Modeling of West Java inflation with Spatial Durbin Model (SDM)

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Abstract. Inflation in Indonesia, in general, can be caused by a combination of various factors, both in terms of demand, supply, and expectations. The contribution of each element that influences inflation is not always the same from time to time. Gordon (1997) explains the determinants of inflation from these three sides, namely demand, supply, and expectations. The importance of expectations in influencing increase was also stated earlier by Chopra (1985). In this study, spatial Durbin for panel data with fixed effects in modeling inflation in the West Java province. The results show that Minimum Work Wage, percentage of poor population, Gross Regional Domestic Product (GRDP), spatial lag of poor population, and spatial lag of GRDP have a significant influence on the Durbins panel spatial model. There is an adjacent regional effect on inflation in the West Java province based on the value of the lambda obtained. Based on the criteria R²-square of 94.29%, it can be concluded that the SDM panel data model has an excellent performance in explaining the diversity of data. The AIC and BIC criteria also show that the SDM panel data model well applied in modeling Regency/City inflation in West Java province.

1. Introduction
Inflation, rising prices of goods and services in general, high will be a burden by many parties. With it, the purchasing power of a currency becomes lower or decreases. With the declining purchasing power of money, the ability of fixed-income people to buy goods and services for daily needs will be even lower. The unstable inflation rate also complicates planning for the business world, does not encourage people to save, and other negative impacts that are not conducive to the economy as a whole.

The price level in a modern economy is a significant indicator or signal in maintaining a balanced allocation of economic resources in a country. High and unstable inflation will obscure these signals and distort prices. Signs that are not clear uniquely distorted will make it difficult for a plan, so it does not motivate the community and the business world to make savings and investment. Because of these negative impacts, each country will always try to control the inflation rate at a low and stable level [1].

In addition to supply and demand factors, inflation can also be caused by expectations. Gordon [2] explains the determinants of inflation from three sides, namely demand, supply, and expectations ("the triangle model"). The importance of expectations in influencing inflation was also stated earlier by Chopra [3], while Sergey examines the relationship between inflation and economic growth [4].

All the
factors that cause an increase above will be used as an analytical tool to explain the main factors that cause inflation in Indonesia.

Indonesia is an archipelago consisting of 34 provinces or comprising more than 740 cities and districts. The many islands and different regional characteristics make each region have economic characteristics and inflation characteristics that are likely to differ from one area to another. In addition to the different inflation characteristics, regional inflation rates also vary. Some regions have lower inflation rates than national inflation, but there are also quite many regions that have higher inflation than the national inflation rate.

On average from 2004 to 2007, there were 34 cities (with a total weighting of 50.9%) out of 45 cities that had one of the leading causes of regions that had higher inflation rates than the national inflation rate was the disruption of the supply side is mainly due to obstruction of distribution. The inflation rate is higher than domestic inflation.

The problem of distribution is a significant problem in influencing inflation in several regions in Indonesia. Various studies conducted by the Bank Indonesia Office (BI) indicate that supply disruption factors have a substantial influence on inflation in the areas. These factors are dependent on supply from other regions and stock management that is not optimal. Limited distribution channels, food production, and food are relatively limited; the mechanism of price formation of some food commodities; the role of distributors and traders in the regions is very dominant. The length of the distribution range, making it a high cost. To achieve the low inflation target, the role of the region in controlling inflation is crucial because the weight of regional inflation in the formation of national inflation is huge.

Some methods that usually used to estimate the factors that influence inflation are Ordinary Least Square (OLS), Quasi-ML, and Maximum Likelihood Estimator (MLE). The modeling of inflation data included in spatial data has also been developed [5–8]. Kelejian and Prucha [9] consider the Generalized Methods of Moment IV / GMM estimator of the SAR and Spatial Autoregressive Model (SAC), Lee [10] focus on the SAR (Quasi-) ML estimator while Arief uses the spatial durbin model to model life expectancy in Central Java [11]. Spatial Durbin Model (SDM) identification study in terms of instrumental variables for group interactions and any spatial weight matrices. It is proof that matrices I, W, and W^2 must be linearly independent, and that parameters in SDM do not have to meet the limitations of common factors derived by Burridge [12]. Nicolas uses the Mundlak approach to the spatial durbin model to determine the adequacy of the random effects specification [13].

In this study, Durbin spatial modeling will be conducted using OLS and MLE methods in estimating the parameters of the Durbin spatial model on inflation data in West Java. The independent variables measured were Minimum Wages for Work (MSE), the number of poor people, and Gross Regional Domestic Product (GRDP). The final goal of this study is to obtain the predicted value of inflation in West Java and the factors that influence it so that matters related to inflation can be overcome as an anticipative action or become a particular policy.

2. Material and method

2.1. Material

The data used in this paper is inflation data in West Java. The type of data used in this study is secondary data. Secondary data used systematically recorded data in the form of panel data (cross and time series data). In this study, the variables used are the Minimum Work Wage (MWW), the number of poor people, and the Gross Regional Domestic Product (GRDP), and the inflation rate from 2014-2017 covering six districts/cities namely Bogor, Sukabumi, Bandung, Bekasi, Depok, and Garut.

The variables used in this study categorized into two, namely the independent variable and the dependent variable. Factors that influence inflation in West Java, which used as a free variable, refer to Endri [14]. The variables in this article has calculated annually issued by the Badan Pusat Statistika (BPS) [15] in various editions with processed units in percent (%).
2.1.1. The independent variables:
1) Minimum Work Wage (MWW)
Minimum Work Wage in Regency/City is the Minimum Wage that applies in the Regency/City Region
2) Percentage of Poor Population
3) Gross Regional Domestic Product (GRDP)
GRDP is the amount of added value generated by all business units in a particular region or is the total value of goods and final services produced by all economic units in an area.

2.1.2. The dependent variable:
The dependent variable that will use in this study is the inflation rate in 2014-2017 in six Regencies/Cities in West Java Province.

2.2. Method
The spatial Durbin panel model (SDM) is used as an analytical method to determine the factors that influence inflation in West Java and, at the same time, estimate the model parameters based on Vega and Elhorst [16]. In this study, the model used in HR for panel data with fixed effects. The stages of the research carried out are as follows: Arrange observation data for each location based on the variables used and then form a weighting matrix \( W \). The next step is perform a normality test with Moran’s I and estimate parameters with the spatial Durbin panel model. Furthermore, test the significance of the parameter coefficients with the F Test and test spatial effects with Moran’s I. The last step is build a spatial Durbin panel model and calculate AIC, BIC and \( R^2 \) to see the goodness of the Durbin panel spatial model.

3. Results and discussion
The West Java Combined Consumer Price Index (CPI) covering seven cities, namely Bogor City, Sukabumi City, Bandung City, Cirebon City, Bekasi City, Depok City, and Garut City experienced an increase in index. CPI from 128.16 in November 2017 to 128.88 in December 2017, thus inflation occurred at 0.56 percent BPS West Java [14]. West Java, which is one of the nearest provinces or close to the Capital City of DKI Jakarta, is also estimated to contribute and impact on inflation in the capital in particular and Indonesia in general. Inflation data and several factors that are assumed to affect inflation in West Java Province presented as dependent and independent variables in Table 1 below.

| Regency/City | Year | Inflation (%) | MWW (Rp)  | Poor Population (%) | GRDP Constant |
|--------------|------|---------------|-----------|---------------------|---------------|
| Bogor        | 2014 | 6.83          | 2,242,240 | 8.91                | 117,340       |
| Bogor        | 2015 | 2.70          | 2,590,000 | 8.96                | 124,487       |
| Bogor        | 2016 | 3.60          | 2,960,325 | 8.83                | 132,086       |
| Bogor        | 2017 | 4.59          | 3,204,551 | 8.57                | 139,952       |
| Sukabumi     | 2014 | 8.38          | 1,565,922 | 8.81                | 35,521        |
| Sukabumi     | 2015 | 2.20          | 1,940,000 | 8.96                | 37,265        |
| Sukabumi     | 2016 | 2.57          | 1,940,000 | 8.96                | 37,265        |
| Sukabumi     | 2017 | 4.10          | 2,376,558 | 8.04                | 41,362        |
| Bandung      | 2014 | 7.76          | 1,735,473 | 7.65                | 61,100        |
| Bandung      | 2015 | 3.93          | 2,001,195 | 8                   | 64,702        |
| Bandung      | 2016 | 2.93          | 2,275,715 | 7.61                | 68,805        |
| Bandung      | 2017 | 3.46          | 2,463,461 | 7.36                | 73,051        |
| Bekasi       | 2014 | 7.68          | 2,447,445 | 4.97                | 197,164       |
| Bekasi       | 2015 | 2.22          | 2,954,031 | 5.27                | 205,950       |
| Bekasi       | 2016 | 2.47          | 3,261,375 | 4.92                | 216,228       |
| Bekasi       | 2017 | 3.01          | 3,530,438 | 4.73                | 228,726       |
Table 1. Cont.

| Location | Year | Value | Population | Moran's I | MWW   |
|----------|------|-------|------------|-----------|-------|
| Depok    | 2014 | 7.49  | 2,397,000  | 2.32      | 35.193|
| Depok    | 2015 | 1.87  | 2,705,000  | 2.4       | 37.529|
| Depok    | 2016 | 2.60  | 3,046,180  | 2.34      | 40.263|
| Depok    | 2017 | 3.93  | 3,297,489  | 2.34      | 42.939|
| Garut    | 2014 | 8.09  | 1,279,359  | 11.26     | 18.850|
| Garut    | 2015 | 3.53  | 1,435,000  | 11.99     | 19.662|
| Garut    | 2016 | 2.75  | 1,632,360  | 11.24     | 20.825|
| Garut    | 2017 | 3.88  | 1,767,686  | 10.84     | 22.063|

Before estimating the model parameter coefficients, a normality test for the independent variable first performed. The results of the correlogram for the MWW (UMK) free variables presented in Figure 1 below. The test carried out using Moran’s I. The MWW free variable was tested based on the year where for lag 2, it is seen that the MWW free variable was approaching the normal distribution for all 2014-2017 data. This test is carried out for all other free variables and based on each year.

![Figure 1. MWW Correlogram data for 2014-2017.](image-url)
3.1. Estimation coefficient of parameter model

The estimated spatial model of the Durbin panel produces parameters that affect the inflation of the province of West Java with a significance level of 5%. The parameter estimation results presented in Table 2.

| Parameter                | Spatial Lag of X (p-value) | Spatial Panel Durbin (fixed effect) (p-value) |
|--------------------------|---------------------------|-----------------------------------------------|
| MWW                      | -3.660e-06 (0.468)        | -4.877e-06(0.036)*                            |
| % Poor Population        | -2.659e+00(0.0267)*       | -1.193e+00(0.045)*                            |
| GRDP                     | 5.812e-05(0.604)          | 1.144e-04(0.026)*                             |
| SL MWW                   | -6.189e-06(0.317)         | 2.114e-06(0.463)                              |
| SL Poor Population       | -4.161e+00(0.001)*        | -2.129e+00(0.0003)*                           |
| SL GRDP                  | 2.554e-05(0.893)          | -1.957e-04(0.028)*                            |
| Lambda                   | -                         | 0.566(3.549e-08)*                             |

Information: (*) Significant on $\alpha = 5\%$, SL: spatial lag.

Based on Table 2 above, it can be concluded that only the percentage parameters of the poor population are significant in the SLX model with a real level of 5%, and there is a spatial lag effect of the percentage of the poor population which is also significant for the SLX model. MWW parameters, rate of poor people, GRDP, spatial lag of poor community, and spatial-lag of GRDP have considerable influence on the Durbin panel spatial model. While the lambda value of 0.565 indicates the relationship of inflation in an area with other regions close to the real level of 5%. In other words, it can be said that there is an influence of the adjacent region on inflation in the province of West Java. For temporal-spatial it does not have a significant effect on inflation of regencies/cities in West Java.

3.2. Model goodness

The selection of the best model is explained based on the criteria of degree of determination (R-square), AIC, and BIC. Based on Table 3, it can be seen that the spatial model of the Durbin panel has better performance with a degree of determination of 94.29%. It shows that the model can explain 94.29% of the diversity of data. The AIC and BIC values of the Durbin panel spatial model are also relatively small which indicates the model is useful in estimating the coefficient parameters.

|                      | Spatial Lag of X Model | Spatial Durbin Panel Model |
|----------------------|-----------------------|----------------------------|
| $R$-square           | 0.869                 | 0.9429                     |
| AIC                  | -                     | 15.649                     |
| BIC                  | -                     | 9.233                      |
| F-significance test  | 0.000108              | -                          |

When compared to the R-square value, it can be concluded that the spatial Durbin panel model is better compared to the SLX model.

4. Summary

The spatial Durbin model has an excellent performance in modeling local spatial and temporal-spatial influences on panel data. Regency/city inflation in West Java province is significantly affected by MSE, GRDP, and the percentage of the poor population. Based on the HR panel data model, the location or adjacent area also provides a significant effect on the model. With the criteria for the degree of determination (R-square) of 94.29%, it can be concluded that the HR panel data model has an excellent performance in explaining the diversity of data. Based on the criteria of AIC and BIC also shows that the HR panel data model well applied in modeling Regency / City inflation in West Java province.
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