Investigating inflation dynamics in Indonesia: Identifying the inflation spillover for enhancing regional inflation control

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Abstract

This study employs a hybrid New Keynesian Phillips curve (NKPC) model, comprising the dynamic panel, spatial dynamic panel, and semiparametric spatial dynamic panel models, to examine the dynamics of regional inflation in Indonesia from Q1 1997 to Q2 2023. The latter model, which employed the inverse distance weight (IDW), was identified as the most optimal model. The findings indicated that the lagged inflation and output gap variables had a notable impact on regional inflation in Indonesia. Furthermore, the significance of the spatial spillover parameters indicates the existence of spatial regional inflation spillover in Indonesia. Jakarta, Central Java, and East Java represent Indonesia's three most significant focal points of inflation dynamics, exerting the most considerable influence on other regions. South Kalimantan, Jakarta, and East Java were the top three regions experiencing the most significant impact from inflationary pressures originating elsewhere. Sensitivity analysis found that a flattened Phillips curve was present throughout the period under study. It is therefore recommended that policies be intensified to control prices, strengthen policy synergies, and improve the efficiency of goods distribution channels, both for the focal point and for regions experiencing inflationary pressures due to spillovers.

Keywords: direct and indirect effect; inflation; non-linear model; semiparametric model; spatial spillover
JEL Classification: C31; E31; F36.

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1. Introduction

Following the COVID-19 pandemic, the global economy faced high inflation pressures in response to (1) tightened monetary policies in various countries, (2) tighter policies related to the COVID-19 pandemic in China, and (3) increased geopolitical pressures as a result of the Russian-Ukrainian war (Bank Indonesia, 2022). Inflation in developed countries such as the United States and the European Union has reached its highest point in recent decades (Bank Indonesia, 2022). Countries across various regions also experience the phenomenon of increasing post-pandemic inflation in developed countries. Despite similar pressures, Indonesian inflation is not as high as in the United States and the European Union. Indonesian inflation in 2022 was 5.51 percent, lower than that of other Asian countries (Bank Indonesia, 2023b).

The interregional inflation correlation, known as the spatial spillover of inflation, is driven by the increased interstate dependence on global supply chains and the liberalization of international trade. Empirical studies found the existence of inflation spillover between regions and countries. (Osorio and Unsal, 2013; Halka and Szafranek, 2017; Istiak *et al.*, 2021; Al-Nassar and Albahouth, 2023). In addition to the global economy, the existence of regional inflation spillover in a country was also empirically found by Aginta (2023), Nagayasu (2017), Yang et al. (2021), and Yesilyurt & Elhorst (2014)In the field of inflation control, studies related to inflation spillover in the regional economy of Indonesia, as an archipelagic country, are essential. Thus, an in-depth analysis of regional inflation correlations is expected to increase the effectiveness of inflation control by understanding the mechanisms of interregional relations and estimating the potential impact on other regions. (Aginta, 2023).

Inflation control policy in Indonesia is placed within the policy framework of achieving inflation targets as the primary focus of monetary policy. However, the complexity of inflation determinants in Indonesia requires a policy mix, both fiscal and other structural policies, as an attempt to control the inflation rate along with monetary policy (Bank Indonesia, 2023). As a response, the government has established the Regional Inflation Control Team or Tim Pengendalian Inflasi Daerah (TPID), which is comprised of related stakeholders involved in commodity price control efforts at the regional level.

Price control at the regional level is one of the keys to price control on the national level. In 2023, the government provided fiscal incentives to districts that were consistently able to maintain inflation levels (Ministry of Finance Republic of Indonesia, 2023). This attempt was made to motivate the regional government to control the price volatility in its region. Furthermore, with an interregional linkage or inflation spillover in Indonesia, it is also necessary to consider providing fiscal incentives to regions that potentially contribute to inflation in other regions. In other words, price volatility control in inflation focal point regions will influence price stability in other regions.

As the largest archipelagic country, Indonesia's regional growth pattern offers immense opportunities for spatial study and policy considerations (Aginta, 2023). However, relatively few studies have been conducted regarding spatial spillover inflation at the regional economic level, even though it has great potential as a reference for effective price control policies. Therefore, this study aims to carry out spatial inflation modeling to see the relationship of inflation between regions in Indonesia through regional level data (34 provinces) during the period Quarter I 1997– Quarter II 2023. The panel data will be analyzed further using a dynamic panel model and a dynamic panel spatial model based on the hybrid New Keynesian Phillips curve (NKPC) model. It was developed by Galí and Gertler (1999) by relating inflation to lagged inflation, expected inflation, and real marginal cost. This study employs the output gap as a proxy of real marginal cost (predictor variable) as discussed by Basarac, Škrabic, and Soric (2011). This research will also explore the possibility of a non-linear relationship between predictor and response variables and then accommodate them in a dynamic panel spatial semiparametric model. In addition, by utilizing the spatial model, this study attempts to find the existence of flattened Phillips curve phenomena during the period of the study through a sensitivity analysis.

This research aims to provide several novelties. First, this research complements previous research related to the spatial spillover of regional inflation in Indonesia, such as that carried out by Aginta (2023), by utilizing an extended of a longer period of data. Second, to the best of the author's knowledge, this study will be the first to use data from the COVID-19 pandemic period while also covering the Monetary Crisis period as a result of the Asian Financial Crisis (AFC) in 1997–1998 and the Global Financial Crisis (GFC), which occurred around 2007–2009, in the field of spatial spillover of inflation in Indonesia. The results of this research are expected to provide input for policy-making related to regional inflation control to strengthen the mix and synergy of inflation control between regions in Indonesia.

The Phillips curve model explains the relationship between inflation and the output gap, where a decrease in unemployment raises inflation. However, in recent decades, this relationship has weakened, known as the flattening of the Phillips Curve (Aginta, 2023). As a result, central banks have difficulty determining the output gap that is in line with the inflation target (Galí and Gertler, 1999). The flattening Phillips Curve phenomenon has led to the New Keynesian Phillips Curve (NKPC) emergence, which explains the relationship between inflation and the output gap. When this relationship weakens, inflation expectations and prices become increasingly crucial in determining inflation. With a forward-looking approach, this theory allows for explaining long-term inflation. However, the NKPC model often fails to describe the dynamics of inflation empirically; thus, it is developed by adding inflation lags (backward-looking) to account for past inflation behavior (Yesilyurt and Elhorst, 2014). Galí & Gertler (1999) introduced a hybrid NKPC model that combines the effects of inflation lags as a rule of thumb in inflation modeling.

Various factors influence the formation of inflation in several regions using the hybrid NKPC model. One focus of the study is the inter-regional linkages or spatial spillover, which shows the influence of spatial interactions on inflation dynamics

(Halka and Szafranek, 2017; Aginta, 2023). Inflation spillovers usually occur through supply chains and production networks (Auer, Levchenko, and Saure, 2021; Bilgin, 2023). Production networks accelerate the transmission of inflation between sectors and countries when there are supply shocks, such as oil prices, but do not play a significant role in demand shocks (Bilgin, 2023). Developed countries are more vulnerable to global shocks and have stronger spillover impacts, while developing countries are more influenced by domestic factors (Osorio and Unsal, 2013; Al-Nassar and Albahouth, 2023).

Empirical studies conducted by Al-Nassar & Albahouth (2023), Halka & Szafranek (2017), Istiak et al. (2021), and Osorio & Unsal (2013) show that inflation spillover has a significant impact on the formation of inflation between regions and between countries. Al-Nassar & Albahouth (2023) and Istiak et al. (2021) conclude that Japan and the United States are the two countries with the largest spillover impacts in the G-7 and G-20. Inflation spillovers between the Euro Area and its five economic partners are wider outside the Eurozone (Halka and Szafranek, 2017), while China has the largest impact in ASEAN and India (Osorio and Unsal, 2013).

Osorio & Unsal's (2013) research shows that more than 60 percent of inflation dynamics in Asia are influenced by domestic factors, especially in countries with a strong domestic demand base, such as China, India, Indonesia, and developed countries such as Japan and Korea. For Indonesia, which is an archipelagic country with significant price variations between regions, it is important to understand inflation dynamics at the regional level and their impact on the national economy (Aginta, 2023). Several studies of inflation in Indonesia generally examine inflation convergence, spatial, and temporal interactions at the provincial and district/city levels (Tirtosuharto and Adiwilaga, 2014; Ridhwan, 2016; Purwono, Yasin, and Mubin, 2020).

Spillover studies in regional economies are still rare, although they are very important for understanding inflation dynamics in heterogeneous regions such as Indonesia. This research helps evaluate the impact of economic and monetary policies, as well as develop more specific regional policy recommendations (Aginta, 2023). Several studies on inflation spillovers to see price dynamics at the regional level include those conducted by Aginta (2023), Nagayasu (2017), Yang et al. (2021), and Yesilyurt & Elhorst (2014). Yang et al. (2021) concluded that there was a significant spillover effect in the Chinese property market. Yesilyurt & Elhorst (2014) conducted a study in Turkey using the output gap as an independent variable and found that the inflation lag in the province and its surrounding areas had a significant impact on inflation, while the output gap did not show a significant effect. On the other hand, Nagayasu (2017) in Japan found a real effect of inflation spillover between provinces, with labor productivity as an independent variable.

Aginta (2023) found that spatial spillover of regional inflation in Indonesia has a significant effect on national inflation dynamics. This study uses spatial weighting in the Phillips curve model and finds differences in spillover effects between general inflation and core inflation. Significant spillover effects only occur in provinces with non-oil and gas sectors. In contrast to Yesilyurt & Elhorst (2014), this study shows that the output gap has significant regional spillover, although it does not yet cover the post-COVID-19 period and an in-depth analysis of the provinces that dominate inflation spillover.

2. Methodology

This study utilizes panel data from 34 provinces in Indonesia covering the period from Quarter I 1997 to Quarter II 2023 (a total of 106 quarters), amounting to 3,604 observations. The observation period includes the Asian Financial Crisis (AFC), which had an impact on the Monetary Crisis in Indonesia around 1997–1998, the Global Financial Crisis (GFC), which occurred around 2007–2009, as well as the COVID-19 pandemic during the 2020–2022 period. The main response and predictor variables used, respectively, are year-on-year (y-on-y) inflation and the output gap from Gross Regional Domestic Product (GRDP) at constant prices, obtained from the BPS-Statistics Indonesia.

The following are the stages of analysis carried out in this research:

1) Data preparation. y-on-y quarterly inflation data for 34 provinces is obtained by the following process

a. Acquisition of initial monthly consumption value (CV) data for the period January 2020–March 2023 as well as monthly month-to-month (m-to-m) inflation for the period January 1996–June 2023 from each city in Indonesia that is obtained from BPS-Statistics Indonesia.

b. From these two data sets, the monthly CV for the period January 1996–June 2023 for each city in Indonesia is obtained.

c. Hence quarterly inflation data can be obtained for the period Quarter I 1997–Quarter II 2023 for each province. For example, y-on-y inflation for the first quarter of 2023 for province A is calculated using the following formula:

$$inf_{A.2023-I} = \left(\frac{\sum_{i=1}^{n_A} \sum_{j=2023Jan}^{2023Mar} CV_{ij}}{\sum_{i=1}^{n_A} \sum_{j=2022Jan}^{2022Mar} CV_{ij}} - 1 \right) \times 100\% \quad (1)$$

with n_A being the number of city at province A and CV_{ij} is the consumption value in the i-th city of CPI at the j-th period.

Before calculating the GDP output gap for Quarter I 1997–Quarter II 2023 for each province, it is first necessary to obtain quarterly GRDP at constant prices data from 34 provinces in Indonesia. However, quarterly data has only been available since the 2010 period. Meanwhile, before that period, BPS-Statistics Indonesia only calculated provincial GDP in annual aggregates. Therefore, the following steps are taken:

a. Initial data acquisition of Annual GRDP at constant prices 2010–2022 from 34 provinces with base year 2010 (2010 = 100), Annual GRDP at constant prices 2000–2013 (2000 = 100), and 1996–2001 (1993 = 100). Then proceed by converting the base year of GRDP at constant prices to 2010 = 100.

b. There are several provinces for which data is not yet available because the province has not yet been formed, i.e. Bangka Belitung in 1996-1999 (a division of South Sumatera), Riau Islands in 1996-2002 (a division of Riau), Banten in 1996-1999 (a division of West Java), North Kalimantan in 1996-2009 (division from East Kalimantan), Gorontalo in 1996-1999 (division from North Sulawesi), West Sulawesi in 1996-2004 (division from South Sulawesi), North Maluku in 1996-1999 (division from Maluku), and West Papua in 1996-2001 (division of

Papua). Therefore, annual GRDP at constant prices interpolation is carried out using the development pattern of the parent or initial province.

c. The process of disaggregating annual GRDP at constant prices data for the 1996–2022 period into quarterly data using the Denton-Cholette (Dagum & Cholette, 2006) and Chow-Lin (Chow and Lin., 1971) temporal disaggregation methods, both without and with representative quarterly data indicators that describe development patterns of GRDP at constant prices. The indicators used in this study are Indonesia's quarterly GRDP at constant prices and the quarterly average IDX Composite Stock Price Index (JKSE) from Yahoo Finance. The best disaggregation results for GRDP at constant prices for Quarter I 1996–Quarter IV 2009 are determined based on the smallest root mean square error (RMSE) value produced by the data disaggregated with actual data for the period Quarter I 2010–Quarter IV 2022. A summary of the temporal disaggregation results is presented in Appendix 1.
d. The seasonal adjustment process by removing or extracting seasonal patterns from the quarterly GRDP at constant prices series for each province, uses the X-13ARIMA-SEATS method developed by the US Census Bureau (Monsell, 2007).
e. The process of calculating potential output, i.e., the maximum potential of a region's GRDP in a certain period, by extracting long-term trend patterns from the quarterly GRDP at constant prices series, that has undergone seasonal adjustments. The method used is the Hodrick-Prescott (HP) filter method (Hodrick and Prescott, 1997).
f. Finally, calculate the quarterly output gap for each province. For example, the output gap calculation formula for province A at the first quarter of 2023 is as follows:

$$outputgap_{A.2023-I} = log\left(\frac{actual\ GRDP_{A.2023-I}}{potential\ GRDP_{A.2023-I}}\right) \tag{2}$$

2) Conduct data exploration to see developments in inflation and output gaps during the research period, both under normal and crisis conditions, as well as visually see the relationship between variables.
3) Estimation of the inflation model. This study adopts the inflation model with the Phillip curve specification used by Aginta (2023), where in its first stage the following dynamic panel regression model is used:

$$y_{it} = \beta y_{it-1} + \gamma x_{it} + \varepsilon_{it} \tag{3}$$

where y_{it} and y_{it-1} are the inflation of the i-th province at t and $t-1$ periods respectively; x_{it} is the output gap predictor variable of the i-th province at t period, β and γ are the parameters that will be estimated, and ε_{it} is an error component. Next, include spatial interaction elements in the model through the Spatial Durbin Model (SDM) as follows:

$$y_{it} = \rho W y_{it} + \beta y_{it-1} + \delta W y_{it-1} + \gamma x_{it} + \Gamma W x_{it} + \varepsilon_{it} \tag{4}$$

where W is a weight matrix with size $N \times N$, which shows the neighborhood structure of each province in Indonesia, with N = 34 (number of provinces), and $\rho, \beta, \delta, \gamma$, and Γ are the parameters to be estimated. This research also uses a spatial autoregressive (SAR) model to accommodate if the parameters δ and Γ are not significant with the following specifications:

$$y_{it} = \rho W y_{it} + \beta y_{it-1} + \gamma x_{it} + \varepsilon_{it} \quad (5)$$

From the two models in Equations (4) and (5), each spatial weighting matrix (W) will be used, which represents the interaction or neighborhood of each analysis unit (province) based on the concepts of inverse distance weighting (IDW), contiguity of Thiessen polygons (Anselin, Syabri and Kho, 2010; Aginta, 2023), and K-nearest neighbor (kNN). In this study, the W matrix is assumed to not change during the research period (Elhorst, 2014).
This research also adds elements of non-linear relationships to the SDM and SAR models above based on the scatter plot results between predictor variables and response variables. Hence a dynamic panel spatial semiparametric model is obtained (Mínguez, Basile and Durbán, 2020, 2022) as follows:

$$y_{it} = \rho W y_{it} + \beta s(y_{it-1}) + \delta W s(y_{it-1}) + \gamma s(x_{it}) + \Gamma W s(x_{it}) + \varepsilon_{it} \quad (6)$$

or called as the PS-SDM model, and

$$y_{it} = \rho W y_{it} + \beta s(y_{it-1}) + \gamma s(x_{it}) + \varepsilon_{it} \quad (7)$$

as the PS-SAR model. Where $s(y_{it-1})$ and $s(x_{it})$ are P-splines functions for variables y_{it-1} and x_{it}, respectively.

4) The selection of the best model from the various models explained in the third step above is carried out based on the AIC and RMSE values.
5) Interpretation of the best model parameter estimation results. If the best model is the SDM, SAR, PS-SDM, or PS-SAR model, then the indirect impact (spillover effect) will be interpreted, i.e. the impact on inflation in a region caused by an increase or decrease in the value of a variable in the surrounding regions. Meanwhile, the direct impact is the impact on inflation in a region that is caused by changes in a variable in the same region. For example, to get the marginal effect matrix with direct and indirect effects in the PS-SDM model, Equation (6) first needs to be changed to:

$$y_{it} = (I - \rho W)^{-1}(\beta s(y_{it-1}) + \delta W s(y_{it-1}) + \gamma s(x_{it}) + \Gamma W s(x_{it}) + \varepsilon_{it}) \quad (8)$$

Hence the marginal effect matrix for y_{it-1} is obtained as follows:

$$\begin{bmatrix} \frac{dE(y_{it})}{dy_{1t}} & \dots & \frac{dE(y_{it})}{dy_{Nt}} \end{bmatrix} = (I - \rho W)^{-1}(\beta I_N + \delta W) \quad (9)$$

The main diagonal and non-main diagonal of the matrix in Equation (9) respectively, show direct effects and indirect effects (LeSage and Pace, 2009).

6) Last, this study also tested the sensitivity of the parameter estimation results in the model by estimating the best model in several different ranges during the research period, i.e. the 1997-1999, 2000-2009, and 2010-2023 periods.

The data analysis process in this study was carried out using Rstudio statistical software. The temporal disaggregation stage uses the temdisagg package (Sax and Steiner., 2013), the seasonal adjustment using the X-13ARIMA-SEATS method uses the seasonal package (Sax and Eddelbuettel, 2018), and the HP filtering stage uses the hpfilter package (Monahov, 2023). The Thiessen polygons are created using GeoDa software.

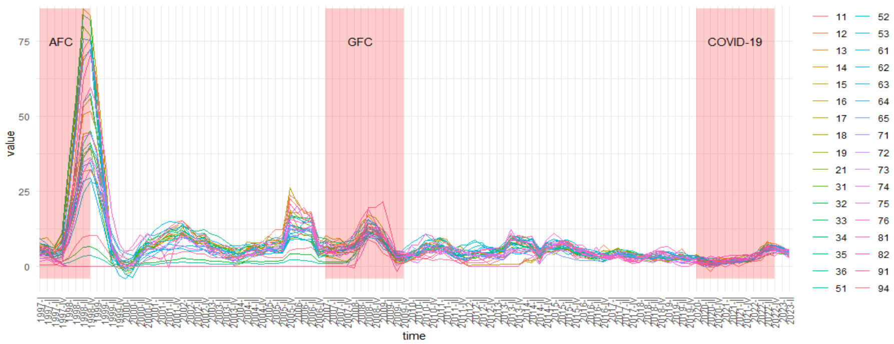
3. Results and Discussion

3.1. Inflation and Output Gap in Time of Various Crises

Regional inflation rates in the nearly four decades of the Indonesian economy currently show spikes and declines in several periods, particularly during times of crisis. The Asian Financial Crisis (AFC), also known as the "monetary crisis," has exerted the greatest pressure on Indonesian inflation in the past four decades, when the inflation reached hyperinflationary conditions. Almost all provinces in Indonesia experienced high inflation during this period; even at the national level, inflation reached 77.63 percent in 1998. The 2008 Global Financial Crisis (GFC) also brought inflationary pressures to almost all provinces in Indonesia, with national inflation reaching double digits (11.06 percent).

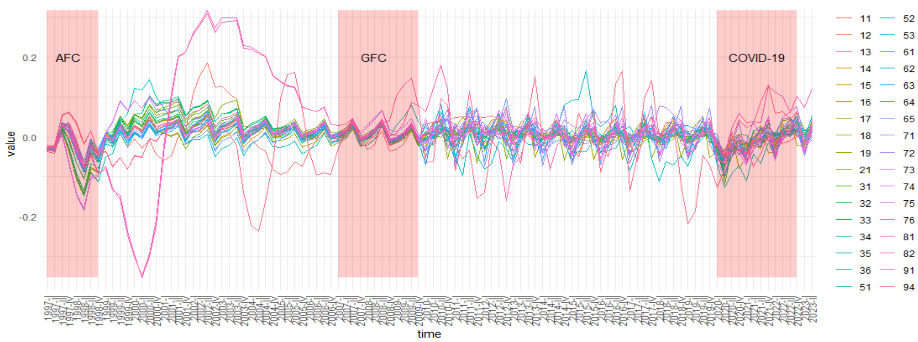
After the GFC, Indonesia's inflation was relatively controlled at single-digit levels as an implementation of the Inflation Targeting Framework (ITF) policy by the central bank (Bank Indonesia). However, during the COVID-19 pandemic that started in 2020, Indonesia's inflation experienced a decline and even reached the lowest record as calculated by BPS-Statistics Indonesia, i.e. 1.68 percent. This pattern is clearly shown in Figure 1 that inflation is higher in crisis conditions, both AFC and GFC, than in normal conditions. While inflation tends to be lower in COVID-19 conditions.

Figure 1. Inflation (year on year) of 34 Provinces in Indonesia, 1997-2023



Source: Processed by Author

Figure 2. Output Gap (Base on Regional GDP at Constant Price) in 34 Provinces in Indonesia, 1997-2023

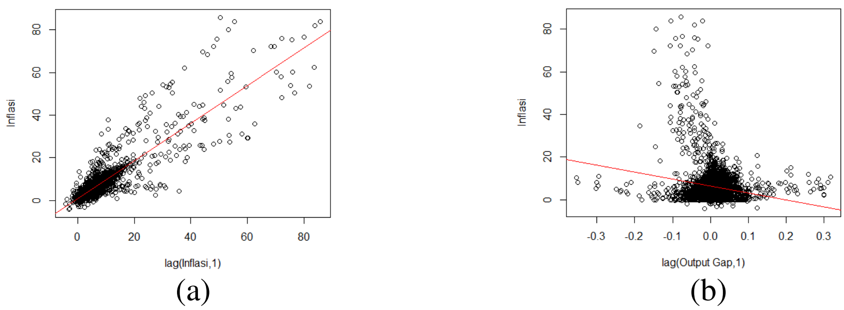


Source: Processed by Author

In line with inflation movements, the regional output gap value also shows strong pressure during times of crisis, as presented in Figure 2. During the AFC period, the regional output gap showed a value moving away from zero, indicating a shock to the economy. In 1998, a positive output gap value was seen as an indication that the Indonesian economy was experiencing excess demand, causing the prices of goods and services (inflation) to rise. However, a year later, a recovery was observed, with the output gap value becoming negative, accompanied by relatively low inflation values. Meanwhile, during the GFC, the shock to the output gap did not appear to be as large as during the AFC. Meanwhile, during the COVID-19 pandemic, the output gap value tended to be positive, especially during the pandemic outbreak (2020), which implied that the Indonesian economy was operating below its potential capacity, as indicated by the low economic growth and inflation during this period.

Next, we will see the pattern of the relationship between the variables used in this research (Figure 3). A unidirectional linear relationship pattern can be seen between the variables inflation and its lag. While the output gap variable has a non-linear relationship pattern visually. Based on these results, the output gap variable is used with a non-linear function (P-spline) in the modeling phase. In addition, a scatterplot between lagged inflation from lags 2 to 5 and actual inflation is presented, as well as a scatterplot between lagged output gap from lags 1 to 4 and actual inflation in Appendix 2.

Figure 3. Scatter Plot of lag of Inflation (a) and lag of Output Gap (b) vs. Actual Inflation



Source: Processed by Author

3.2. Formation of Spatial Weighting Matrix (Spatial Weight)

The Inverse Distance Weight (IDW) spatial weighting matrix is calculated based on the distance of each centroid between provinces. The contiguity matrix of the polygon map of Indonesia cannot be formed because several provinces do not have direct borders. Therefore it needs to be converted into Thiessen polygon before a contiguity-based matrix can be constructed. The theoretical source of Thiessen polygon construction can be found in Yamada (2016). Determining the number of neighbors (K) in the K-nearest neighbor (kNN) based weighting matrix is done by exploratory model estimation with the number K=2,3,...,11 and then selecting K based on the AIC value. In this study, the optimal number of K in the SDM, SAR, PS-SDM, and PS-SAR models is 8. The results of the determination of the optimal number of K are presented in Appendix 3.

4.3. Addition of Spatial and Non-Linear Components: Does It Improve Model Performance?

This study uses the hybrid NKPC model specification (Galí and Gertler, 1999) with and without the addition of spatial variables in the model estimation. There is one dynamic panel model (without adding spatial variables) and four spatial model specifications with a combination of three types of spatial weighting matrices, namely Inverse Distance Weight (IDW), Thiessen polygon, and K-nearest neighbor (kNN). Thus, 13 model specifications were estimated, which were used to find the best estimation model based on the criteria for the lowest AIC and RMSE values. A summary of the estimation results from the dynamic panel model (PD), the dynamic panel spatial (SDM and SAR), and the dynamic panel spatial semiparametric models (PS-SDM and PS-SAR) is presented in Table 1.

The results of the non-spatial model estimation demonstrate that the inflation lag and output gap exert a considerable influence on inflation, a finding that aligns with the predictions of the standard Phillips curve model. In addition, the spatial spillover parameters for inflation, inflation lag, and output gap variables in all spatial model specifications demonstrate statistical significance, indicating that there is a spillover effect among Indonesian provinces for these three variables. This result confirms the findings of the previous study conducted by Aginta (2023), but differs from the findings of the study conducted by Yesilyurt & Elhorst (2014), which found insignificant regional spillovers for the output gap. Therefore, with regard to regional inflation spillovers, this study validates the findings of previous studies conducted by Aginta (2023), Nagayasu (2017), Yang et al. (2021), and Yesilyurt & Elhorst (2014).

Table 1. Summary of Estimation Results

	Dynamic Panel	SDM			SAR		
		IDW	Thiessen	kNN	IDW	Thiessen	kNN
Intercept	0.843*	0.157*	0.440*	0.250*	-0.296*	0.0283	-0.210*
W inflation (rho)		0.779*	0.440*	0.605*	0.352*	0.2429*	0.329*
Inflation (-1)	0.876*	0.905*	0.834*	0.859*	0.702*	0.7544*	0.709*
W(inflation (-1))		-0.701*	-0.341*	-0.502*			
Output Gap	-11.462*	-1.632	-2.908*	-2.211	-5.855*	-7.051*	-6.157*
W(Output Gap)		-4.905*	-9.980*	-8.041*			
s(Output Gap)							
W(s(Output Gap))							
K kNN				8			8
AIC	19,673	10,508	11,879	11,195	12,266	12,551	12,301
RMSE	3.801	3.902	4.007	4.146	4.191	4.023	4.148

Source: Processed by Author
Note: *) significant at the significance level α= 0.05, **) smallest AIC and RMSE values

Table 2. Summary of Estimation Results (Continued)

	PS-SDM			PS-SAR		
	IDW	Thiessen	kNN	IDW	Thiessen	kNN
Intercept	0.596	1.918*	2.740*	0.38	0.584	0.512
W inflation (rho)	0.730*	0.410*	0.558*	0.336*	0.228*	0.313*
Inflation (-1)	0.906*	0.837*	0.861*	0.705*	0.755*	0.711*
W(inflation (-1))	-0.667*	-0.33*	-0.479*			
Output Gap						
W(Output Gap)						
s(Output Gap)	-3.235	-4.224	-4.611	-5.506	-5.061*	-5.444*
W(s(Output Gap))	-4.293	-11.198*	-16.073*			
K kNN			8			8
AIC	10,477**	11,793	11,099	12,247	12,513	12,277
RMSE	3.409**	3.788	3.767	4.085	3.925	4.043

Source: Processed by Author
Note: *) significant at the significance level α= 0.05, **) smallest AIC and RMSE values

In general, the parameter estimation results for the whole model are not significantly different and have the same direction. Different directions were found only for the estimated intercept parameters. The addition of spatial elements to the SDM and SAR models can improve the goodness of fit of the model based on AIC values compared to the dynamic panel model. However, this is not the case when looking at the ability of the model to make predictions based on the RMSE values. Moreover, the use of the spatially lagged inflation and output gap variables in the SDM and PS-SDM models is able to improve the model's goodness of fit based on AIC values compared to the use of only the SAR and PS-SAR models. The use of the output gap variable in a non-linear form, namely the P-spline, is able to improve model performance in terms of both AIC and RMSE values, although it is not optimal as this variable is not significant in the PS-SDM model with an IDW weight matrix.

The best model based on the minimum AIC and RMSE criteria is the semiparametric spatial dynamic panel model (PS-SDM) specification with the IDW spatial weighting matrix. The optimal model, as determined by the minimum AIC and RMSE criteria, is the semiparametric spatial dynamic panel model (PS-SDM) specification with an IDW spatial weighting matrix. These findings will enhance the existing body of literature on the subject, particularly in relation to the use of the Spatial Durbin Model (SDM) to examine regional inflation dynamics and spatial spillovers, as demonstrated by Aginta (2023) and Nagayasu (2017). The incorporation of semiparametric models has been demonstrated to enhance the performance of the resulting models, as evidenced by the findings of this study. In this model specification, the inflation lag, the spatial aspects of inflation, and the spatial aspects of the inflation lag have a significant impact on the formation of regional inflation in Indonesia. Meanwhile, the semiparametric element of the output gap and its spatial form have no significant effect on the inflation rate.

4.4. Dynamics of Inflation and Output Gap in Provinces in Indonesia

Based on the best model, i.e. the PS-SDM model, interpretation will then be carried out on the direct and indirect effects (spillover effects) of the lagged of inflation and the output gap on the actual inflation. The marginal effect of these two variables in the PS-SDM model can be obtained from the matrix in Equation 5.

Table 3. Summary of Marginal Effect on the PS-SDM Model

Variable	Average Direct Impact	Average Indirect Impact (Spatial Spillover)
Inflation (-1)	0.972	-0.002
Output Gap	-3.469	-0.013

Source: Processed by Author

Interesting findings regarding the impact of lagged inflation and the output gap on the actual inflation at the provincial level in Indonesia are presented in Table 2. Looking at the magnitude of the impact, both direct and indirect, it can be seen that the largest impact is transmitted by the output gap variable. This means that the actual inflation in a particular province is influenced by the development of its economic level in the same period. The magnitude of the direct impact of the output gap is -3.469; in other words, if there is an increase (decrease) in the output gap of a province by 1 percent, it will cause a decrease (increase) in inflation in the same province by 3.469 percent on average. Meanwhile, the magnitude of the output gap spillover is -0.013, meaning that an increase (decrease) in the output gap of 1 percent in neighboring provinces will cause a decrease (increase) in inflation in another province by 0.013 percent on average.

In contrast to the output gap, which has an impact in the same direction (both marginal effects are negative), the lagged inflation has a marginal effect in a different direction. The direct impact has a positive direction, i.e. 0.972, while the spillover impact is -0.002. In other words, the lagged inflation in a certain province will have a positive effect on the actual inflation in the same province. Meanwhile, on average, the laggged inflation in neighboring provinces has a negative impact on the actual inflation in a certain province. Based on the magnitude of these two impacts, the magnitude of the direct impact from the province itself is much greater than of the spillover impact from neighboring provinces.

4.5. Focal Points of Inflation in Indonesia

This study will diverge from previous studies, such as by Aginta (2023), Nagayasu (2017), Yang et al. (2021), and Yesilyurt & Elhorst (2014), which concentrate more on general regional inflation spillovers. Instead, this study will endeavor to investigate which regions are both contributors and recipients of inflation spillovers. To elaborate, the matrix of marginal effects generated in the preceding discussion can be analyzed at the provincial and island levels. In a spatial context, a change in the lagged inflation variable and the output gap in a specific province will undoubtedly give rise to alterations in actual inflation in other neighboring provinces (the spillover effect).

Table 4. Average Impact Created by Each Island on Actual Inflation in Other Provinces

Island	Inflation (-1)	Rank	Output Gap	Rank
Sumatera	-0.020	1	-0.129	1
Java	-0.017	2	-0.108	2
Bali Nusra	-0.005	6	-0.030	6
Kalimantan	-0.008	4	-0.054	4
Sulawesi	-0.013	3	-0.085	3
Maluku & Papua	-0.008	5	-0.052	5

Source: Processed by Author

Table 4 summarises the average impact received by surrounding provinces when there is a change in a variable in one province on each island in Indonesia. It can be seen that, on average, the provinces in Sumatera have the largest role (rank 1) in influencing the actual level of inflation in other provinces. The second largest influence comes from the island of Java, followed by Sulawesi, Kalimantan, Maluku, and Papua. This order holds for both the inflation lag and the output gap variables. The magnitude of the impact created by each province is presented in Appendix 4. Looking more closely at the national level, the provinces with the largest impact on the inflation levels are the DKI Jakarta, Central Java, and East Java.

Knowing the role of each region, both islands and provinces, we then see how vulnerable the actual inflation on an island or province is to changes in a variable in other provinces. The impact summary results in Table 4 show the same ranking as the results in Table 3, with Sumatera being the most vulnerable island to inflation when there is a change in the inflation lag and output gap in other islands. The average impact of each province is shown in more detail in Appendix 5. When there is a change in the inflation lag or output gap in the surrounding provinces, the provinces most affected are South Kalimantan, DKI Jakarta, and East Java.

Table 5. Average Impact Received by Actual Inflation for Each Island Due to Changes in Variables in Other Provinces

Island	Inflation (-1)	Rank	Output Gap	Rank
Sumatera	-0.021	1	-0.135	1
Java	-0.014	2	-0.092	2
Bali Nusra	-0.006	6	-0.035	6
Kalimantan	-0.010	4	-0.066	4
Sulawesi	-0.012	3	-0.079	3
Maluku & Papua	-0.008	5	-0.051	5

Source: Processed by Author

4.6 Sensitivity of Estimation Results in Different Periods: Is There a Flattened Phillips Curve Phenomenon?

Aginta (2023) used the idea of a flattening Phillips curve in his research on regional inflation spillovers in Indonesia. However, because of the study's limited data coverage, the flattening Phillips curve phenomenon on regional inflation in Indonesia cannot be empirically demonstrated. As a result, the study does not objectively demonstrate this occurrence on regional inflation data in Indonesia. However using a larger dataset, this research proved the empirical validity of this phenomenon, especially when considering the three major crises of the AFC, GFC, and COVID-19 pandemic.

The estimation results of the best model, i.e. the PS-SDM, in different periods, with each period containing crisis conditions (AFC, GFC, and COVID-19), show different patterns. The degree of actual inflation spillover between provinces has a positive value with an increasing trend between periods, from 0.562 in the 1997–1999 period to 0.761 in 2010–2023.

Table 6. Summary of Sensitivity Test Results

	PS-SDM		
	1997-1999	2000-2009	2010-2023
Intercept	0.465	0.130	0.031
W inflation (rho)	0.562 *	0.792*	0.761 *
Inflation (-1)	0.911 *	0.908*	0.798 *
W(inflation (-1))	-0.543 *	-0.725 *	-0.601 *
s(Output Gap)	5.842	-1.916*	0.040
W(s(Output Gap))	-2.313	-0.259	0.511

Source: Processed by Author
Note: *) significant at the significance level α= 0.05

The inflation lag variable has a positive influence with a pattern of decreasing value. In other words, the influence of lagged inflation in a certain province is decreasing relative to the actual inflation of the same province. The spatial lag inflation variable from other provinces has a negative influence on the actual inflation in a given province. The magnitude decreases over time, from -0.543 in the 1997-1999 period to -0.601 in the 2010-2023 period. Finally, the estimated parameters of the semiparametric variable output gap show that there is a decrease in the Phillips curve, from 5.842 in the 1997-1999 period to 0.040 in the 2010-2023 period, which means that a flattened Phillips curve has occurred in Indonesia during the this period.

4. Conclusion

This study has empirically examined the dynamics of regional inflation in Indonesia based on the Phillips curve theory (the hybrid New Keynesian Phillips curve) by using data from 34 provinces and a quarterly data series for the period 1997-2023, which covers three major crisis conditions in Indonesia (the Asian financial crisis, the global financial crisis, and the COVID-19 pandemic). The addition of spatial variables in this modeling was done considering that Indonesia is the largest archipelagic country in the world, so the inter-regional linkage factor is an important aspect to consider in explaining regional inflation dynamics. Inflation lags and output gaps have been shown to have a significant impact on regional inflation in Indonesia, both in modeling with and without the addition of spatial elements. However, addition of spatial elements to the model specifications has been shown to increase the performance of the model and prove the importance of inflation spillovers in regional inflation dynamics in Indonesia.

The dynamic panel spatial semiparametric model (PS-SDM) with the IDW weighting matrix is found to be the best model that can be used to examine regional inflation dynamics in Indonesia. This model specification concludes that the spatial aspect of inflation, the lagged inflation, and the spatial aspects of the lag of inflation have a significant impact on regional inflation in Indonesia. The level of inflation in a province is more dominantly influenced by the performance of its economic level (which is reflected in the value of the marginal effect of the output gap) and the regional lag of inflation. Meanwhile, the spillover effects of both the output gap and inflation lag from surrounding areas are still worth considering, although the effects are relatively small.

The island of Sumatra is shown to have the largest inflation spillover effect compared to other islands in Indonesia. The three provinces that play the largest role in influencing the level of inflation are DKI Jakarta, Central Java, and East Java. This has implications for the need for more intensive price control policies in these focus areas, such as the provision of fiscal incentives. With these fiscal incentives, it is hoped that regional governments, especially the TPID, will have more room to design price control programs in their regions. This is important given that price control in focal areas will have an impact on other areas that receive spillover effects from that region. Meanwhile, the provinces that have received the highest inflation spillovers from the fluctuation of inflation to their surroundings are the provinces of South Kalimantan, DKI Jakarta, and East Java. These regions need to synergize their
price control policy with the regions that have an impact on inflation spillovers. The proportional fiscal stimulus is also important for these provinces to maintain price stability from the impact of inflation fluctuations from other provinces as inflation focal points. In addition, the disruptions of distribution channels and transportation costs betweenregions must also be anticipated to reduce price fluctuations.

In addition, the results of the sensitivity test show that there is a shift in the Phillips curve over the period 1997-2023, with the magnitude of the estimated parameters for the output gap variables tending to decrease (the flattened Phillips curve). For future studies, it would be interesting to examine inflation spillover studies using core inflation data, so that temporary shock factors in headline inflation data can be eliminated. When constructing the output gap variable, it is also necessary to consider separating the regional economies dominated by the oil and gas sector from the non-oil and gas sector, as they generally have different economic structures.

References

[1] Aginta, H. (2023) 'Inflation and Spatial Spillovers in a Large Archipelago: Evidence from Indonesia', *Economic Papers,* pp. 1–13. Available at: https://doi.org/https://doi.org/10.1111/1759-3441.12381.

[2] Al-Nassar, N.S.. and Albahouth, A.A. (2023) 'Inflation Spillovers among Advanced and Emerging Economies: Evidence from the G20 Group', *Economies*, 11(4). Available at: https://doi.org/https://doi.org/10.3390/economies11040126.

[3] Anselin, L., Syabri, I. and Kho, Y. (2010) 'GeoDa: An Introduction to Spatial Data Analysis', in *In: Fischer, M., Getis, A. (eds) Handbook of Applied Spatial Analysis*. Berlin, Heidelberg:

[4] Auer, R., Levchenko, A.A. and Saure, P. (2021) 'International Inflation Spillovers Through Input Linkages', *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/https://doi.org/10.2139/ssrn.2952281.

[5] Bank Indonesia (2022) *Laporan Perkembangan Ekonomi Keuangan dan Kerja Sama Internasional*.

[6] Bank Indonesia (2023) *Kajian Ekonomi dan Keuangan Regional Laporan Nusantara Juli 2023*.

[7] Basarac, M., Škrabic, B. and Soric, P. (2011) 'The hybrid phillips curve: Empirical evidence from transition economies', *Finance a Uver - Czech Journal of Economics and Finance*, 61(4), pp. 367–383.

[8] Bilgin, N.M. (2023) 'Inflation Diffusion Through Production Networks', *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/https://doi.org/10.2139/ssrn.4164364.

[9] Cholette, E.B.D.& P.A. (2006) *Benchmarking, Temporal Distribution, and Reconciliation Methods for Time Series. Lecture Notes in Statistics*. New York: Springer-Verlag.

[10] Chow, G.C. and Lin., A.-L. (1971) 'Best linear unbiased interpolation, distribution, and extrapolation of time series by related series.', *The Review of Economics and Statistics*, 53(4), pp. 372–375.

[11] Elhorst, J.P. (2014) *Spatial Econometrics: from Cross-Sectional Data to Spatial Panels*. Heidelberg: Springer. Available at: https://doi.org/https://doi.org/10.1007/978-3-642-40340-8.

[12] Galí, J. and Gertler, M. (1999) 'Inflation dynamics: A structural econometric analysis', *Journal of Monetary Economics*, 44(2), pp. 195–222. Available at: https://doi.org/https://doi.org/10.1016/S0304-3932(99)00023-9.

[13] Halka, A. and Szafranek, K. (2017) 'Whose Inflation Is It Anyway? The Inflation Spillovers Between The Euro Area and Small Open Economies', *SSRN Electronic Journal*, 223. Available at: https://doi.org/https://doi.org/10.2139/ssrn.2805885.

[14] Hodrick, R.J. and Prescott, E.C. (1997) 'Postwar U.S. Business Cycles: An Empirical Investigation', *Journal of Money, Credit, and Banking*, 29, pp. 1–16. Available at: https://doi.org/https://doi.org/10.2307/2953682.

[15] Istiak, K. *et al.* (2021) 'The Spillover of Inflation among the G7 Countries', *Journal of Risk and Financial Management*, 14(8), p. 392. Available at: https://doi.org/https://doi.org/10.3390/jrfm14080392.

[16] LeSage, J.. and Pace, K.R. (2009) *Introduction to Spatial Econometrics*. London: Chapman

and Hall/CRC.

[17] Mínguez, R.., Basile, R.. and Durbán, M. (2020) 'An alternative semiparametric model for spatial panel data', *Stat Methods Appl*, 29, pp. 669–708. Available at: https://doi.org/https://doi.org/10.1007/s10260-019-00492-8.

[18] Mínguez, R.., Basile, R.. and Durbán, M. (2022) 'An introduction to pspatreg: A new R package for semiparametric spatial autoregressive analysis', *REGION*, 9(2), pp. 1–15. Available at: https://doi.org/doi: 10.18335/region.v9i2.450.

[19] Ministry of Finance Republic of Indonesia (2023) *Kemenkeu dan Kemendagri Beri Insentif Fiskal Untuk Daerah Berkinerja Baik dalam Pengendalian Inflasi*.

[20] Monahov, A. (2023) 'An R Implementation of the One- and Two-Sided Hodrick-Prescott Filter', *SSRN* [Preprint]. Available at: https://doi.org/https://ssrn.com/abstract=4387670 or http://dx.doi.org/10.2139/ssrn.4387670.

[21] Monsell, B. (2007) 'The X-13A-S Seasonal Adjustment Program', in *Proceedings of the 2007 Federal Committee on Statistical Methodology Research Conference*.

[22] Nagayasu, J. (2017) 'Regional inflation, spatial locations and the Balassa-Samuelson effect: Evidence from Japan', *Urban Studies*, 54(6), pp. 1482–1499. Available at: https://doi.org/https://doi.org/10.1177/0042098016629915.

[23] Osorio, C. and Unsal, D.F. (2013) 'Inflation dynamics in Asia: Causes, changes, and spillovers from China', *Journal of Asian Economics*, 24, pp. 26–40. Available at: https://doi.org/https://doi.org/10.1016/j.asieco.2012.10.007.

[24] Purwono, R., Yasin, M.Z. and Mubin, M.K. (2020) 'Explaining regional inflation programmes in Indonesia: Does inflation rate converge?', *Economic Change and Restructuring*, 53(4), pp. 571–590. Available at: https://doi.org/https://doi.org/10.1007/s10644-020-09264-x.

[25] Ridhwan, M.M. (2016) 'Inflation differentials, determinants, and convergence: Evidence from Indonesia subnational data', *The Journal of Developing Areas*, 50(5), pp. 257–276. Available at: https://doi.org/10.1353/jda.2016.0030.

[26] Sax, C. and Eddelbuettel, D. (2018) 'Seasonal Adjusment by X-13ARIMA-SEATS in R', *Journal of Statistical Software*, 87(11), pp. 1–17. Available at: https://doi.org/doi: 10.18637/jss.v087.i11.

[27] Sax, C. and Steiner., P. (2013) 'Temporal Disaggregation of Time Series.', *The R Journal*, 5(2), pp. 80–87. Available at: https://doi.org/DOI:10.32614/RJ-2013-028.

[28] Tirtosuharto, D. and Adiwilaga, H. (2014) 'Decentralization and Regional Inflation in Indonesia', *Buletin Ekonomi Moneter dan Perbankan*, 16(2), pp. 137–154. Available at:

https://doi.org/10.21098/bemp.v16i2.441.

[29] Yamada, I. (2016) 'Thiessen Polygons', in *In International Encyclopedia of Geography: People, the Earth, Environment and Technology (eds D. Richardson, N. Castree, M.F. Goodchild, A. Kobayashi, W. Liu and R.A. Marston)*. Available at: https://doi.org/https://doi.org/10.1002/9781118786352.wbieg0157.

[30] Yang, X., Zhang, Y. and Li, Q. (2021) 'The role of price spillovers: what is different in China', *Empir Econ*, 60, pp. 459–485. Available at: https://doi.org/https://doi.org/10.1007/s00181-020-01989-y.

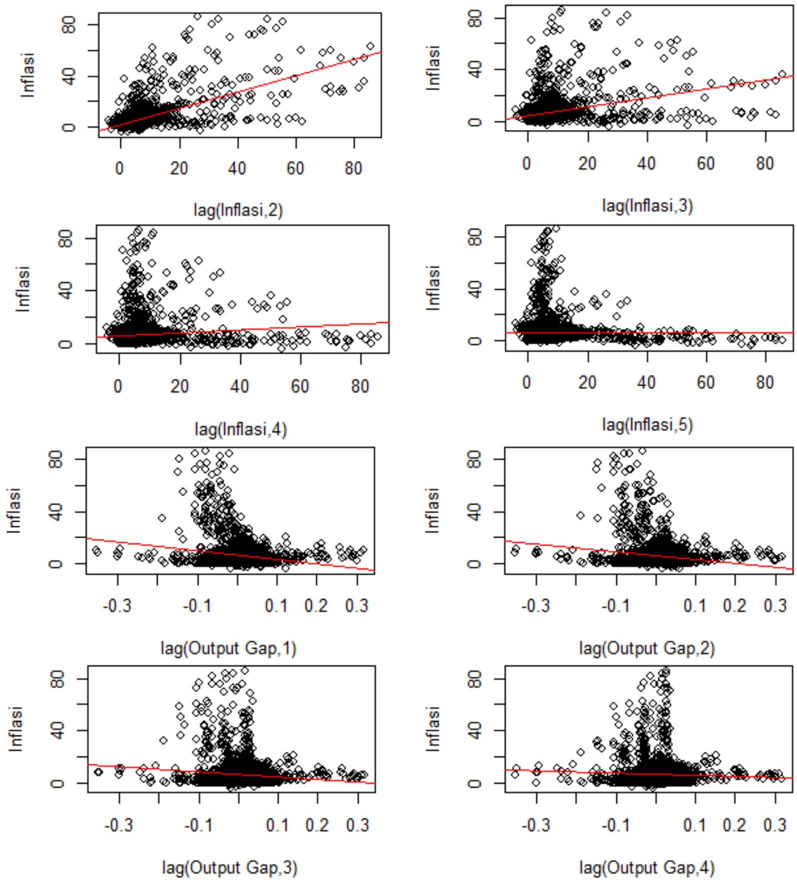
[31] Yesilyurt, F. and Elhorst, J.P. (2014) 'A regional analysis of inflation dynamics in Turkey', *Annals of Regional Science*, 52(1), pp. 1–17. Available at: https://doi.org/https://doi.org/10.1007/s00168-013-0570-4.

Appendix 1. Summary of Annual GRDP at Constant Prices Temporal Disaggregation

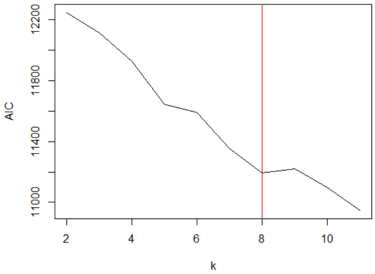
Method	Indicator/s	Mean of RMSE
Denton-Cholette	-	1,297.07
Denton-Cholette	JKSE	3,161.41
Denton-Cholette	Indonesian Quarterly GRDP at Constant Prices	1,019.92*
Chow-Lin Maxlog	JKSE	1,512.92
Chow-Lin Maxlog	Indonesian Quarterly GRDP at Constant Prices	1,040.51
Chow-Lin Maxlog	JKSE & Indonesian Quarterly GRDP at Constant Prices	1,068.14

Note: *) the best disaggregation method

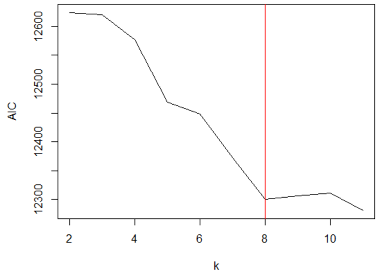
Appendix 2. Scatter Plot of Lag of Inflation dan Lag of Output Gap vs. Actual Inflation



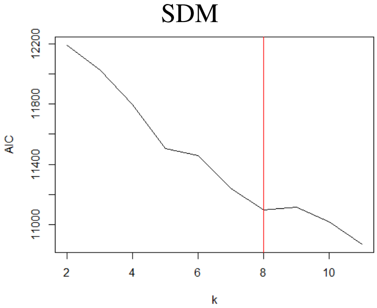
Appendix 3. Determining the optimal number of K in kNN weights



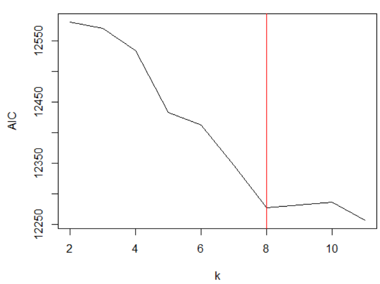
SDM



SAR model



PS-SDM



PS-SAR model

Appendix 4. Average Impact Created by Each Province on Actual Inflation in Other Provinces

Prov. Code	lag(Inflation,1)	Rank	Output Gap	Rank	Prov. Code	lag(Inflation,1)	Rank	Output Gap	Rank
11	-0.001	33	-0.005	33	52	-0.002	25	-0.001	25
12	-0.001	27	-0.009	27	53	-0.002	19	-0.013	19
13	-0.002	13	-0.015	13	61	-0.002	24	-0.010	24
14	-0.002	14	-0.014	14	62	-0.001	30	-0.007	30
15	-0.003	9	-0.017	9	63	-0.004	4	-0.022	4
16	-0.003	7	-0.019	7	64	-0.000	34	-0.002	34
17	-0.002	12	-0.015	12	65	-0.002	22	-0.012	22
18	-0.003	10	-0.017	10	71	-0.002	18	-0.013	18
19	-0.002	17	-0.014	17	72	-0.002	23	-0.011	23
21	-0.001	31	-0.006	31	73	-0.003	5	-0.019	5
31	-0.004	1	-0.027	1	74	-0.003	6	-0.019	6
32	-0.001	32	-0.006	32	75	-0.002	15	-0.014	15
33	-0.004	2	-0.023	2	76	-0.001	26	-0.009	26
34	-0.002	21	-0.013	21	81	-0.002	20	-0.013	20
35	-0.004	3	-0.023	3	82	-0.003	8	-0.018	8
36	-0.003	11	-0.016	11	91	-0.001	28	-0.008	28
51	-0.001	29	-0.008	29	94	-0.002	16	-0.014	16

Appendix 5. Average Impact Received by Actual Inflation in One Province on Changes in a Variable in Other Provinces

Prov. Code	Lag (Inflation,1)	Rank	Output Gap	Rank	Prov. Code	Lag (Inflation,1)	Rank	Output Gap	Rank
11	-0.002	21	-0.0127	21	52	-0.0018	24	-0.0119	24
12	-0.002	17	-0.0131	17	53	-0.0018	27	-0.0118	27
13	-0.002	14	-0.0133	14	61	-0.0018	32	-0.0115	32
14	-0.002	11	-0.0142	11	62	-0.0018	26	-0.0118	26
15	-0.002	10	-0.0142	10	63	-0.0028	1	-0.0182	1
16	-0.002	9	-0.0142	9	64	-0.0017	33	-0.0112	33
17	-0.002	8	-0.0143	8	65	-0.0020	19	-0.0130	19
18	-0.002	7	-0.0144	7	71	-0.0018	28	-0.0117	28
19	-0.002	18	-0.0130	18	72	-0.0019	22	-0.0121	22
21	-0.002	34	-0.0112	34	73	-0.0022	12	-0.0139	12
31	-0.003	2	-0.0180	2	74	-0.0025	5	-0.0162	5
32	-0.002	30	-0.0117	30	75	-0.0021	15	-0.0132	15
33	-0.003	4	-0.0178	4	76	-0.0018	25	-0.0118	25
34	-0.002	20	-0.0130	20	81	-0.0018	23	-0.0119	23
35	-0.0028	3	-0.0180	3	82	-0.0021	13	-0.0135	13
36	-0.0020	16	-0.0131	16	91	-0.0018	29	-0.0117	29
51	-0.0018	31	-0.0116	31	94	-0.0022	6	-0.0145	6

Appendix 6. Codes and Names of Provinces in Indonesia

Province	Province Code	Province	Province Code
Aceh	11	West Nusa Tenggara	52
North Sumatera	12	East Nusa Tenggara	53
West Sumatera	13	West Kalimantan	61
Riau	14	Central Kalimantan	62
Jambi	15	South Kalimantan	63
South Sumatera	16	East Kalimantan	64
Bengkulu	17	North Kalimantan	65
Lampung	18	North Sulawesi	71
Bangka Belitung Islands	19	Central Sulawesi	72
Riau Islands	21	South Sulawesi	73
DKI Jakarta	31	Southeast Sulawesi	74
West Java	32	Gorontalo	75
Central Java	33	West Sulawesi	76
DI Yogyakarta	34	Maluku	81
East Java	35	North Maluku	82
Banten	36	West Papua	91
Bali	51	Papua	94