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Spatial dependence in household consumption: A provincial analysis of real expenditure in Indonesia 2024

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Abstract

Household consumption is a driving force behind the economic growth. This study aims to identify the determinants of real expenditure per capita in Indonesia by province in 2024. The data used in this study are sourced from the Statistics Indonesia (BPS), which include real expenditure per capita as dependent variable, gross regional domestic product (GRDP) per capita, unemployment rate, mean years of schooling (MYS), government expenditure, inflation, and poverty rate as independent variables. These variables were modelled using a spatial model due to spatial autocorrelation. The selection of the spatial model, between Spatial Autoregressive (SAR) model and Spatial Error Model (SEM), was carried out using the Lagrange Multiplier test. The results indicate that the SEM is suitable for analysing real expenditure per capita spatially. The estimation results show that the variables of GRDP per capita and MYS have a significant and positive effect on real expenditure per capita, whilst the variables of unemployment rate, government expenditure, and the poverty rate have a significant negative effect. The inflation variable has no significant influence on real expenditure per capita. The spatial autocorrelation component in the model's residuals has a significant influence within the model.

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INTRODUCTION

Household consumption is a key component in boosting the national economy. Household consumption in Indonesia plays a vital role in driving national economic growth due to its significant contribution to Gross Domestic Product (GDP). Over the past five years, household consumption has consistently made the largest contribution to GDP. In 2024, the contribution of

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household consumption reached 54.04 per cent of Indonesia's total GDP (BPS, 2025). In addition to impacting economic growth, household consumption also impacts the production sector. The high level of household consumption in Indonesia, reflected in its contribution to GDP, indicates high public demand for goods and services (Soekirman, 2024). This encourages production sectors to continue to develop and innovate in meeting the needs of household consumption. Growth in the production sector can generate investment as well as create jobs. This contributes to increased economic growth (Sugiarto & Wibowo, 2020). Therefore, household consumption can have both a direct and an indirect impact on economic growth through the production sector.

The crucial role of household consumption in the national economy has yet to reach its full potential. This is reflected in the growth of household consumption, which has tended to stagnate at around 5 percent over the last ten years. Household consumption experienced a sharp decline to 2.63 per cent in 2020 due to the COVID-19 pandemic (BPS, 2025). Nevertheless, in 2022, consumption growth stabilized at 4.94 percent. However, in the subsequent period in 2023 and 2024, household consumption growth remained only around 5 per cent. This growth remains below the National Medium-Term Development Plan (RPJMN) 2020–2024 target of 5.4 percent (Presiden RI, 2020). This indicates that public expenditure on consumption has not yet seen a significant increase. Stagnant growth in household consumption may result in stagnant economic growth and the development of production sectors (Soekirman, 2024; Sugiarto & Wibowo, 2020).

National household consumption is heavily influenced by household consumption in each province. Therefore, efforts to increase household consumption at the national level must begin with the provinces of Indonesia (Sugiarto & Wibowo, 2020). Household consumption in a province is influenced not only by the province's socio-economic conditions, but also by its geographical conditions (Lian et al., 2023). In the Indonesian economy, geographical variations and infrastructure disparities create significant differences in consumption patterns between provinces. These differences pose a challenge for the government in formulating policy. Each region undoubtedly requires specific policies to boost household consumption expenditure. However, consumption patterns among communities are interlinked across neighbouring regions. The level of consumption within a region can be influenced by both local factors and factors from neighbouring regions (Huang et al., 2022). Consumption patterns in neighbouring regions tend to be similar. This is due to similarities between neighbouring regions in terms of culture, climate, and geographical conditions, meaning that the commodities consumed tend to be the same. Furthermore, neighbouring regions tend to share similar infrastructure, which influences commodity prices so that they are relatively similar (Bedi et al., 2025). Consequently, research on inter-regional consumption must account for the effects of inter-regional linkages. Therefore, this study employs an area-based spatial model to analyze inter-provincial household consumption expenditure in Indonesia.

Several previous studies have examined the socio-economic factors influencing household consumption using a quantitative approach. A study by Meng et al. (2018) analyzed household food expenditure in Ghana and found that consumption was strongly influenced by income, educational attainment, marital status and age (Meng et al., 2018). Furthermore, Zhang & Li (2021), in their study in China, demonstrated that household consumption is influenced not only by income but also by housing wealth, government expenditure, and government expenditure particularly in the form of social security and subsidies, which can reduce precautionary saving, thereby encouraging households to increase consumption (Li & Zhang, 2021). However, these studies have not considered the spatial effects on household consumption. On the other hand, the study by Putra et al. has utilized a spatial model to analyze food expenditure in Indonesia (Putra et al., 2020). Nevertheless, the study remains limited to food expenditure and does not yet cover non-food expenditure. In fact, household consumption expenditure, which drives the national economy growth, encompassing both food and non-food expenditure. Therefore, this study aims to address the limitations of previous studies by utilizing a spatial model to analyze total expenditure.

This study uses a spatial regression model to analyze household consumption expenditure in each province of Indonesia. Household consumption expenditure refers to the expenditure on food and non-food items per person within a province. Consequently, the study aims to analyze the determinants of real expenditure per capita in Indonesia by province in 2024 using a spatial regression model. This study is expected to enrich the literature on household consumption analysis using a spatial approach at the provincial level in Indonesia. Furthermore, the results of this study are expected to serve as a basis for the government in formulating more precise and accurate region-based strategies to boost household consumption.

METHOD

Theoretical Framework

In Keynes' Theory, consumption is the main component of national income. In the theory, consumption (C) is strongly influenced by disposable income (Y_d), which is total income (Y) minus taxes (T). Therefore, spending on consumption is determined by current income (Mankiw, 2019). The consumption function in Keynes' theory can be written with the formula: $C = f(Y_d)$. From this function, disposable income has a positive influence on consumption expenditure. The higher the disposable income, the higher the expenditure on consumption. The magnitude of the effect of disposable income on consumption is always less than one. This is because total expenditure has the same maximum value as disposable income. The total expenditure is divided into expenditure for consumption and for savings (Drakopoulos, 2020).

Household consumption is influenced by socio-economic factors within a region. Previous research on household consumption has shown that GRDP per capita, poverty rate, and unemployment rate have a significant impact on household consumption (Agyepong et al., 2024; Putra et al., 2020). Other studies indicate a significant influence of inflation and government expenditure on household consumption (Li & Zhang, 2021; Sugiarto & Wibowo, 2020). From an educational perspective, previous research indicates a significant influence of educational attainment on household consumption (Aina & Sonedda, 2022; Meng et al., 2018). Therefore, this study utilises the variables of GRDP per capita, unemployment rate, mean years of schooling (MYS), government expenditure, inflation, and poverty rate, which were found to have a significant influence in previous studies, to model the real expenditure per capita in Indonesia.

Data

This study uses secondary data obtained from Statistics Indonesia (BPS) website. The data collected is cross section data from 38 provinces in Indonesia in 2024. The data collected is adjusted to the theory used. Real expenditure data per capita is used as a measure of total household consumption expenditure. Real GRDP per capita data is used as an approach to the size of disposable income. In addition, this study also used other data, namely government expenditure, unemployment rate, mean years of schooling, inflation, and the poverty rate. These variables are adjusted to the economic and socio-demographic components that affect people's consumption patterns in previous studies. For MYS, the variable is used to illustrate the effect of education on total household consumption. Details of the data used are presented in Table 1. Several variables in this study, namely real expenditure per capita, real GRDP per capita, and government expenditure, were rescaled from its original unit in BPS to unit in Table 1. Variables of real expenditure per capita and real GRDP per capita were rescaled from Rupiah to million Rupiah, whilst the government expenditure variable was rescaled from million Rupiah to trillion Rupiah. This is done to simplify the figures and align the scale with other variables expressed in percentages and years, thereby facilitating the interpretation of regression model.

Table 1. Details of data

No	Variables	Unit
1	Real Expenditure per Capita (Expend)	Million Rupiah
2	Real Gross Regional Domestic Product per Capita (GRDP)	Million Rupiah
3	Unemployment Rate (Unemploy)	Percent
4	Mean Years of Schooling (MYS)	Year
5	Government Expenditure (G)	Trillion Rupiah
6	Inflation	Percent
7	Poverty Rate (Poverty)	Percent

Global Moran's I

The proximity of areas within spatial data gives rise to spatial autocorrelation. Spatial autocorrelation is a concept that describes the relationship or correlation between the same variable in neighbouring areas (Anselin, 1988). Spatial autocorrelation in spatial data can be measured using various methods, one of which is Global Moran's I (Moran's I). This method is the most commonly used measure for assessing spatial autocorrelation in spatial data due to its similarity to Pearson's correlation. Moran's I is used to measure autocorrelation for a single variable (univariate) based on spatial weights (Yamada, 2024). The values produced by this method range from -1 to 1. A positive Moran's I value indicates a positive relationship between a variable and regions, whilst a negative value indicates an inverse relationship (Isazade et al., 2023). A Moran's I value of zero indicates the absence of spatial autocorrelation between regions for a given variable. The Moran's I method used to calculate spatial autocorrelation for a variable between regions j and i is based on previous research (Putra et al., 2020), as presented in equation (1),

$$I = \frac{n}{\sum_i \sum_j W_{ij}} \frac{\sum_i \sum_j W_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_j (x_j - \bar{x})} \quad (1)$$

where I is the global Moran's I, ranging between −1 and 1. Additionally, n is the number of spatial units indexed by i and j; x refers to the variable; $\bar{x}$ denotes the mean of x; W_{ij} is a matrix of spatial weights of unit i and j.

Spatial Autoregressive Model

The Spatial Autoregressive (SAR) model is a type of spatial model that incorporates spatial weights into the model. This model is used when there is spatial autocorrelation in a dependent variable (LeSage & Pace, 2009; Rüttenauer, 2022). Therefore, the SAR model incorporates the dependent variable, which is given a spatial lag based on spatial weights, as an independent variable, referred to as the autoregressive (Kobylińska, 2021). The SAR model used is adapted from a model in previous research (Putra et al., 2020), which is presented in the equation (2),

$$y_i = \alpha + \rho \sum_j W_{ij} y_j + \sum_q X_{iq} \beta_q + \varepsilon_i \quad (2)$$

where y_i is the dependent variable in location i. Additionally, α is constant value; ρ is a parameter that relates the dependent variable of y_i to the variable of the spatial weighted of $W_{ij} y_j$; W_{ij} is a matrix of spatial weights of unit i and j; X_{iq} is independent variable q-th in location i; β_q is coefficient of independent variable q-th; and ε_i is error model in location i.

Spatial Error Model

Just like the SAR model, the Spatial Error Model (SEM) incorporates spatial weights into the model. This model is used when there is spatial autocorrelation in the residuals (Kobylińska, 2021; LeSage & Pace, 2009). This means that in the SEM, there are inter-regional characteristics that are unobserved or not used as independent variables, but which exhibit spatial autocorrelation (Rüttenauer, 2022). Consequently, spatial autocorrelation in the SEM occurs in the residuals. The SEM model employed is adapted from a previous study (Putra et al., 2020), as presented in equation (3),

$$y_i = \alpha + \sum_q X_{iq}\beta_q + u_i \quad (3)$$
$$u_i = \lambda \sum_j W_{ij}u_j + \varepsilon_i$$

where u_i is spatial correlated error component in location i; and λ is a spatial error coefficient.

Lagrange Multiplier Test

The choice of spatial model, whether SAR or SEM, is determined by the presence or absence of spatial autocorrelation in the dependent variable or the model's residuals. This determination is not sufficiently robust when using Moran's I; therefore, it must be tested using the Lagrange Multiplier (LM) test (Anselin, 1988). This testing comprises two tests: the LM_ρ test, used to test for the presence or absence of autocorrelation in the dependent variable, and the LM_λ test, used to test for the presence or absence of autocorrelation in the residuals (Rüttenauer, 2022). The LM_ρ test is used to test $H_0: \rho = 0$ vs $H_A: \rho \neq 0$ assuming $\lambda = 0$, whilst the LM_λ test is used to test $H_0: \lambda = 0$ vs $H_A: \lambda \neq 0$ assuming $\rho = 0$ (Millo, 2025). If the LM_ρ test yields a significant result, the SAR model will be used in spatial modelling; conversely, if the LM_λ test yields a significant result, the SEM will be used in spatial modelling. However, in some cases, neither of these tests can determine the spatial autocorrelation present in the data; consequently, both tests were developed into the robust LM (RLM) (Rüttenauer, 2022). The RLM test shares similarities with the LM test, which is also divided into two tests: the RLM_ρ and RLM_λ, with the same hypotheses. Therefore, to determine the appropriate spatial model, both the LM and RLM tests are conducted simultaneously.

In determining the appropriate spatial model based on the LM test, there are several stages that must be followed. These stages are presented in Figure 1. In the initial stage, the research data, particularly the dependent variable, are tested for the presence or absence of spatial autocorrelation using Moran's I (Yamada, 2024). If the result is significant, an OLS regression (non-spatial regression) is constructed based on the research variables, which is used as the basis for selecting the spatial model (Rüttenauer, 2022). If the results of the Moran's I test are not significant, the model in the study cannot use a spatial model (use non-spatial regression).

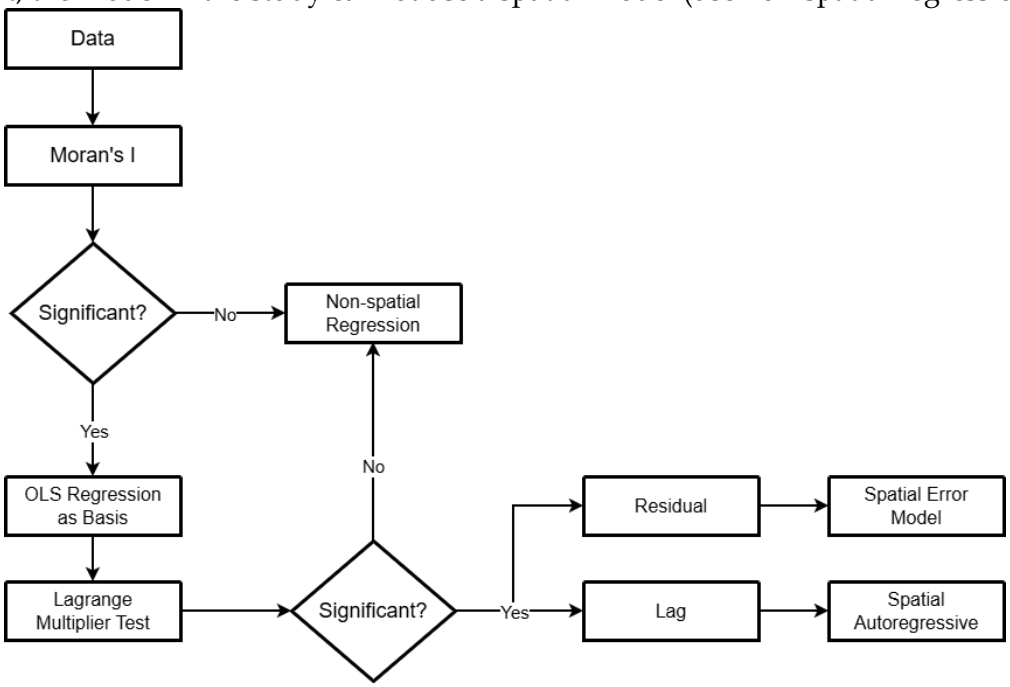


Figure 1. Stages of spatial model selection

In the next stage, based on the OLS regression formed in the previous stage, LM and RLM tests are conducted on the lags and residuals model (Millo, 2025). If the LM and RLM tests are not significant, either for the lags or residuals model, the study cannot use a spatial model (use

non-spatial regression). If the results are significant for the lag, the SAR model is more appropriate for use than SEM and non-spatial regression. If the results are significant for the residual model, SEM is more appropriate than SAR and non-spatial regression.

RESULTS AND DISCUSSIONS

Spatial Variation of the Variables by Provinces

Prior to modelling, the variables in this study were explored using thematic maps. These thematic maps were used to examine the distribution of the variables across Indonesia's provinces, as shown in Figure 2. The darker the colour shown on the thematic map, the higher value of the variable in that province. Figure 2a shows the distribution of real expenditure per capita in each province. The resulting distribution pattern indicates that real expenditure per capita on the island of Sumatra tends to cluster at high expenditure levels, whilst in the Maluku, Nusa Tenggara, and Papua regions, they cluster at low expenditure levels. This indicates the presence of spatial autocorrelation in the real expenditure per capita variable.

In addition to examining the distribution of the dependent variable, thematic maps are also used to examine the distribution of the independent variables in this study. Figures 2b, 2c, 2d, 2f, and 2g illustrate the distribution of each independent variable, namely government expenditure, unemployment rate, mean years of schooling, inflation, and poverty rate. These five variables exhibit characteristics that tend to vary or differ between neighbouring provinces. Therefore, these five variables are indicated as having no spatial autocorrelation. However, in Figure 2e, which shows the distribution of the GRDP per capita variable, the distribution of this variable tends to cluster in the regions of Sumatra, Java, Bali, and Nusa Tenggara. This indicates the presence of spatial autocorrelation in the GRDP per capita variable across provinces.

Moran's I of the Dependent Variable

The results of the exploratory analysis using thematic maps indicate the presence of spatial autocorrelation in the real per capita expenditure variable, which was used as the independent variable. To confirm this indication, this study used Moran's I. Prior to calculating Moran's I, this measure requires a spatial weighting matrix (Yamada, 2024). The spatial weighting matrix in this study employed the queen contiguity measure. Once the matrix had been successfully calculated, Moran's I could be calculated and visualised in the form of a scatter plot, as shown in Figure 3. The scatter plot of Moran's I indicates a positive relationship in the real expenditure per capita variable between neighbouring provinces, with Moran's I value of 0.409. This means that provinces with high real per capita expenditure tend to be neighbours of provinces that also have high expenditure, and vice versa for provinces with low expenditure. The pseudo p-value for Moran's I is 0.002. This value means that there is significant spatial autocorrelation in the real per capita expenditure variable at the 5 percent significance level. This strengthens the evidence that the spatial pattern of real per capita expenditure is not random, but rather that there is a significant pattern of inter-regional correlation.

Classical Assumption Tests

The results of the analysis using Moran's I indicate the presence of spatial autocorrelation in the real expenditure per capita variable. Consequently, modelling of real expenditure per capita must employ a spatial regression model. If the modelling is carried out using non-spatial regression, the error variance of the model will not be constant due to the inter-regional dependence of the model's errors (LeSage & Pace, 2009; Rüttenauer, 2022). This means that the assumption of homoscedasticity will not be met, resulting in a biased and inconsistent model. Prior to spatial modelling, the influence of the independent variables on real expenditure per capita must be modelled using Ordinary Least Squares (OLS) estimator or non-spatial regression model as a basis for selecting the spatial model (Rüttenauer, 2022). The results of the model estimation using OLS are presented in Table 2. Using OLS, there are three variables that

significantly influence real expenditure per capita, namely GRDP per capita, government expenditure, and poverty rate, at a 5 percent significance level. Furthermore, the error from the OLS estimation results can be used to test classical assumptions and determine the best spatial model.

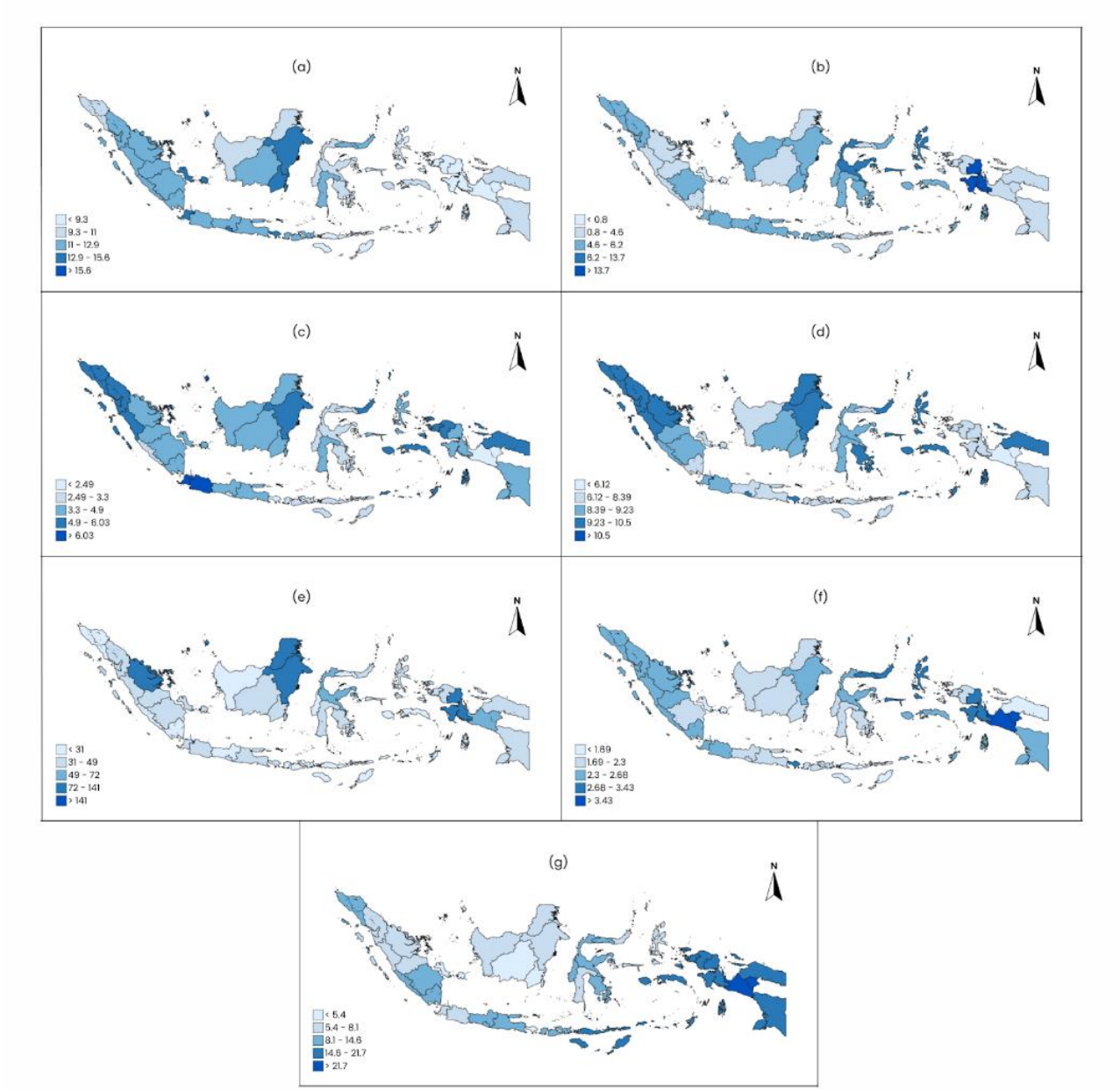


Figure 2. Thematic maps for the variables: (a) real expenditure per capita, (b) government expenditure, (c) unemployment rate, (d) mean years of schooling, (e) GRDP per capita, (f) inflation, and (g) poverty rate

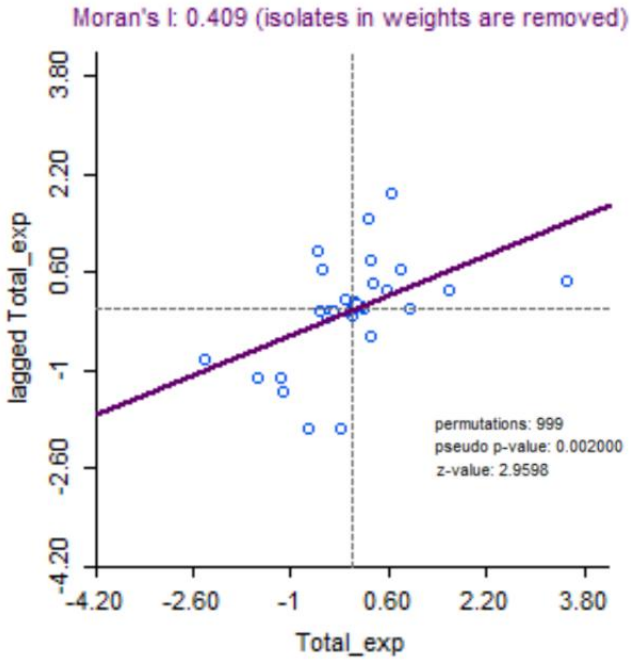


Figure 3. The Moran's I of real expenditure per capita

Table 2. Estimation results from the OLS estimator

Variables	Coefficient	Probability
Constant	8.458	0.012*
GRDP	0.024	0.004*
Unemploy	-0.217	0.318
MYS	0.609	0.079
G	-0.171	0.047*
Inflation	0.113	0.817
Poverty	-0.162	0.003*

Note: *significant at 5 percent significance level

Once the OLS estimates had been obtained, the residuals from the model were used to test the classical assumptions. These tests were conducted to assess the assumptions of non-multicollinearity, homoscedasticity, and normality. The results of the non-multicollinearity assumption test are presented in Table 3. The Variance Inflation Factor (VIF) values for all independent variables are less than 10, which is the threshold for multicollinearity. This means that there is no strong correlation between the independent variables in the model. Therefore, the non-multicollinearity assumption is met.

Table 3. VIF values of the independent variables

Variables	VIF
GRDP	1.332
Unemploy	1.591
MYS	2.975
G	1.211
Inflation	1.211
Poverty	2.104

In addition to the assumption of non-multicollinearity, the assumptions of normality and homoscedasticity also need to be tested. The results of the tests for these two assumptions are presented in Table 4. The normality assumption was tested using the Jarque-Bera test. The result of this test yielded a probability of 0.536, that indicates the residuals of model are normally

distributed at the 5 percent significance level. This means that the normality assumption is met. Furthermore, the test for homoscedasticity was conducted using the Breusch-Pagan test. The results of this test yielded a probability of 0.045, that indicates the variance of residuals in the model is not constant, or that heteroscedasticity is present. This means that the assumption of homoscedasticity is violated. Thus, the assumption of normality is met, but the assumption of homoscedasticity is not met in the regression model, that estimated using OLS estimator.

Table 4. Normality and homoscedasticity tests

Assumptions	Probability
Normality	0.536
Homoscedasticity	0.045*

Note: *significant at 5 percent significance level

Spatial Model Selection

After estimation using OLS and testing the classical assumptions, the next step is to select an appropriate spatial regression model. The selection of the spatial regression model was carried out using the LM and RLM tests on the lags or residuals of the model. The results of these tests are presented in Table 5. The LM test on the lags (LM_ρ) yielded a probability of 0.844, whilst the RLM_ρ test yielded a probability of 0.446. This implies that spatial autocorrelation in the dependent variable does not have a significant effect within the model at the 5 percent significance level; consequently, the SAR model is unsuitable for modelling the influence of the independent variables on real expenditure per capita. However, the LM_λ and RLM_λ yielded probability of 0.025 and 0.019, respectively. This implies that spatial autocorrelation in the model's residuals has a significant effect within the model at the 5 percent significance level; consequently, SEM is more appropriate than the SAR model. Therefore, the model suitable for modelling the effect of the independent variables on real expenditure per capita is SEM.

Table 4. Normality and homoscedasticity tests

Test	Probability
$\boldsymbol{LM_\rho}$	0.844
$\boldsymbol{RLM_\rho}$	0.446
$\boldsymbol{LM_\lambda}$	0.025*
$\boldsymbol{RLM_\lambda}$	0.019*

Note: *significant at 5 percent significance level

Spatial Analysis of Independent Variables

Based on the results of the spatial model testing, the model used in this study is SEM. The estimation results from the SEM regarding the influence of independent variables on real per capita expenditure are presented in Table 6. From the probability results, the spatial correlation component, namely lambda, has a significant effect at the 5 percent significance level within the model. This indicates that there is spatial autocorrelation in the residuals of the model across provinces. Furthermore, among the independent variables, only one variable does not have a significant effect within the model, namely the inflation variable. The classical assumption of SEM is met, namely the assumption of homoscedasticity. The probability from the Breusch-Pagan test yielded a value of 0.199. This means the assumption of homoscedasticity was met, so there are no issues regarding spatial heterogeneity. In the model comparison test between SEM and the classical regression model estimated using OLS, the likelihood ratio (LR) test results showed a probability of 0.001, meaning that SEM is superior to the classical regression model. Therefore, SEM can be used to model real per capita expenditure. The estimation results from SEM can be expressed in the form of the equation given in equation (4),

$$\widehat{Expend}_\iota = 8.518 + 0.027GRDP_i - 0.349Unemploy_i + 0.651MYS_i - 0.132G_i + 0.071Inflation_i - 0.170Poverty_i + \hat{u}_i \quad (4)$$

$$\hat{u}_i = 0.514 \sum_{j=1}^{37} w_{ij}\hat{u}_j$$

Table 6. Estimation results from the SEM

Variables	Coefficient	Probability
Constant	8.518	0.001*
GRDP	0.027	0.000*
Unemploy	-0.349	0.042*
MYS	0.651	0.016*
G	-0.132	0.022*
Inflation	0.071	0.855
Poverty	-0.170	0.001*
Lambda	0.514	0.000*

Note: *significant at 5 percent significance level

The results of partial testing on all independent variables show that there are five variables that have a significant effect, namely GRDP per capita, unemployment rate, MYS, government expenditure, and poverty rate. GRDP per capita and MYS have a significant positive effect on real expenditure per capita. GRDP per capita has a coefficient value of 0.027. This value indicates that every increase in GRDP per capita by IDR 100 million will increase real expenditure per capita by IDR 2.7 million, assuming other variables are constant. This shows that GRDP per capita, which is a measure of each person's income in a province, strongly influences the real expenditure per capita in that province. These results are in line with Keynes' Theory and previous study that shows a positive and significant influence between income and public consumption (Mankiw, 2019; Putra et al., 2020). In addition, the MYS variable has a coefficient of 0.651. That means that every increase in MYS by one year will increase real expenditure per capita by IDR 0.651 million, assuming other variables are constant. This shows that the length of a person's education will affect the amount of income spent on consumption. The longer the average education of people in a province, which indicates a highly educated society, the greater the public expenditure in the province. This finding is in line with previous study, which shows a positive and significant effect of the length of education on household consumption in Italy (Aina & Sonedda, 2022).

In addition to the variables of GRDP per capita and MYS, the variables of unemployment rate, government expenditure, and the poverty rate have influence on real expenditure per capita. The three variables have a significant negative influence. The unemployment rate variable produces a coefficient value of -0.349. That means that an increase in unemployment by 1 percentage point will reduce real expenditure per capita by IDR 0.349 million, assuming other variables are constant. A high percentage of unemployment in a province can have an impact on the low consumption expenditure of the people in that province. However, the result of this study is not in line with previous study, which showed a positive effect of the unemployment rate on food consumption (Putra et al., 2020). On the other hand, a previous study conducted with time series regression showed a negative effect of the unemployment rate on household consumption, which is in line with this study (Sugiarto & Wibowo, 2020). This could happen because the previous study only focused on food consumption. The government expenditure variable produced a coefficient value of -0.132. That means an increase in provincial government expenditure by IDR 10 billion will reduce real expenditure per capita by IDR 1.32 million. This shows that provincial government expenditure in Indonesia is still inefficient. The amount of government expenditure aimed at increasing public consumption actually results in a decrease of spending on public consumption. However, these findings are inversely proportional to previous study, which shows a positive effect of government expenditure on public consumption when analyzed in time series (Sugiarto & Wibowo, 2020).

The variable poverty rate also has a negative influence on real expenditure per capita. The resulting coefficient value is -0.170. That means an increase of the poverty in province by 1 percent point will reduce real expenditure per capita by IDR 0,170, assuming other variables are constant. This shows that a high poverty rate in a province will have an impact on the low real expenditure per capita in that province. This phenomenon was also shown in a previous study in Ghana, which showed a significant difference between the consumption of poor and non-poor households (Agyepong et al., 2024). The inflation variable has no significant effect on real expenditure per capita. This shows that price increases in a province will not have an impact on the real expenditure of people in that province. Inflation that occurs has no impact on changes in public consumption because there are substitute goods. This means that when there is an increase in the price of an item that causes inflation, people will switch to other goods that have a fixed price and the same benefits, so the amount of public consumption will not change (Borkotoky, 2018). However, this finding is not in line with previous study, which shows a negative effect of inflation on household consumption in Indonesia (Sugiarto & Wibowo, 2020). The study analyses the impact of inflation on household consumption using a panel data model covering 33 provinces over the period from 2010 to 2019. During certain periods, the substitution effect no longer applies in maintaining household consumption because, ultimately, the prices of substitute goods will also rise due to increased demand (Borkotoky, 2018). This means that inflation can reduce household consumption, although this takes a certain amount of time. Therefore, inflation does not have a strong effect on household consumption due to the substitution effect cross-sectionally.

In addition to the independent variables, there is also a lambda component, which is the spatial autocorrelation in the residuals of model, which has a significant effect in the model. That means there is spatial autocorrelation between provinces in Indonesia in terms of model's residuals or other variables that are not included in the model. The resulting lambda coefficient value is 0.514. An example is West Java Province, which is adjacent to Banten, Central Java, and DKI Jakarta Province, with a lambda coefficient of 0.514. This value indicates that an increase in the value of other variables outside the model by 1 unit in Banten, Central Java, and DKI Jakarta Province will increase real per capita expenditure in West Java Province by IDR 0.514 million, assuming other variables are constant. This shows that there are other variables that affect real expenditure per capita and have spatial autocorrelation. These variables could be variable of average living area per capita and average disposable income per household, which is shown to have significant effect on total expenditure per capita and has spatial autocorrelation in previous study in Taiwan (Huang et al., 2022). The study revealed that total expenditure per capita in one country or city is influenced by household characteristics, including average living area per capita and average disposable income per household, in neighbouring countries or cities.

CONCLUSION

Using the LM test on lags and residuals, the spatial model employed to model the influence of independent variables on real expenditure per capita is SEM. This model indicates the presence of spatial correlation in the model's residuals across provinces in Indonesia. The estimation results from the SEM indicate that the variables of GRDP per capita and MYS have a positive and significant effect on real expenditure per capita, whilst the variables of unemployment rate, government expenditure, and poverty rate have a negative and significant effect. As for the inflation variable, it does not have a significant effect on real expenditure per capita. The spatial autocorrelation component in the model's residuals has a significant influence within the model, indicating that there are other variables affecting real expenditure per capita that exhibit spatial autocorrelation across provinces in Indonesia.

This study has several limitations that should be considered in future research. It focuses solely on the presence or absence of spatial autocorrelation in the dependent variable or residuals of the model. This study has not conducted further analysis regarding the presence or absence of

spatial autocorrelation in the independent variables. Therefore, future research could undertake such analysis, thereby enabling the use of alternative models, such as the Spatial Lag-X (SLX), the Spatial Durbin Model (SDM), or the Spatial Durbin Error Model (SDEM), to address spatial autocorrelation in the independent variables. Furthermore, the inclusion of additional variables is also necessary in future research. The findings of this study indicate the presence of other variables (residuals of the model) that exhibit spatial correlation across provinces. In future research, these variables could be identified to determine which variables have spatial correlations in influencing total household consumption in each province in Indonesia.

AUTHOR CONTRIBUTIONS

DK designed the research, collected data, analyzed data, wrote the results section, and edited the paper; AF wrote the introduction, results, and references section; HM analyzed data, wrote the introduction and research methods; IM explored data with thematic map, wrote the introduction and results section. NM wrote the introduction and research methods section; GP validated and reviewed the results.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding the publication of this manuscript.

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