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Indonesia's Economic And Non-Economic Effects With Spatial Regression

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Abstract: The purpose of this study is to analyze the influence of economic and non-economic aspects on the analysis method used is model analysis using a spatial econometric approach. The spatial econometric model is used to answer the research objectives, namely how the influence of spatial and non-spatial aspects on the human development index between Western Indonesia (KBI) and Eastern Indonesia (KTI) Indonesia. Data This study uses panel data, taking the research location of Indonesia which includes 34 provinces. The research was conducted using data series for the observation period 2015-2021. the results of the study show that between KBI and KTI there is a spatial relationship between provinces and the models used are different. in KBI, the three variables used have a positive effect on human development using the SAR model. in KTI, neighboring regions have an influence on HDI values. while the variables of GRDP per capita and internet users have no effect on HDI in region i. but the HDI of region i is influenced by GRDP per capita, poverty and internet users in area j.

Keywords: HDI, GDRP per capita, internet users, spatial and non spatial

I. INTRODUCTION

Each region seeks to encourage economic development by optimizing the potential of its resources, both from natural resources, capital resources and human resources. Humans play an important role in every development work program so that it must be followed by human development as a basis in the economic development of a country. Development can be successful if a country can increase economic growth and improve people's lives (Alwi, 2019). Human capital as the wealth of the nation is important in the development process. The importance of human capital places humans not only as a means of development but as the ultimate goal of the development process (Resce, 2021). The existence of quality human capital, economic development will increase output and the economy will be better, and improve the quality of human resources. Development balanced with superior resources will produce an advanced whole order of life in various economic, social and environmental fields so that human quality has a big share to determine the success of managing regional development (Arisman, 2018).

The existence of quality human capital, economic development will increase output and the economy will be better, and improve the quality of human resources. Human capital based on the Human Development Index is an important tool used for global applications related to community prosperity, especially those directly related to human quality (Abraham, et al 2020). Indonesia is one of the member countries of ASEAN (Association of Southeast Asian Nations). ASEAN is a cooperation organization between countries in Southeast Asia that aims to improve welfare and advance people's lives with fair opportunities for human development (Fatimah, 2019). ASEAN members consist of 10 countries, namely Indonesia, Singapore, Malaysia, the Philippines, Cambodia, Laos, Brunei Darussalam, Vietnam, Thailand, and Myanmar. In continuity, each country in ASEAN has similar characteristics related to regional conditions, but the quality of human resources in each country is different.

Indonesia with a high HDI value ranks 5th in ASEAN and 114th out of 189 countries analyzed by UNDP. Although Indonesia's HDI value is in the high category, it is still below Singapore, Brunei Darussalam, Malaysia and Thailand. In addition, HDI growth in the last year has not been optimal, meaning that Indonesia's HDI value has increased but its growth has slowed down. So this still needs improvement to overcome the decline in HDI growth and it is hoped that the increase will be better.In addition, the existence of inequality in human development is also supported by inequality in poverty in Indonesia. The poverty rate can be seen that there are differences between the Western Indonesia Region (KBI) and Eastern Indonesia Region (KTI). One of the regional aspects of economic development is the emergence of geographical human development inequality. Inter-regional linkages are an important aspect of development by looking at the interrelationships between regions that interact with each other socially, economically and developmentally. To describe the regional context, regional dimensions and interactions between neighboring regions must also be taken into account. Thus, HDI between regions is related to other regions.

II. LITERATURE REVIEW

According to neo-classical theory, the theory of the development of classical theory pioneered by Adam Smith (Sadono, 2003). The school focuses its theory on the combination of labor, capital, and technological progress. The role of humans in classical theory is passive, meaning that the population is only an external factor to increase output (Hakiki et al, 2020). The classical growth model also adheres to the assumptions of constant returns to scale and diminishing marginal productivity. However, this is not in line with the new growth theory proposed by Paul Romer in his theory known as endogenous theory (Romer, 1986). The background of Romer's thought is due to one of the failures of the neo-classical model in explaining the long-run growth pattern due to the wrong specification of the model. According to Romer, the capital intended by the neoclassical theory is only for production machines, excluding human capital. Endogenous growth theory rejects the existence of diminishing returns because the theory assumes that human capital can generate wealth to continue to increase output. Thus, endogenous growth theory tries to explain the assumption of increasing returns to scale in the long-term growth pattern of the country (Winarti et al, 2014). The theory is also not in line with Amartya Sen's capability theory which argues that wealth is not the main goal of development (Aimon, 2012). In fact, some countries with high incomes have low standards of health and education, resulting in regional economic and social inequality. Quality human capabilities are much more important as they are fundamental to development. Amartya Sen argues that welfare cannot be measured by income or utility alone, but by human capabilities. Quality human capabilities are much more important because they are fundamental to development. Amartya Sen argues that welfare cannot only be measured based on income or utility but also human capabilities. Therefore, the capability theory focuses more on improving human capabilities through health, education and decent living.

Human capital based on the Human Development Index is an important tool used for global applications related to community prosperity, especially those directly related to human quality (Abraham, et al 2020). In addition, the HDI can provide an overview to see the government's achievements related to human development. Differences in resources and the ability of regions to manage them will affect the success of economic development. Human development is important because if a region does not have potential Natural Resources (SDA), it can use Human Resources (HR) to develop and advance its region (Desmiarti, 2019).

III. METHODOLOGY

The method of analysis used is model analysis using a spatial econometric approach. The spatial econometric model is used to answer the research objectives, namely how the influence of spatial and non-spatial aspects on the human development index between Western Indonesia (KBI) and Eastern Indonesia (KTI) Indonesia. The research was conducted using data series for the observation period 2015-2021. The type of data used in this study is secondary data. Data sources are officially published from the Central Bureau of Statistics and related institutions. Some of the data needed include data related to human development in Indonesia, namely the Human Development Index (HDI), GRDP per Capita (KAP) Internet User Households (INT) and Poverty (MSKN).

The determinants of the economic Human Development Index (HDI) between provinces in Indonesia analyzed in this study are Income per Capita (KAP), Internet User Households (INT) and Poverty (MSKN) for each province as well as endogenous interaction variables (ρ), exogenous interactions (θ) and interactions between error components (λ), then the functional model design built in this study is:

$$Y = f(X1, X2, X3\ \rho, \theta, \lambda)$$
$$IPM = f(KAP, MSKN, INT\ \rho, \theta, \lambda)$$

This research tries to analyze the influence of each independent variable on the dependent variable using spatial econometric models. There are four spatial panel data models that will be used in this study, namely the Spatial Lag Model (SLM), Spatial Error Model (SEM), Spatial Durbin Model (SDM) and Spatial Autoregressive Combined Model (SAC). Spatial panel data regression modeling in this study is as follows:

3.1 Spatial Lag Model (SLM)

The model of economic development disparities between regions with the Spatial Lag Model approach assumes that there is spatial autoregressive in the response variable, then the spatial panel data regression equation is as follows:

$$IPM_{it} = \rho \sum_{j-1}^{34} W_{ij} IPM_{jt} + \beta_1 KAP_{it} + \beta_2 INT_{it} + \beta_3 MSKN_{it} + \mu_i + \epsilon_{it}$$

where ρ is the spatial autoregressive coefficient of the response variable, μ is the region specific effect, ε~N(0, σ2I).

3.2 Spatial Error Model (SEM)

The model of economic development disparities between regions using the Spatial Error Model approach assumes that the error term follows a spatial autoregressive process, so the spatial data panel regression equation is as follows:

$$IPM_{it} = \beta_1 KAP_{it} + \beta_2 INT_{it} + \beta_3 MSKN_{it} + \lambda \sum_{j-1}^{34} W_{ij}\, u_i + \epsilon_{it}$$

where λ is the spatial autoregressive error coefficient, μ is the region-specific effect, u is the spatially correlated error and ε~N(0, σ2I).

3.3 Spatial Durbin Model (SDM)

The Spatial Durbin Model assumes that there is spatial autoregressive through the response and predictor variables, so the spatial data panel regression equation for the economic development disparity model between regions is as follows:

$$IPM_{it} = \rho \sum_{j-1}^{34} W_{ij} IPM_{jt} + \beta_1 KAP_{it} + \beta_2 INT_{it} + \beta_3 MSKN_{it} + \mu_i + \epsilon_{it} + \theta_3 \sum_{j-1}^{38} W_{ij}\, u_i + \epsilon_{it}$$

where ρ is the spatial autoregressive coefficient of the response variable, θ is the spatial autoregressive coefficient of the predictor variable, μ is the region specific effect and ε~N(0, σ2I).

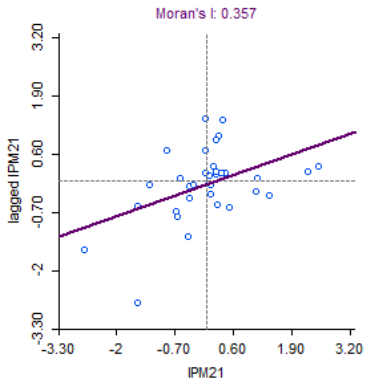
3.4 Spatial Autoregressive Combined Model (SAC)

The model of economic development disparities between regions with the Spatial Autoregressive Combined Model approach assumes that there is spatial autoregressive in the response variable and error term, then the spatial data panel regression equation is as follows:

$$IPM_{it} = \rho \sum_{j-1}^{34} W_{ij} IPM_{jt} + \beta_1 KAP_{it} + \beta_2 INT_{it} + \beta_3 MSKN_{it} + \mu_i + \lambda \sum_{j-1}^{38} W_{ij}\, u_{jt} + \epsilon_{it}$$

Where ρ is the spatial autoregressive coefficient of the response variable, λ is the spatial autoregressive error coefficient, u is the spatially correlated error, μ is the region specific effect and ε~N(0, σ2I).

Before determining the regression, we first calculate the Moran index to determine the spatial relationship. One of the tests used in checking for the presence of spatial autocorrelation. Spatial autocorrelation is an estimate of the correlation between observed values related to the spatial location of the same variable. If spatial autocorrelation is positive, it indicates the similarity of values from adjacent locations and tends to cluster. Whereas negative spatial autocorrelation indicates that adjacent locations have different values and patterns tend to spread. in the figure it can be seen that the value of the Indonesian morans index is 0.357, meaning that the value has a positive spatial autocorrelation so that the next trial can be carried out



IV. RESULTS AND DISCUSSION

4.1 Statistic Deskriptive

Tabel 4.1 Descriptive Statistics of Western Indonesia

Variabel	Obs	Mean	Std. Dev.	Min	Max
IPM	147	71.75224	3.298767	65.59	81.11
KAP	147	10.60425	0.557090	9.919	12.07
INT	147	65.34878	16.78055	27.66	95.44
MSKN	147	8.733333	3.63257	3.42	17.16

Sumber: processed data, 2015-2021

Based on the table, it can be seen that during the study period, the average human development index was 71.75224. In the 2015-2021 period, the lowest level of human development index was 65.59, namely West Kalimantan Province in 2015. Meanwhile, in the same period, the highest level of human development index was 81.11, namely DKI Jakarta Province in 2021. The low value of West Kalimantan's HDI is due to low per capita expenditure, meaning that the purchasing power of the community towards a number of basic needs is still not optimal. This is to measure the achievement of development for a decent life.

Furthermore, during the study period, the average GRDP per capita was obtained at 10,60425. In the 2015-2021 period, the lowest level of GRDP per capita was 9,919, namely Bengkulu Province in 2015. Meanwhile, in the same period, the highest level of GRDP per capita was 12.07, namely DKI Jakarta Province in 2021. For the internet user household variable, in the 2015-2021 period, the lowest internet user household was 27.66, namely Lampung Province in 2015. Meanwhile, in the same period, the highest level of internet user households was 95.44, namely DKI Jakarta Province in 2021. Lampung Province was the lowest province in 2015 because in that year most of the population was still internet illiterate and local television was still the community's choice.

As for the poverty variable, in the 2015-2021 period, the average poverty rate was 8,733. Meanwhile, the lowest percentage of poor people was 3.42, namely DKI Jakarta Province in 2019. Meanwhile, in the same period, the highest percentage of poor people was 17.16, namely Bengkulu Province in 2015. The increase in poverty in Bengkulu is due to the increase in open unemployment, both

in residents who do not have a diploma and those who have a diploma. However, the majority of poverty in Bengkulu comes from the highly educated population. Meanwhile, the data on the results of research related to the use of research variables in Eastern Indonesia are as follows.

Table 4.2 of Descriptive Statistics of Eastern Indonesia

Variabel	Obs	Mean	Std. Dev.	Min	Max
IPM	91	67.6767	4.004675	57.25	75.69
KAP	91	10.20798	0.432523	9.314	11.07
INT	91	54.56352	18.10508	16.28	87.8
MSKN	91	14.32088	6.661197	3.61	28.4

Sumber: processed data, 2015-2021

Based on the table, it can be seen that the Eastern Indonesia Region during the study period obtained an average human development index of 147 observations of 67.6767 greater than 4.004675, meaning that the data is normally distributed. In the 2015-2021 period, the lowest level of human development index was 57.25, namely Papua Province in 2015. Meanwhile, in the same period, the highest level of human development index was 75.69, namely Bali Province in 2021. The low HDI value in Papua is due to the high number of school dropouts. So that this affects the calculation of the Human Development Index from the education aspect. Meanwhile, the high Human Development Index in Bali is due to economic recovery which stimulates the three aspects of the Human Index calculation to also increase.

Furthermore, during the study period, the average GRDP per capita was 10,20798. In the 2015-2021 period, the lowest level of GRDP per capita was 9,314, namely East Nusa Tenggara Province in 2015. Meanwhile, in the same period, the highest level of GRDP per capita was 11.07, namely Papua Province in 2017. For the internet user household variable, in the 2015-2021 period, the lowest internet user household was 16.28, namely Papua Province in 2015. Meanwhile, in the same period, the highest level of internet user households was 87.8, namely Bali Province in 2021. Papua Province was the lowest province in 2015 because in that year access to the region was still low, which also affected most of the internet networks that were disconnected.

As for the poverty variable, in the 2015-2021 period, the lowest percentage of poor people was 3.61, namely Bali Province in 2019. Meanwhile, in the same period, the highest percentage of poor people was 28.4, namely Papua Province in 2015. The increasing poverty rate in Papua is because according to the type of region, the poor are concentrated in rural areas, in September 2015 as many as 37.34 percent of the poor lived in rural areas while in urban areas only 3.61 percent.

4.2 Estimation Results of Spatial Panel Data Model

Before determining the spatial panel data regression, it is necessary to calculate the Hausman test. The Hausman test is conducted to compare or choose which is the best model between the fixed effect or random effect model. Decision making by looking at the p value of the Chi-Square statistic or the probability (p) of Cross-Section Random. The hypothesis is as follows.

H0: choose the random effect model, if the p value of Chi-Square> 5%
Ha: choose the fixed effect model, if the p value of Chi-Square < 5%

Tabel 4.3 Hausman Test Western Indonesia

chi (3) = (b – B) ‘ [(V_b – V_B)^(-1)] (b-B)
= 8.65
Prob > chi = 0.0344

Sumber: processed data

Based on the Hausman test table above, the chi-square probability value is 0.0344 which is smaller than alpha 0.05 (0.0344 <0.05), thus rejecting H0 and accepting the Ha hypothesis. Then the right model to use is the fixed effect model. Thus, based on the Hausman test, the appropriate model used to analyze the level of human development index in the Western Region of Indonesia (KBI) is to use the fixxed effect model rather than the random effect model. The model is different in Eastern Indonesia as follows.

4.4 Tabel Hausman Test Eastern Indonesia

chi (3) = (b – B) ‘ [(V_b – V_B)^(-1)] (b-B)
= 2.97
Prob > chi = 0.3961

Sumber: processed data

Based on the Hausman test table above, the chi-square probability value of 0.3961 is greater than alpha 0.05 (0.3961> 0.05) so that Ha is rejected and H0 is accepted. Then the right model to use is the fixed effect model. Thus, based on the Hausman test, the appropriate model used to analyze the level of human development index in Eastern Indonesia (KTI) is to use the random effect model.

4.3 Spatial Panel Data Regression Estimation Results

The best model selection can be done by comparing the probability, Log Like hood, R-square and AIC values of the SAR, SEM and SDM models. The following are the results of the three models.

Table 4.5 of Spatial Panel Data Regression Results for the Western Region of Indonesia

	KBI			KTI		
	SAR	SEM	SDM	SAR	SEM	SDM
Main						
KAP	1.901***	3.263***	1.677***	-0.411 ns	-0.898 *	-0.071ns
MSKN	-0.099***	-0.0714*	-0.064*	-0.147***	-0.205**	-0.132 **
INT	0.033***	0.048***	0.036***	0.189***	0.0667***	0.05ns
_cons				27.619***	76.145***	14.5017*
Wx						
KAP			1.301*			1.36***
MSKN			-0.138***			0.021 ns
INT			0.001 ns			0.001ns
Spatial						
Rho	0.351***		0.001*	0.6667***		0.625***
Lambda		-0.082ns			0.3442ns	
R^2	0.1596	0.4333	0.0692	0.6829	0.8110	0.5521
Lglikelihood	68.0386	45.8223	71.8158	-39.6187	-60.6888	-29.2416
AIC	-126.077	-81.645	54.64321	93.23734	135.3776	78.4832

Sig.codes : **** ($p \leq 0.0001$), *** ($p \leq 0.001$), **($p \leq 0.01$), *($p \leq 0.05$), ($p \leq 0.10$), ns ($p > 0,10$)

Based on the table above, it can be seen that from observation 147, we can find out the best model used to analyze the human development index. Based on the output produced, the following are the results of various modeling that has been done so as to form the use of the best model that will be used as a reference for further research.

4.4 Best Model Selection

Indicators used to determine the best model by looking at several indicators including R-sq, Log-likelihood and AIC. Based on these three indicators, it is the best model to estimate the human development index in Western Indonesia (KBI) and Eastern Indonesia (KTI). Based on this determination, the value of R2 and Log-likehood is the largest and the value of AIC is the smallest. So that when the model is fulfilled, it can be determined regarding the determination of the model to be selected. The following is a comparison of the R-sq, Log-likelihood and AIC values of the three models:

Tabel 4.6 Indicators for Determining the KBI Model

Indikator	AIC	Log Likehood	R-square
SAR	-126.0772	68.0386	0.1596
SEM	-81.6447	45.8223	0.4333
SDM	71.8158	71.8158	0.0692

Sumber: processed data

Based on the table on determining the best model based on three indicators by looking at the comparison of R-sq, Log-likelihood and AIC, it can be seen that the smallest AIC value is the SAR model of -126.0772. The largest R-sq value is the SEM model of 0.4333 and the largest log-likelihood value is the SDEM model of 71.8158. So that these results cannot be concluded that the model used as an indicator of determination so that the most important component that can be seen is the smallest AIC value is SAR.

Based on the output obtained in the table above, the results of the SAR model in the Western Region of Indonesia (KBI) can be seen that independent variables such as X1 (KAP), X2 (MSKN) and X3 (INT) have a p-value less than $\alpha = 5\%$ of 0.000, meaning that the three variables affect HDI. However, for variable X2, it can be seen that the poverty variable has an influence but is not significant. This means that if the poverty rate of region i increases by 1%, it will reduce HDI by 0.099 per year with the assumption that the GRDP per capita and internet user variables are considered constant. Meanwhile, variables X1 and X3 have an influence and are significant, meaning that if the level of GRDP per capita and internet users in region I increases by 1%, it will increase HDI by 1.901 and 0.033 per year. While from the spatial value, it can be seen that Pvalue $0.00 < \alpha = 5\%$, it shows that the spatial regression model can provide a better explanation. However, judging from the probability of variables and spatial compared to the SEM model, it can be seen that the SAR model is better than the SEM and HR models. This is because the spatial SEM probability value > 5% means that it is not able to explain spatial regression and the SDM p-value is < 5% but the value is greater than SAR.

Table 4.7 Indicators for Determining the KTI Model

Indikator	AIC	Log Likehood	R-square
SAR	93.23734	-39.6187	0.6829
SEM	135.3776	-60.6888	0.8110
SDM	78.4832	-29.23734	0.5521

Sumber: processed data

Based on the table on determining the best model based on three indicators by looking at the comparison of R-sq, Log-likelihood and AIC, it can be seen that the smallest AIC value is the HR model of 78.4832. The largest R-sq value is the SEM model of 0.8110 and the largest log-likelihood value is the SDEM model of -29.2416. So that these results cannot be concluded that the model used as an indicator of determination so that the most important component that can be seen is the smallest AIC value is SDEM.

V. CONCLUSIONS

Based on the results of the analysis in the previous chapter, this study resulted in the following conclusions.

Between the two regions, it can be seen that the effect of X1 (GRDP per capita), X2 (poverty) and X3 (internet users) on HDI has a difference based on the output obtained in the table above the results of the SAR model in the Western Region of Indonesia (KBI) can be seen that independent variables such as X1 (KAP), X2 (MSKN) and X3 (INT) have a p-value of less than $\alpha = 5\%$ of 0.000, meaning that the three variables have an effect on HDI. However, for variable X2, it can be seen that the poverty variable has an influence but is not significant. This means that if the poverty rate of region i increases by 1%, it will reduce HDI by 0.099 per year with the assumption that the GRDP per capita and internet user variables are considered constant. Meanwhile, variables X1 and X3 have an influence and are significant, meaning that if the level of GRDP per capita and internet users in region I increases by 1%, it will increase HDI by 1.901 and 0.033 per year.

While from the spatial value, it can be seen that Pvalue $0.00 < \alpha = 5\%$, it shows that the spatial regression model can provide a better explanation. However, judging from the probability of variables and spatial compared to the SEM model, it can be seen that the SAR model is better than the SEM and HR models. This is because the spatial SEM probability value > 5% means that it is not able to explain spatial regression and the SDM p-value is < 5% but the value is greater than SAR.

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