Xplore, 2013, *Vol. 1(1):e5(1-7)* © 2013 Departemen Statistika FMIPA IPB

Evaluation of Factors Influencing Food Insecurity in Central Java Using Spatial Panel Data Analysis

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***Abstract*—Food insecurity refers to the consequence of inadequate consumption of nutritious food at region, society or household, considering the physiological use of food by the body as being within the domain of nutrition and health. However, household with food insecure still found in almost whole provinces with high proportion. So, it is necessary to do a research to determine factors that influence food insecurity in a province by calculating spatial effect of inter-regency or municipality. In this research, food insecurity that will be analyzed is food insecurity in Central Java using spatial panel data analysis. Cross-section unit in this research is 35 regencies or municipalities in Central Java province which was observed for 4 years (2007-2010) as time series unit.The analysis result in this research show that fixed effect model with SAR are better used for modelling food insecuity in Central Java. This model show that production of paddy (X2) and local government original receipt of regency or municipality (X3) influence percentage of citizen with food insecure that consume calorie under basic requirement 2100 kkal/capita/day (Y) with R^2 (95.88%). Coefficient of λ indicates that spatial autoregressive effect significant in influencing percentage of citizen with food insecure in Central Java.**

***Keywords*-food insecurity; spatial panel data analysis; fixed effect model; SAR**

I. Introduction

A. Background

Food is the necessary basic needed for everybody through physiological, social, and antrhopological. Food always related with society effort for living on. If this primary requirement unfulfilled, then food insecurity will impact for various life aspect [1]. Food security refers to a household's physical and economic access to adequate, safe, and nutritious food that fulfills the dietary needs and food preferences of household for living an active and healthy life. Food security levels are classified into four levels: food secure, food less secure, food vulnerable, and food insecure (Law No. 7/1996).

Food supply in national or regional is apparently adequate is not assured that individu or household in food security condition [2]. Sutawi (2008) [3] explained that availability and achievability on aggregate scale, Indonesia citizen is appertained food secure. However, household with food insecure still found in almost whole provinces with high proportion. Based on National Socio-Economic Survey data of Statistics Indonesia in 2006, the lowest percentage of citizen with food insecure was at Bali province (4.8%) and the highest was at Special District of Yogyakarta (20%). Even in whole provinces which well known as central location of food production like South Sumatera, South Sulawesi, East Java, West Java, and Central Java, had high proportion of food insecure citizen over 10%.

Based on the above informations, it is necessary to do a research to determine factors that influence food insecurity in a province by calculating spatial effect of inter-regency or municipality. In this research, food insecurity that will be analyzed is food insecurity in Central Java, province with the lowest average expenditure per capita for food in Java island based on Statistics Indonesia in 2008. The data from this research is spatial panel data built by cross-section and time series data that have specific interaction between spatial units. So, the analysis that can be used for this data type is spatial panel data analysis.

B. Objective

The aim of this research is to determining factors that influence food insecurity in Central Java using spatial panel data analysis.

II. LITERATURE REVIEW

A. Food Insecurity

Food insecurity refers to the consequence of inadequate consumption of nutritious food at region, society or household, considering the physiological use of food by the body as being within the domain of nutrition and health. Those are two form of food insecurity, first, chronic food insecurity, that can be happened repeatedly in certain of time because of low purchasing power and low quality of resource. Second, transient food insecurity is happened because of urgen situation like nature or social disaster [4].

[1] explained that food insecurity can be influenced by production of paddy, rice aid, rice suply, and rice purchasing. This research used regression analysis. [5] explained that food insecurity a province can be influenced by food insecurity from each regency or municipality in that province. This research result explained that factors that influence food insecurity using panel data analysis are general allocation fund, local government original receipt, income percapita, harvested area of paddy, and production of paddy.

B. General Model of Panel Data

If the same units of observation in a cross-sectional sample are surveyed two or more times, the resulting observations are described as panel data set. Cross-section data refers to data that are collected from many units or subjects at one point in time. Time series data is a set of observations on the values that a variable takes at different times. There are another names for panel data, such as pooled data (pooling of time series and cross-sectional observations), combination of time series and cross-section data, micropanel data, longitudinal data (a study over time of a variable or group of subject), event history analysis and cohort analysis.

If each unit cross-section has the same number of time series observation, it is called balance panel data. Otherwise, if each unit cross section has a different number of time series observation, it is called unbalance panel data. In panel data also come across the terms short panel and long panel. In short panel the number of cross-sectional subject, N, is greater than the number of time periods, T. Then in a long panel, T is greater than N [6]. The structure of panel data is sorted first by spatial units then by time [7].

A panel data regression differs from a regular time-series or cross-section regression, in that it has a double subscript on its variables, i.e.

$$y_{it} = \alpha + \mathbf{x}'_{it}\beta + u_{it}, \tag{1}$$

$i = 1, 2, \ldots, N$; $t = 1, 2, \ldots, T$ with i denoting unit cross section or individuals and t denotes the time series dimension. y_{it} denotes response for i observation and t time period. α is a scalar, β is a vector of $K \times 1$, $\mathbf{x}_{it}$ is a vector of $K \times 1$ for i observation and t time period and u_{it} denotes error.

Most of the panel data applications utilize a one-way error component model for the disturbances,

$$u_{it} = \tau_i + \epsilon_{it}, \tag{2}$$

where τ_i denotes the unobservable individual-specific effect and ϵ_{it} denotes error for *i* observation and *t* time period [8].

1) Pooled Model: Pooled model is one of the models panel data analysis. Assumption in this model is the regression coefficient (constant or slope) between cross-section unit and time series unit is the same. Then, to estimate the parameters used ordinary least square (OLS) [6].

2) Fixed Effect Model: The fixed effect model is an appropriate specification if we are focusing on a specific set of *N*. The assumptions for this model are (1) τ_i is assumed to be fixed parameters to be estimated, (2) ϵ_{it} disturbances stochastic independent and identically distributed IDD (0, σ^2_ϵ), (3) $E(\mathbf{X_{it}}, \epsilon_{it}) = 0$, $\mathbf{X}_{it}$ are assumed independent with ϵ_{it} for all i and t [8]. Parameters estimation in fixed effect model is estimated by within estimator, can be explained as follows.

For the panel data regression,

$$y_{it} = \alpha + \mathbf{x}'_{it}\beta + \tau_i + \epsilon_{it} \tag{3}$$

these equation are averaged for over time gives:

$$\bar{y}_i = \alpha + \bar{\mathbf{x}}'_{i.}\beta + \tau_i + \bar{\epsilon}_{i.} \tag{4}$$

therefore, subtracting equation 4 from equation 3 gives

$$y_{it} - \bar{y}_i = (\mathbf{x}'_{it} - \bar{x}'_{i.})\beta + (\epsilon_{it} - \bar{\epsilon}_{i.}) \tag{5}$$

Equation 5 is called within transformation [7].

Model above is estimated with OLS method. This fixed effects least squares, also known as least squares dummy variables (LSDV) [8].

3) Random Effect Model: The random effects model is an appropriate specification if we are drawing *N* individuals randomly from a large population. The assumptions for this model are 1 τ_i is normal distribution N(0,σ^2_τ), ϵ_{it} disturbances stochastic independent and identically distributed IDD (0,σ^2_ϵ), 2 $E(X_{it}, \tau_i) = 0$ and $E(\mathbf{X_{it}}, \epsilon_{it}) = 0$, X_{it} are assumed independent with ϵ_{it} for all *i* and *t*.

Consistent estimator obtained by OLS, but this case can make unbiased standart error. Therefore, Generalize Least Square (GLS) is better used for this model [8].

4) Chow Test: Chow test is used for examining the significant between pooled model and fixed effect model. The hypothesis for this test is:

H0 : $\tau_1 = \tau_2 = \ldots = \tau_{N-1} = 0$ (the model followed pooled model)

H1 : There is one minimum *i* so $\tau_i \neq 0$ (the model followed fixed effect model) The test statistic for Chow test is:

$$F_0 = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT - N - K)} \tag{6}$$

with the restricted residual sums of squares (RRSS) being that of OLS on the pooled model, the unrestricted residual sums of squares (URSS) being that of the LSDV regression, *N* denotes quantity of observations and *K* denotes quantity of variables. The decision for reject H_0 if $F_0 > F_{(N-1, N(T-1)-K, \alpha)}$ or if $p - value < \alpha$ [8].

5) Hausman Test: Hausman test is used for examining the significant between fixed effect model and random effect model. The hypothesis in a population, if the individual is taken at random an a sampel, the panel data model supposition is random effect model, but if the individual who used from the whole of the population, then tend to use fixed effect model. The hypothesis for this test is:

H0 : $E(\tau_i|X_{it}) = 0$ (the model followed random effect model)

H1 : $E(\tau_i|X_{it}) \neq 0$ (the model followed fixed effect model) The test statistic for Hausman test :

$$\chi^2_{hit} = \widehat{\mathbf{q}}' \left[Var(\widehat{\mathbf{q}})^{-1}\right] \widehat{\mathbf{q}} \tag{7}$$

where $\widehat{\mathbf{q}} = \widehat{\beta}_{\text{random}} - \widehat{\beta}_{\text{fixed}}$

$\widehat{\beta}_{\text{random}}$ = coefficient vector of independent variable from random effect model

$\widehat{\beta}_{\text{fixed}}$ = coefficient vector of independent variable from fixed effect model The decision for reject $H_0\ if\ \chi^2_{hit} > \chi^2_{k,\alpha}$ with k is dimension vector of β or if $p - value < \alpha$ [8].

C. Spatial Panel Data Analysis

Panel data model with spatial specific effect will have specifying interaction between spatial units. The model may contain a spatially lagged dependent variable or spatial autoregressive process in the error term, it is called spatial autoregressive model (SAR) and spatial error model (SEM) [7]. SAR focus on spatial correlation of explanatory variable, while the SEM focus on the shape of error [9]. The structure of spatial panel data is sorted first by time and then by spatial units [7].

1) Spatial Autoregressive Model (SAR): The spatial autoregressive model expressed by the following equation:

$$y_{it} = \lambda \sum_{j=1}^{N} w_{ij} y_{jt} + \mathbf{x}_{it}^{'} \beta + \tau_i + \varepsilon_{it} \tag{8}$$

where λ is called the spatial autoregressive coefficient and w_{ij} is an element of a spatial weights matrix ($\mathbf{W}$) describing the spatial arrangement of the units in the sample and $i \neq j$. Estimation for parameters in this model using Maximum Likelihood Estimator (MLE) [7].

2) Spatial Error Model (SEM): The spatial error model expressed by the equation :

$$\mathrm{y_{it}}{=}\mathbf{x'}_{\mathrm{it}}{+}\tau_{\mathrm{i}}{+}\Phi_{\mathrm{it}} \tag{9}$$

$$\Phi_{\mathrm{it}}{=}\rho\sum_{\mathrm{j=1}}^{\mathrm{N}} \mathrm{w_{ij}}\Phi_{\mathrm{it}}{+}\epsilon_{\mathrm{it}} \tag{10}$$

where Φ reflects the spatially autocorrelated error term and ρ is called the spatial autocorrelation coefficient. Estimation for parameters in this model using MLE [7].

3) Spatial Weight Matrix: Spatial weight matrix is a weight matrix summarizes the spatial reliationship in the data. The main diagonal from this matrix consists of zeros. Because weight matrix shows the reliationships between all of the observation, its dimension is always NxN, where N is the number of observation. The most natural way to represent the spatial relationships with area data is through the concept of contiguity.

$$w_{ij} = \begin{cases} 1, \text{if } i \text{ and } j \text{ neighbours} \\ 0, \text{otherwise} \end{cases}$$

There are three types of contiguity that are commonly considered :

1) Rook Contiguity A spatial unit is a neighbour of another unit if both areas share a common edge (side).
2) Bishop Contiguity A spatial unit is a neighbour of another unit if both areas share a common vertex (region that tangent corner from another region that being observed).
3) Queen Contiguity A spatial unit is a neighbour of another unit if both areas share a common edge or vertex.

After determining spatial weight matrix that will be used, then do normalization. This means that matrix is transformed so that each of the rows/collumn sums to one. It is common, but not necessary for normalization matrix is used row-normalizing. Column-normalizing is the other method for normalization, otherwise also can do with divide the element of matrix with the biggest character root from that matrix [10], [7].

D. Lagrange Multiplier Test

The examining of spatial interaction effects in cross-sectional data developed Lagrange Multiplier (LM) tests for a spatially lagged dependent variable and a spatial error correlation. The hypothesis for this test is:

- Spatial autoregressive model
  H_0 : $\lambda = 0$ (there is no dependence of spatial autoregressive)
  H_1 : $\lambda \neq 0$ (there is dependence of spatial autoregressive)
- Spatial error model
  $H\_0 : \rho = 0$ (there is no dependence of spatial error)
  $H\_1 : \rho \neq 0$ (there is dependence of spatial error)

The test statistic for LM used:

$$\mathrm{LM}_{\lambda}{=}\frac{\left[\mathbf{e}^{'}\left(\mathbf{I_T}\bigotimes\mathbf{W}\right)\mathbf{Y}/\widehat{\sigma}^2\right]^2}{\mathrm{J}} \tag{11}$$

$$\mathrm{LM}_{\rho}{=}\frac{\left[\mathbf{e}^{'}\left(\mathbf{I_T}\bigotimes\mathbf{W}\right)\mathbf{e}/\widehat{\sigma}^2\right]^2}{\mathrm{T}\times\mathrm{T_W}} \tag{12}$$

where the symbol $\otimes$ denotes the Kronecker product, $\mathbf{I}_T$ denotes the identity matrix and it is subscript the order of this matrix, $\hat{\sigma^2}$ denotes mean square error of panel data model, $\mathbf{W}$ denotes spatial weights matrix which have been normalized and $\mathbf{e}$ denotes the residual vector of a pooled regression model without any spatial or timespecific effects or residual vector of panel data with fixed/random effect with spatial and/or time period. Finally, J and T_w are defined by:

$$\mathrm{J} = \frac{1}{\widehat{\sigma}^2}\left[\left(\mathbf{a'_1 a_2 a_1}\right) + \mathrm{TT_W}\widehat{\sigma}^2\right] \tag{13}$$

$$\mathrm{T_W}{=}\ \mathrm{tr}\left(\mathbf{W}W{+}\mathbf{W'W}\right) \tag{14}$$

where,

$$\mathbf{a_1}{=}\ (\mathbf{I_T}\bigotimes\mathbf{W})\mathbf{X}\widehat{\beta} \tag{15}$$

$$\mathbf{a_2}{=}\mathbf{I_{N}}_T{-}\mathbf{X}(\mathbf{X}^{'}\mathbf{X})^{-1}\mathbf{X}' \tag{16}$$

where $\mathbf{I}_{NT}$ denotes identity matrix and "tr" denotes the trace of a matrix. The decision for reject H_0 if the value of LM statistic greater than $\chi^2_{(q)}$ value with $q = 1$ (q is the number of spatial parameters) or if $p - value < \alpha$ [9], [7].

III. METHODOLOGY

A. Data Sources

The data that is used in this research is secondary data. The data derived from three sources: National Sosio-Economic Survey, Data and Proverty Information, and Central Java in Figure. Response variable of this research is percentage of citizen with food insecure in each regency or municipality. The number of explanatory variables are five variables. Cross-section unit in this research is 35 regencies or municipalities in Central Java province which was observed for four years (2007-2010) as time series unit.

B. Method

Methodologies of this research are summarized as follows:

1) Exploration of data to observe the characteristic of data.
2) Perform panel data analysis :
   - Estimate the parameter of pooled model.
   - Estimate the parameter of fixed effect model.
   - Examine the influence of individual to establish a model that is used through the Chow test. If H_0 is accepted, the pooled model is used, but if H_0 rejected then go to next step.
   - Estimate the parameter of random effect model.
   - Examine the significance of random effect model or fixed effect model by using the Hausman test. If H_0 is accepted, the random effect model is used, but if H_0 rejected then fixed effect model is used.
3) Determine the spatial weights matrix (W).
4) Examine the effect of spatial interaction by using Lagrange Multiplier (LM) test.
5) Estimate the parameters for the equation of spatial panel data model.
6) Examine the assumptions

IV. RESULT AND DISCUSSION

A. Data Exploration

From this exploration is gotten information that Wonosobo is a regency with the highest average value of citizen percentage with food insecure with 27.1%. Wonosobo has the lowest total of local government original receipt and actual receipt of region when compared with another regencies with characterictic similarity of agricultural (Kudus, Banjarnegara, Purbalingga, and Temanggung). Regency or municipality with the lowest average value of citizen percentage with food insecure is Semarang Municipality (5.3%). Although Semarang Municipality is not included municipality where became central of food production, but when compared with another regency or municipality in Central Java province, total of local government original receipt and actual receipt of region is the highest. And Semarang Municipality is capital of Central Java province. Another information from this exploration is found some groups of regencies or municipalities that neighboring with average value of citizen precentage with food insecure almost same. The first group consist of Purbalingga, Banjarnegara, Kebumen, and Wonosobo with average value of citizen precentage with food insecure revolve 26%. The second group consist of Grobogan and Sragen revolve 20%. The third group consist of Boyolali, Sukoharjo, and Karanganyar revolve 15%. And the last group consist of Magelang, Purworejo, and Temanggung with average value of citizen precentage with food insecure revolve 16%. Based on that information it has possibility that food insecure could be influenced by closeness inter region or municipality. It can be happened because of characteristic similarity from those regencies or municipalities. According to the data, can be seen that percentage of citizen with food insecure that consume calorie under basic requirement 2100 kkal/capita/day (Y) and percentage of expenditure percapita for food (X5) have high stretches of value as compared to the other variables. To solve this problem, natural logarithm transformation is taken for whole variables.

B. Panel Data Analysis

This research used alpha 5%. The result for estimating parameter of panel data analysis for pooled model, fixed effect model and random effect model are presented in Table I, Table II and Table VI. From Table I, explanatory variables that significant for pooled model are local government original receipt of regency or city (X3) and percentage of expenditure per capita of regency or city for food (X5) with R^2 value is 41.34%.

Table I
THE RESULT OF POOLED MODEL

Variable	Coefficient	P-Value
C	1.097	0.491
X1	0.128	0.735
X2	-0.014	0.97
X3	-0.241	0.003
X4	0.043	0.578
X5	1.375	0.031
R^2	0.4133	

Then from Table II, explanatory variables that significant for fixed effect model are production of paddy (X2) and local government original receipt of regency or municipality (X3). R^2 value for this model is 95.13%.

And explanatory variables that significant for random effect model are harvested area of paddy (X1), production of paddy (X2) and local government original receipt of regency or municipality (X3) that can be seen in Table VI. R^2 value for this model is 95.17%.

Table II
THE RESULT OF FIXED EFFECT MODEL

Variable	Coefficient	P-Value
C	10.251	0
X1	0.137	0.64
X2	-0.622	0.013
X3	-0.359	0
X4	0.021	0.502
X5	0.045	0.871
R^2	0.9513	

Table III
THE RESULT OF RANDOM EFFECT MODEL

Variable	Coefficient	P-Value
C	5.544	0
X1	0.768	0.002
X2	-0.647	0.006
X3	-0.416	0
X4	-0.001	0.979
X5	0.048	0.86
R^2	0.9517	

Furthermore, will be done examine the influence of individual to establish a model that is used through the Chow and Hausman Test.

1) Chow Test: Chow Test is used to choose appropriate model betwen pooled model and fixed effect model. Statistic value of cross-section F that is goten is 32.457 with p-value 0.000, where $p-value(0.000) < \alpha(0.05)$, so H_0 is rejected. It shows that appropriate model that is used for temporary is fixed effect model.

2) Hausman Test: Hausman test is used to choose appropriate model betwen fixed effect model and random effect model. Statistic value of cross-section random that is gotten is 27.752 and p-value 0.000 where $p - value(0.000) < \alpha(0.05)$, H_0 is rejected. So the model that is used is fixed effect model.

C. Spatial Panel Data Analysis

The method that can be used to detected spatial effect is Lagrange Multiplier Test (LM-Test). Before analyze spatial effect with LM-Test, it is required determination spatial weight matrix. The most natural way to represent the spatial relationships with area data is through the concept of contiguity. Contiguity concept that is used in this research is queen contiguity because this concept more reguler to used and from data exploration is estimated that food insecure could be influenced by closeness inter region or municipality. And from the map could be seen that neighborhood position be in edge (side) and corner (vertex).

After determining spatial weight matrix then next step is normalization. This means that matrix is transformed so that each of the rows or column sums to one. Normalization that is used in this research is row-normalitation.

1) Lagrange Multiplier Test: Spatial effect can be detected by Lagrange Multiplier (LM) tests for spatial autoregressive model (SAR) and spatial error model (SEM). The calculation result can be seen in Table 4. LM-value for SAR is 63.956 bigger than $\chi^2_{(1)}$ (3.841) at $\alpha = 5\%$ or $p - value(0.000) < \alpha(0.05)$. And LM-value for coefficient SEM is 937.211, bigger than $\chi^2_{(1)}$ (3.841) at $\alpha = 5\%$ or $p-value(0.000) < \alpha(0.05)$. So for both test H_0 is rejected. It means that those are dependence of spatial autoregressive and spatial error.

Table IV
THE RESULT OF LM-TEST

	LM-Value	$\chi^2_{(1)}$	$P - value$
SAR	639.561	3.841	0.000
SEM	937.211	3.841	0.000

Because both tests are significant, estimate the specification is appointed by the empirical literatur. [7] gave example that in the empirical literature on strategic interaction among local government, the situation where taxation and expenditures on public service interact with taxation and expenditures on public services in nearby jurisdiction is follow theoretically consistent for the spatial autoregressive model. And from exploration data was gotten that it has possibility that food insecure in a regency or municipality could be influenced or have interact with regencies or municipalities nearby. So the model that will be estimates is SAR.

2) Spatial Autoregressive Model (SAR): Variables that significant in fixed effect model are production of paddy (X2) and local government original receipt of regency or municipality (X3). Two of those variables are used to build SAR model. The estimation and examine result of the parameter can be seen in Table 5. Variables production of paddy (X2), local government original receipt of regency or municipality (X3), and λ significant at α = 5%, that can be seen from $p - value < \alpha(0.05)$ with R^2 95.88%.

Table V
ESTIMATION AND EXAMINATION PARAMETER OF SAR MODEL

Variable	Coefficient	P-Value
X2	-0.406	0.000
X3	-0.175	0.004
δ	0.420	0.000
R^2	0.9588	

So, appropriate models for percentage of citizen with food insecure that consume calorie under basic requirement 2100 kkal/capita/day (Y) in 35 regency or municipality which was observed for 4 years (2007-2010) are :

$$\text{Ln } y_{it} = 0.420 \sum_{j=1}^{N} w_{ij} y_{jt} - 0.406 \text{Ln } x2_{it} - 0.175 \text{Ln } x3_{it} + \text{Ln } \tau_i$$

3) Examination The Assumption of SAR: Assumptions that must be fulfilled are residual deviation is homogenous, non-autocorrelation inter residual, residual normality, and no multicollinearity. Examination the first assumption, homogeneity of residual deviation can be detected with Glejser Test. This test is performed by regression betwen absolute residual and all explanatory variables. If all explanatory variables are not significant influence toward absolute residual, it means that the model is not happend heterogeneity problem. Based on result of Glejser Test that is shown in Table 6, observably that all explanatory variables are not significant influence toward absolute residual value at alpha 5%. It provides an explanation that homogeneity assumption is fulfilled.

Table VI
THE RESULT OF GLEJSER TEST FOR SAR

	Coefficient	$P-value$
C	0.4258	0.068
X2	-0.008586	0.100
X3	-0.01510	0.235

Second assumption is non-autocorrelation inter residual can be detected with Durbin-Watson Test. Durbin-Watson value that is gotten is 2.644 . At k=2, α = 5% and n= 140 are gotten dL= 1.6950 and dU= 1.7529. Because of dU $<$ DW $<$ 4-dU, it indicates that residual is interdependent at α = 5%. So non-autocorrelation assumption is fulfilled.

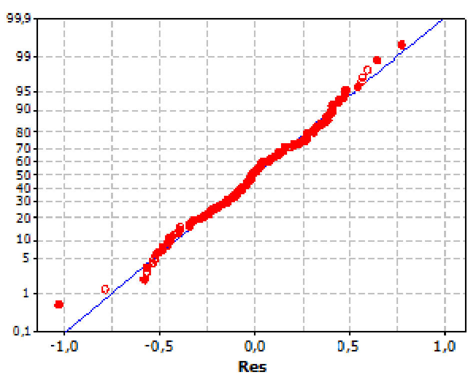

Figure 1. Probablity plot of residual

Third assumption is residual normality can be detected with Kolmogorov-Smirnov Test. H_0 for this test is residual from model has normal distribution. P-value that is gotten is 0.116, biger than α = 5%. It indicates that residual from this model is normal distribution, the assumption is fulfilled.

The last assumption that must fulfilled is no multicollinearty inter explanatory variables. For detecting multicollinearity, can be detected with Variance Inflation Factors (VIF) value. If for all explanatory variables have VIF-value $<$ 10, it means that no multicollinearity inter explanatory variables. Based on Table 7, all explanatory variables have VIF-value $<$ 10, it provides an explanation that no-multicollinaerity assumption is fulfilled.

Table VII
THE RESULT OF MULTICOLLINEARITY TEST FOR SAR

Variable	VIF-value
X2	1.0
X3	1.0

V. CONCLUSION AND RECOMMENDATION

A. Conclusion

Fixed effect model with SAR are better used for modelling food insecuity in Central Java. This model show that production of paddy (X2) and local government original receipt of regency or municipality (X3) influence percentage of citizen with food insecure that consume calorie under basic requirement 2100 kkal/capita/day (Y) with R^2 95.88%. Coefficient of λ indicates that spatial autoregressive effect significant in influencing percentage of citizen with food insecure in Central Java.

B. Recommendation

Based on that result, for government it is suggested to decide foreigh for increasing production of paddy and local government original receipt. For the next researcher, it is suggested to use another contiguity concept like distance or characteristic similarity of economic region (local government original receipt of regency, general allocation fund, etc).

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