Corruption in Indonesia, Challenges for a Sustainable Development Strategy

Noor Syaifudin

Kementerian Keuangan Republik Indonesia

Yanrui Wu

UWA: University of Western Australia

Dhani Setyawan (✉ ghanisetyawan83@gmail.com)

Ministry of Finance of Republic of Indonesia <https://orcid.org/0000-0001-7440-0937>

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Abstract

This study extends the literature by investigating the relationship between sustainable development and corruption in a panel of thirty-three provinces in Indonesia during 2004-2012. In measuring sustainable development, this study employs composite indices consist of 20 indicators covering economic, social, environmental, and institutional aspects in Indonesia's regional economies. The findings show a significant negative relationship between sustainable development and corruption. This study suggests that anti-corruption initiatives by the government should focus on improving governance and maximizing the social value of natural resource exploitation. Besides, the government should address the issues of productivity and sustainable population growth to ensure economic development sustainability.

JEL codes: C33, C43, D73, Q01

1. Introduction

By balancing economic, environmental, and social interests for the prosperity of present and future generations, sustainable development has drawn scholars' attention globally. The principles of sustainable development are essential to ensure any country's healthy economic growth (Vinnichuk et al., 2013). Further, sustainable development also a part of a non-decreasing element of intertemporal social welfare (Aidt, 2011). However, sustainable development faces many challenges. One of them is corruption, particularly in developing countries such as Indonesia. This country is one of the world's largest developing economies but suffering from corruption practices. The Corruption Perception Index (CPI) of Indonesia is ranked 88 out of 168 countries by 2015 (UGM, 2015a).

How far the impacts of corruption on sustainable development remain debatable. This study aims to investigate the corruption – sustainable development connections in Indonesia. This study reveals the effects of corruption on sustainable development and contributes to ensuring successful sustainable development implementation while confronting corruption practices in developing countries. This understanding is helpful to design additional policies on sustainable development in Indonesia. Lessons learned from this study could be adapted not only in Indonesia but also in other countries facing similar situations.

Most recent studies in this topic employed country-level data where the CPI was the proxy of corruption (Aidt, 2011; Guney, 2014; Lameira et al., 2013). This study, however, investigates the effect of corruption on sustainable development at the province level, including all data from 33 provinces across Indonesia. The data of corruption cases released by the Supreme Audit Agency/ SAA (*Badan Pemeriksa Keuangan*) is employed as the corruption level's proxy. This approach is innovative and empirical, based on evidence from sub-national levels.

This study examines the SAA data in an econometric model constructed from the conventional growth model and is modified to meet the research objectives. Twenty indicators covering institutional, economic, environmental, and social features are employed to measure Indonesia's provinces' sustainable development level. Conventional growth and panel regression analysis (i.e., ordinary least square, fixed, and random effects) are employed to explain the connections between corruption and sustainable development. This study applies Instrumental Variables Estimation and also General Method of Moments to address endogeneity and multicollinearity issues.

The rest of the paper is as follows. Section 2 presents contemporary issues on sustainable development and corruption in Indonesia, including the positive and negative effects on sustainable development. Section 3 describes the methodology and models employed in this study. Section 4 presents the estimation results. Section 5 discusses the findings from the model. Section 6 concludes the paper with suggestions for further research.

2. Contemporary Issues On Sustainable Development And Corruption In Indonesia

(a) *Definitions of sustainable development and corruption*

Many studies agree that sustainable development balances economic, ecological, and socio-cultural aspects. The economic approach refers to maximizing income while maintaining a constant or increasing stock of capital. The ecological approach means preserving resilience and strength of biological and physical systems, and the socio-cultural approach denotes upholding the stability of social and cultural systems. Further, Khan and Khan (2012) mentioned that the three determinants of sustainable development are consumption, production, and distribution. Scutaru (2013) saw sustainable development as combining economic theory with the study of natural sciences. This combination of economic theory and natural sciences analysis enables creating a comprehensive view of economic, social, and environmental aspects.

Thus, sustainable development is defined as the interaction between environment and human factors and may combine the economic, natural, and social processes into a single ecological, economic system. Anttila-Hughes (2012) agrees that sustainable development improves welfare, which is limited by natural constraints, while human development plays an essential part in achieving it. Besides, sustainable development leads to human investment in the present with impact in the future. Bayburina and Golovko (2009) considered that human capital and its

elements can be viewed as the locomotive of a company's growth and are essential in maintaining sustainable development. Dumitrana et al. (2009) argued that there are two basic concepts of sustainable development: the concept of needs and the environmental capacity and ability to satisfy current and future needs. Goodwin (2003) mentioned that sustainable development must maintain or increase all productive capital stocks, including natural capital, which is often depleted through economic production.

Jakimhovski (2011) believed that to achieve sustainable growth, economic improvement has to be achieved, and energy and materials consumption and waste products have to be reduced. Achieving sustainable development needs to be supported through efficient production promotion, reducing unnecessary consumption, and applying energy efficiency and renewable energy policies. Peters (2013) saw sustainable development encompassing overarching issues related to the environment, economy, social issues, globalization, institutional governance, and public governance. The conclusion is that sustainable development calls for multi-stakeholder participation.

Furthermore, corruption is associated with misconducts, including fraud, receiving bribes, and similar actions where persons enrich themselves or other persons, or parties, resulting in a financial loss to the state. In the context of a state's administration, corruption is an illegal behavior of a person's official duties for personal benefits (individual, family, own group) (Klitgaard, 1988). From a behavioral perspective, corruption is public officials' behavior for personal interests by breaking the rules (Goodman, 1974). Corruption is also considered government officials' acts in exploiting public property for private interests (Aidt, 2009).

Measuring the level of corruption is debatable because it is unclear and intangible (Kaufmann et al., 2006). However, there are two approaches to measure corruption level, perception-based and experience-based indicators (Carballo, 2010). Perception-based indicators are composite indexes of corruption perceptions from various stakeholders'. Meanwhile, experience-based indicators are based on citizens' experience when dealing with corruption. Currently, Corruption Perceptions Index (CPI) by Transparency International and Worldwide Governance Indicators (WGI) by World Bank Institute (WBI) are the two most commonly used perception-based indicators provided at the country level.

(b) *The impact of corruption on sustainable development*

Corruption affects development has become a long debate in the literature. Leff (1964) and Huntington (1968) indicate corruption might avoid strict and inelastic bureaucracies at the micro-level and speed up development, known as the concept of 'greasing the growth wheels.' However, based on empirical studies, current scholars argue that corruption negatively affects development (Butler et al., 2009; Carballo, 2010).

Aidt (2009) took a neutral stance and found no effect of corruption on the Gross Domestic Product (GDP) growth rate. However, using GDP only to represent development, without considering social and environmental aspects, might result in a wrong conclusion. GDP only measures current economic activity and does not include natural capital, human well-being, and productivity. Therefore, using sustainable development indicators, including economic, environmental, and social aspects, is more reliable to measure corruption's effects on development (Aidt, 2011).

Corruption might slow down the implementation progress of sustainable development. North (1990) indicates that high-level corruption is associated with less effective and less efficient governance, which would increase uncertainty in trade and investment as the economic aspects of sustainable development. Other studies also indicate the adverse effects of corruption on sustainable development's environmental aspects (Damania et al., 2003; Ferreira-Tiryaki, 2008). Carballo (2010) reveals the harmful effects of corruption on the social aspects of sustainable development.

(c) *Corruption in Indonesia*

Efforts on confronting corruption in Indonesia increased recently, which is indicated by many corruption cases. Many corruption cases by officials or authorities, exposed by Corruption Eradication Commission/ CEC (*Komisi Pemberantasan Korupsi*) or Supreme Audit Agency/ SAA (*Badan Pemeriksa Keuangan*) (Figure 1). The CPI in Indonesia has been improved from 19 (ranked 41 of 41 countries) in 1995 to 36 (ranked 88 of 168 countries) in 2015. This index represents stakeholders' perceptions of how the Indonesian government handles corruption problems.

Although some anti-corruption policies have been introduced, the implementation faces many challenges. The first anti-corruption act was enacted in the post-New order under the Habibie regime in 1999, but this failed to halt budget leakages (UGM, 2015a). The State Property Inspection Commission and Ombudsman were established under the president, Abdurrahman, from 2000 to 2001. The institution aims to record the assets of government officers and to oversee public services. However, this institution is unable to implement law enforcement. Corruption Eradication Commission was established under the administration of Megawati, who served between 2001 and 2004. However, there is no significant change in corruption practices under her regime.

Susilo, the next president from 2004 to 2014, did not introduce new legislation or institution, but he implemented the existing anti-corruption laws. Eradicating corruption is among his main political agenda. Significant corruption cases involving high-rank officers and ministers were exposed. Today, efforts on confronting corruption are still ongoing but far from the end since corruption is still standard practice in Indonesia (UGM, 2015b).

Java Island is the center of corruption in Indonesia (UGM, 2015a), which might result from higher fiscal capacity in Java Island compared to the other islands. Figure 2 presents that 1,161 people accused in corruption cases come from four provinces in Java, representing 40% of the national number (3,099 people). Another 60% scattered across the other 29 provinces.

Another indicator of corruption level is the ratio between Cost of Corruption (CC) and Cost for the Accused (CA), as indicated in Table 1. Cost of Corruption is the amount of state loss caused by corruption, while the Cost for the Accused is the amount for which the accused is judged and must pay back. For example, Table 1 shows that the accused need to pay just about 29.4% of the actual state loss caused by their misconduct behavior. Among the five most significant corruption cases, the ratio (CC/CA) is only 4.7%. Even in Jambi province, it is less than 1% (0.68%). This low ratio indicates weak enforcement of law and encourages more corrupt behavior.

Table 1 Comparison of Cost of Corruption and Cost for the Accused

Provinces	Cost of Corruption (Real 2015) (Billion IDR) (CC)	Cost for the Accused (Real 2015) (Billion IDR) (CA)	Ratio Cost for the Accused Over Corruption (CA/CC) (%)
Jakarta Special Region	89,176	16,148	18.11
North Sumatera	41,862	781	1.87
West Java	41,429	696	1.68
Jambi	20,506	140	0.68
Banten	17,885	209	1.17
Riau	2,452	782	31.91
East Kalimantan	1,825	172	9.42
Gorontalo	1,146	15	1.32
East Java	1,134	424	37.40
South Kalimantan	756	24	3.19
North Sulawesi	622	259	41.72
Maluku	575	497	86.42
Central Java	507	203	40.00
Aceh	407	44	10.76
Lampung	303	150	49.42
South Sumatera	250	58	23.08
West Sumatera	238	78	32.86
Bali	212	5	2.13
Southeast Sulawesi	189	72	38.18
South Sulawesi	186	64	34.12
Central Kalimantan	169	13	7.77
Papua	141	68	48.33
Bengkulu	137	24	17.13
Central Sulawesi	108	28	25.67
East Nusa Tenggara	100	47	46.70
West Kalimantan	82	25	29.93
Riau Islands	70	69	98.85
Yogyakarta Special Region	65	12	18.21
West Nusa Tenggara	57	10	18.41
West Sulawesi	52	7	13.60
North Maluku	46	8	17.10
West Papua	24	20	83.26
Bangka Belitung Islands	21	17	79.43
Indonesia	222,729	21,166	29.39

Source: University of Gadjah Mada (2016)

Bribery dominates corruption cases in Indonesia, comprising almost half of all cases (Figure 3). Procurement and budget misuse follow in the following places. Bribery is linked with public service, licensing, and authorization, while procurement is related to tenders, public assets, and amortization. Moreover, budget misuse is associated with budget planning, projections, and preparation.

3. Methodology And Model Specifications

(a) Variables

This study employs provincial-level data on corruption behavior released by the SAA. Econometric modeling and conventional growth analysis are employed to explain the relationship between corruption and sustainable development. These approaches have been applied in several studies analyzing economic growth in other countries and using country-level data (Chen and Wu, 2012; Wu, 2014). Following the literature, several control variables are used to identify the links between corruption and sustainable development. Variables are employed in ratio because SDI and corruption data are provided in ratio. In this study, corruption is incorporated into the equation as follows:

$$SDI_{it} = \alpha_i + \beta_1 LC_{it} + \beta_2 LE_{it} + \beta_3 GRP_{it} + \beta_4 Den_{it} + \beta_5 Ed_{it} + \beta_6 Inv_{it} + d_1 + d_2 + \varepsilon_{it} \quad (1)$$

SDI is the independent variable. It is a *Sustainable Development Index* comprised of two scenarios. *SDI₁* is constructed based on equal weights being allotted among the indicators of sustainable development. *SDI₂* is an index based on the same weights among the sustainable development aspects. Furthermore, corruption level is approached by two variables, *Loss per Capita (LC)* and *Loss over Expenditures (LE)*.

Furthermore, *GRP*, *Den*, *Ed*, and *Inv* represent *Gross Regional Product per Capita*, *Population Density*, *Education*, and *Investment* of the i^{th} province in period t , respectively. d_1 is the dummy variable of provinces in *Java*, while d_2 is the dummy variable for Oil and Gas Producer provinces. Table 2 presents all variables and the definitions included in this study.

Table 2 Control Variables *)

No	Variable	Definition
1	GRP non-Oil and gas per capita	Real GRP non-Oil and Gas/ capita (in the constant year 2000)
2	Population Density	Population/ total area (people/ square km)
3	Net Enrolment Ratio (Primary)	Net Enrolment Ratio (Primary)
4	Investment	Investment/ GRP
5	Java	Dummy
6	Oil and Gas Producer	Dummy

*) data for control variables were collected from the Central Statistics Agency

(b) Modeling and analysis approaches

In order to reduce variable bias, panel regression modeling and analysis are employed, including pooled Ordinary Least Square (OLS), fixed and random effects (Forbes, 2000). Furthermore, the Hausman specification test is conducted to decide the most suitable model. Instrumental Variables Estimation (IVE) and General Method of Moments (GMM) are applied to deal with endogeneity and multicollinearity issues.

IVE is required to address potential issues on the reverse causal relationship between sustainable development and corruption. Instrumental variables relate to corruption but have no relationship with the sustainable development index Aidt (, 2011). Following literature such as Mauro (1995), Porta et al. (1998), Hall and Jones (1999), and Gupta et al. (2002), latitude and ethnicity are instrument variables for corruption. Furthermore, Bentzen (2012) indicates that individualism and hierarchy could also explain corruption levels. Many objections and caveats are linked to the chosen variables (Acemoglu, 2005; Easterly and Levine, 1997; Hall and Jones, 1999). However, with data limitation, this study uses *Area* (land area in each province) as the instrument variable to explain corruption. The corruption level in Java is higher than in Non-Java, but provinces in Java are smaller than provinces in Non-Java.

This study conducts two types of GMM to address endogeneity and multicollinearity (difference GMM and system GMM). The J-statistic or Sargan value was employed to test the validity of instruments or the problem of over-identification.

4. Results

(a) Preliminary results

Table 3 presents the summary statistics of variables. The mean value of SDI_1 is 0.6147, which shows a medium achievement of sustainable development among provinces in Indonesia. The lowest is in East Nusa Tenggara (0.5023), and the highest is in Riau Islands (0.7445). Furthermore, the mean value of SDI_2 is 0.6138, where Jambi is the lowest (0.4954), and again, Riau Islands is the highest at (0.7595). The *Loss per Capita log* shows that the lowest corruption is occurred in Yogyakarta (4.2054), while the highest is West Papua (12.8169). Moreover, the natural *log Loss over Expenditure* suggests that Yogyakarta is the lowest (-9.7866) and Maluku is the highest (-3.4318).

The disparity is observed in real *GRP per Capita*, indicating a significant difference between real *GRP per Capita* among the provinces. Table 3 shows that GRP per Capita is 7.8 million on average, where the lowest is only 1.8 million in Gorontalo and the highest is 45.5 million in DKI Jakarta. *Log Population Density* shows that West Papua is the lowest (1.7268) while DKI Jakarta is the highest (9.6059). The enrolment ratio in primary school as a proxy of *Education* shows that about 91% of Indonesians had finished their primary school. Table 3 indicates that the lowest enrollment is in Papua (70%), and the highest is in Aceh (97%). Overall, Table 3 presents a low-level investment in Indonesia. On average, there is only 7% of *Investment* over GRP in Indonesia. The lowest is in West Sulawesi (0.04%), and the highest is in North Maluku (73%).

Table 3 Summary Statistics of the Variables

Variable	Mean	Standard Deviation	Min	Max
SDI_1	0.6147	0.0500	0.5023	0.7445
SDI_2	0.6138	0.0541	0.4954	0.7595
log Loss per Capita	8.6740	1.4470	2054	12.8169
log Loss over Expenditure	-5.8042	1.2265	-9.7866	-3.4318
GRP non-Oil and Gas per Capita	7.7662	6.9278	1.8041	45.5100
log Density	4.7530	1.5943	1.7268	9.6059
Enrolment: Primary	0.9054	0.1348	0.7013	0.9732

Table 4 presents the Pearson correlation matrix to observe the pair-wise relationship among variables. *GRP per Capita*, *Population Density*, *Education*, and *Investment* are all found to correlate with SDI positively. Furthermore, both types of corruption (*LC* and *LE*) are negatively correlated with *SDI*. Table 4 also explains the correlation between corruption and other explanatory variables where all are negatively correlated. The results also suggest that most correlation coefficient indicates potential endogeneity bias which will be addressed by conducting Instrumental Variables estimations.

Table 4 Correlation Matrix of Variables

	SDI 1	SDI 2	log Loss per Capita	log Loss over Expenditure	GRP non-Oil and Gas per Capita	log Density	Enrollment: Primary	Investment per GRP	Java	Oil and Gas Producer
SDI 1	1									
SDI 2	0.9503	1								
log Loss per Capita	-0.2116	-0.2647	1							
log Loss over Expenditure	-0.4222	-0.4884	0.8856	1						
GRP non- Oil and Gas per Capita	0.6178	0.7304	-0.1809	-0.3284	1					
log Density	0.2071	0.2696	-0.6140	-0.3906	0.2981	1				
Enrolment: Primary	0.0429	0.0753	-0.1149	-0.1142	0.0281	0.1888	1			
Investment	0.1410	0.2176	-0.0279	-0.1438	0.3001	0.1628	0.0298	1		
Java	0.2091	0.2616	-0.5584	-0.3091	0.2501	0.8052	0.1121	0.1291	1	
Oil and Gas Producer	0.3047	0.2755	-0.0938	-0.0870	0.3895	0.1137	0.0100	-0.0584	-0.0010	1

Source: Author's estimates

Tables 5a – 5d present a cross-tabulation of *SDI* and corruption variables (*LC* and *LE*). Provinces included in these tables are categorized based on corruption and sustainable development level. Bengkulu, South East Sulawesi, Gorontalo, West Sulawesi, Maluku, North Maluku, and East Nusa Tenggara are provinces always in *High Corruption* and *Low Sustainability*, indicating a need for central government to support those provinces. Meanwhile, Riau Islands, Jakarta Special Region, West Java, Yogyakarta Special Region, East Java, Bali, East Kalimantan, South Sulawesi are provinces consistently in *Low Corruption* and *High Sustainability*.

Table 5a Cross-tabulation of SDI₁ and Loss per Capita

	Low Corruption	High Corruption
Low Sustainability	Jambi	Aceh
	Lampung	Bengkulu
	Central Java	South Kalimantan
	West Nusa Tenggara	North Sulawesi
	West Kalimantan	South East Sulawesi
	Central Sulawesi	Gorontalo
	Papua	West Sulawesi
		Maluku
		North Maluku
		East Nusa Tenggara
High Sustainability	West Sumatera	North Sumatera
	South Sumatera	Riau
	Riau Islands	Bangka Belitung Islands
	Jakarta Special Region	Banten
	West Java	Central Kalimantan
	Yogyakarta Special Region	West Papua
	East Java	
	Bali	
	East Kalimantan	
	South Sulawesi	

Table 5b Cross-tabulation of SDI₁ and Loss over Expenditure

	Low Corruption	High Corruption
Low Sustainability	Aceh	Bengkulu
	Jambi	East Nusa Tenggara
	Bengkulu	West Kalimantan
	Central Java	South Kalimantan
	West Nusa Tenggara	North Sulawesi
	Central Sulawesi	South East Sulawesi
	Papua	Gorontalo
		West Sulawesi
		Maluku
		North Maluku
High Sustainability	Bangka Belitung Islands	North Sumatera
	Riau Islands	West Sumatera
	Jakarta Special Region	Riau
	West Java	South Sumatera
	Yogyakarta Special Region	Banten
	East Java	Central Kalimantan
	Bali	West Papua
	East Kalimantan	
	South Sulawesi	

Table 5c Cross-tabulation of SDI₂ and Loss per Capita

	Low Corruption	High Corruption
	Jambi	Aceh
Low Sustainability	Lampung	Bengkulu
	Central Java	East Nusa Tenggara
	West Nusa Tenggara	South East Sulawesi
	West Kalimantan	Gorontalo
	Central Sulawesi	West Sulawesi
	Papua	Maluku
		North Maluku
High Sustainability	West Sumatera	North Sumatera
	South Sumatera	Riau
	Riau Islands	Bangka Belitung Islands
	Jakarta Special Region	Banten
	West Java	Central Kalimantan
	Yogyakarta Special Region	South Kalimantan
	East Java	North Sulawesi
	Bali	West Papua
	East Kalimantan	
	South Sulawesi	

Table 5d Cross-tabulation of SDI₂ and Loss over Expenditure

	Low Corruption	High Corruption
Low Sustainability	Aceh	Bengkulu
	Jambi	East Nusa Tenggara
	Lampung	South East Sulawesi
	Central Java	Gorontalo
	West Nusa Tenggara	West Sulawesi
	West Kalimantan	Maluku
	Central Sulawesi	North Maluku
	Papua	
High Sustainability	Bangka Belitung Islands	North Sumatera
	Riau Islands	West Sumatera
	Jakarta Special Region	Riau
	West Java	South Sumatera
	Yogyakarta Special Region	Banten
	East Java	Central Kalimantan
	Bali	South Kalimantan
	East Kalimantan	North Sulawesi
	South Sulawesi	West Papua

(b) *Estimation results*

The estimation model comprises two dependent variables, SDI_1 and SDI_2 . This method has three estimations: pooled OLS, fixed effect (FE), and random effect (RE) models. The Hausman statistic test rejected the RE models, so this study omitted the RE models. Tables 6a and 6b show the results based on the two corruption variables, *Loss over expenditure* and *Loss per capita*. This study looks at two different specifications, with and without control variables, to address control variables' appropriateness.

Table 6a shows the results of SDI_1 , and Table 6b presents SDI_2 . Both tables indicate that corruption correlates negatively to sustainable development. The relationships are robust among several models, with and without control variables. The correlation is less robust when corruption is represented by Loss per capita with control variables (model 4).

In pooled OLS regression models of SDI_1 , when corruption is figured by *Loss over Expenditure*, the increase of one standard deviation of corruption will decrease the level of sustainable development by 0.017% (model 1) and 0.011% (model 3), *ceteris paribus*. When corruption is represented by *Loss per Capita*, the increase of one standard deviation of corruption will decrease the level of sustainable development by 0.007% (model 2) and 0.006% (model 4).

By including control variables in Model 3 and Model 4, *GRP per Capita* positively affects sustainable development, but Population Density negatively influences sustainable development. In model 4, dummy variables (*Java*; and *Oil and Gas Producer*) positively impact sustainable development.

Pooled OLS regression models of SDI_2 show that the increase of one standard deviation of corruption presented by *Loss over Expenditure* will decrease in the level of sustainable development by 0.022% (Model 9) and 0.013% (Model 11). When corruption is presented by *Loss per Capita*, the increase of one standard deviation level of corruption will decrease 0.01% sustainable development level (Model 10 and 12).

In Model 11 and 12, *GRP per Capita* positively correlates with sustainable development, while Population Density negatively correlates. In model 12, *Education* represented by the enrolment ratio in primary school positively correlated with SDI_2 .

Table 6a Estimation Results for Baseline Models (Fixed Effect Models) – Dependent Variable SDI_1

Pooled OLS Regression Models					Fixed Effect Models			
SDI ₁	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Loss over Expenditure	-0.0172***		-0.0110***		-0.0068***	-0.0045**		
	[-7.99]		[-5.52]		[-3.86]	[-2.87]		
Log Loss per Capita		-0.0073***		-0.0059**			0.0011	-0.0024
		[-3.72]		[-3.01]			[0.62]	[-1.51]
GRP non-Oil and Gas per Capita			0.0043***	0.0048***		0.0096***		0.0102***
			[11.20]	[12.18]		[7.26]		[7.60]
Log Density			-0.0097***	-0.0118***		0.0189		0.0251
			[-3.99]	[-4.43]		[1.22]		[1.60]
Enrolment Ratio: Primary			0.0137	0.0235		0.0110		0.0100
			[0.78]	[1.42]		[1.00]		[0.97]
Investment per GRP			-0.0435	-0.0372		-0.0109		-0.0071
			[-1.69]	[-1.40]		[-0.65]		[-0.42]
Java			0.0231	0.0296**		(omitted)		(omitted)
			[2.54]	[3.20]				
Oil and Gas Producer			0.0115	0.0122*		-0.0034		-0.0039
			[2.71]	[2.56]		[-0.16]		[-0.18]
Constant	0.5152***	0.6781***	0.5428***	0.6523***	0.5752***	0.4164***	0.6051***	0.4305***
	[40.37]	[39.24]	[28.41]	[24.27]	[55.36]	[6.22]	[39.07]	[6.37]
Observations	294	295	288	289	262	257	263	258
Adjusted R-squared	0.1755	0.0415	0.4692	0.4339	0.0654	0.1993	-0.1238	0.1817
Hausman Test						75.24***		46.82 ***
						[0.00]		[0.00]

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1

Java omitted because of collinearity

Table 6b Estimation Results for Baseline Models (Fixed Effect Models) – Dependent Variable SDI_2

Pooled OLS Regression Models					Fixed Effect Models			
SDI ₂	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log Loss over Expenditure	-0.0215***		-0.0132***		-0.0086***	-0.0052***		
	[-9.60]		[-3.45]		[-4.88]	[-3.87]		
Log Loss per Capita		-0.0099***		-0.0079**			0.0026	-0.0019
		[-4.71]		[-3.01]			[1.43]	[-1.42]
GRP non-Oil and Gas per Capita			0.0055***	0.0061***		0.0119***		0.0125***
			[16.30]	[16.95]		[10.54]		[10.79]
Log Density			-0.0107***	-0.0134***		0.0373**		0.0436**
			[-5.16]	[-5.47]		[2.80]		[3.20]
Enrolment Ratio: Primary			0.0288	0.0374*		0.0104		0.0093
			[2.20]	[2.44]		[1.11]		
Investment per GRP			-0.0308	-0.0227		0.0006		0.0055
			[-1.46]	[-0.93]		[0.04]		[0.37]
Java			0.0257**	0.0328***		(omitted)		(omitted)
			[4.49]	[3.85]				
Oil and Gas Producer			0.0053	0.0059		-0.0052		-0.0063
			[1.54]	[1.34]		[-0.29]		[-0.34]
Constant	0.4893***	0.6996***	0.5126***	0.6562***	0.5640***	0.3065***	0.5916***	0.3209***
	[36.82]	[37.93]	[37.43]	[26.52]	[54.50]	[5.35]		[5.48]
Observations	294	295	288	289	262	257	263	258
Adjusted R-squared	0.2359	0.0669	0.6284	0.5900	-0.0322	0.4275	-0.1168	0.4001
Hausman Test						82.19***		82.49***

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1

(c) *Instrumental variable estimations*

In general, Instrumental Variable Estimation (IVE) shows consistent results with the baseline models in Table 61 and 6b. The full results of instrumental variable estimations are presented in Table 7a and 7b. Table 7a presents models with *SDI₁* and Table 7b with *SDI₂* as the dependent variables. In both tables, corruption is negatively correlated with sustainable development. In Model 17, employing *Loss per Capita* as the estimator of *SDI₁* and uses *Area* and *lag log Loss per Capita* as instrumental variables, corruption (*LC*) and *Population Density* show negative effects on sustainable development. Meanwhile, *GRP per Capita*, *Java*, and *Oil and Gas Producer* positively correlate to sustainable development. Similar results are also observed in Model 19 employing *Loss over Expenditure* and use *Area* and *lag log Loss over Expenditure* as instrumental variables.

In Table 7b when SDI2 represented sustainable development, the models also support the negative relationship between corruption and sustainable development. Model 21 and Model 23 also confirm negative connections between *Population Density* and sustainable development.

Table 7a Instrumental Variable Estimates (2SLS) – Dependent Variable: SDI_1

Stage	2 nd	1 st	2 nd	1 st
	(17)	(18)	(19)	(20)
Dep. Variable	SDI ₁	Log Loss per Capita	SDI ₁	Log Loss over Expenditure
Endogenous variable	Log Loss per Capita		Log Loss over Expenditure	
Instrument variables	Area, Lag Log Loss per Capita		Area, Lag Log Loss over Expenditure	
Log Loss per Capita	-0.0089***			
	[0.003]			
Log Loss over Expenditure			-0.0170***	
			[0.003]	
GRP non-Oil and Gas per Capita	0.0048***	0.0186*	0.0042***	-0.0012
	[0.000]	[0.010]	[0.000]	[0.009]
Log Density	-0.0130***	-0.2772***	-0.0100***	-0.0967
	[0.003]	[0.089]	[0.002]	[0.082]
Enrolment Ratio: Primary	0.0195	-0.5756	-0.0023	-0.6778
	[0.022]	[0.484]	[0.025]	[0.567]
Investment per GRP	-0.0352	-0.0443	-0.0432*	-0.1229
	[0.026]	[0.584]	[0.025]	[0.565]
Java	0.0274***	-0.1617	0.0160*	-0.3432
	[0.010]	[0.237]	[0.010]	[0.232]
Oil and Gas Producer	0.0138***	-0.0472	0.0131***	-0.0272
	[0.005]	[0.108]	[0.005]	[0.106]
Area		-2.21e-06*		-1.35e-06
		[1.23e-06]		[1.19e-06]
Lag Log Loss per Capita		0.6382***		.6335***
		[0.044]		[0.045]
Constant	0.6889***	5.072384***	0.5265***	-0.9476
	[0.040]	[0.775]	[0.026]	[0.641]
Observations	264	264	263	263
R-squared	0.478	0.709	0.501	0.601

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 7b Instrumental Variable Estimates (2SLS) – Dependent Variable: SDI_2

Stage	2 nd	1 st	2 nd	1 st
	(21)	(22)	(23)	(24)
Dep. Variable	SDI ₂	Log Loss over Expenditure	SDI ₂	Log Loss per Capita
Endogenous variable	Log Loss over Expenditure		Log Loss per Capita	
Instrument variables	Area, Lag Log Loss over Expenditure		Area, Lag Log Loss per Capita	
Log Loss per Capita			-0.0115***	
			[0.003]	
Log Loss over Expenditure	-0.0198***			
	[0.003]			
GRP non-Oil and Gas per Capita	0.0054***	-0.0012	0.0062***	0.0186*
	[0.000]	[0.009]	[0.000]	[0.010]
Log Density	-0.0111***	-0.0967	-0.0149***	-0.2772***
	[0.002]	[0.082]	[0.003]	[0.089]
Enrolment Ratio: Primary	0.0231	-0.6778	0.0376*	-0.5756
	[0.024]	[0.567]	[0.020]	[0.484]
Investment per GRP	-0.0310	-0.1229	-0.0221	-0.0443
	[0.023]	[0.565]	[0.024]	[0.584]
Java	0.0177**	-0.3432	0.0295***	-0.1617
	[0.009]	[0.232]	[0.009]	[0.237]
Oil and Gas Producer	0.0065	-0.0272	0.0069	-0.0472
	[0.004]	[0.106]	[0.005]	[0.108]
Area	1.19e-06		-2.21e-06*	
	[0.045]		[1.23e-06]	
Lag Log Loss per Capita	0.6335***		0.6382***	
	[0.045]		[0.043]	
Constant	0.4846***	-0.9476	0.6965***	5.0724***
	[0.024]	[0.641]	[0.037]	[0.775]
Observations	263	263	264	264
R-squared	0.639	0.601	0.617	0.709

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1.

(d) General method of moments

The GMM models show that the corruption variables in the models are good predictors to measure the relationships between corruption and sustainable development. GMM estimation results confirm the results of IVE and baseline models indicating that corruption has a negative effect on sustainable development at the province level in Indonesia.

Table 8a General Method of Moments (GMM) – Dependent Variable: SDI₁

SDI ₁	(25)	(26)	(27)	(28)
	Difference GMM		System GMM	
Log Loss over Expenditure	-0.009		-0.0237***	
	[-0.57]		[-5.99]	
Log Loss per Capita		0.0060***		0.0044
		[3.45]		[0.95]
GRP non-Oil and Gas per Capita	0.0066***	0.0077***	0.0038***	0.0044
	[5.65]	[6.49]	[10.85]	[10.27]
Log Density	0.0860***	0.0698***	-0.0114***	-0.0034
	[5.67]	[4.34]	[-5.00]	[-0.85]
Enrolment Ratio: Primary	0.0157	-0.0084	0.5436***	-0.6041
	[0.61]	[-0.66]	[25.96]	[9.89]
Investment per GRP	-0.0003	0.0096	-0.0010	0.0164
	[-0.02]	[0.43]	[-0.03]	[0.37]
J-statistic	98.00	90.68	43.94	51.52
	[0.000]	[0.000]	[0.914]	[0.713]

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 8b General Method of Moments (GMM) – Dependent Variable: SDI₂

SDI ₂	(29)	(30)	(31)	(32)
	Difference GMM		System GMM	
Log Loss over Expenditure	-0.0032*		-0.0274***	
	[-2.34]		[-7.15]	
Log Loss per Capita		0.0059***		0.0024
		[3.71]		[0.51]
GRP non-Oil and Gas per Capita	0.0096***	0.0113***	0.0044***	0.0052***
	[9.09]	[10.33]	[13.01]	[12.01]
Log Density	0.1004***	0.0815***	-0.0123***	-0.0051
	[7.39]	[5.52]	[-5.54]	[-1.27]
Enrolment Ratio: Primary	0.0204	-0.0060	0.5161***	0.6208***
	[0.88]	[-0.51]	[25.38]	[10.01]
Investment per GRP	0.0404*	0.0632**	0.0284	0.0569
	[2.40]	[3.05]	[0.83]	[1.27]
J-statistic	135.55	119.66	54.46	60.25
	[0.000]	[0.000]	[0.608]	[0.394]

Source: Author's estimates

Note: *** p<0.01, ** p<0.05, * p<0.1.

5. Conclusion

This study aims to analyze the relationship between corruption and sustainable development. The negative trend relationship shows the two different corruption measures used in this study are significant. This study suggests that the sustainable development level will follow the corruption level reduction. The fixed effect models also confirm robust results about the negative effect of corruption on sustainable development. Finally, the instrumental variables and GMM estimates also point in the same direction and suggest that corruption has a significantly negative effect on sustainable development.

In this study, the sustainable development index comprises indicators and groups based on four sustainable development aspects: economic, environmental, social, and institutional. More significant comprehensive reforms to eradicate corruption and to enhance governance are needed. Moreover, the anti-corruption program should also consider social and environmental aspects, including corruption in exploiting natural resources that have high social value to the community. Additionally, the government needs to address productivity and birth rate control to boost the sustainable development level. It is expected that in the long run, through a low level of corruption, the level of sustainable development in Indonesia will increase. This improvement can be seen by enhancing each aspect of sustainable development witnessed at the province level.

Declarations

Availability of data and materials

All data generated or analysed during this study are available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

Noor Syaifudin (Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Validation; Visualization; Writing – original draft)

Yanrui Wu (Conceptualization; Resources; Supervision; Validation; Visualization)

Dhani Setyawan (Formal analysis; Project administration; Resources; Visualization; Writing – review & editing)

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Figures

Figure 1

Indonesia's Corruption Perceptions Index (CPI) 1995-2015 Source: Transparency International (1995-2015)

Figure 2

Number of People Accused of Corruption Cases by Provinces (2010-2015) Source: University of Gadjah Mada (2016)

Figure 3

Types of Corruption Addressed by Corruption Eradication Commission (2015) Source: University of Gadjah Mada (2016)