Food security in Java Island, Indonesia: Panel data of ordinary least square approach

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Abstract. Food security over the past few years has become a major problem faced by developing countries, including Indonesia, and needs to be resolved properly. Therefore, this study aims to determine the factors that influence the food security of the population in Java Island. The data used in this study were secondary data taken from the Central Bureau of Statistics (BPS) in 2008-2017, namely data on real prices of cooking oil, real sugar prices, real beef prices, real price of rice, food and non-food expenditures, real per capita income, and area of agricultural land. The data was analyzed using a fixed effect regression panel data model. The results of the study show that the factors influencing the share of food expenditure in Java Island were the variables of real prices of rice and real per capita income.

1. Introduction

Food is a very basic human need because it influences human existence and survival, both in terms of quantity and quality. The Law of the Republic of Indonesia Number 18 of 2012 defines food as everything derived from biological sources of agricultural, plantation, forestry, fisheries, water and water products, both processed and unprocessed which are intended as food or beverages for human consumption, including ingredients of additional food, food raw materials, and other materials used in the process of preparing, processing and making food or drinks [1]. Food needs that can be fulfilled properly will have consequences for maintaining the level of food security of the population, especially the staple food of the population, i.e. rice [2].

Food security of population is a problem that is often faced by developing countries including Indonesia. In Indonesia, food security is a problem that needs to be resolved properly since the high level of food security will reflect the better quality of life of the population. The concept of food security keeps developing from time to time. In Indonesia, it was initiated for the first time through the Law of the Republic of Indonesia Number 7 of 1996 on Food stating that food security is a condition of fulfilling household food which is reflected in the availability of adequate food, both in quantity and quality, safe, equitable and affordable [3]. In this concept, food security only considers aspects of food availability for the population in Indonesia. However, in 2012, the law was revised into the Law of the Republic of Indonesia Number 18 of 2012. It defines food security as a condition of fulfilling food for the country up to the individual level, which is reflected in the availability of adequate food, both in number and quality, safe, diverse, nutritious, equitable and affordable and does not conflict with religion, beliefs and culture of society, to be able to live a healthy, active and productive life in a sustainable manner [1]. Based on the Law of the Republic of Indonesia Number 18 of 2012, it can be
concluded that the focus of measuring the current level of food security is not only on aspects of food supply, but also aspects of food access for the population, and aspects of utility or absorption of food, both at the regional and level household and individual [4,5].

The level of food security of a region can be determined using various methods. One of those methods is calculating the share of food expenditure (SFE) [6]. It is the proportion of food expenditure to total household expenditure, and it has a negative relationship with household income which has been empirically proven that the higher the household income, the lower the share of food expenditure.

Studies related to the level of food security of the population in a region have been carried out. With primary data and OLS (Ordinary Least Square) method, a research in Manokwari Regency measures household food security with a share of food expenditure. The results show that the factors affecting household food security in Manokwari Regency are income, cooking oil prices and kerosene prices; while variables of the number of family members, farmer education, rice prices, sugar prices, vegetable prices, fish prices and egg prices do not affect the share of food expenditure [7]. Furthermore, research carried out in Iran using the binary logistic method concluded that the average per capita income has a negative significant effect [8]. Research in Nepal and Bangladesh concluded that the area of land tenure is a factor that has a positive effect on the level of household food security [9].

Java Island is one of the islands of rice production centers in Indonesia [10]. Based on data from the Central Bureau of Statistics of the Republic of Indonesia, rice production averaged 33,511,839 tons per year in Java, equivalent to rice of 19,316,491 tons per year in the period 2004-2015. Rice production in Java Island accounts for 53.63% of national rice production, with an average rice consumption per capita population reaching 98.03 kg / capita / year. Therefore, it can be seen that the island of Java plays a very important role for the availability of food for the population in Indonesia. Although Java Island is a food production center with high food availability, based on studies conducted by BKP in 2017, it shows that there are still three provinces included in the category of food insecurity, namely East Java, West Java and Banten [11]. Therefore, this study aims to determine the factors that influence the level of food security of the population in Java Island.

2. Materials and methods

The data used in this study are secondary data which includes data on real prices of beef (BP), sugar (SP), cooking oil (COP), rice (RP), real per capita income (PCI), and area of agricultural land (AL). Data sources were obtained from the Central Bureau of Statistics (BPS) and the method used in this research was panel data regression analysis.

Panel data regression analysis is an analysis that combines two data, namely cross section data and time series which use observational data on one or more variables in one unit continuously over a period of time. This regression analysis is known to have several advantages, such as control heterogeneity of individuals with cross section data assumed to be homogeneous (no other influences entered); for example, in this case time, and in time series data, data will change at every interval period of time. This regression is also known to provide more informative data and can minimize the bias that occurs because it categorizes units into larger groups [12].

The time series data used is the data from 2008-2017 with cross section data retrieved from three provinces in Java, namely West Java, East Java, and Banten. The three provinces were selected by purposive sampling method considering that the three provinces were rice production centers, but at the same time included in the category of food insecurity regions [11]. Data were analyzed using Eviews 9.0 software. The panel data regression equation to find out the factors that influence the food security of the population in Java can be seen in the equation as follows:

\[
\ln (SFE) = \alpha_0 + \alpha_1 \ln (BP) + \alpha_2 \ln (SP) + \alpha_3 \ln (COP) + \alpha_4 \ln (RP) + \alpha_5 \ln (PCI) + \alpha_6 \ln (AL) + u_i
\]

Sign of expected estimate \( \alpha_5, \alpha_6 < 0; \alpha_1, \alpha_2, \alpha_3, \alpha_4 > 0 \)

Where: SFE= Share of food expenditure (%); BP= Real prices of beef (Rp/Kg); SP= Real prices of
sugar (Rp/Kg), COP = Real prices of cooking oil (Rp/Kg), RP = Real prices of rice (Rp/Kg), PCI = Real per capita income (Rp/capita), AL = Area of agricultural land (Ha), u = Error term

Estimates with panel data regression models are carried out with three approaches, including Common Effect Model (CEM), Fixed Effect Model (FEM), and random effect model (REM). CEM is the simplest approach assuming the intercepts of each variable are the same, and the coefficients on all-time series and cross section units. FEM approach is assumed that there is no time specific effect and only focuses on the specific individual effects where the intercepts of each individual are different, but the intercept for time series units is constant. Meanwhile, REM approach involves correlation between error terms due to changes time and research unit. The selection of the best panel data regression estimation model to be used among these models is based on the chow test, hausman test, and Breush Pagan Lagrange Multiplier test [13]. In this study, the random effect model cannot be done because the number of cross sections is smaller than the number of independent variables. Therefore, choosing the best model is done to choose between the common effect or fixed effect models using Chow Test [14]:

2.1. Chow test
The testing of the common effect model is better than the fixed effect model determined by the Chow test; so, the hypothesis is: $H_0: \alpha_1 = \alpha_2 = \ldots = \alpha_N$ (common effect); $H_1$: there is at least one different $\alpha_i$ $i: 1,2,\ldots,N$. Test statistics is:

$$F = \frac{(RSSS-URSS)/(N-1)}{URSS/(NT-N-K)}$$

Where: RSSS: sum square residual OLS model, URSS: sum square residual fixed model, N: number of cross section units, T: number of time units, K: the number of parameters to be estimated.

$H_0$ is rejected if $F$ count > $F(N-1, NT-N-K; \alpha)$ which means that intercept for all unit cross sections is not the same, then the regression model equation is a fixed effect model.

3. Result and discussion
This study uses secondary data, i.e. food security of population in Java Island from 2008 to 2017. Before being analyzed, the model used in this study has fulfilled all classical assumption tests. Therefore, a further test can be done to select the regression model using the best panel data through two estimation approaches, including the common effect and fixed effects models. The random effect model cannot be done because it does not fulfill the requirement for the random effect model, i.e. the number of cross sections is greater than the number of dependent variables in the model. The results of the analysis to determine the best model, namely between the common effect model and the fixed effect, can be done using the Chow Test. The results of the analysis can be seen in table 1 as follows.

| Effects Test          | Statistics | d.f | Prob. |
|-----------------------|------------|-----|-------|
| Cross-section F       | 6.151      | (2.22) | 0.008 |
| Cross-section chi-square | 13.325 | 2   | 0.001 |

Source: Secondary Data Analysis, 2019

According to table 1, it can be seen that the probability of the chi-square cross-section is 0.001 < $\alpha$ (0.05); thus, $H_0$ is rejected. In addition, it can be concluded that the fixed effect model is better than the common effect model. Therefore, established the best model between both, further analysis can be carried out in the form of multiple linear regression to determine the factors that influence food security of the population on Java. The regression results can be seen in table 2.

According to table 2, it can be seen that the Adjusted $R^2$ value is 0.520, indicating that 52.00% of the variation in food security of population variables in Java can be explained by the independent variables contained in the regression model. Meanwhile, the probability of an F test of 0.002 < $\alpha$ (0.01)
can be interpreted that the variable real price of beef, real price of sugar, real price of cooking oil, real price of rice, real per capita income, and agricultural land area altogether affect food security variable significantly.

Table 2. Determinants of food security (share of food expenditures) population on Java Island.

| Variables | Coefficient | Standard Error | t-statistics | Sig. |
|-----------|-------------|----------------|--------------|------|
| C         | 15.575      | 7.948          | 1.959        | 0.063|
| BP        | 0.049       | 0.094          | 0.522        | 0.607|
| SP        | 0.001       | 0.056          | 0.017        | 0.986|
| RP        | 0.286**     | 0.111          | 2.578        | 0.018|
| COP       | 0.174       | 0.162          | 1.070        | 0.297|
| AL        | -0.469      | 0.570          | -0.822       | 0.420|
| PCI       | -0.678**    | 0.262          | -2.588       | 0.017|

Adjusted R² 0.520  
F statistics 4.934  
F. Sig 0.002

Source: Secondary Data Analysis, 2019  
Notes:** refers to significant at the error rate 5% (α=0.05)  
* refers to significant at the error rate 10% (α=0.10)

The constant value that has a probability of 0.063 <α (0.10) indicates that if the independent variable contained in the model is considered constant or zero, the effect of other variables outside the model on the food security variable is 15.575. If other variables outside the model increase by 1%, food security will increase by 15.575%. In addition, as observed in table 2, it is known that the variables that have a significant effect on food security include rice prices and real per capita income of the population.

The variable of real price of rice shows a positive influence on the share of food expenditure. This positive influence shows that the increasing real price of rice will cause an increase in the share of food expenditure. The regression coefficient of real price of rice is 0.286, indicating that for every 1% increase in the real price of rice, the share of food expenditure will increase by 0.286%. The higher share of food expenditure indicates a lower level of food security. This can occur due to increasing food prices will cause food to be difficult to reach for the population as well as will lead to a decrease in food security. High food prices have an impact on price stability which will later affect food security and nutrition [15]. Food prices are important matters that need to be considered. Since even though food is available in large quantities, if the food cannot be bought by the community, the food needed to meet the living needs of the population is difficult to fulfill properly due to expensive food prices. Therefore, to maintain food security of the population, the stability of food prices needs to be considered, so that food prices become affordable, and the population can access food well and food security can be improved.

According to table 2, it can be seen that the regression coefficient of real per capita income is -0.678. Based on the results of regression analysis, it can be seen that the real per capita income variable has individually a significant effect on the share of food expenditure. It means that for every 1% increase in income, the share of food expenditure will decrease by 0.678%. On the other words, the higher the income of the population, the lower the share of food expenditure. It might occur since income is inversely proportional to the share of food expenditure. The declining share of food expenditure shows that food security is increasing. Then, increasing the income of the population will lead to an increase in the ability of households to buy various consumption needs with better quality. This result is consistent with research conducted in Nepal, Malawi, Tanzania, Uganda and Madagascar. The study shows that food security of population will be closely related to calories from food consumed by community, so that lower income will cause someone to spend their income more for food consumption than for non-food consumption. This situation will reverse when the population
experiences an increase in income, so that there is residual income that can be spent on non-food consumption [16].

4. Conclusion
The food security of the population in Java is influenced by the variables of real price of rice and real per capita income of the population. The variable of real price of rice has a positive influence on the variable of share of food expenditure, while the income variable of the real per capita income of the population has a negative influence on the variable of share of food expenditure. The higher share of food expenditure will indicate a lower level of food security. Efforts to improve food security can be carried out by stabilizing affordable food prices for the population and increasing the per capita income of the population in Java Island.

Acknowledgments
Thank you, the authors convey to the Education Fund Management Institute (LPDP) for their assistance, both financially and non-financially so that the authors can publish the results of research related to the food security of the population in Java Island, Indonesia.

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