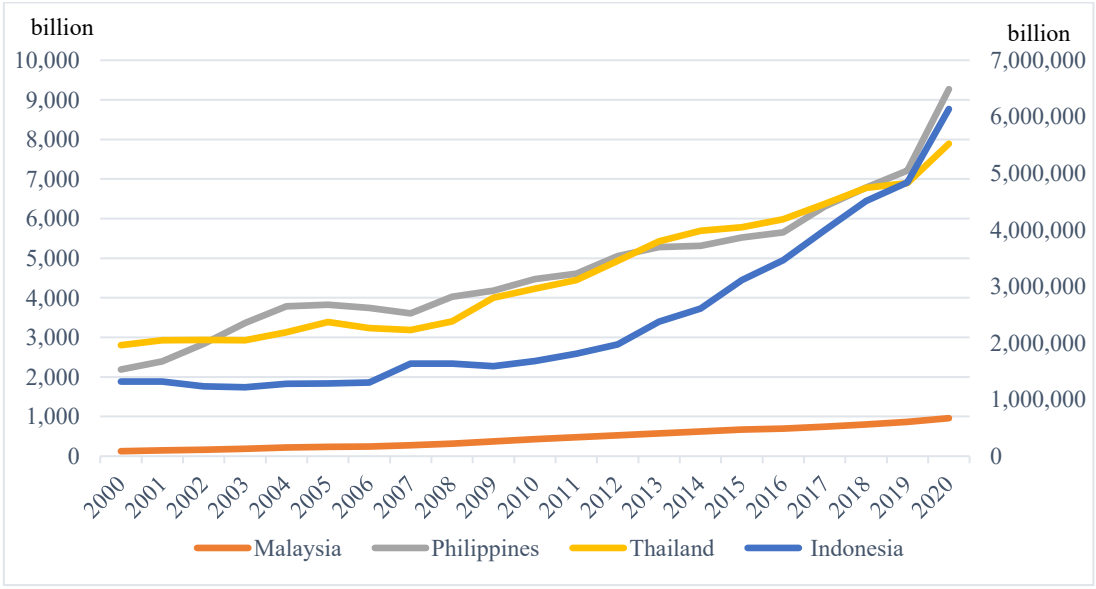
Lastly, Sri Lanka, as the latest country that is currently unable to pay its debt interest of US$78 million, has resulted in Moody's Investors Services and Fitch Ratings declaring Sri Lanka in default. A default generally will reduce investors' confidence and threaten to devalue one's currency. Currently, Sri Lanka owes USD$50 billion to its foreign creditors, has zero foreign currency reserves and can no longer afford to import essential items such as food and fuel. In 2009, after the civil war, Sri Lanka decided to focus on supplying goods to its domestic market without plans of exporting them and to rely heavily on imports for its items. This has cost Sri Lanka minimal income from exports and expanding expenditure on imports, thus reducing its foreign currency reserves (Perera, 2022).

In 2019, President Rajapaksa introduced a huge tax cut, which cost the government a year of lost revenue, approximately US$1.4 billion (Perera, 2022). Moreover, China, as Sri Lanka's biggest bilateral creditor for the past 10 years, have been extending loans amounting to US$6.5 billion for extensive infrastructure developments such as a coal power plant, a highway, an airport and a port (Jayasinghe, 2022). Sri Lanka's public debt in 2021 rose to 119% of GDP compared to 94% of GDP in 2020 (Nozaki et al., 2022). In conclusion, some of the reasons why Sri Lanka is where it is today are due to limited sources of revenue and high public debt. A debt can be a great tool in driving an economy to its maximum potential, but the setback of it when it is not well managed can be detrimental. Therefore, it is very important

for governments to pay close attention in managing debt by understanding the composition and factors contributing to public debts (Appiah-Kubi et al., 2022).

Problem Statement

In the last quarter of 2020, it is reported that the average debt-to-GDP ratio of emerging countries in Asia is 63.5%. While it is lower than the global average of 105.4%, the emerging countries should remain cautious, as historically, public debt expands along with a growing economy. This can be explained with a scenario where a nation progresses with a growing ageing population, social needs will increase, and development using debt financing will also expand, hence public debt will also rise. In most cases, Governments will refinance this debt instead of paying it off, which will add to the medium-to-long-term debt burden of a nation (Jong Woo, 2021). This study focuses on ASEAN-4 countries, which consist of Indonesia, Malaysia, Thailand and the Philippines ("ASEAN-4 - Finance & Development," 2006). Public debt in nominal value has been on the rising trend for these four countries since 2002 as shown in Figure 1. Furthermore, in 2020, there was a sharp increase in public debt due to the COVID-19 pandemic.



Source: World Economic Outlook database

Figure 1: ASEAN-4 Debt in Local Currency (2002-2020)

Global rating agencies often lack confidence in emerging countries to sustain a high debt to GDP ratio compared with advanced economies. This will usually lead these rating agencies to downgrade the country's credit rating (Jong Woo, 2021). Hence, in the midst of the COVID-19 pandemic in April 2020, Thailand's outlook was revised from positive to stable by S&P Global Ratings due to economic and political unpredictability during the pandemic (S&P Global Ratings Lowers Thailand's Outlook on Coronavirus Uncertainty, 2020). This was followed by Indonesia, where its outlook was revised from stable to negative by S&P Global Ratings as the rating agency assumes Indonesia will continue to face additional fiscal and external risk in the coming 2 years (S&P Global Ratings Revises Indonesia's Outlook to Negative, 2020).

Subsequently, the Philippines' Long-Term Foreign-Currency Issuer Default Rating (IDR) outlook was revised by Fitch Ratings to stable from positive. This revision is because the rating agency is expecting the nation's near-term macroeconomic and fiscal outlook to continue to weaken as a consequence of the pandemic (Fitch Revises Outlook on Philippines to Stable; Affirms at BBB, 2020). There was no exception for Malaysia, but it was worse for the nation as the IDR was downgraded from A- to BBB+ by Fitch Ratings due to a number of factors, such as additional fiscal burden (Fitch Downgrades Malaysia to "BBB+"; Outlook Stable, 2020). Based on Jong Woo

(2021), a downgrade will cause investors to lose confidence, thus causing capital outflows and a fall in local currency.

Furthermore, the Supreme Audit Agency (BPK) of Indonesia cautioned the Government of a possible inability to finance it expanding debt. BPK Chairman Agung Firman Sampurna highlighted the national debt to government revenue is at 19.06 percent in 2020 which is higher compared to IMF recommendation of 7 percent to 10 percent. Moreover, Indonesia's government debt to revenue ratio stood at 369 percent, drastically larger than IMF's threshold of 90 to 150 percent ("BPK Raises Concern about Govt's Ability to Service Debt," 2021). In addition, the Institute of International Finance in its Global Debt Monitor report highlights that debt service charges pose a burden to emerging countries such as the Philippines, Indonesia, South Africa, India and Turkey. This is due to an increase in spending as well as revenue losses during the pandemic ("Debt Service Seen to Be a 'Greater Burden' for PHL," 2021).

Research Objectives and Questions

Public debt levels have become a critical economic concern for nations worldwide, influencing fiscal stability, growth prospects, and socio-economic development. Understanding the determinants of public debt is essential for policymakers seeking to implement effective fiscal strategies and ensure sustainable economic management. This study aims to explore the key factors influencing public debt levels, with a particular focus on corruption, government investment, government consumption, and tax revenue. By investigating these variables, the research seeks to provide empirical insights into their relationship with public debt, contributing to both academic discourse and policy formulation.

The study is guided by the following specific objectives:

i. To examine whether corruption influences public debt levels, as corrupt practices may lead to inefficient resource allocation and increased borrowing.
ii. To assess the impact of government investment on public debt, considering that infrastructure and development projects often require substantial borrowing.
iii. To analyse the role of government consumption in shaping debt levels, given that excessive public spending can strain fiscal balances, and
iv. To evaluate how tax revenue affects public debt, since higher revenue may reduce reliance on borrowing, while lower collections could exacerbate debt accumulation.

To achieve these objectives, the study addresses the following research questions:

i. Does corruption influence the public debt level?
ii. Does government investment influence the public debt level?
iii. Does government consumption influence the public debt level? and
iv. Does tax revenue influence the public debt level?

By answering these questions, the research will provide a clearer understanding of the fiscal and institutional factors that shape public debt dynamics. The findings could assist governments in designing policies that enhance debt management, curb wasteful expenditures, and strengthen revenue generation. Ultimately, this study seeks to contribute to the broader economic literature on public debt while offering practical recommendations for sustainable fiscal governance.

LITERATURE REVIEW

Governance

Good governance is fundamental for a healthy and sustainable public finance (Kim et al., 2017). However, corruption increases public debt regardless of the size of the public expenditure (Del Monte & Pennacchio, 2020). This research focuses on Organisation for Economic Co-operation and Development (OECD) countries for a period of 20 years from 1995, and further findings show public debt will drop 25% in the short term if 50% amount

of the corruption is reduced. Moreover, based on Apergis & Apergis (2019) findings, there is a higher public debt recorded during a highly corrupted government. Apart from this, there are a few studies on the relationship between corruption, public debt and economic growth. Studies (Park, 2022; Mendoza et al., 2020) found that higher corruption levels correlate with increased debt, as misallocation of funds leads to inefficient borrowing in Indonesia and the Philippines. Findings from Monte & Papagni (2001) explain that there is a long-term effect on economic growth if corruption exists during procurement made by government officials, as the amount of investment towards economic activities reduces. In addition, Ibrahim's (2021) research, which focuses on the impact of corruption on public debt and economic growth in 20 developing countries from 1996 to 2018, proves that a large amount of corruption slows economic growth in the long run.

Research by Hofmann & Rasiah (2019) indicated that transparent fiscal policies reduce debt risks, but political instability can worsen borrowing trends in both Malaysia and Thailand. Meanwhile Cooray et al., (2017), whose empirical analysis focuses on 126 countries for the period 1996-2012, concludes that government spending and shadow economy have a positive influence on corruption as well as public debt. Similarly, in research that is done on many countries Benfratello et al. (2017), explains that the effects of corruption are stronger in advanced countries compared to less-developed countries. Generally, the findings conclude that corruption increases public debt. On the other hand, based on Dzhumashev (2014) when the actual government size is above the ideal level, corruption can help boosts the economic productivity. This is because corruption influences the difficulty of governance as well as the competency of effective public inputs. Thus, growth is influenced by a combination of the impact of private efficiency because of the changes in the difficulty of governance and effective inputs from the government. This research further explains that it is not a straightforward relationship between the aspects of governance, corruption, and economic performance.

Government Investment

There is a huge amount of research done to understand the economic factors that influence the public debt levels. Jiranyakul (2017) noted that public investment and inflation are key drivers for public debt in Thailand, with high inflation reducing real debt burdens but increasing borrowing costs. Focusing on public investment, according to Velasco (2000) at the cost of the whole population who pay taxes, public investment increases due to corruption which benefits only a small number of people. Therefore, the hike in public expenditure forces an increase in debt issuance. Moreover, it is typical for a government to borrow in order to finance public investment, which includes physical infrastructure and human capital. As a rule, to speed up the growth of an economy, legislation will engage in increasing capital formation, thus the magnitude of capital formation growth will alter the nation’s debt level (Swamy, 2015). However, this also depends on the percentage of private investment, as if there is a bigger participation from the private sector, government spending will decrease. Thus, this will translate to a lower public debt (Appiah Kubi et al., 2022).

One of the strategies in fiscal stabilising policy for Greece is to temporarily narrow down public investment, as well as concurrently increase the labour tax rate to help stabilise rising public debt (Germaschewski & Wang, 2022). This shows that public investment has a direct relationship with public debt. Another study discusses the government's plans to invest in politically desirable projects by refinancing current COVID-19 loans. This strategy helps create spending space for this current expenditure. In the last two years, federal investment stood at 11.3%. However, if the yield for government bonds rises, it will add to the interest load on the government expenditure. Thus, it will be a huge burden for the future generation to take over the debt if the government proceed to invest using the fiscal space created from refinancing (Broer, 2022).

Government Consumption

In the Philippines and Indonesia, recurrent spending (e.g., subsidies, wages) has been linked to rising debt (World Bank, 2023). Meanwhile, on government consumption, according to research by Swamy (2015), the author explains that the size of government final consumption affects the amount of the government’s borrowings. Swamy further elaborates that the government's final consumption impacts how much the government borrows, hence the government debt level is also impacted. Based on Uprasen's (2022) findings, the increase in total public

debt, specifically due to domestic public debt in Thailand during the COVID-19 pandemic, has added to economic growth in general. However, the authors remind that the nature of this debt is to uphold consumption instead of investing in projects that will bring a multiplier effect to the economy. In addition, Wang (2021) explains large amount of consumption will results in a significant stimulus effect on the Greek economy during COVID-19 pandemic but at the expenses of a deteriorating fiscal position. This further proves that public consumption impacts public debt. In the Malaysian context, Lean & Smyth (2019) observed that government spending and oil price shocks contribute to debt accumulation, but strong export performance mitigates risks.

Tax Revenue

Meantime, narrowing on tax revenue, Tanzi (1998) explains when there is high interaction between the taxpayer and the tax auditor, as well as when there is minimal supervision between the tax and customs officers, bribery surges. Thus, tax revenue decreases when individuals or companies bribe government officials to evade tax payment. A decrease in tax revenue will reduce the fiscal balance and increase the issuance of public debt (Kaufmann et al., 2009). Additionally, when the size of the shadow economy increases due to corruption, the amount of tax revenue reduces (Friedman et al., 2000; Johnson et al., 1997). Alburo & Ablan (2021) emphasised that tax inefficiency and infrastructure spending lead to higher debt, but remittances and FDI help ease fiscal pressures in the Philippines.

Moreover, Ademmer & Boysen-Hogrefe (2022), concluded that errors in forecasting tax revenue may extensively influence public debt build-up in a research done on German states. Undoubtedly, a higher tax rate results in higher tax revenue collection. However, when tax collection is reduced due to a distortionary tax, this will result in lower tax revenue. Weak tax collection in Indonesia and the Philippines forces higher borrowing (Bautista & Yap, 2020). Additionally, a contractionary policy to slow down an overheating economy will result in deflating GDP, thus lowering one's debt affordability (De-Córdoba et al., 2021).

Gross Domestic Product

Furthermore, based on Sadik-Zada & Gatto (2019) findings on GDP, a greater growth rate of the aggregated GDP has an empirically negative impact on the public debt. While Pirtea et al., (2013) whose research was on the factors that impact public debt in Romania, concluded that the real GDP growth rate has a significant impact on public debt. Furthermore, the same finding was concluded from Sinha et al. (2011) research, even though this paper focuses on high- and middle-income group countries. A study on Indonesian public debt by Sukmana & Kurniati (2020) found that fiscal deficits and exchange rate fluctuations significantly increase public debt, while GDP growth helps stabilise it.

While Hu et al. (2021) research focus on GDP growth rate and debt/GDP value for 20 countries for the period of 1791 to 2009, the findings explains when debt to GDP ratio value falls below 70% the relationship between debt to GDP ratio and GDP growth is significant. However, if the debt ratio grows above 70%, it will have an adverse impact on the average GDP growth. In addition, in the case of Lebanese public debt, from a short-term angle, it is concluded that an improved primary fiscal performance and a greater economic growth rate assist in lowering public debt in the short run (Ibrahim, 2021a).

RELEVANT THEORIES

Bureaucracy Model

According to William Niskanen, who adopted a bureaucracy model in 1971, the bureaucrats are likely to increase the government budget and restrict information from parliamentarians. In the opinion of the model, bureaucrats desire "power, pay and prestige", which can be obtained from a budget. Thus, bureaucrats consistently incline towards a bigger budget. Bureaucrats who have the power to determine the type of policies being implemented tend to influence the process, especially for policies that are related to their own personal gain, such as emoluments and benefits (Liu & Mikesell, 2014). It is observed that those who decide the level of government spending are

also the recipients of this larger expenditure (Rubinfeld et al., 1979). Furthermore, bureaucrats with unlimited information on the actual cost of public consumption are able to mark up the cost to obtain a bigger budget.

Fiscal Illusion Theory

In the fiscal illusion theory, Buchanan & Wagner (1977) explains that politicians are inclined to introduce, to a feasible extent, programmes related to the new government to allure voters, thus resulting in a larger government. Politicians are driven to deceive the public to bring in voters without being criticised for the larger government expenditure. Hence, for the citizens to misjudge the costs of public sector goods and services, the politicians will arrange and exploit the fiscal framework, thus creating an illusion. The bigger the number of manipulating items in the fiscal framework, the larger the government expenditure (Liu & Mikesell, 2014).

Keynesian Theory

The main basis of Keynesian theory is demand, where it is measured as the total expenditure from households, businesses and the government. Furthermore, these are the main drivers of an economy. This theory further elaborates free market cannot independently self-balance to achieve full employment. Thus, government involvement through public policies is needed to achieve full employment and stable prices. An economy's output of goods and services consists of four parts, which are consumption, investment, government purchases and net exports. One of these parts will contribute to an increase in demand.

However, during a recession, demand will be sluggish due to lower spending. Thus, based on Keynesian theory, an intervention is needed to help build up the economy. There are three principles in this theory, which are that aggregate demand is impacted by the public and private sectors. Under this theory, it is supported that a demand involves a mixture of the public and private sectors. Secondly, prices specifically, emolument, react slowly to adjustments of supply and demand. Lastly, when there is a change in demand, the impact is usually on real output or employment. The Keynesian economist believes that prices are inflexible, thus movement on any item of expenditure, such as consumption, investment or public spending, can cause output to be different. Keynesian further elaborates that when other elements of spending are the same, but there is an increase in government expenditure, this will result in an increase in output.

Keynes supports countercyclical fiscal policies that act against business cycles, where Keynes encourages deficit spending in labour-intensive infrastructure projects to help boost employment and stabilise employment during recession. Keynes further elaborates that the government should help solve problems in the short term instead of waiting for the market to fix it in the long run, as he believes it might be too late then. However, this does not imply that the government should modify policies every few months to help run the economy (*What Is Keynesian Economics? - Back to Basics*, 2014).

Theoretical Underpinning of the Related Model

This study will adopt the bureaucracy model and the Keynesian theory. Corrupted public servants will allocate public money to things or projects that are able to bring in a larger amount of bribes. Based on Shleifer & Vishny, (1993), the essence of corruption is it is done privately. Thus, this will move the focus of public investment to those in defence and infrastructure if these provide greater chances for corruption to happen (Liu & Mikesell, 2014). According to research by Gupta et al., 1998, corruption has results in higher expenditure in military as a share to GDP and total public spending. Moreover, based on Delavallade (2006) findings, it explains that public servant corruption will increase the portion of government expenditure on energy, culture, housing and defence, while the spending portion will decrease on sectors related to education, health and social protection.

In addition, Keynesian theory will also be adopted in this study. It is the opinion of Keynesian economists that the government could control the aggregate demand and the amount of national revenue using expenditure and tax policies. The government budget balance is tax revenue at time t minus government expenditure at time t. Thus, the equation below is derived:

$B_t = G_t - T_t$ ……1)

where,

B_t = Balance budget
G_t = Government expenditure
T_t = Tax revenue

Meanwhile, equation two for government debt is derived as below:

$D_t = (1 + r)D_{t-1} + B_t$ ……2)

where,

D_t = Public debt
r = Interest rate

Thus, equation three for government debt becomes as below:

$D_t = (1 + r)D_{t-1} + G_t - T_t$ ……3)

Hence, the public sector debt is the accumulation of budget balance and interest payments in order to service the public debt (Mah et al., 2013).

Conceptual Framework

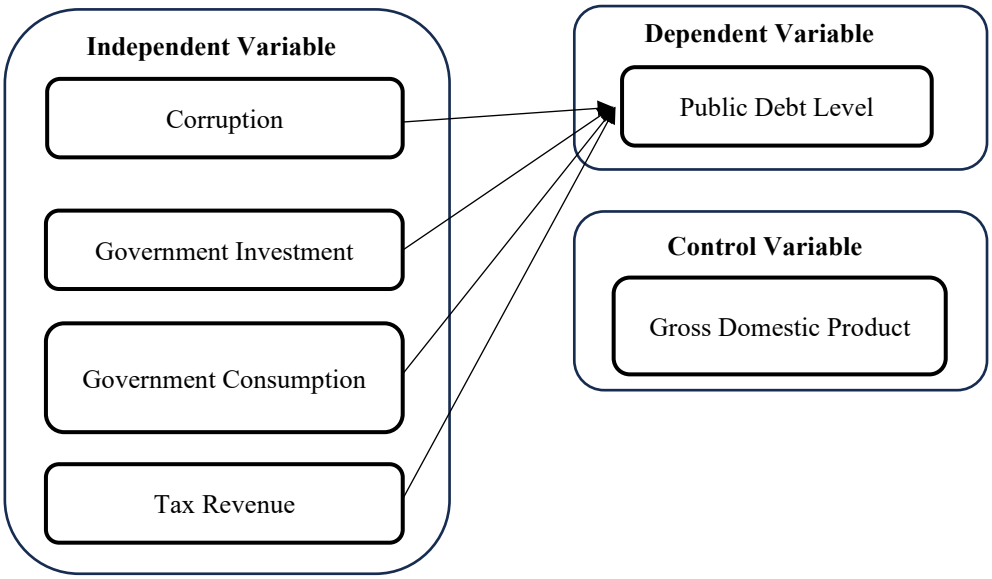


Figure 2: Conceptual Framework

Based on the literature review above, the theoretical framework is further enlarged. Thus, the conceptual framework developed for this study is as illustrated in Figure 2.

Based on this, this study tests the following hypothesis:

Hypothesis 1: Corruption has a positive influence on the public debt level

Equation three shows that government expenditure is directly correlated with public debt. Government expenditure is the spending on goods and services, which includes public consumption and public investment. Public debt will increase when government investment increases (Appiah-Kubi et al., 2022; Swamy, 2015; Velasco, 2000). Hence, the following hypothesis is derived:

Hypothesis 2: Government investment has a positive influence on the public debt level

As mentioned above, when government expenditure increases, public debt increases as well. Based on the International Monetary Fund's fiscal stance, when the current fiscal balance is positive, it is suggested that the government to finance public consumption using its own revenue (*Guidelines for Fiscal Adjustment - How Should the Fiscal Stance Be Assessed?*, 2010). This study assumes that government consumption is financed using public debt. Therefore, the following hypothesis is derived:

Hypothesis 3: Government consumption has a positive influence on the public debt level

Equation three shows that the value of tax revenue has an opposite impact on public debt. Thus, when tax revenue increases, public debt decreases. This is supported by the findings from Kaufmann et al., (2009). Therefore, below hypothesis is derived:

Hypothesis 4: Tax revenue has a negative influence on the public debt level

METHODOLOGY

Target Population and Unit of Analysis

The target population for this study is the ASEAN-4 countries, which are defined as Indonesia, Malaysia, Thailand and the Philippines ("ASEAN-4 - Finance & Development," 2006). These ASEAN-4 countries are selected because they are the top four developing countries in terms of gross domestic product in the region (*World Development Indicators*, 2022). In addition, the population size is four. Meanwhile, the unit of analysis for this study is one country in ASEAN-4. Census will be applied for this study, where all the related information from the target population will be gathered.

Dependent Variable

The dependent variable for this study is public debt. Public debt in this research is proxied by the general government's gross debt (Appiah Kubi et al., 2022). The IMF defines general government gross debt as all liabilities that require the refund of principal and interest from the debt or to the lender at a future date (*World Economic Outlook Database*, 2022). The nature of the data is yearly and is sourced from the World Economic Outlook database.

Independent Variables

In this study, four independent variables have been identified, which are corruption, government investment, government consumption and tax revenue. The proxy for corruption is the control of corruption ratio (Appiah-Kubi et al., 2022) where the data ranges from -2.5 to 2.5. The -2.5-ratio range is defined as total corruption, while the 2.5 ratio is defined as no corruption (Kaufmann et al., 2010). According to the World Bank, the ratio measures the rate at which public officials exercise public power for personal gain. It includes both petty and grand forms of corruption. It also measures the ability of state policies and institutions to fight and prevent corruption (*Worldwide Governance Indicators*, 2022). The data derived is yearly data, and it is sourced from the World Development Indicators database.

While for government investment, it is proxied by gross fixed capital formation (Swamy, 2015) (Swamy, 2015). The World Bank defines gross fixed capital formation, which was formerly known as gross domestic fixed investment, as including land improvements, plant, machinery, and equipment purchases, the construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings (*World Development Indicators*, 2022)The data is obtained from the World Development Indicators database, and it is a yearly dataset.

Subsequently, for government consumption, it is proxied by general government final consumption (Appiah-Kubi et al., 2022). The World Bank interpret it as all government current expenditures for purchases of goods and

services, which also includes compensation of employees in the form of wages and salaries (*World Development Indicators*, 2022). The data is yearly data and is garnered from the World Development Indicators database.

Lastly, tax revenue data is obtained from the World Development Indicators database (Appiah-Kubi et al., 2022). Based on the World Bank, it is defined as mandatory transfers to the central government for public purposes. Some mandatory transfers, such as fines, penalties and most social security contributions, are excluded. Refunds and corrections of incorrectly collected tax revenue are considered negative revenue (*World Development Indicators*, 2022). The set of data is yearly data.

Control Variable

This study consists of one control variable, which is gross domestic product. The gross domestic product is proxied by GDP per capita measured in constant 2015 US$ (Appiah-Kubi et al., 2022). The World Bank explains it as gross domestic product divided by mid-year population. GDP is the sum of gross value added by all resident producers in the economy, plus any product taxes, minus any subsidies not included in the value of the products. Data are in constant 2015 U.S. dollars (*World Development Indicators*, 2022). The source of data is from the World Development Indicators database and is yearly data.

Data Collection

In this study secondary data technique will be applied. The data will be collected from the World Economic Outlook database, the Worldwide Governance Indicators database and the World Development Indicators database (Appiah-Kubi et al., 2022). The data collection period is from 2002 to 2020 due to data availability.

Data Analysis

Panel Data Diagnostic Test

In order to analyse the relationship between the independent variables and the dependent variable, the empirical model for this study is described as below:

$$PD_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 GI_{it} + \beta_3 GC_{it} + \beta_4 TR_{it} + \beta_5 CV_{it} + \varepsilon_{it} \ldots\ldots\ldots 4)$$

where,

PD_{it} = Public debt
β_{it} = Intercept
C_{it} = Corruption
GC_{it} = Government consumption
GI_{it} = Government investment
TR_{it} = Tax revenue
CV_{it} = A vector of control variables
ε_{it} = error term

For this study, a panel data regression is used to analyse the empirical model above. In balanced panel data research, among the abundant pooling models, the most familiar panel effect models are the Fixed Effect model and the Random Effect model. Hence, the most suitable regression model will be selected among the ordinary least squares method (OLS), fixed effect model and random effect model to assess the relationship between public debt with corruption, government investment, government consumption and tax revenue (Soh et al., 2021).

However, if there is the presence of heteroscedasticity, autocorrelation and cross-sectional dependence, the best model to use to mitigate this issue when the time dimension (T) of the panel is bigger than the cross-sectional dimension (N) is by using the feasible generalised least squares (FGLS) method (Hoechle, 2007). Furthermore, before the regression is done, the data would be tested to ensure the results are unbiased. The data processing test includes, but is not limited to, normality test, multicollinearity test, heteroskedasticity test, autocorrelation test and cross-sectional dependence test.

FINDINGS

Descriptive Statistics

Descriptive statistics analysis results for the whole dataset are presented in Table 1. The table shows the number of observations, the mean, the standard deviation, the minimum and maximum observation for each variable. It is shown that there are 80 observations for each variable. The mean value for public debt level as a percentage of GDP is 44.728 with a standard deviation of 11.481. Meanwhile, the range of value for public debt is between 22.955 to 71.393.

While for corruption, the mean value is -0.371 with a standard deviation of 0.373, and the range value is between -1.137 and 0.397. The data range for the control of corruption ratio ranges from -2.5 to 2.5, where the -2.5-ratio range is defined as total corruption, while the 2.5 ratio is defined as no corruption (Kaufmann et al., 2010). Hence, the corruption value shows that the corruption level for countries in the study is in the middle of the ratio range.

Investments as a percentage of GDP mean value is 24.374, and the standard deviation is 4.165, where the minimum value is 18.182 and the maximum value is 32.812. Furthermore, the mean value of expenditure as a percentage of GDP is 11.949, while the standard deviation is 2.796. The range of the value is 7.257 for a minimum value and a value of 18.253 for the maximum value. Moreover, the mean value of tax revenue as a percentage of GDP is 12.973. The standard deviation is 1.803 with a minimum and maximum range value of 8.31 and 16.139, respectively. Lastly, the mean value of GDP per capita growth is 4.414 with a standard deviation of 3.01. The range value for GDP is between -9.518 and 7.513.

Table 1. Summary of Descriptive Statistics Results

Variables	Obs	Mean	Std. Dev.	Min	Max
Debt	80	44.728	11.481	22.955	71.393
Corruption	80	-0.371	0.373	-1.137	0.397
Investment	80	24.374	4.165	18.182	32.812
Expenditure	80	11.949	2.796	7.257	18.258
Taxrevenue	80	12.973	1.803	8.31	16.139
GDP	80	4.414	3.01	-9.518	7.513

Correlation Analysis

Table 2 shows the Pearson correlation results between all the variables in this research. The results show that corruption, expenditure and tax revenue are positively correlated with debt as a percentage of GDP. The values are 0.199, 0.140 and 0.120, respectively. Investment and GDP are negatively correlated with debt as a percentage of GDP, with values of -0.735 and -0.197, respectively.

As mentioned in the previous chapter, the hypothesis for Pearson correlation is that the null hypothesis shows that the correlation coefficient is not significant, while the alternative hypothesis is that the correlation coefficient is significant. If the *p*-value is less than the significance level of 5% the null hypothesis is rejected; thus, the correlation coefficient between the variables would be significant. The *p*-value for investment and debt, expenditure and corruption, tax revenue and corruption, tax revenue and expenditure, tax revenue and investment and lastly GDP with expenditure is less than the significance level of 5%, indicating the correlation coefficients are statistically significant.

Table 2. Pearson Correlation Coefficient Matrix (Pairwise Correlation)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Debt	1.000					
(2) Corruption	0.199	1.000				
	(0.077)					
(3) Investment	-0.735***	-0.015	1.000			
	(0.000)	(0.892)				
(4) Expenditure	0.140	0.396***	-0.100	1.000		
	(0.216)	(0.000)	(0.378)			
(5) Tax Revenue	0.120	0.383***	-0.270***	0.772***	1.000	
	(0.288)	(0.000)	(0.015)	(0.000)		
(6) GDP	-0.197*	-0.036	0.075	-0.375***	-0.029	1.000
	(0.080)	(0.751)	(0.507)	(0.001)	(0.799)	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Panel Data Diagnostic Test

A few diagnostic tests were conducted to verify the normality of the data as well as the presence of heteroscedasticity, autocorrelation, cross-sectional dependence and multicollinearity in the panel data. In addition, in this research, the data used is a balanced panel data where all the cross-sectional units of data have the same number of time series observations. Table 3 shows the summary of the diagnostic test results for normality, heteroscedasticity, autocorrelation and cross-sectional dependence that were conducted on the baseline data.

The null hypothesis for the normality test states the variable is normally distributed, while the alternative hypothesis states the variable is not normally distributed. Hence, from the results, the p-value for the normality test is 0.181, which is more than the 5% significance level; therefore, the null hypothesis cannot be rejected, and it can be concluded that the variable is normally distributed.

Next, on Breusch-Pagan heteroscedasticity test the hypothesis is as below:

$$H_0 = \sigma_i^2 = \sigma^2$$
$$H_i = \sigma_i^2 \neq \sigma^2$$

If the *p*-value is less than 0.05, the null hypothesis is rejected. From the p-value result, which is less than 0.05, it can be concluded that heteroscedasticity exists.

Table 3 : Summary of Diagnostic Test Results

Test Type	*p*-value / Prob>F / Pr
Shapiro-Wilk W (Normality test)	0.181
Breusch-Pagan (Heteroscedasticity Test)	0.009
Woolridge Test (Autocorrelation Test)	0.005
Breusch-Pagan LM test (Cross-Sectional Dependence Test)	0.000

Meanwhile, the null hypothesis for the Woolridge test for autocorrelation is that there is no autocorrelation present, while the alternative hypothesis is that there is autocorrelation present. In Table 4.3, the result is 0.005, which is less than 5% significance level; thus, the null hypothesis is rejected. Hence, it is concluded that first-order autocorrelation is present in this set of data.

Next, on the cross-sectional dependence test, a Breusch-Pagan LM test was conducted. The Pr is 0.000, which is less than the significance level of 5%, hence we fail to accept the null hypothesis, where it is mentioned that the panels are not correlated. Thus, it is concluded that the panels are correlated. Hence, it is concluded that there is the presence of heteroscedasticity, autocorrelation and cross-sectional dependence on this set of data.

Table 4: Variance Inflation Factor (VIF) Results

Variable	VIF
Expenditure	3.95
Tax revenue	3.58
GDP	1.52
Corruption	1.22
Investment	1.17
Mean VIF	2.29

The table 4 results show the VIF value for the variables expenditure, tax revenue, GDP, corruption and investment is 3.95, 3.58, 1.52, 1.22, and 1.17, respectively. Furthermore, the mean VIF value is 2.29, which is all well below the value of 5. Hence, it can be concluded that there is no possibility of multicollinearity in the set of variables used in this research. From the discussion above, the data is normal, and there is no multicollinearity present in the set of data. In addition, since heteroscedasticity, first-order autocorrelation and cross-sectional dependence are present, hence, to treat this condition a FGLS method is used to run the regression analysis (Hoechle, 2007).

Regression Analysis Results

The regression analysis is to study the relationship between public debt level and independent variables in this study, which are corruption, investment, expenditure and tax revenue, with a control variable of GDP. Table 5 shows the regression analysis results using FGLS. In the earlier chapter, it was mentioned that for the first hypothesis, corruption has a positive influence on the public debt level and from Table 5, it is interpreted that a unit change in corruption is associated with a 303.1% change in the public debt level, with a range of contribution between 82% and 598.0%. Moreover, the relationship between corruption and public debt level is positive; however, this variable has an insignificant relationship with the dependent variable, as the *p*-value is more than 5%.

Next, the second hypothesis is that government investment has a positive influence on the public debt level. The results can be interpreted as each unit change in government investment is associated with a 150.5% change in the public debt level. Meanwhile, the range of contribution is between 130.3% to 170.7%. Nevertheless, the relationship between government investment and public debt level is negative, which is the opposite of the hypothesis, although the significance level is less than 1%. Thus, it can be interpreted that this independent variable has a significant relationship with the dependent variable.

Table 5. Cross-Sectional Time-Series FGLS Regression Results

Debt	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Corruption	3.031	2.949	1.028	0.304	-2.748	8.81	
Investment	-1.505	.202	-7.468	0.000	-1.9	-1.11	***
Expenditure	1.41	.442	3.191	0.001	.544	2.277	***
Taxrevenue	-1.764	.566	-3.118	0.002	-2.873	-.655	***
GDP	-.044	.126	-.35	0.726	-.29	.202	
Constant	91.349	8.655	10.554	0	74.386	108.313	***
Mean dependent var		44.728	SD dependent var			11.481	
Number of obs		80	Chi-square			84.752	

*** *p*<.01, ** *p*<.05, * *p*<.1

Thirdly, the hypothesis is that government consumption has a positive influence on the public debt level. The results explain that each unit change in government consumption is associated with a 141.0% change in the public debt level, while the range of contribution is between 96.8% to 185.2%. Besides, the relationship between government consumption and public debt level is positive, which is in line with the hypothesis. In addition to this, the *p*-value between these two variables is less than 1% which is lower than the 5% significance level; hence, it can be concluded that the relationship is significant.

Lastly, the hypothesis for tax revenue is that each unit change in tax revenue is associated with a 176.4% change in the public debt level. In addition, the range of contribution is between 119.8% to 233.0%. Apart from this, the coefficient shows that tax revenue has a negative influence on the public debt level, which is in line with the

hypothesis. Additionally, the *p*-value for the variable is less than 1% which proves the relationship between tax revenue and public debt level is significant.

To summarise, the independent variable that is significant with public debt level is government investment, government consumption and tax revenue. While government consumption and tax revenue have a relationship that is in line with the hypothesis, the government investment relationship with the dependent variable is opposite to the hypothesis.

Robustness Check

For a robustness check, some additional control variables were added to the model (Del Monte & Pennaccchio, 2020). Firstly, the exchange rate is added to the model. Pirtea et al. (2013) share that the Leu-Dollar exchange rate has a compelling impact on the public debt, while it is the opposite for the Leu-Euro. Hence, the Romanian government should strategise in increasing local currency-denominated debt as well as euro-denominated debt in its external debt portfolio to minimise currency risk. Additionally, Mijiyawa (2022) A study on the trend of external debt and its driving factors in heavily indebted poor countries concludes that the nominal exchange rate has a serious influence on the external debt to GDP ratio.

Apart from this, Indonesia in the long run is expected to experience a moderate impact from its long-run external debt due to the devaluation of its currency against the US dollar. Indonesia has adopted this floating foreign exchange regime since 1977 (Nazamuddin et al., 2022). Meanwhile, Fisera et al. (2021) conducted a study on the long-term consequence of declining local currency on the external debt for 41 emerging countries. In this research, it is found that the affordability of external debt drops when a local currency value drops broadly, which results in an increase in the external debt to GDP ratio. However, for a further developed emerging economy, the external debt burden may reduce in the long term if the country experiences a lesser currency depreciation. The case is the opposite for poorer emerging countries.

Whereas for the exchange rate, it is proxied by the national currency per US dollar (Appiah-Kubi et al., 2022). The World Bank interpretation is the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market (World Development Indicators, 2022). The yearly data is derived from the World Development Indicators database.

While the second additional control variable would be inflation, Das & Ghate (2022), whose research focuses on India from 1959 until 2018, conclude that inflation plays a significant role in reducing the public debt level. While Thepmongkol & Sethapramote (2018) suggest that using seigniorage income can help increase the inflation rate, hence lowering the public debt level. Moreover, a simulation and estimation approach on 19 advanced countries on the impact of inflation on the debt-to-GDP ratio concludes that a shock of 1% on the inflation rate can help lower the debt-to-GDP ratio by approximately 0.7% on average. These findings suggest that the debt-to-GDP ratio is slightly lower when modestly higher inflation with some additional financial control is applied.

The inflation control variable is proxied by the annual percentage change in the consumer price index (Appiah-Kubi et al., 2022). The World Bank explains inflation as the consumer price index that reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly (*World Development Indicators*, 2022). This data set is also a set of yearly data, and it is obtained from the World Development Indicators database.

In Table 6, the results of the robustness check are similar to the original regression results, where corruption has a positive influence on the public debt level. However, the *p*-value for corruption is more than 5% significance level, which explains that the variable is not significant in this study.

Table 6. Robustness Check Results

Debt	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Corruption	1.895	3.092	.613	0.540	-4.166	7.956	
Investment	-1.243	.266	-4.669	0.000	-1.765	-.721	***
Expenditure	1.036	.496	2.089	0.037	.064	2.009	**
Tax revenue	-2.149	.665	-3.23	0.001	-3.452	-.845	***
GDP	-.096	.132	-.73	0.466	-.355	.162	
Exchangerate	-.001	0	-1.404	0.160	-.001	0	
Inflation	-.062	.229	-.269	0.788	-.51	.387	
Constant	95.881	9.012	10.639	0.000	78.217	113.545	***
Mean dependent var		44.728	SD dependent var			11.481	
Number of obs		80	Chi-square			85.621	

*** $p<.01$, ** $p<.05$, * $p<.1$

Moreover, for government investment, the coefficient shows a negative relationship between government investment and public sector debt level, which is similar to the original regression. While the *p*-value is less than 0.05, which explains that government investment has a significant relationship with the public debt level.

In addition, from Table 6, it is proven that the variable government consumption has a positive relationship with public debt level, as it has a positive coefficient. However, the *p*-value from Table 6 is slightly higher than from Table 4.5; nevertheless, government consumption is still significant as the value is less than 5% significance level. This result is similar to the original regression results.

Lastly, for tax revenue, it has a negative relationship with public debt level, which is consistent with the original regression. Furthermore, this variable is significant as its *p*-value is less than the 5% significance level. In conclusion, all the variables in the robustness check have a similar result to the original regression in terms of coefficient as well as significance. Table 7 below summarises the findings of this research.

Table 7. Summary of Key Research Findings On Public Debt Determinants

	Variable	Hypothesis	Relationship with Public Debt
1	Corruption	Corruption has a positive influence on the public debt level	Not Significant
2	Government Investment	Government investment has a positive influence on the public debt level	Negative
3	Government Consumption	Government consumption has a positive influence on the public debt level	Positive
4	Tax Revenue	Tax revenue has a negative influence on the public debt level	Negative

CONCLUSIONS

It has been found that government investment has an influence on the public debt level. However, the relationship is negative and was the opposite of the hypothesis drawn, where an increase in government investment reduces the public debt level. Miyamoto et al. (2020) explain that higher investment may not necessarily have a significant impact on a government budget, as the increase in spending may be offset by higher revenue earned by the government or due to a reduction in other spending.

In addition, this result is also similar to the findings of Omrane Belguith & Omrane (2017), where their research concluded that gross fixed capital formation, which is a proxy for government investment, has a negative and significant impact on the public debt. In addition, Appiah-Kubi et al. (2022) point out that generally, an increase in government investment will help increase government expenditure, thus public debt should increase. Nevertheless, the percentage of private investment does play a role too, where if there is a larger involvement from the private sector, it helps reduce government participation, hence government spending will decrease. Therefore, it would result in a lower public debt level.

Moreover, Mourougane et al. (2016) research on whether an increase in public investment can sustainably improve economic growth for OECD countries has resulted in similar findings. The findings shared that public investment can indeed advance growth and lessen public debt. Furthermore, this result is the most obvious for European countries such as Ireland and Portugal. Hence, higher public investment, which may be due to higher revenue, a reduction in spending, as well as the involvement of the private sector, may be the reason why it has an inverse relationship with public debt.

Conversely, Appiah-Kubi et al. (2022) research on government investment in African countries has resulted in a positive and secure relationship with public debt level, which is the opposite of the findings in this study. The author shares that this is due to inadequate revenue mobilisation in the country, hence the government had to borrow in order to finance the country's infrastructure projects, such as road construction, railway construction, schools and hospitals. Furthermore, participation from the private sector in capital formation is negligible, and this has led to public debt accumulation.

Secondly, in this study, the third hypothesis drawn was that government consumption has a positive influence on the public debt level, and the results from this study were significant and supported this hypothesis. This finding is backed up by research from Swamy (2015), where the author elaborates that the size of the government's final consumption influences the amount of the government's borrowings. Swamy further explains that the government's final consumption impacts how much the government borrows, hence the government debt level is also impacted.

Moreover, in de-Cordoba, Molinari, & Torres (2021), findings explain for Greece between the period of 2009-2011, the government successfully managed to reduce Greece's primary spending; however, debt service charges, as well as the economic recession, continue to put upward pressure towards the debt-to-GDP ratio. Thus, even with a reduction in primary spending, government expenditure may increase due to commitments such as debt service charges. Furthermore, Cooray et al. (2017) prove that an increase in government expenditure has a statistically positive effect on public debt, which is similar to this study's findings. Therefore, an increase in government consumption due to commitments such as debt service charges may be the contributing factor to an increase in the government's public debt level.

In contrast, Appiah-Kubi et al. (2022) findings for government consumption have a significant negative relationship with the levels of public debt in Africa, which conflicts with the findings of this study. This is because the government ensures the emoluments of public officials are well taken care of by paying wages and salaries regularly. Moreover, the government also ensures that public officials are provided with the necessary resources in order to ease public service delivery. This has resulted in an enhancement in public sector delivery, which can be seen from the revenue generation. Therefore, Appiah-Kubi et al. (2022) conclude that increased government consumption has helped increase tax revenue, which in turn helps reduce the public debt level.

Lastly, this study's findings are significant and agree with the fourth hypothesis drawn, which is that tax revenue has a negative influence on the public debt level. This is supported by findings from Arusha, Ratbek, & Schneider (2017), where their findings conclude that a large shadow economy reduces tax revenue, which then results in a higher public debt. Based on Smith (1994), the shadow economy is ‘‘market-based production of goods and services, whether legal or illegal, that escapes detection in official estimates of GDP".

Similarly, Appiah-Kubi et al. (2022), whose research on public debt in Africa concluded the same findings as this study. The authors further elaborate that African economies have been growing due to a balanced approach in policy to support growth and development through tax revenue, which in turn assists in reducing the public debt level in Africa. Moreover, Ademmer & Boysen-Hogrefe (2022) concluded that errors in forecasting tax revenue may drastically affect public debt growth in the German states. Thus, a decrease in tax revenue, which may be due to various reasons such as a large shadow economy or an error in forecasting tax revenue, can bring detrimental effects towards the public debt level in a country by increasing it.

On the other hand, there is one research by de-Cordoba, Molinari, & Torres, (2021) that concludes an opposite result compared with this study where the researcher simulates a fiscal package where spending in decrease by increase in value added tax, labor taxes and corporate taxes as well as increase public investment by increasing transfer. This simulation has resulted in an increase in the debt ceiling.

POLICY CONCLUSION

In this research, the following policy conclusion can be drawn from the findings. Governments looking to ensure the sustainability of public debt level growth should make it a mission to reduce government consumption as well as increase tax revenue, and lastly manage their government investment, as these contribute to the increase and decrease of public debt. However, the task of balancing these three contributing factors is challenging.

In general, the task to enhance and strengthen the quality of governance and public institutions may contribute to higher tax revenue, lean government expenditure, and enhanced government investment. Even it seems like a simple institutional reform is time-consuming, and countries with large public debt accumulation may find themselves in a state of failure prior to seizing control of their public debt (Cooray, Dzhumashev, & Schneider, 2017).

One more approachable and implementable method may be a combination of reducing and restructuring government consumption. The government needs to manage its government consumption and government investment not only by reducing spending but also in changing the structure of spending by for one is prioritising programme and projects to be implemented as well as considering various methods of financing which may include among others, privatization of projects as well as Public-Private Partnership (PPP) before deciding in increasing public debt.

Furthermore, the government should improve tax collection by having a clear mandate to reform the tax system, secure high-level political commitment and buy-in from all stakeholders, simplify the tax system, restrict exemptions, reform indirect taxes on goods and services, introduce comprehensive tax administration reforms and enhance audit and verification programs. However, the government should strategise the optimal timing and design of reform measures to match the country's situation (Akitoby, 2018). These reforms may contribute to more efficient government consumption and tax administration, and should further contribute to the trimming of public borrowing and therefore, public debt (Cooray, Dzhumashev, & Schneider, 2017).

LIMITATION OF THE STUDY

Firstly, this research is limited to ASEAN-4 countries, which are Indonesia, Malaysia, Philippines and Thailand, that are similar in terms of economic condition. Secondly, there is a lack of long-term longitudinal information for all four countries, which is a common issue in many studies. Lastly, the proxy of public debt level is towards the general government debt, which is only one part of the total debt of the whole public sector.

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