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Corruption and Economic Growth in ASEAN Member Countries

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Abstract

This study examines the effect of corruption on economic growth and determines the corruption threshold in nine ASEAN member countries in 1999–2016. This study assesses whether the effect of corruption is growth-enhancing or growth-deteriorating in different corruption threhsolds using a sample-splitting and threshold model. In contrast to the existing literature, this study does not group countries based on income level and therefore can reveal the corruption level of a country relative to a corruption threshold. The estimation results show that the adverse effect of corruption on economic growth is stronger for countries with corruption levels above the second threshold of 80.

Keywords: corruption; economic growth; threshold model; ASEAN

JEL classifications: D73; H0; O4

1. Introduction

There has been a continuous debate regarding the relationship between corruption and economic growth. Despite the abundant researches done on the direct ramification of corruption on economic growth, there still have yet to be a single definite conclusion. A number of notable studies by Mauro (1995), Blackburn, Bose, & Haque (2006), and other researchers show a proof of the negative effect corruption has on economic growth. Conversely, Méon & Weill (2010) and Kato & Sato (2015), and other researchers have done noteworthy studies that present evidences of favorable consequences of corruption which confirm the “greasing the wheels” hypothesis while arguing for the growth-enhancing effect of corruption.

Complementing the verdicts on immediate impact of corruption, particularly in public spending sectors, d’Agostino, Dunne, & Pieroni (2016) find that the circuitous influence of corruption by way of consumption and military expenditure has strong negative impacts. In this study, the effect of corruption through the components of government expenditure is investigated using the interaction terms of corruption as well as government consumption and investment expenditures. Government contribution to the economy could be depicted through consumption and investment expenditure (Devarajan, Swaroop, & Zou 1996). Likewise, investment expenditure is directed to potentially productive sectors and affects long-term economic growth (d’Agostino, Dunne, & Pieroni 2016). Our study suggests that each type of expenditure has differences in productivity because of the different resources allocated to them by the government. This may cause differences in the ancillary impact of corruption via diverse segments of government expenditure.

Some studies asserted that countries have disparate production functions and institutional efficiency, explaining why the effects of corruption differ among countries. Some studies, such as those by Haque & Kneller (2009) and Bose, Capasso,

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& Murshid (2008), adopt a nonlinear relationship and find a corruption threshold around which its effect on economic growth changes from growth-enhancing to growth-deteriorating. As long as the corruption level of a country stays under the country's particular threshold, it will uphold the "greasing the wheels" hypothesis. However, when the corruption level went beyond the threshold, corruption will impede economic growth. By utilizing sample-splitting and threshold model developed by Hansen (2000), this study fill the gap left by existing studies by estimating the corruption threshold on top of investigating the impact of corruption on economic growth through elements of government expenditure specifically consumption and investment. The threshold model is unique in its application. The model determines a certain corruption level around which the corruption effect changes from positive to negative and allows for parameter estimates that directly affect economic growth to be estimated in different corruption levels. To address the endogeneity issue, this study employs an instrumental variable estimation using a two-stage least squares (2SLS) estimator in a separate part.

Many studies have examined corruption and growth nexus using cross-country data, considering the extensive availability of data on corruption from Transparency International, the World Bank, and the International Country Risk Guide (ICRG). However, none of them focus on a member of a regional organization in Southeast Asia such as ASEAN (Association of Southeast Asian Nations). ASEAN is a regional, intergovernmental organization comprising ten countries in Southeast Asia – Singapore, Malaysia, Indonesia, Brunei Darussalam, Vietnam, Thailand, Philippines, Lao PDR, Myanmar, and Cambodia. The purpose of this organization is to promote intergovernmental cooperation and to facilitate economic, political, security, military and educational, and sociocultural integration among the members and other countries in Asia. Their economic welfare seems to be entrapped in the middle-income level despite their high corruption levels. The small number of countries may become a limitation in conducting an empirical analysis. Despite the lack of observations, the relationship between economic growth and corruption in ASEAN member countries displays a unique pattern. Some countries, such as Malaysia and Singapore, have both dominant economies and low levels of corruption, while other countries are struggling with a severe corruption problem and entrapped in the middle and low-income levels. This uniqueness provides an ideal case for the study of the effect of corruption. Therefore, this study may contribute to the analyses of the effect of corruption on economic growth, serving as the first study conducting a threshold model on ASEAN member countries. In addition, Abe (2018) finds that in developing Asia-Pacific countries, corruption is likely to be the cause of difficulty in advancing beyond the middle-income bracket. Differences in domestic politics, economic openness, and state domination distinguish the pattern of corruption and economic growth in Asian countries from that in other regions (Rock & Bonnet 2004).

Another purpose of this study is to use the corruption threshold to determine the position of the corruption level of a country relative to the threshold, indicating the corruption performance of the country. Most countries have corruption levels above the threshold for long periods of time. However, some countries manage to lower their corruption levels below the threshold. Contrary to the existing studies that group countries based on the income level or geographical conditions, this study does not differentiate countries into groups by income. This approach confirms that corruption level does not directly correspond with income.

Two research questions are addressed in this study. Firstly, what are the consequences of corruption on economic growth when considering different cor-

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ruption thresholds in ASEAN member countries? Secondly, has the corruption level of a given country improved or deteriorated over time? To answer the research questions, this study utilizes a 1999–2016 panel data of nine ASEAN member countries along with the threshold model of Hansen (2000) to approximate the corruption threshold and analyze the impact of corruption on economic growth in different threshold. The endogeneity problem is addressed using instrumental variable estimation. To answer the second research question, we grouped the countries according to the values of corruption threshold to evaluate their corruption performance over the years. In the progress of answering these questions, this study transpired two verdicts. Firstly, the impact of corruption on economic growth appeared to be statistically insignificant when the corruption level is low. By contrast, corruption lowers economic growth when it is rampant. The second finding is that in the past ASEAN member countries have been wrestling with corruption with only a few successfully lower their level of corruption. Moreover, every single one of them have yet to be able to get out of the high corruption group over the years observed in the study.

Before this paper disclose its conclusion in the fifth section, it will exhibit the empirical outcome in the fourth section. Ahead of those section, this paper chronicle existing studies on the second section. The third section will follow that with illustration of methodology and utilized data.

2. Literature Review

There are ample studies which identify proofs that corruption is harmful towards economic growth. One of which is by Mauro (1995) where it states that, after controlling for institutional efficiency, corruption demonstrates a negative correlation with economic growth through impacting both public and private investments. Blackburn, Bose, & Haque (2006) confirm that corruption is harmful to investment and growth. Kaufmann & Wei (2000) along with Guriev (2004)) reveals that corruption generates unpredictability for investors thus countries with rampant corruption have escalating investment risk. Using a meta-analysis approach, Saddiq & Abu Bakar (2019) conclude that six out of 103 studies of corruption indicate that economic and financial crimes hinder economic growth not only in developing countries but also emerging countries. A recent study by Awdeh & Hamadi (2019) has found evidence that corruption is one of determinants that hinders the development of economic activities in Middle East and North Africa (MENA) region. Conversely, there are researches that exposes beneficial impact of corruption on economic development. Meon & Weill (2010) discovered that corruption is barely disadvantageous for countries that are institutionally scarcely effective. In other words, the effect of corruption on economic growth is positively correlated with efficiency for ineffective institutions. Huang (2016) states that despite high corruption levels, South Korea and China are experiencing economic advancement. Colombatto (2003) reports that, for inefficient institution and during political instability, corruption could act as “speed money”. Kato & Sato (2015) discovers that in India, when taking into account the corruption determinants for firm behavior, “greasing the wheels” effect is demonstrated at the firm level. Lučić, Radišić, & Dobromirov (2016) have found the time frame of the interaction between corruption and economic development within the time period from 1995–2011. They come to conclusion that the strongest causality between corruption and economic development appears in the period from 2000–2005. The findings of the direct effect of corruption on economic growth have been inconclusive, depending on the methodology, data sample, and period.

Nonetheless, numerous existing studies that use a linear specification came up with inconclusive outcome. This could mean that countries have distinct production functions and institutional efficiencies that may cause varied effects of corruption. Considering this, some studies find evidence of a non-linear relationship between corruption and growth nexus. Durlauf & Johnson (1995) unearth numerous corruption regimes after delving into a non-linear specification. Governance quality affected the impact of corruption asserted Aidt, Dutta, & Sena (2008). For government with inefficient governance, corruption is beneficial but in the case of good governance corruption is disadvantageous for the government. Bose, Capasso, & Murshid (2008) discovered a corruption threshold which dictates two particular regimes by the level of the corruption. The corruption level is immense and has a destructive effect on growth in the first regime. On the contrary, corruption level is low and it promote growth in the second regime. Both Aidt (2009) and Dzhumashev (2014a) also endorse this discovery. Trabelsi & Trabelsi (2014) have found evidence of an optimal corruption threshold. Both high and low corruption levels can decrease economic growth, and under this optimal threshold, a moderate level of corruption can benefit economic growth. Another study by Ahmad, Ullah, & Arfeen (2012) concludes that the relationship between corruption and economic growth is non-linear, and a decrease in corruption raises the economic growth rate in an inverted U-shaped pattern.

The inconclusive findings regarding the direct effect of corruption on growth have also motivated recent works to investigate the indirect effect of corruption through government expenditure. The studies suggest that there are differences in the productivity of each type of expenditure because the government devotes different resources to each. Dzhumashev (2009) dictates that despite the indirect effect established to be statistically significant, numerous empirical studies failed to attain a robust negative result in regards to the direct impact of corruption. He also finds that the direct effect of corruption appears to hamper economic growth after including the interaction between corruption and government expenditure in estimations. Some scholars find that corruption is likely to favor large projects, such as infrastructure, rather than administrative sectors (Shleifer & Vishny 1993; Mauro 1997). Keefer & Knack (2000) promote the notion that corruption takes part in public expenditure inefficiency which induces rent-seeking through modifying the budget structure. Fisman & Gatti (2002) and Dzhumashev (2014b) have also done studies which back that statement. Moreover, although d'Agostino, Dunne, & Pieroni (2016) found evidences that corruption in investment expenditure would cause a positive effect, the same study concur the notion that when associated with military and consumption expenditure there are adverse consequences to corruption. In contrast with the extant studies, we focused on two components of government expenditure: consumption and investment. Devarajan, Swaroop, & Zou (1996) stated that in order to realize the whole involvement of the government to the economy, it is necessary to measure consumption and investment expenditures. Similarly, d'Agostino, Dunne, & Pieroni (2016) found that investment expenditure is aimed towards conceivably productive sectors and impacted economic growth in the long-term.

In addition, some studies elaborate on some determinant factors of economic growth in ASEAN member countries. Karim, Karim, & Nasharuddin (2018) examine a relationship between corruption and the inflow of foreign direct investment (FDI) in ASEAN-5 countries. They find that the relationship between corruption and GDP is significant for the inflow of FDI. Less corrupt countries can attract a higher inflow of FDI in ASEAN-5 countries. Another study focuses on the relationship between tourism and economic growth in ASEAN countries (Ardra & Martawardaya 2017). This study reveals

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that tourism has also proven to increase GDP per capita and increase the human development index (a measure of poverty reduction). However, no existing studies analyze the relationship between corruption and economic growth and determine the corruption threshold in ASEAN member countries.

Hence, in order to obtain better understanding of the impact of corruption on economic growth, we must focus on a nonlinear relationship to determine the threshold effect among ASEAN member countries and analyze the impacts of corruption on economic growth by accounting for different corruption thresholds. The corruption threshold is measured in this study. In addition, this study evaluates whether corruption may support economic growth or show a growth-deteriorating effect. We examined the effect of corruption on economic growth under different corruption thresholds. In addition, the corruption threshold can be used as a tool to evaluate the position of the corruption level of a country over time. Some countries have succeeded in maintaining a low corruption level, while other countries are struggling with a corruption problem that hinders their economic development process. Interestingly, we evaluated that some countries manage to lower their corruption levels to a low corruption level in a particular year.

3. Method

3.1. Data and the Initial Model

The data cover nine out of the ten ASEAN member countries (Singapore, Malaysia, Indonesia, Cambodia, Thailand, Vietnam, Myanmar, Philippines, and Lao PDR) from 1999 to 2016. The starting year is 1999 because Cambodia became an ASEAN member in 1999. Brunei Darussalam is not included in the dataset because it is not registered in the Corruption Perception Index (CPI) database of Transparency International where we collected our data on corruption.

Prior to introducing the data and variable construction, it is important to outline the baseline model. The focal point of this study is on the relationship of corruption, private investment, government consumption, and investment expenditures with economic growth. The baseline model is as follows:

$$\begin{aligned} \mathrm{y_{it}} &= \alpha_1 + \beta_1(\mathrm{corruption_{it}}) + \beta_2(\mathrm{investment_{it}}) \\ &\quad + \beta_3(\mathrm{govcons_{it}}) + \beta_4(\mathrm{govinvestment_{it}}) \\ &\quad + \beta_5(\mathrm{control\ variable_{it}}) + \mathrm{e_{it}}, \end{aligned} \tag{1}$$

where $\mathrm{y_{it}}$ is the growth rate of gross domestic product (GDP) per capita obtained from the World Bank, proxying economic growth, the subscript i and t are country and period indexes, respectively, and $\mathrm{e_{it}}$ is the error term. Among the independent variables, corruption is measured according to the corruption perception index (CPI) compiled from Transparency International. The CPI ranges from zero to 100, from more corruption to less corruption. However, for practical interpretations, the CPI is reversed; therefore, zero represents less corruption. Private investment (referred to as $\mathrm{investment}$) is the gross fixed capital formation of private investment as a share of GDP.

Government expenditure data are sourced from the International Monetary Fund which encompass two elements, investment ($\mathrm{govinvestment}$) and consumption ($\mathrm{govcons}$), calculated as shares of GDP. Government consumption expenditure includes all current government expenditures involving the purchases of goods and services as well as the compensation of employees (salary). Investment expenditure involves payments for the acquisition of fixed capital assets, stock, land, or intangible assets, such as schools, hospitals or roads. We focused on these two economic classifications for comparison since many studies related to cross-country analyses employ similar classifications. The government investment expenditure is expected to support economic development in developing countries. However, there is an argument that an increase in investment expenditure in a corrupt environment is more likely to create rent-seeking than to promote economic development. A corrupt environment can represent an additional premium on government investment, leading to lower investment opportunities for economic growth (Mauro 1998).

The control variables, which are expected to have immediate impact on economic growth, are sourced from the World Bank. The primary GDP per capita, which is in USD, is utilized as control for the convergence effect of income tiers. The GDP growth rate is anticipated to be adversely related to the primary income at the onset of the dataset. Economic openness is indicated by trade which is generated from the summation of exports and imports as a share of GDP. Mean years of schooling (*schooling*), signifying investment in human capital, is the average number of years of schooling received by part of the population who are 25 years of age or older. In order to obtain the multi-year implication of physical infrastructural development, one-year lags in private investment ($\mathrm{investment\ t-1}$) and government investment expenditure ($\mathrm{govinvestment\ t-1}$) are utilized.

To obtain the effect of corruption through the components of government expenditure, the interaction terms of corruption as well as government investment and consumption expenditures are set as $\mathrm{cor} * \mathrm{govinvestment}$ and $\mathrm{cor} * \mathrm{govcons}$ respectively. In order to acquire the correlation between corruption and private investment there is another variable which is $\mathrm{cor} * \mathrm{investment}$ that portrays the interaction term between corruption and private investment. Dzhumashev (2009) claims that the impact of corruption on economic growth is enhanced when engaging with public spending and private investment. He discovers that the interaction term between corruption and private investment portrays a statistically significant detrimental correlation with economic growth. On the contrary, the interaction term between corruption and public spending unearths a favorable impact on economic growth that is statistically significant.

Due to the possibility of endogeneity problem rising from the causality between corruption and economic growth, we utilized an instrumental variable two-stages least square (2SLS) estimation. However, the direction of causality could switch from economic growth to corruption, vice versa. Paldam (2002) argues that economic growth could reduce corruption because a growing economy tends to pursue more endeavors in order to fight against corruption. A considerable hurdle in most studies that use a 2SLS estimation is the necessity to find an appropriate instrumental variable. In this case, the instrumental variable need to have a correlation with corruption as the endogenous variable but without any correlation with the exogeneous explanatory variables. In order to take into account the causality, age of democracy (denoted as *democracy*) is used as the instrumental variable. The sum of years of perpetual democratic rule that goes back to the year 2000 and varying from zero to 1 is the definition of democracy in this case. This definition and measurement of democracy is identical with Persson, Tabellini, & Trebbi (2003). The democracy need to appropriate with the exclusion constraint and has a connection with economic growth (the dependent variable) solely as a consequence of its impact on corruption (the endogenous variable). Eicher & Leukert (2009) claims that a constitutional arrangement is a vital determinant of corruption. An estimation of political institution can be utilized as a mean for corruption as stated in "Hierarchy of Institutions" hypothesis. Persson & Tabellini (2003) argued that nations with longer democratic tradition have managed corruption effectively. Further, they argued that the age of democracy does not have a direct impact on economic growth.

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The age of democracy is the appropriate instrumental variable to fit the exclusion restriction when compared to other feasible variables which have been exercised in the extant literature. This include but not limited to the problematic ethnolinguistic fractionalization index (Mauro 1995; Aidt 2009; Pellegrini & Gerlagh 2004, among others) as well as voice accountability (Aidt, Dutta, & Sena 2008; Gupta, Davoodi, & Alonso-Terme 2002). Some studies argue that due to public officials being biased for their own ethnic group that leads to bribe-taking, a region which contains various ethnic groups could encourage corruption. Furthermore, separate researches discovered that the ethnolinguistic fractionalization index has correlation with economic growth (Easterly & Levine 1997).

Table 1 shows the descriptive statistics while Table 2 portrays a correlation matrix for the principal variables. Several variables like $\mathrm{govinvestment}$ and $\mathrm{govinvestment\ t-1}$ and $\mathrm{investment}$ and $\mathrm{investment\ t-1}$, illustrate stern multicollinearity problem with correlation coefficients above 0.8 (in order to preserve space, the coefficient is not shown). Therefore, to prevent the complication, those variables are not regressed collectively in the same calculation.

3.2. Threshold Model

Using a nonlinear approach, the existing literature finds multiple thresholds in the relationship between corruption and economic growth (Durlauf & Johnson 1995). Some extensive empirical analyses of the nonlinear approach are conducted by Aidt (2003) and Aidt, Dutta, & Sena (2008). They employ a threshold model refined by Caner & Hansen (2004) which contribute the instrumental variable process in the threshold model calculation. Contrary to Aidt, Dutta, & Sena (2008),this study conducted a sample-splitting and threshold model estimation developed by Hansen (2000) that does not directly address the endogeneity issue and uses the instrumental variable as the threshold estimation of Caner & Hansen (2004). This research holds two different aspects compared with the method utilized by Aidt, Dutta, & Sena (2008). The main difference is that the threshold estimation of Caner & Hansen (2004) is only available for cross-sectional analysis (see Aidt, Dutta, & Sena 2008, p.207) and not for panel data, while this study utilized panel data. Unfortunately, an estimator for structural systems with threshold effects and the instrumental variable have not yet been developed for panel data. Another aspect is that the threshold estimation of Caner & Hansen (2004) handles potential endogeneity within the right-hand-side variable. Nevertheless, this calculation does not take into account the endogeneity of the threshold variable. Aidt, Dutta, & Sena (2008) composes corruption (endogenous) within the right-hand-side variable. Furthermore, the quality of the institution as the threshold variable is expected to be an exogenous variable. Nevertheless, this research constructs corruption as the descriptive variable in the right-hand-side in addition to the threshold variable. If we considered corruption as an endogenous variable both as the right-hand-side and threshold variable, the model of Caner & Hansen (2004) will not be able to handle the circumstances. Therefore, the threshold evaluation of Caner & Hansen (2004) is not applicable for our model. Our optimum alternative is to utilize instrumental variable (2SLS) evaluation separately then assess the connection between corruption and economic growth in the absence of threshold effect to acquire unbiased calculations. Moreover, the threshold assessment of Hansen (2000) also controls for the threshold effect, enabling the data to ascertain potential growth regimes and permitting all parameters in the model to vary in regimes, comparable to the features of the model of Caner & Hansen (2004).

The alternative of the threshold model emphasizes

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Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
gdp per capita growth	162	4.37	4.14	-14.35	13.58
initial gdp per capita	162	3664.20	7637.99	173.65	24936.83
corruption	162	67.38	22.90	7.00	94.00
investment	162	17.70	7.45	2.24	37.64
govcons	162	11.18	6.46	3.46	32.11
govinvestment	162	7.46	3.97	2.01	20.61
trade	162	129.82	101.77	0.17	141.60
schooling	162	7.09	2.56	2.10	15.67

Source: Author's calculation

Table 2: Simple Correlation Matrix

	gdp per capita growth	initial gdp per capita	corruption	investment	govcons	govinvestment	trade	schooling
gdp per capita growth	1.00							
initial gdp per capita	-0.13	1.00						
corruption	0.18	-0.20	1.00					
investment	-0.14	0.58	-0.56	1.00				
govcons	-0.16	-0.06	0.05	0.24	1.00			
govinvestment	0.19	-0.01	0.01	-0.11	0.15	1.00		
trade	0.23	0.68	-0.70	0.59	0.06	-0.02	1.00	
schooling	-0.09	0.40	-0.39	0.43	0.20	0.03	0.39	1.00

Source: Author's calculation

two things. Firstly, the model offers understanding into the significance of estimating the threshold and examining the impact of corruption in distinct corruption regimes. It demonstrates that the impact of corruption differs amidst nations since nations have distinct production functions and quality of institutions. Secondly, among a distinct corruption regime, corruption and economic growth are collectively determined, which indicates that the correlation between corruption and growth is regime specific (Aidt, Dutta, & Sena 2008). Corruption threshold is characterized as a specific number which dictate whether the impact of corruption eon economic growth is growth-enhancing or growth-deteriorating. The threshold figure categorizes corruption, the threshold variable, into two different regimes. The first regime contains nations with corruption level below the corruption threshold while the second regime contains nations with corruption level above the corruption threshold.

Before regressing the model specification to gain the parameter estimates, we need to verify the statistical significance of a threshold effect with the hypotheses as follows:

$$\mathrm{H}_0 : \beta_1 = \beta_2$$
$$\mathrm{H}_1 : \beta_1 \neq \beta_2.$$

A linear regression ($\beta_1 = \beta_2$) fails to reject with the null hypothesis of no threshold. This means that there is no threshold that exist in the calculation. The alternative hypothesis ($\beta_1 \neq \beta_2$) is present in the case of a rejected null hypothesis. Thus, we could determine the existence of a threshold (γ) in the calculation. The significance level of the bootstrap p-value implies the rejection of the null hypothesis. It is also indicated by the threshold value supposing the p-value is below the 5 percent significance level.

Following that we need to ascertain the threshold value (γ). The model composes the confidence regions on the bases of the likelihood ratio statistic $(\mathrm{LR_n}(\gamma))$ in order to acquire the confidence interval for the threshold value (γ). With regards to the heteroscedasticity-robust assumption, likelihood ratio statistic is inscribed as follows:

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$$\mathrm{LR_n}(\gamma) = \frac{\mathrm{S_n}(\gamma) - \mathrm{S_n}(\hat{\gamma})}{\mathrm{S_n}(\hat{\gamma})},$$

The likelihood ratio is $\mathrm{LR_n}(\gamma)$ while the residual sums of squares under the null $\mathrm{H_0} : \beta_1 = \beta_2$ and alternative $\mathrm{H_1} : \beta_1 \neq \beta_2$ are $\mathrm{S_n}(\gamma)$ and $\mathrm{S_n}(\gamma)$, respectively. The model sets a critical value with the confidence level of 95 percent which is accessible in Hansen (2000, p.582). By means of plotting the likelihood ratio to the threshold value estimate (γ) and the critical value, the threshold value is acquired. A visual method could aid in presenting the threshold value that is acquired when the likelihood ratio line intersect with the critical value line in a specific number. Furthermore, the threshold model uses the bootstrapping process and assists the creation of confidence level regions with 1000 reiterations for every regression. The first, second, and multiple thresholds are tested consecutively. The bottom of every model specification in the calculation results discloses the bootstrap p-value and 95 percent confidence interval.

After the threshold testing concludes in proof of the first threshold, we started to regress the estimation in order to discover the parameter estimates. For the purpose of dividing the samples into two regimes, the first threshold is utilized. The first regime contains the nations whose corruption levels are below the threshold value. Moreover, the impact of corruption is deliberated to portray the proof of "greasing the wheel" hypothesis on economic growth. Conversely, the second regime contains the nations that have corruption level above the threshold and thus undergo growth-deterioration.

The baseline estimations are as follows:

$$\mathrm{y_{it}} = \beta_1 \mathrm{X_{it}} + \mathrm{e_{it}} \quad \text{if} \quad \mathrm{corruption_{it}} \leq \gamma \qquad (2)$$

$$\mathrm{y_{it}} = \beta_2 \mathrm{X_{it}} + \mathrm{e_{it}} \quad \text{if} \quad \mathrm{corruption_{it}} > \gamma, \qquad (3)$$

$\mathrm{y_{it}}$ stand for the growth rate of gross domestic product (GDP) per capita, the subscript i designates the country, the subscript t designates the period, and $\mathrm{e_{it}}$ portrays the error term. Corruption is a threshold variable, γ signify the threshold value that splits the threshold variable into two regimes, while $\mathrm{X_{it}}$ which composed of corruption, private investment, government consumption expenditure, and investment expenditure is the essential explanatory variables and a vector of the control variables. Since this study focuses not only on the corruption threshold but also on the effect of corruption on growth, corruption is considered under both explanatory and threshold variables, following the baseline estimation of Hansen (2000, p.577). The model allows the parameter estimates to vary depending on the threshold value. Bose, Capasso, & Murshid (2008) use a similar approach and report no statistical problem arising from the equation. Equations (1) and (2) can be written in a single regression form as follows:

$$\begin{aligned}\mathrm{y_{it}} &= \beta_1 \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} \leq \gamma) \\ &\quad + \beta_2 \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} > \gamma) + \mathrm{e_{it}}, \qquad (4)\end{aligned}$$

where $\mathrm{y_{it}}$, $\mathrm{corruption_{it}}$, γ, $\mathrm{e_{it}}$, and $\mathrm{X_{it}}$ are as above, and I(.) is an indicator function of the threshold variable.

The model considers the presence of multiple thresholds by deriving a sample-splitting technique to test for the second and multiple thresholds. Further testing for the presence of a second threshold using data splitting is performed by employing the following equation:

$$\begin{aligned}\mathrm{y_{it}} &= \beta_1 \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} \leq \gamma_1) \\ &\quad + \beta_2 \mathrm{X_{it}} \mathrm{I}(\gamma_1 < \mathrm{corruption_{it}} \leq \gamma_2) \\ &\quad + \beta_3 \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} > \beta_2) + \mathrm{e_{it}}, \qquad (5)\end{aligned}$$

The multiple-threshold (j-thresholds) equation is as follows:

$$\begin{aligned}\mathrm{y_{it}} &= \beta_1 \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} \leq \gamma_1) \\ &\quad + \sum_{\mathrm{j}=2}^{\mathrm{J}-1} \beta_2 \mathrm{X_{it}} \mathrm{I}(\gamma_{\mathrm{j}-1} < \mathrm{corruption_{it}} \leq \gamma_{\mathrm{j}}) \\ &\quad + \beta_{\mathrm{j}} \mathrm{X_{it}} \mathrm{I}(\mathrm{corruption_{it}} > \gamma_{\mathrm{j}}) + \mathrm{e_{it}}, \qquad (6)\end{aligned}$$

where y_{it}, $corruption_{it}$, γ, e_{it}, and X_{it} are as above, and I(.) is an indicator function of the threshold variable.

Moreover, proof for the second threshold is supported by the existence of the first threshold. Nevertheless, the value of the second threshold is remarkably erratic. A sample-splitting technique-based output procedure is supplied by this model. Firstly, the sample is divided into two subsamples dependent on the first threshold value, at which point the exact procedure can be done to assess the statistical significance of a second threshold impact on every subsample.

4. Results

4.1. The Threshold Model Estimation Results

We concluded two separate processes in order to functionalize the threshold model. Initially, we calculated equation (4) to verify for the existence of the first corruption threshold. The p-value exposes that the null hypothesis of no thresholds is rejected 5 percent significance level. The conclusions affirm the existence of the first threshold at a corruption level of 69. A visual approach (graph 1) could help demonstrate that the threshold value of 69 is acquired whenever the likelihood ratio statistic (blue line) exceed the critical value of 7.35 (red line) (Hansen 2000, p.582). Consequently, because threshold testing uncovers the appearance of the first threshold, we continue to measure the parameters in the model specification of equation (4). The threshold model divides the countries into two separate regimes dependent on the first corruption threshold. The first regime contains nations with corruption level under the corruption threshold value of 69. Whereas, the second regime contains nations with corruption levels beyond the threshold value of 69. We are able to investigate the impact of corruption on economic growth either in the first and second regimes because the threshold model provides for the measured coefficients to differ for the first and second regimes. The calculation conclusions for the first threshold are shown in Table 4.

Furthermore, the existence of the first threshold signifies the possibility of the second threshold. We divide the sample into two subsamples in accordance with the first threshold because the second threshold value is significantly indefinite. Following that we constructed an akin threshold testing as the first threshold using equation (4) for those two subsamples. Whenever testing the existence of the second threshold, the p-value illustrates a significance level below 5 percent which signifies the existence of the second threshold.

The next step is obtaining the threshold value estimate and estimating the parameters in the model specification. Using the likelihood ratio statistic, we obtained the second threshold of 80. Graph 2 provides visual information when the likelihood ratio statistic (blue line) crosses the critical value (red line). Two regimes are constructed based on the second threshold value. The first regime consists of countries with corruption levels between 69 and 80. The second regime is for countries with corruption levels above 80. Similar to the first threshold, in the second threshold, the model allows for the estimated coefficient to vary in regimes regarding the second threshold value. The estimation results for the second threshold are demonstrated in Table 5. Stata program is used to produce all the graphs and supplied by the threshold model of Hansen (2000). The bottom of every column in Tables 4 and 5 disclosed the threshold value, 95 percent confidence interval, bootstrap p-value, number of observations, and R-squared. Table 3 compiled the first and second threshold values, p-values, and the 95 percent confidence interval for all specifications in columns (1) through (7).

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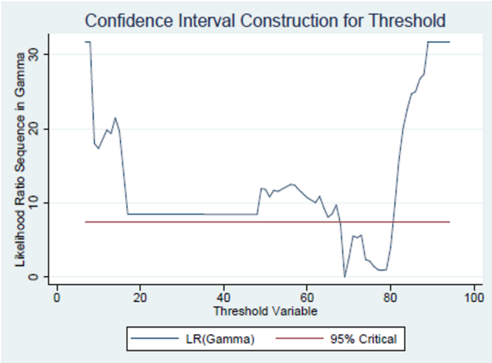
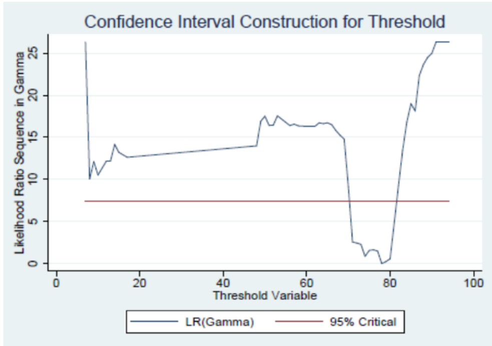


Graph 1. The First Threshold Value



Graph 2. The Second Threshold Value

Table 3: Corruption Threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
First Threshold	69	69	69	69	69	69	69
Bootstrap p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95% Confidence Interval	17; 80	68; 80	17; 80	17; 80	17; 80	48; 80	68; 80
Second Threshold	80	80	80	80	80	80	80
Bootstrap p-value	0.000	0.000	0.000	0.035	0.000	0.010	0.017
95% Confidence Interval	70; 81	72; 81	72; 81	72; 81	75; 81	72; 81	72; 81

Source: Author's calculation

Referring to the model specifications in Tables 4 and 5, column (1) is used as the reference point on top of being the controls for corruption, private investment, government consumption, and investment expenditures. While the addition of initial GDP per capita, trade, and schooling to the prior stipulation are portrayed in column (2). Implementation of the impact of one-year lagged private investment is shown in column (3). Whereas the implementation of the impact of one-year lagged government investment expenditure is indicated in column (4). Both columns are done in order to examine the multi-year impact of investment on economic growth. Whilst column (5) is where the model got introduced to the interaction term between corruption and private investment. Lastly, column (6) and column (7) include the interaction terms of corruption as well as government consumption and investment expenditures are included, respectively.

Table 4 reports the estimation results for the first corruption threshold. Corruption may negatively affect economic growth in the second regimes and is statistically significant at 1 percent significance level in the second regime in columns (1) through (7). Unlike the countries in the first regime that has corruption level below the first corruption threshold of 69, the countries within the second regime have higher corruption level. The effect of corruption seems statistically insignificant for countries with corruption levels below the first corruption threshold of 69. This finding confirms the neo-classical theory that corruption hampers economic growth of countries with a severe corruption problem.

Private investment shows a growth-enhancing effect in regimes in most specifications. However, the one-year lagged private investment reveals a growth-enhancing effect only in the first regime for countries with low corruption levels. It is worth noting that most of the ASEAN member countries have achieved rapid and favorable economic growth to the middle-income level; however, they pose economic stagnation, being entrapped in the middle-income level over time. In the study from the World Bank, Yusuf & Nabeshima (2009) provide evidence

Table 4: Threshold Model Estimation Results – The First Threshold

Dependent variable:	(1)		(2)		(3)		(4)	
real GDP per capita growth	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$
corruption	-0.005	-0.021***	-0.045	-0.168***	-0.013	-0.372***	-0.089	-0.165***
	(0.094)	(0.053)	(0.084)	(0.065)	(0.100)	(0.103)	(0.085)	(0.063)
investment	0.036***	0.094**	0.072***	0.126*			0.069***	0.132*
	(0.005)	(0.044)	(0.006)	(0.081)			(0.006)	(0.082)
govcons	-0.167***	-0.151*	-0.201***	-0.014*	-0.217***	-0.080**	-0.245***	-0.036***
	(0.015)	(0.094)	(0.016)	(0.008)	(0.089)	(0.041)	(0.017)	(0.008)
govinvestment	0.077***	0.184*	0.103***	0.179*	0.131***	0.063***		
	(0.013)	(0.108)	(0.014)	(0.095)	(0.015)	(0.012)		
initial gdp per capita			-0.0001***	-0.004***	-0.0010***	-0.006***	-0.0030***	-0.004***
			(0.0003)	(0.001)	(0.0004)	(0.002)	(0.0002)	(0.001)
trade			0.014***	0.032***	0.009***	0.036***	0.012***	0.032***
			(0.002)	(0.008)	(0.001)	(0.010)	(0.002)	(0.008)
schooling			0.175	0.180	0.009	0.207	0.175	0.178
			(0.219)	(0.139)	(0.185)	(0.151)	(0.221)	(0.144)
investment (t-1)					0.084***	0.185		
					(0.010)	(0.130)		
govinvestment (t-1)							0.042***	0.185**
							(0.015)	(0.086)
cor*investment								
cor*govcons								
cor*govinvestment								
threshold value	69		69		69		69	
95% Confidence Interval	[17,80]		[68,80]		[17,80]		[17,80]	
Bootstrap p-value	0		0		0		0	
Obs	54	108	54	108	54	108	54	108
R2	0.029	0.415	0.048	0.474	0.096	0.486	0.042	0.476

Dependent variable:	(5)		(6)		(7)	
real GDP per capita growth	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$	1^{st} regime $\text{cor} \leq 69$	2^{nd} regime $\text{cor} > 69$
corruption	-0.038	-0.041***	-0.112	-0.166***	-0.076	-0.182***
	(0.081)	(0.056)	(0.108)	(0.068)	(0.083)	(0.067)
investment	0.024**	0.099**	0.067**	0.137*	0.070**	0.139*
	(0.010)	(0.040)	(0.029)	(0.081)	(0.038)	(0.081)
govcons	-0.300**	-0.024***	-0.225*	-0.015**	-0.262*	-0.016**
	(0.145)	(0.009)	(0.128)	(0.008)	(0.136)	(0.008)
govinvestment	0.155***	0.069***	0.195***	0.077***	0.255***	0.067**
	(0.042)	(0.016)	(0.014)	(0.026)	(0.042)	(0.026)
initial gdp per capita	-0.0004*	-0.0039***	-0.0006**	-0.0043***	-0.00041**	-0.0044***
	(0.0002)	(0.001)	(0.0003)	(0.001)	(0.0002)	(0.001)
trade	0.016***	0.031***	0.014***	0.031***	0.014***	0.031***
	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)	(0.008)
schooling	0.176	-0.181	0.172	-0.180	0.192	-0.180
	(0.222)	(0.139)	(0.221)	(0.139)	(0.214)	(0.139)
investment (t-1)						
govinvestment (t-1)						
cor*investment	-0.002**	-0.001*				
	(0.001)	(0.0007)				
cor*govcons			-0.004	-0.001		
			(0.003)	(0.010)		
cor*govinvestment					-0.001	-0.003**
					(0.003)	(0.001)
threshold value	69		69		69	
95% Confidence Interval	[17,80]		[48,80]		[68,80]	
Bootstrap p-value	0		0		0	
Obs	54	108	54	108	54	108
R^2	0.026	0.418	0.053	0.474	0.043	0.475

Source: Author's calculation

Notes: The dependent variable is GDP per capita growth rate.
The asterisks stand for the p-value significance levels (*p<0.1; **p<0.05; ***p<0.01).
Standard errors are in parentheses.
At the bottom of each regime, threshold level, 95% confidence interval, the bootstrap p-value, number of observations and joint R2, are reported.
Estimation was performed using a code written by Hansen (2000) for Stata.
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of the Malaysian economic stagnation and how it fails to nurture industrial innovation. However, other countries may have a different cause of economic stagnation.

Consumption expenditure appears to hinder economic growth and is statistically significant in regimes in all specifications. On the other hand, government investment expenditure is found to support economic growth in regimes in all specifications. The one-year lag in government investment expenditure seems to promote economic growth, and the multi-year effect of government investment seems to be stronger for all countries in both the first and second regimes. These results are consistent with the findings by Mauro (1997) and suggest that government investment expenditure significantly contribute to the economic performance of the ASEAN member countries. Likewise, trade seems to enhance economic growth both in the first and second regimes and is statistically significant at 1 percent significance level in most specifications. This finding confirms the theoretical assumption that trade is a factor contributing to economic development and expected to support the economy in developing countries. The remarkable increase of FDI benefits from the abundant supply of inexpensive labor available in the industrial sector of most Southeast Asian countries. Schooling shows no statistical significance in regimes in most specifications. Cohen & Soto (2007) argue that the accumulation of human capital is expected to generate long-term, sustainable economic growth; however, observed from the empirical results, human capital does not appear to be the growth-enhancing factor.

By utilizing the interaction terms between corruption and the focus variables, as shown in column (5) through (7), we could pinpoint the impact of corruption via private investment and elements of government expenditure. The focus variables used here are private investment, government consumption, and investment expenditures. Brambor, Clark, & Golder (2006) suggest the application of a marginal plot to evaluate the marginal effect of each variable in the interaction term. Berry, Golder, & Milton (2012) explain that when two constitutive variables interact (for example, X and Z), there are two ways to interpret the marginal effects in an interaction model. First, following the example above, we can take variable Z as a conditioning variable that alter the effect of variable X on Y, the dependent variable. Likewise, with the conditioning variable, X, it modifies the effect of Z on Y. Hansen (2000) threshold model dissect the threshold effect in the estimation with a clear-cut manner. The computation of marginal effects in the post estimation evaluations is not integrated in the threshold model. On the contrary, In the threshold model we comprehend the relationship between the marginal effect of corruption and the conditioning variables, which are private investments, government consumption, and investment expenditures. When the coefficient estimates of the interacting variables are used, the perceptions of the interaction terms are clear-cut because the threshold model cannot compute the marginal effects. Therefore, in order to be able to increase the substantial information from the interactive models, we recommend the program developer development of post estimation tests which encompass marginal effects and marginal plots.

Regarding the effect of corruption through private investment and the components of government expenditure, the effect of corruption that depends on private investment reveals a negative association with economic growth in regimes in column (5). The impact of corruption on the economic growth that depends on consumption expenditure appears statistically insignificant in column (6). Moreover, the effect of corruption on the economic growth that is conditional on investment expenditure can be a threat to economic growth only in the second regime in column (7). These results confirm the findings by Dzhumashev (2009). He finds that the effect of corruption through private investment and government expenditure on economic growth is stronger than their direct effect on growth.

Table 5 reports the results from the second threshold. The estimation results are constructed for both the first and second regimes based on the corruption threshold value of 80. The first regime displays the estimated parameters for countries with corruption levels between 69 and 80 using 63 observations. The second regime shows the estimated parameters for countries with corruption levels above 80 using 45 observations. All the estimation results for the second threshold are presented in Table 5.

The model specifications in Table 5 are similar to the ones in Table 4 for the first threshold. In all estimations, corruption seems to hinder economic growth in regimes, and it is statistically significant. The adverse effect of corruption appears more robust in the second regime than in the first regime. An increase of 1 level of corruption will reduce economic growth by 0.182 to 0.404 percent in the second regime, while it only decreases economic growth by 0.093 to 0.203 percent in the first regime. Private investment indicates a supporting effect on economic growth and is statistically significant at 5 percent only in the first regime that comprises countries with low corruption levels. Similar to private investment, lagged private investment indicates a positive impact on growth in the first regime. This finding suggests that private investment seems to have a convincing supporting impact on growth for countries with low corruption levels.

In summary, consumption expenditure negatively impacts economic growth in the first regime in most specifications and is statistically significant. In contrast, government investment expenditure is found to be statistically insignificant in regimes in most specifications. Trade encourages economic growth in regimes in most specifications. However, the effect of schooling in ASEAN member countries is statistically insignificant in most specifications.

The effects of corruption on the economic growth that are conditional on the components of government expenditure indicate a growth-deteriorating effect both for consumption and investment expenditures. The effects are statistically significant at 1, 5 and 10 percent significance levels in all regimes in columns (6) and (7). Conversely, the effect of corruption on economic growth which rely upon private investment is statistically insignificant in column (5) in all regimes.

4.2. The Groups of Countries Based on Corruption Threshold

Based on the first and second corruption threshold values in the estimation results, this research proposes that corruption thresholds provide a measurement to evaluate the corruption performance of a country. According to the corruption thresholds found in the empirical results, we questioned whether over time a country's corruption level has decline or flourish. Contrary to Bose, Capasso, & Murshid (2008), we grouped countries based on their corruption thresholds revealed in the estimation in lieu of income level and geographical location. This decision is made based on our aim to assess which countries manage to lower their level of corruption and which countries unable to do so over time.

First, the initial threshold values at 69 and 80 for the second threshold are utilized to analyze the corruption performance of the countries. The countries are divided into three groups: the first group comprises countries with corruption levels below 69, the second group with corruption levels between 69 and 80, and the third group with corruption levels above 80.

According to Table 6, most ASEAN member countries are grouped under the middle corruption group.

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Table 5: Threshold Model Estimation Results – The Second Threshold

Dependent variable:	(1)		(2)		(3)		(4)	
real GDP per capita growth	1^{st} regime	2^{nd} regime	1^{st} regime	2^{nd} regime	1^{st} regime	2^{nd} regime	1^{st} regime	2^{nd} regime
	69<cor≤80	cor≥80	69<cor≤80	cor≥80	69<cor≤80	cor≥80	69<cor≤80	cor≥80
corruption	-0.093*	-0.182***	-0.191**	-0.305***	-0.107**	-0.289***	-0.190**	-0.314**
	(0.055)	(0.015)	(0.098)	(0.017)	(0.013)	(0.073)	(0.099)	(0.173)
investment	0.073	0.055	0.206**	0.041			0.200**	0.075
	(0.088)	(0.106)	(0.094)	(0.096)			(0.094)	(0.129)
govcons	-0.362***	-0.205	-0.128**	-0.376	-0.562	-0.230	-0.123**	-0.431
	(0.065)	(0.231)	(0.065)	(0.253)	(0.615)	(0.072)	(0.060)	(0.289)
govinvestment	0.023	0.068	0.147	0.008	0.215	0.042***		
	(0.124)	(0.167)	(0.099)	(0.144)	(1.559)	(0.153)		
initial gdp per capita			-0.003***	-0.007**	-0.0038***	-0.004***	-0.003***	-0.008**
			(0.001)	(0.003)	(0.001)	(0.000)	(0.001)	(0.004)
trade			0.038***	0.029*	0.122**	0.007	0.051***	0.030*
			(0.010)	(0.016)	(0.051)	(0.011)	(0.010)	(0.017)
schooling			0.079	-0.303	0.046	-0.093	0.079	-0.306
			(0.119)	(0.275)	(0.514)	(0.154)	(0.119)	(0.269)
investment (t-1)					1.220***	-0.008		
					(0.484)	(0.087)		
govinvestment (t-1)							0.119	0.090
							(0.102)	(0.223)
cor*investment								
cor*govcons								
govinvestment								
Threshold value	80		80		80		80	
95% Confidence Interval	[70,81]		[72,81]		[72,81]		[72,81]	
Bootstrap p-value	0.000		0.016		0.000		0.035	
Obs	63	45	63	45	63	45	63	45
R^2	0.338	0.526	0.594	0.559	0.553	0.486	0.591	0.561

Dependent variable:	(5)		(6)		(7)	
real GDP per capita growth	1^{st} regime	2^{nd} regime	1^{st} regime	2^{nd} regime	1^{st} regime	2^{nd} regime
	69<cor≤80	cor≥80	69<cor≤80	cor≥80	69<cor≤80	cor≥80
corruption	-0.221***	-0.288**	-0.203**	-0.343**	-0.102**	-0.404**
	(0.083)	(0.150)	(0.099)	(0.156)	(0.049)	(0.166)
investment	0.207**	-0.059	0.205**	-0.036	0.205**	-0.043
	(0.094)	(0.105)	(0.094)	(0.097)	(0.093)	(0.096)
govcons	-0.121	0.612**	-0.128**	0.379	-0.131	0.379***
	(0.071)	(0.232)	(0.065)	(0.254)	(0.066)	(0.254)
govinvestment			-0.147	-0.002		
			(0.100)	(0.142)		
initial gdp per capita	-0.003***	-0.006	-0.003***	-0.008**	-0.002***	-0.008**
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
trade	0.036*	0.030*	0.043***	0.029*	0.043***	-0.029
	(0.019)	(0.016)	(0.014)	(0.016)	(0.010)	(0.016)
schooling	0.079	-0.304	0.069	-0.304	0.079	-0.304
	(0.120)	(0.276)	(0.119)	(0.274)	(0.119)	(0.274)
investment (t-1)						
govinvestment (t-1)						
cor*investment	-0.003	-0.005				
	(0.001)	(0.011)				
cor*govcons			-0.002**	0.004***		
			(0.001)	(0.001)		
govinvestment					-0.002*	-0.0052***
					(0.001)	(0.002)
Threshold value	80		80		80	
95% Confidence Interval	[75,81]		[72,81]		[72,81]	
Bootstrap p-value	0.000		0.010		0.017	
Obs	63	45	63	45	63	45
R^2	0.590	0.525	0.593	0.557	0.594	0.559

Source: Author's calculation

Notes: The dependent variable is GDP per capita growth rate.
The asterisks stand for the p-value significance levels (*p<0.1; **p<0.05; ***p<0.01).
Standard errors are in parentheses.
At the bottom of each regime, threshold level, 95% confidence interval, the bootstrap p-value, number of observations and joint R2, are reported.
Estimation was performed using a code written by Hansen (2000) for Stata.
The script is available on request.

Table 6: Country Groups Based on Corruption Threshold

Country	First Group corruption≤69	Second Group 69<corruption≤80	Third Group corruption>80
	Period	Period	Period
Indonesia		1999 & 2007–2016	2000–2006
Cambodia		1999–2006	2007–2016
Lao PDR		2015–2016	1999–2014
Myanmar			1999–2016
Malaysia	2000	1999 & 2001–2016	
Philippines		1999–2016	
Singapore	1999–2016		
Thailand		1999–2016	
Vietnam		1999–2016	

Source: Author's calculation

Myanmar remains in the high corruption group and Singapore in the low corruption group over the years of the study. The Philippines, Thailand, and Vietnam belong to the middle corruption group. Moreover, Indonesia experiences a declining level of corruption from 2000-2006 and joins the middle corruption group in 2007. Lao PDR shows a similar performance to Indonesia. The corruption level of Lao PDR declines from 2015–2016. In contrast, Malaysia manages to lower its corruption level in 2000, rising back to the middle-income group from 2001 to 2016. However, Cambodia suffers from a corruption problem. Cambodia shifts to the high corruption group from 2007 to 2016.

Global financial crises, war, and political instability may be the reasons why corruption has become a severe problem over the years in ASEAN member countries. The Asian financial crisis in 1998 hit the economies of the Southeast Asia countries including ASEAN member countries. Observed from Table 6, following the Asian financial crisis period, eight out of nine ASEAN member countries, excluding Singapore, face a corruption problem and are located in the middle and high corruption groups. In addition, the threshold approach may be too restricted for evaluating the complexity of corruption, although it may provide insights for assessing whether corruption in a country has been improving or regressing compared to other countries.

4.3. Instrumental Variable Estimation Results

We recognized the apparent endogeneity issue from the connection between corruption and growth which have yet to be addressed appropriately by the threshold model of Hansen (2000). Thus, to solve the case we went ahead to calculate the 2SLS estimator.

In 2SLS estimation, we applied the growth equation as follows:

$$\begin{aligned} \mathrm{y_{it}} &= \alpha + \beta_1 \mathrm{corruption_{it}} + \beta_2 \mathrm{investment_{it}} \\ &\quad + \beta_3 \mathrm{govcons_{it}} + \beta_4 \mathrm{govinvestment_{it}} \\ &\quad + \beta_5 \mathrm{X_{it}} + \theta_\mathrm{t} + \theta_\mathrm{i} + \varepsilon_\mathrm{it}, \end{aligned} \tag{7}$$

GDP per capita growth rate is portrayed as $\mathrm{y_{it}}$. The focus explanatory variables are written as $\mathrm{corruption_{it}}$, $\mathrm{investment_{it}}$, $\mathrm{govcons_{it}}$, $\mathrm{govinvestment_{it}}$. The vector of the control variables is denoted as $\mathrm{X_{it}}$. Country fixed effect is θ_i while year fixed effects it θ_t. Lastly, the error term is indicated by ε_it. The correlation between corruption and error term could produced estimation bias, thus the age of democracy is used to correct the estimation bias while corruption is taken as an endogenous variable. $\mathrm{dem*investment}$, $\mathrm{dem*govcons}$, and $\mathrm{dem * govinvestment}$ denoted the instruments for the interaction term variables of $\mathrm{cor * investment}$, $\mathrm{cor * govcons}$, and $\mathrm{cor * govinvestment}$ respectively.

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Table 7 displays the 2SLS estimation results. Validity checks are properly performed to test the instruments and model specifications. In the application of the age of democracy as the instrumental variable, the Hansen J statistics of over identification test reject the null hypothesis and imply that the instruments are fully identified, and the R-squared values show reasonable coefficients. The Kleibergen-Paap rk LM-statistic's *p*-values for the under-identification test reject the null hypothesis, implying that the equation is full rank and fully identified. The F-statistic for weak identification tests contain values greater than the Stock-Yogo critical values indicating that the instruments are not weak. The rule of thumb for weak identification tests is that the F-statistic values must be above 10 or greater than the Stock-Yogo critical values. The assumption that corruption is endogenous is tested using a C-test, and the result confirms that the corruption variable is endogenous. The F-statistics, R-squared values, under-identification test results, weak identification test results, Stock-Yogo critical values and Hansen J statistics are available at the bottom of each estimation. The model specifications in Table 7 from columns (1) through (7) are similar to the specifications in the threshold model. The country and year fixed effects are included in all estimations. We controlled for heteroscedasticity-robust estimations in all estimations.

Corruption reveals a growth-deteriorating effect on economic growth for all specifications in columns (1) through (7) and is statistically significant at 1 percent level. This finding confirms the existing literature, among others that of Mauro (1995), Tanzi & Davoodi (1998), Aghion, Alesina, & Trebbi (2004), and Blackburn, Bose, & Haque (2006), demonstrating that the adverse effects of corruption in developing countries hinder economic growth. Private investment becomes a supporting factor to economic growth and is statistically significant at 10 percent level in most estimations. Interestingly, emerging countries, such as Malaysia, Indonesia, and Thailand, display a unique fact. Despite their high corruption levels, they show economic growth in Asia, primarily through industrialization.

Consumption and investment expenditures indicate a growth-enhancing effect for the ASEAN member countries in most specifications and are statistically significant. Different from the threshold model, the effect of government consumption expenditure changes to enhancing economic growth and is statistically significant after controlling for the endogeneity problem. Trade consistently performs as the factor contributing to economic growth in most specifications. The effect of schooling as human capital investment tends to show a statistically insignificant effect on economic growth.

The computation of the marginal effects of corruption in columns (5) through (7) is the primary focus of the interaction models. The impact of corruption by way of private investment and government expenditures is investigated. As shown by columns (5), (6), and (7), the marginal impact of corruption towards the economic growth which relies on private investment and the components of government expenditure unveils a growth-deteriorating consequence, statistically significant at 1 and 10 percent levels. The results confirm the finding by Dzhumashev (2009) that the interaction terms between corruption and government spending become stronger than the direct effect of corruption without applying the interaction terms. In contrast, the marginal effects of private investment and the components of government expenditure on the economic growth that are conditioned on corruption are found to be positive and statistically significant at 1 and 5 percent levels. After controlling for the endogeneity issue using 2SLS estimation, we found that the adverse effect of corruption on economic growth is convincing.

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Table 7: The Two-Stages Least Squares Estimation Results without Threshold Effect

Dependent variable: GDP per capita growth rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)
corruption	-0.409***	-0.412***	-0.389***	-0.403***	-0.472**	-0.439***	-0.482***
	(0.125)	(0.122)	(0.128)	(0.105)	(0.207)	(0.138)	(0.159)
investment	0.085*	0.089*		0.102*	0.096*	0.085**	0.098*
	(0.052)	(0.051)		(0.052)	(0.051)	(0.042)	(0.061)
govcons	0.161*	0.213**	0.271***	0.317***	0.238*	0.213**	0.121*
	(0.093)	(0.095)	(0.093)	(0.063)	(0.138)	(0.108)	(0.071)
govinvestment	0.171**	0.149*	0.204**		0.167*	0.142*	0.148**
	(0.082)	(0.084)	(0.079)		(0.091)	(0.081)	(0.075)
initial gdp per capita		-0.00071***	-0.00061***	-0.00064***	-0.00071**	-0.00072***	-0.00076***
		(0.0002)	(0.00019)	(0.00018)	(0.00029)	(0.00016)	(0.00025)
trade		0.034**	0.029*	0.029**	0.041*	0.036**	0.041**
		(0.015)	(0.016)	(0.013)	(0.023)	(0.017)	(0.017)
schooling		0.053	0.095	0.066	0.092	0.063	0.042
		(0.161)	(0.159)	(0.163)	(0.173)	(0.166)	(0.179)
investment (t-1)			0.084				
			(0.073)				
govinvestment (t-1)				0.201**			
				(0.079)			
cor*investment					-0.064		
					(0.166)		
cor*govcons						-0.030***	
						(0.011)	
cor*govinvestment							-0.099***
							(0.017)
marginal effect of corruption					-0.286***	-0.186*	-0.134***
					(0.088)	(0.112)	(0.025)
marginal effect of investment					0.077*		
					(0.043)		
marginal effect of govcons						0.128*	
						(0.079)	
marginal effect of govinvestment							0.091**
							(0.084)
R-squared	0.86	0.84	0.85	0.74	0.64	0.64	0.71
F-statistic (p-value)	76.39 (0.00)	73.35 (0.00)	98.4 (0.00)	87.83 (0.00)	91.4 (0.00)	90.89 (0.00)	87.76 (0.00)
Country fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes
Heteroskedasticity-robust	yes	yes	yes	yes	yes	yes	yes
Under-identification test:							
rk LM statistic (p-value)	33.87 (0.00)	43.76 (0.00)	23.10 (0.00)	35.73 (0.00)	35.20 (0.00)	26.57 (0.00)	20.30 (0.00)
Weak identification test:							
Cragg-Donald Wald F-statistic	88.93	90.16	96.45	88.86	95.55	38.49	42.02
Kleibergen-Paap rk Wald F-statistic	49.76	52.57	49.93	52.45	49.99	66.953	28.47
Stock-Yogo weak ID test critical value:							
10% maximal IV size= 16.38							
Hansen J statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	162	162	162	162	162	162	162

Source: Author's calculation

Notes: The dependent variable is GDP per capita growth rate.
The asterisks stand for the p-value significance levels (*p<0.1; **p<0.05; ***p<0.01).
Standard errors are in parentheses.
At the bottom of each column, joint R^2, F-statistic (p-value), country and year fixed effects, heteroskedasiticity robust, under-identification test (p-value), weak identification test, Stock-Yogo weak ID test critical value, overidentification test (Hansen J Statistic) and number of observations, are reported.

5. Conclusion

To conclude, this study proposes that calculating the corruption threshold contributes an improved comprehension of the effect of corruption on economic growth. Sample-splitting and threshold model is a distinct method to calculate the corruption threshold. The model allows corruption and other parameter estimates that directly affect economic growth to vary in regimes. We could then analyze their effects on economic growth based on their corruption levels.

The view that the government sector is a source of corruption has increased the interest in the effect of corruption through the components of government expenditure. From the estimation results, corruption has no significant adverse effect on economic growth for countries with corruption levels below

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the first threshold of 69; in contrast, the effect of corruption may hinder the economies of high corruption countries when the corruption level reaches the second corruption threshold of 80. Another finding is that the effect of corruption is convincing and stronger when corruption interacts with private investment and the components of government expenditure. The marginal effects of corruption on the economic growth that depends on private investment and the components of government expenditure reveal a growth-deteriorating effect and statistically significant at 1 and 10 percent levels. In contrast, the marginal effects of private investment and the components of government expenditure on the economic growth that are conditioned on corruption are found to be positive and statistically significant at 1 and 5 percent levels after controlling for the endogeneity problem by using the instrumental variable. Over the years, the governments of ASEAN member countries with high corruption levels have implemented serious efforts to combat corruption and have managed to lower their corruption levels below the threshold. Simultaneously, with corruption eradication actions, governments need to allocate more resources towards investments and efficiently manage consumption expenditures.

Furthermore, the corruption threshold can evaluate the corruption performance of a country over the years. Singapore has succeeded in maintaining its corruption level below the threshold over the years in this study. On the other hand, Myanmar is struggling with a serious corruption problem. Some countries (Vietnam, Thailand, and the Philippines) has managed to lower their corruption level; yet, they are positioned in the middle corruption group. Indonesia and Lao PDR has succeeded and shifted to the middle corruption group while Cambodia fails to maintain its corruption level in the middle, shifting to the high corruption group. Likewise, Malaysia is struggling to maintain its corruption level in the middle corruption group. None of them has succeeded to shift to the low corruption group over the years of the study. The evaluation of the corruption performance of a country may provide a better understanding on how a government should act to reduce its corruption level.

This study limitation is the calculation of the marginal effects in the interaction models, particularly in the threshold model. We suggest that, in future studies, the development of post estimation tests in the threshold model includes marginal effects and marginal plots to improve the research testing theories in the interaction models. This research demonstrates that the corruption threshold can represent an indicator for governments among ASEAN member countries to act when its effects impede the economy. The corruption threshold can function as a tool to evaluate whether the corruption level of a country is improving or declining. The pattern for the ASEAN member countries might differ from those of other regions. Hence, it is recommended that further researches consider data specific to other regions or across regions.

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