Advances in Economics, Business and Management Research, volume 143
2nd International Seminar on Business, Economics, Social Science and Technology (ISBEST 2019)

Dynamic Panel Data Analysis of Poverty in Indonesia

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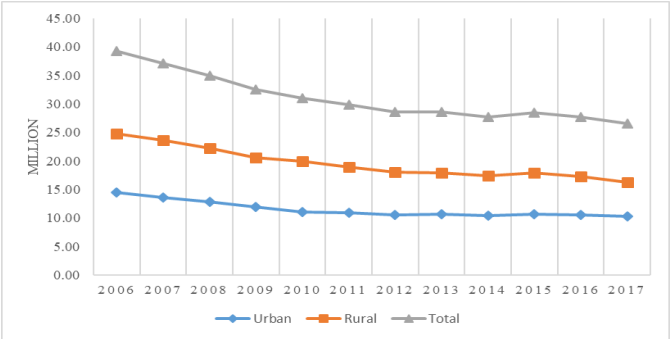
***Abstract*—Poverty is one of the main problems in most developing countries including Indonesia. Indonesia has five large islands consisting of Sumatra, Java and Bali, Kalimantan, Sulawesi, and Papua - Maluku - Nusa Tenggara. This study aims to analyze the determinants of poverty in villages by focusing on geography, education and health aspects. The analysis model used is modeling using the dynamic panel data regression method. The results of this study that urban villages have lower number of poor people than rural villages. In addition, villages with lowland topography have lower number of poor people. For distance variable, the farther away the villages from the regency/city capitals, the higher the number of poor people. In the education aspect, in villages with better education facilities, the number of poor people is generally lower. This also occurs for the health facilities and health workers variables. This shows that the characteristic of poverty determinant in several islands in Indonesia are heterogeneous. In conclusion, the determinant of poverty are geographical locations and the availability of education and health facilities.**

Keywords: education, geography, health, poverty

I. INTRODUCTION

The problem of poverty is vastly complex and multidimensional [1-8] and it is related to social, economic, cultural and other aspects [9-12] Poverty is one of the main problems in most developing countries [13,14] including Indonesia, so that poverty reduction becomes a major goal in development planning in these countries. Indonesia as a developing country with a large population cannot avoid the poverty complexities. Indonesia has five big island consist of Sumatra, Java and Bali, Kalimantan, Sulawesi, and Papua – Maluku – Nusa Tenggara. Figure 1 shows the number of poor people in Indonesia over period 2006 – 2017. The total poor people Indonesia decrease over the period as well as both in rural and urban area. The data also shows that the number of poor peoples in rural area are higher than urban area.

A study in China argues that geography can influence poverty [15]. The cause of economic inequality in various regions of the world is the geography hypothesis [16]. A study in Rwanda states that adverse climate [17] and weather can cause productivity to decline and this condition can increase poverty [18-21].



Source: Central Statistical Agency.

Fig. 1. The number of poor people in Indonesia.

The level of education is an important element in reducing poor households [22-25]. Basically, poverty is closely related to the low level of education [26]. Education is consumption and investment commodities [27] and thus has an impact on education [28]. In developing countries, basic education is much higher than higher education [29]. Nowadays, high costs are needed to get quality education [30], so that economically weak communities cannot afford to pay it. In fact, many children do not go to or drop out of school because of poverty. In terms of human resources, poverty can hamper the acquisition of learning and other pedagogical materials [31].

In both developed and developing countries, poverty or low income is a determinant of health, where this is always synonymous with lower health degrees. Poverty is the root of many health problems [32,33].

II. METHODS

This study used Village Potential (Podes) data published by the Central Statistics Agency (BPS). Podes includes an overview of the village government administration throughout Indonesia. Information collected includes geography, education, and health. This study uses all panel villages over five periods, namely 2006, 2008, 2011, 2014, and 2018.

The empirical model used to answer the research goal is as follows:

$$Poverty_{it} = \alpha + durban_{it} + dlowland_{it} + distance_{it} + qsmp_{it} + qsma_{it} + qpus_{it} + qdoc_{it} + qmidv_{it} + droadasp_{it} + u_{it} \quad (1)$$

Based on previous studies, poverty is dynamic, which means that poverty in the previous period can affect the poverty of the current period. The standard dynamic model is formulated with the following equation:

$$y_{it} = \alpha + \delta y_{it-1} + x'_{it}\beta + u_{it}$$

Where y_{it} is the independent variable, y_{it-1} is the lag 1 from the dependent variables, x'_{it} is a group of explanatory variables, and u_{it} is the *one-way error component* model consisting of two types of errors, namely:

$$u_{it} = \mu_i + v_{it}$$

Where $\mu_i \sim IID(0, \sigma_\mu^2)$ and $v_i \sim IID(0, \sigma_v^2)$ are independent of each other and among themselves.

The dynamic panel data regression is characterized by two sources of persistence over time. Autocorrelation due to the presence of a lagged dependent variable among the regressors and individual effects characterizes the heterogeneity among the individuals. Since y_{it} is function of μ_i, it immediately follows that y_{it-1} is also a function of μ_i. Therefore, y_{it-1}, a right-hand regressor is correlated with the error term. This renders the OLS estimator biased and inconsistent even if the v_i is not serially correlated. For the fixed effects (FE) estimator, the within transformation wipes out the μ_i, but $(y_{it-1} - \bar{y}_{i.-1})$ where $\bar{y}_{i-1}$=$\sum_{t=2}^{T} y_{i,t-1}$ / (T – 1) will still be correlated with $(v_{it} - \bar{v}_i)$ even if the v_{it} is not serially correlated. This is because $y_{i,t-1}$ is correlated with $\bar{v}_i$ by construction.

To estimate dynamic panel data, equation (1) above was modified into the following equation:

$$Poverty_{it} = \alpha + poverty_{it-1} + durban_{it} + dlowland_{it} + distance_{it} + qsmp_{it} + qsma_{it} + qpus_{it} + qdoc_{it} + qmidv_{it} + droadasp_{it} + u_{it} \quad (2)$$

In equation (2) the independent variable $poverty_{it-1}$ was added which shows lag 1 of the dependent variable.

III. Results and Discussion

The results of the analysis using Stata 15.1 produced variable coefficients for Indonesia model and island models. Table 1 shows the statistical summary of the variables used in this study. There are 263.905 observations/villages. The average number of poor people per village was 906 people. In terms educational facilities, the average number of Junior High School per village was 1.02 units and the average number of Senior High School per village was 0.53 units (see Table 1). Meanwhile, in terms of health facilities and health workers, the average number of health centers and doctors per village was 0.34 units and 0.73 people, respectively.

TABLE I. Statistical Summary of Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
dependent variable				
number of poor people (poverty)	905.74	1390.52	0	55307
independent variables				
dummy variable for urban=1, rural=0 (durban)	0.47	0.50	0	1
dummy variable for lowland=1, non-lowland=0 (dlowland)	0.78	0.41	0	1
distance to regency/city capital (distance)	47.94	53.33	0	1025
the quantity of junior high schools (qsmp)	1.02	1.55	0	36
the quantity of senior high schools (qsma)	0.53	1.18	0	40
the quantity of health centers (qpus)	0.34	0.53	0	10
the quantity of doctors (qdoc)	0.73	3.21	0	196
the quantity of midwives (qmidv)	1.78	2.58	0	98
dummy variable for asphalt road (droadasp)	0.71	0.45	0	1

The average number of midwives is higher than doctors, which there was 1.78 midwives per village. This shows that there are still a number of villages that do not have junior high schools, senior high schools, health centers, and doctors. From Table 1, the data also shows the high variation for several variables such as number of poor people, education facilities, and health facilities.

TABLE II. Estimation Result for Indonesia Model

Dependent: number of poor people	Coefficient
Lag 1 number of poor people	-0.02
	(0.01)
Dummy urban	-333.98***
	(18.55)
Dummy lowland	-13.20
	(8.23)
distance to regency/city capital	0.35***
	(0.04)
the quantity of junior high schools	-14.30
	(8.84)
the quantity of senior high schools	2.71
	(11.30)
the quantity of health centers	-132.56***
	(14.94)
the quantity of doctors	1.47
	(4.17)
the quantity of midwives	4.24
	(4.06)
dummy variable for asphalt road	7.14
	(7.37)
year2011	-49.00***
	(7.99)
year2014	558.81***
	(20.90)
year2018	591.18***
	(28.70)
constant	897.91***
	(18.74)
observation	158,343
number of villages	52,781

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The regression results as shown in Table 2, show the villages in urban areas has a lower quantity of poor people than in those in rural areas. This occurs because employment and economic opportunities in urban are higher than rural area. In addition, distance from village administration official to capital of regency/city shows the positive effects. This result is consistent with the coefficient of urban-rural variable where villages with farther from capital of regency/city have lower employment and economic opportunities.

TABLE III. ESTIMATION RESULT OF PROVINCE MODELS

Dependent: number of poor people	Sumatra	Java	Kalimantan	Sulawesi	Papua – Maluku – Nusa Tenggara
lag 1 number of poor people	0.00	-0.02	-0.06	0.20***	0.04
	(0.04)	(0.02)	(0.08)	(0.04)	(0.05)
dummy urban	-233.62***	-449.48***	-268.10***	92.55***	-214.39***
	(25.41)	(30.95)	(61.71)	(24.48)	(65.11)
dummy lowland	-26.60**	-13.74	-46.50**	9.07	47.21*
	(11.02)	(19.66)	(21.01)	(18.89)	(24.19)
distance to regency/city capital	0.04	1.64***	0.13	0.08	0.10**
	(0.11)	(0.32)	(0.08)	(0.10)	(0.05)
the quantity of junior high schools	0.94	-23.11*	-22.16	-27.52*	94.80***
	(13.70)	(14.04)	(23.24)	(14.40)	(31.16)
quantity of senior high schools	-5.30	-6.29	21.07	-13.18	32.45
	(24.63)	(16.20)	(29.22)	(16.96)	(33.76)
the quantity of health centers	15.95	-346.79***	-63.08**	-3.72	-2.24
	(22.36)	(30.14)	(29.87)	(17.77)	(36.30)
the quantity of doctors	2.71	5.27	-33.78*	-4.13	11.39
	(7.80)	(4.95)	(19.47)	(9.62)	(10.47)
the quantity of midwives	9.23**	-11.84	36.10	6.56**	15.38
	(4.29)	(10.17)	(29.74)	(3.20)	(9.53)
dummy variable for asphalt road	-1.58	0.35	-0.89	-35.97**	15.88
	(12.19)	(15.56)	(26.36)	(15.94)	(26.72)
year2011	-45.69***	-72.25***	-24.84	67.20***	14.07
	(11.02)	(14.89)	(19.58)	(13.00)	(24.16)
year2014	350.67***	795.04***	357.54***	156.37***	364.20***
	(24.53)	(36.06)	(65.29)	(24.89)	(65.97)
year2018	449.00***	806.45***	330.53***	153.80***	347.05***
	(33.41)	(53.53)	(77.30)	(33.06)	(78.23)
Constant	432.75***	1,435.50***	435.32***	376.24***	388.09***
	(23.47)	(39.17)	(49.63)	(27.51)	(54.60)
observations	44,745	73,209	14,268	15,276	10,845
number of villages	14,915	24,403	4,756	5,092	3,615

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2 and Table 3 show the estimation result of Indonesia model and island models, respectively. In Table 2 and Table 3, the variable of lag 1 for the number of poor people in the village is not significant in Indonesia model and several island model. This variable only affects current poverty variable with positive sign in Sulawesi model. The results show that poverty condition in the villages are not related across periods. Geographical variables include dummy villages in urban areas (durban), dummy villages with lowland topography (dlowland), and distance to regency/city capitals (distance). The results of this study are in accordance with Gallup and Sach [34] and Szwarcwald [35].

In island models as shown in Table 3, we find that availability of education facilities, especially on junior high school, has negative relationship with poverty in Java and Sulawesi models, but positive in Papua-Maluku-Nusa Tenggara model.

These result indicate that the correlation between education facilities and poverty is heterogeneous. It has positive coefficient when education facilities are higher in villages that many poor peoples. The negative coefficient, as expected in this study, means education can increase human capital accumulation and expand economic opportunities for poor people.

The estimation results in Table 2 and Table 3 has been tested for autocorrelation as shown in appendices 1. There are no autocorrelations for Indonesia model as well as for Sumatera and Kalimantan model. The results of this study are in accordance with Shaw et al. [36], Schellenberg et al. [37], and Gwatkin et al. [38].

In Table 2, the coefficients of education variables, the number of junior and senior high schools, in Indonesia model is not significant. In the literature, education can decrease poverty level. But, this result indicates that the number of education facilities is not related with poverty reduction. The other aspect of education that probably influence poverty is the accessibility.

In Table 2, the availability of health center/auxiliary health center in villages can decrease poverty. For health workers, the number of doctors as well as midwives are not significant. For island models as shown in Table 3, the availability of health centers/auxiliary health center is also negatively significant in Java and Kalimantan models. For the number of doctors, we find negative significant on Kalimantan, while other islands are not significant. For the quantity of doctors, we find positive significant only in Sulawesi and Sumatra, while others islands are not significant.

In Table 3, the urban variable in island models generally show negative result. The positive coefficient is only in Sulawesi model. The lowland variable has negative significant in Sumatra and Kalimantan models, while positive significant in Papua – Maluku – Nusa Tenggara model. In distance variable, the significant coefficient occurs in Java and Papua – Maluku – Nusa Tenggara with positive significant. These results are in accordance with previous studies such as Okojie [39], Armstrong et al. [40] and Sanz, et al. [41]. The regression coefficient result in island models are generally consistent with the Indonesia model.

IV. CONCLUSION

In the geographical aspect, the results of the analysis show that in general urban villages have a lower poor people than rural villages; villages with lowland topography is not significant for Indonesia models, while for island models show lowland topography have a lower number of poor people than villages with valley or slope topography; the farther away the villages from the regency/city capitals, the higher the number of poor people in these villages. Education aspect, the results of the analysis show that in villages with better education facilities, the number of poor people is lower only for several models, like Java and Kalimantan. In the health aspect, the number of health centers and the number of doctors and midwives in general have a negative effect on the number of poor people.

This study has several limitations. First, the measurement of the number of poor people in the villages used only the number of residents receiving the state health insurance. In reality, the recipients are indeed poor people, but there is a possibility that there are poor people who do not receive the insurance (for various reasons), so the number of poor people is not fully reflected in this data. Second, the number of villages observed over five periods (2006, 2008, 2011, 2014, and 2018) has increased due to village administrative expansion. In villages experiencing such expansion, especially in the main villages, the continuity of time-series data is an important issue that needs further attention in future studies.

This result of this study recommends the need for providing the health and education facilities in the village level. In addition, the poverty alleviation program should focus on rural villages, villages with hill topography, and village with father away from capital district. These policies hopefully can decrease the number of poor people in the almost villages effectively.

ACKNOWLEDGMENT

The authors would like to express their gratitude to the Universitas Sebelas Maret, Universitas Terbuka, and Universitas Pasir Pengaraian Riau. The authors especially would like to acknowledge support from Rumah Publikasi Indonesia for publishing this study.

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