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Analysis About Inflation Persistence in West Sumatra Province: Pre-Post the COVID-19 Pandemic

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Abstract

This research is based on significant inflation fluctuations due to global economic disruptions, changes in consumption patterns, and the impact of a pandemic that triggers shock inflation away from its average value. The purpose of the study is to analyze between inflation persistence before and after the COVID-19 pandemic in West Sumatra Province. The variables used in this study include general inflation and commodity group inflation. This study uses a univariate autoregressive (AR) approach with monthly inflation time series data for 2017-2019 (pre-pandemic) and 2021-2023 (post-pandemic). Data obtained from the Central Bureau of Statistics of West Sumatra. The results showed that the persistence rate of general inflation before and after the pandemic was in a controlled category with an average length of time back to its natural level of less than one month. All commodity group inflation variables such as processed food, housing, health, and education are in the low inflation persistence category with the length of time to return to its natural level of less than 3 months both before and after the pandemic. The results are different for the inflation variables of the transportation, communication, and financial services commodity groups which have a low inflation persistence rate before the pandemic, but high after the COVID-19 pandemic with a length of time to return to its natural level of 8.09 months. This research is expected to help policy makers in formulating strategic steps to maintain inflation and regional economic stability.

Keywords: *COVID-19 Pandemic, Inflation Persistence, Univariate Autoregressive.*

Introduction

The COVID-19 pandemic has created inflationary and deflationary dynamics in almost all parts of the world since the beginning of 2020. Global inflation reached 8.8% in 2022, with the Eurozone recording the highest inflation in history by reaching more than 10% in October 2022. In contrast, some emerging economies experienced hyperinflation, such as in Argentina which recorded annual inflation of 94.8% in 2022. In particular, disruptions to supply chains and production chains moderated by redistribution policies lead not only to long-term supply-side inflation, but also to potential deflation stemming from higher idiosyncratic risks (Caporale et al., 2022).

The COVID-19 pandemic has also significantly changed consumption patterns in a short period of time. Consumers tend to shift their spending from services to household goods and technology during periods of social and commercial restrictions. Demand for goods such as electronics, household appliances, and groceries soared, while spending on travel, entertainment, and restaurants saw a sharp decline. For example, in the United States, retail sales of online goods increased 32% in 2020 compared to the previous year (World Bank, 2023).

China's COVID-19 concerns have also resulted in a stronger impact on inflationary spillovers. Xu & Lien (2024) overall find pandemic-induced shocks have a direct and persistent impact on inflation spillovers across categories. Strong inflationary phenomena also occur in the UK and Germany. Using credit card data with features that distinguish online and in-person transactions, Grigoli & Pugacheva (2024) conclude that higher inflation rates have occurred in the first year of the pandemic, and deflated thereafter. This phenomenon is enough to explain that the turmoil of the pandemic event has an impact on inflation volatility as a result of changes in people's consumption patterns.

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The analysis of inflation trend not only looks at the level of volatility, but also the level of persistence. Inflation persistence refers to the speed and rate at which inflation returns to normal after a disturbance (Robalo Marques, 2004) . More persistent inflation results in changes in household savings, investment, weakened purchasing power, savings that lose value, makes it difficult for people and families to budget for current and future costs, and can affect every dimension including the overall financial health of the country (Ahmad et al., 2024.

In addition, the higher degree of inflation persistence can make it difficult for monetary policy to effectively reduce the inflation rate, so it needs special handling of inflation control in each region and area (Arimurti & Trisnanto, 2011) . High inflation persistence is generally considered bad because it is difficult to control and tends to increase economic uncertainty. So keeping inflation persistence at a low level is a desirable goal, as this helps to create a stable and predictable economic environment (Fuhrer, 2010).

Some researchers found various research results related to the study of inflation persistence at the regional level in Indonesia at least in the last decade. Among those researches show the high inflation persistence degree has happened in some regions, among others: Wahyudi (2021) in East Java Province, Farida (2020) in Surabaya, Iskandar & Subekan (2018) in West Papua Province, and Azwar (2017) in South Sulawesi Province. Meanwhile, the results of other studies found a low degree of persistence stated byand Purwanti (2022) in West Java Province. This indirectly illustrates that the persistence phenomenon that occurs in various regions in Indonesia has different results.

High inflation volatility and persistence creates uncertainty in business and investment planning. Investors and businesses may become more reluctant to invest or expand their businesses in the region due to the unpredictable inflation risk. In addition, persistent inflation will weaken people's purchasing power and reduce consumption levels, which in turn can hamper local economic growth. To see the phenomenon of inflation persistence that occurs in West Sumatra province, we can see the difference between actual inflation and average inflation as shown in graph 1 below.

Figure 1. Actual and Average Inflation of West Sumatra Province (in % yoy) 2014-2023 Period (Monthly)

Source: Central Bureau of Statistics, 2024

Based on Figure 1, it can be seen that the actual inflation fluctuation in West Sumatra Province is quite dynamic with the highest point of inflation of 8.49% in September 2022 and deflation of -2.13% in February 2015. The phenomenon that can be observed is the occurrence of a shock which is reflected in the actual inflation that is different from the average inflation of 2.30%. In addition, inflation stays longer below the average of 2.30% after the deflation in February 2015 until December 2016 and then in February 2020 until December 2021. This is allegedly due to the shock of subsidized administered price increases in the first period and the shock caused by the COVID-19 pandemic in the second period. Inflation achievement is generally formed from the inflation achievement of commodity groups, the following inflation fluctuations and average inflation of commodity groups in West Sumatra Province are presented in Figure 2 below:

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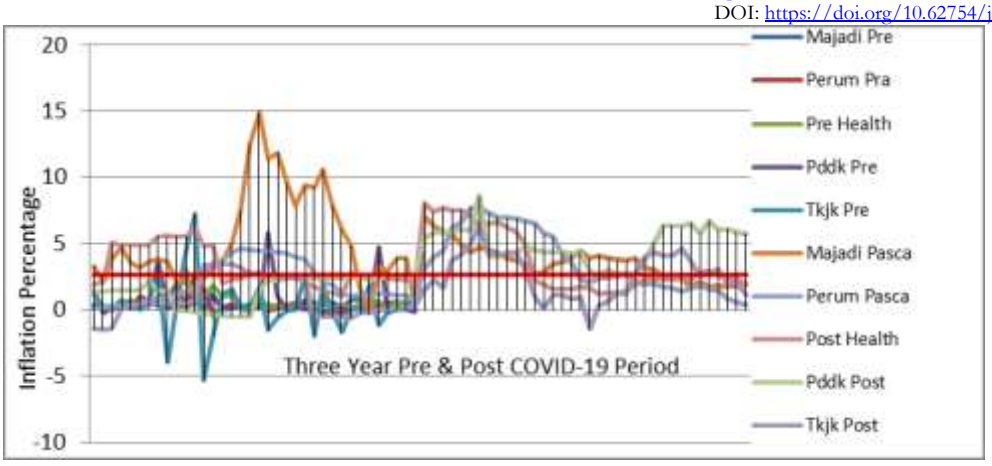

Figure 2. Actual Inflation and Average Inflation of Commodity Groups in West Sumatra Province (in % yoy) 2017-2019 and 2021-2023 Period (Monthly)

Source: Central Bureau of Statistics, 2024

As can be seen from Figure 2, the inflation amplitude of commodity groups such as processed food, beverages, cigarettes and tobacco (Majadi), housing, water, electricity, gas and fuel (Perum), health (Kesh), education, recreation and sports (Pddk), and transportation, communication and financial services (Tkjk) before the pandemic and after the COVID-19 pandemic fluctuated and some commodities experienced a shock above other commodities such as what happened to processed food, beverages, cigarettes and tobacco (Majadi) after COVID-19 with inflation reaching 15%, and transportation, communication and financial services (Tkjk) after COVID-19 experienced deflation to -5.6%, away from the average commodity group inflation rate of 2.60%.

The study of inflation persistence study will be focused on West Sumatra Province which has a unique economic structure dominated by the agricultural sector, tourism, and distinctive socio-cultural dynamics, showing the importance of commodity price fluctuations on inflation, making it an attractive location for inflation persistence studies. According to data from the Central Bureau of Statistics (BPS) of West Sumatra Province, the agricultural sector contributed 25.11% to the province's Gross Regional Domestic Product (GRDP) in 2022. On the other hand, the tourism sector in West Sumatra Province grew 11.5% in 2019 before experiencing a drastic decline during the COVID-19 pandemic (BPS West Sumatra, 2022) . Therefore, understanding the persistence of inflation in West Sumatra Province is not only important for regional economic stability, but also for developing more effective economic policies that take into account unique local dynamics.

Literature Review

Inflation Persistence

In general, persistence measurement can be grouped into two approaches, namely univariate and multivariate approaches (Robalo Marques, 2021) . The main difference between these two methods is in their ability to analyze various sources of disturbance or shock that affect inflation. The univariate approach cannot further analyze the sources of disturbances because all types of disturbances will be mixed into a single parameter. In contrast, the multivariate approach can analyze various types of disturbances and examine specific disturbances to inflation persistence.

The relationship with time series testing techniques through autoregressive models. This approach can also be categorized as a statistical approach given that the test can be conducted without giving clear information about the structural and cost effects incurred in the design process. The shock contained in this univariate model is assumed to behave as white noise in the autoregressive process component. Following Levin & Piger (2021) inflation is assumed to move following a stationary autoregressive process of order ϱ generally

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written as the following equation:

$$\pi t = \mu + j\ \pi t\text{-}j + \varepsilon t \text{ .....(1)}$$

The degree of persistence is measured by the sum of the autoregressive coefficients α. The constant parameter μ represents the average inflation, and εt is a random error element that has the possibility of heteroscedasticity but has no autocorrelation or (εt-1, εt) = 0. If s ≠ 0 with an average E (εt) = 0. Referring to Andrews & Chen (1994) then equation (1) can be parameterized into an augmented Dickey-Fuller equation (2) as follows:

$$\pi t = \mu + \varrho\ \pi t\text{-}1 + \Delta\ \pi t\text{-}j + \varepsilon t \text{ .....(2)}$$

By restricting the value of ϱ = the sum of the values of αj in equation (2). While δj is a simple transformation of αj where δk = αk. According to Andrews & Chen (1994) the parameter ϱ is the measurement scale of the best inflation persistence degree. Note that the augmented Dickey Fuller equation (2) can be tested for the value of ϱ = 1 which indicates the existence of a unit root in the inflation variable. But if the value of ϱ < 1 then inflation is stationary.

Following Gujarati (2004) the average length of time required by inflation to return to the inflation rate before the shock in this case is μ can be approximated by the formula:

$$\pi t = \varrho/(1\text{-}\varrho) \text{.....(3)}$$

This formula calculates how long it takes for inflation to absorb 50% of the shock. The larger the value of ϱ, the longer it takes for inflation to return to its long-run behavior. This shows the high degree of inflation persistence. For example, if the value of ϱ = 0.5 for monthly data, it means that 50% of the shock will be absorbed by inflation in just 1 month, while the remaining 50% will be absorbed gradually and decreasingly until finally the impact of the shock shrinks and approaches zero. If the value of ϱ = 0.95 then the time needed for inflation to absorb 50% of the shock becomes longer, which is about 19 months.

Methodology

Sampling

This research uses secondary data obtained from the Central Bureau of Statistics (BPS) of West Sumatra Province. The data collected is monthly *time series* data from 2017-2019 and 2021-2023. With a total sample for each period of 36.

Variables

Inflasi Umum

- Headline inflation (inflation) is a measure of the overall rate of increase in prices for all commodity goods and services in an economy over a given period. General inflation includes all types of goods and services consumed by households. In this study, the headline inflation data used in the pre- and post-COVID-19 periods uses the percentage unit (%) of monthly inflation (year-on-year), because the central bank in determining the inflation target is based more on changes in annual inflation (year-on-year).

- Commodity group inflation is the change in the price level of a particular commodity group of goods and services in the consumption basket used to calculate headline inflation. In this study, the commodity group inflation data also uses the percentage unit number (%) of commodity group inflation on a monthly basis (year-on-year). In the period before and after the COVID-19 pandemic, it is divided into the same 5 inflation commodities, namely, processed food, beverages, cigarettes and

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tobacco (Majadi), housing, water, electricity, gas and fuel (Perum), health (Kesh), education, recreation and sports (Pddk), and transportation, communication and financial services (Tkjk).

The operational definition of the research variables is described to avoid misunderstanding between the author and the reader, and to obtain a clear picture of this research, it can be seen in table 1.

Table 1. Operational Definition of Variables

No.	Variables	Code	Operational Definition	Unit	Data Source
Estimation of *AR (Autoregressive)* Inflation Persistence Before COVID-19					
1.	Inflation	Inflation (Y_t)	The general inflation used is the province's *year on year* inflation.	Percent	BPS
2.	Commodity inflation	Majadi ($X1_{,t}$)	Inflation of processed food, beverages, cigarettes and tobacco commodities	Percent	BPS
3.	Commodity inflation	Perum ($X2_{,t}$)	Housing, water, electricity, gas and fuel commodity inflation	Percent	BPS
4.	Commodity inflation	Kesh ($X3_{,t}$)	Health commodity inflation	Percent	BPS
5.	Commodity inflation	Pddk ($X4_{,t}$)	Education, recreation and sports commodity inflation	Percent	BPS
6.	Commodity inflation	Tkjk ($X5_{,t}$)	Transportation, communication and financial services commodity inflation	Percent	BPS
***AR (Autoregressive)* Estimation of Inflation Persistence After COVID-19**					
1.	Inflation	Inflation (Y_t)	The general inflation used is the province's *year on year* inflation.	Percent	BPS
2.	Commodity inflation	Majadi ($X1_{,t}$)	Inflation of processed food, beverages, cigarettes and tobacco commodities	Percent	BPS
3.	Commodity inflation	Perum ($X2_{,t}$)	Housing, water, electricity, gas and fuel commodity inflation	Percent	BPS
4.	Commodity inflation	Kesh ($X3_{,t}$)	Health commodity inflation	Percent	BPS
5.	Commodity inflation	Pddk ($X4_{,t}$)	Education, recreation and sports commodity inflation	Percent	BPS
6.	Commodity inflation	Tkjk ($X5_{,t}$)	Transportation, communication and financial services commodity inflation	Percent	BPS

Research Design

The estimation of inflation persistence degree is conducted on the general inflation variable and 5 inflation commodity groups for the period before and after the COVID-19 pandemic. The form of the autoregressive equation of inflation before and after the COVID-19 pandemic is described in the following equation:

$$Y_t = \emptyset_0 + \emptyset_1 Y_{t-n} + \epsilon_t \quad \text{.....(4)}$$

$$X_{1,t} = \theta_{1,0} + \theta_{1,1} X_{1,t-n} + \epsilon_t \text{.....(5)}$$

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$$X_{2,t} = \theta_{2,0} + \theta_{2,1}X_{2,t-n} + \epsilon_t \text{.....(6)}$$

$$X_{3,t} = \theta_{3,0} + \theta_{3,1}X_{3,t-n} + \epsilon_t \text{.....(7)}$$

$$X_{4,t} = \theta_{4,0} + \theta_{4,1}X_{4,t-n} + \epsilon_t \text{.....(8)}$$

$$X_{5,t} = \theta_{5,0} + \theta_{5,1}X_{5,t-n} + \epsilon_t \text{.....(9)}$$

Where:

Y_t, - $X_{1,t}$-$X_{5,t}$: Headline inflation at time t

$\emptyset_0$: Constant

Y_{t-n} : *Autoregressive* coefficient of headline inflation at time n

εt : *Error* or *noise* component.

AR formula with order ρ can be described in the following general equation (10):

$$\pi t = \mu + \sum_{j=1}^{k} a_j \pi_{t-j} + \varepsilon_t \text{ .....(10)}$$

Where :

πt : monthly inflation rate at time t

μ : a constant to control for average inflation

$\sum_{j=1}^{k} a_j$: sum of AR coefficients

ε_t : random error term or residuals from regression

Inflation persistence is said to be high if the current inflation rate is influenced by its lag value, with its coefficient close to 1. In this case, inflation is said to approach the unit root process. the criteria for classifying inflation persistence in this study, namely if:

$\rho > 0.80$ = High inflation persistence

$\rho \leq 0.80$ = Low inflation persistence

The determination of $\varrho = 0.80$ as the threshold of high or low inflation persistence in this study is based on strong theoretical and empirical justification. This threshold allows for a more focused analysis in understanding the behavior of regional inflation and its impact on economic policy. Specifically, there is no universal standardized indicator explicitly formulated by world economists to set the threshold of high or low inflation persistence rate, such as autoregressive (AR) coefficient of 0.80. However, this threshold is generally adapted based on empirical practice from previous research and consideration of the economic characteristics of each region. Empirical research shows that inflation with $\varrho > 0.80$ tends to have a duration of disturbance effect of more than 1 year Gujarati (2004) . At a level of 0.80, inflation requires on average 5 periods to absorb 50% of the disturbance impact, making it a relevant threshold to indicate high resistance to economic stability (Levin & Piger, 2021).

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Results

Univariate Autoregressive Model Selection Test

Stationarity Test

The stationarity test aims to determine whether the research data is stationary or not. If the data has been stationary, then the data avoids runaway regression. Unit root test (Root Test) on all data variables using Dickey Fuller and Augmented Dickey Fuller Test, whose calculations use E-views software. In general, all research variables for the pre-COVID-19 period are not stationary at the level stage with probability >0.05 (α 5%), so they must proceed to the degree of integration test stage at the next order, namely first different. At the integration test stage, all variables have a Prob value <0.05 so it can be concluded that all variables in this study are stationary in the first differentiation, so they can be used in autoregressive analysis. The test results can be seen in tables 2 and 3 below:

Table 2. Stationarity Test

Stationarity Test of Variables Before the COVID-19 Pandemic					
Variables	**ADF Statistic**	**The critical value of McKinnon**			**Prob***
		1%	**5%**	**10%**	
Inflation	-2.652.552	-3.639.407	-2.951.125	-2.614.300	**0.0928**
Majadi	-2.604.447	-3.632.900	-2.948.404	-2.612.874	**0.1017**
Perum	-0.013113	-3.632.900	-2.948.404	-2.612.874	**0.9510**
Kes	-1.527.982	-3.639.407	-2.951.125	-2.614.300	**0.5076**
Pddk	-2.215.379	-3.632.900	-2.948.404	-2.612.874	**0.2046**
Tkjk	-1.827.087	-3.632.900	-2.948.404	-2.612.874	**0.3617**
Variable Stationarity Test After COVID-19 Pandemic					
Variables	**ADF Statistic**	**critical value of McKinnon**			**Prob***
		1%	**5%**	**10%**	
Inflation	-2.178.620	-3.653.730	-2.957.110	-2.617.434	**0.2175**
Majadi	-1.288.755	-3.632.900	-2.948.404	-2.612.874	**0.6238**
Perum	-2.272.915	-3.653.730	-2.957.110	-2.617.434	**0.1864**
Kes	-1.653.087	-3.632.900	-2.948.404	-2.612.874	**0.4456**
Pddk	-2.506.970	-3.632.900	-2.948.404	-2.612.874	**0.1225**
Tkjk	-1.636.030	-3.632.900	-2.948.404	-2.612.874	**0.4541**

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Table 3. Integration Degree Test (first difference)

Stationarity Test of Variables Before the COVID-19 Pandemic					
Variables	**ADF Statistic**	**The critical value of McKinnon**			**Prob***
		1%	**5%**	**10%**	
Inflation	-3.615.337	-3.639.407	-2.951.125	-2.614.300	**0.0106**
Majadi	-5.471.162	-3.639.407	-2.951.125	-2.614.300	**0.0001**
Perum	-3.629.424	-3.639.407	-2.951.125	-2.614.300	**0.0103**
Kes	-3.944.444	-3.639.407	-2.951.125	-2.614.300	**0.0046**
Pddk	-7.445.607	-3.639.407	-2.951.125	-2.614.300	**0.0000**
Tkjk	-5.747.588	-3.639.407	-2.951.125	-2.614.300	**0.0000**
Variable Stationarity Test After COVID-19 Pandemic					
Variables	**ADF Statistic**	**critical value of McKinnon**			**Prob***
		1%	**5%**	**10%**	
Inflation	-7.504.422	-3.653.730	-2.957.110	-2.617.434	**0.0000**
Majadi	-4.450.625	-3.639.407	-2.951.125	-2.614.300	**0.0012**
Perum	-6.342.502	-3.653.730	-2.957.110	-2.617.434	**0.0000**
Kes	-6.249.893	-3.639.407	-2.951.125	-2.614.300	**0.0000**
Pddk	-6.443.058	-3.639.407	-2.951.125	-2.614.300	**0.0000**
Tkjk	-5.131.791	-3.639.407	-2.951.125	-2.614.300	**0.0002**

Autoregressive Estimation Results

The regression results with the univariate autoregressive approach for the general inflation variable and commodity groups for the period before the COVID-19 pandemic in this study can be written in the following equations:

$$Y_t = 0.864822 + 1.230827Y_{t-1} + \mathbf{0.369856Y_{t-2}} + 0.246519Y_{t-3} + 0.071401Y_{t-4} + \epsilon_t \quad \text{.....(11)}$$

$$X1_{,t} = 0.290313 + \mathbf{0.105047X1}_{,t-1} + 0.086896X1_{,t-2} + 0.102563X1_{,t-3} + 0.192370X1_{,t-4} + \epsilon_t \quad \text{.....(12)}$$

$$X2_{,t} = 0.018502 + 0.267643X2_{,t-1} + \mathbf{0.120994X2}_{,t-2} + 0.612756X2_{,t-3} - 0.189640X2_{,t-4} + \epsilon_t \quad \text{.....(13)}$$

$$X3_{,t} = 0.166673 + 0.269715X3_{,t-1} + \mathbf{0.331618X3}_{,t-2} + 0.033860X3_{,t-3} + 0.010501X3_{,t-4} + \epsilon_t \quad \text{.....(14)}$$

$$X4_{,t} = 1.290036 + 0.380786X4_{,t-1} + \mathbf{0.204694X4}_{,t-2} + 0.007608X4_{,t-3} + 0.082947X4_{,t-4} + \epsilon_t \quad \text{.....(15)}$$

$$X5_{,t} = 0.545439 + \mathbf{0.584293X5}_{,t-1} + 0.025103X5_{,t-2} - 0.007953X5_{,t-3} + 0.118785X5_{,t-4} + \epsilon_t \quad \text{.....(16)}$$

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Furthermore, the same test is also carried out for general inflation variables and commodity groups in the period after the COVID-19 pandemic, the regression results can be written into the following mathematical equations:

$Y_t = 0.489442 + 0.865912Y_{t-1} + 0.401209Y_{t-2} + 0.0076439Y_{t-3} + \mathbf{0.382003Y_{t-4}} + \epsilon_t$……………………..(17)

$X1_{,t} = 0.092793 + \mathbf{0.191268Y_{t-1}} - 0.030978Y_{t-2} + 0.099403Y_{t-3} - 0.334869Y_{t-4} + \epsilon_t$……………….…… (18)

$X2_{,t} = 0.014821 + 0.587952Y_{t-1} - 0.050947Y_{t-2} + 0.447975Y_{t-3} + \mathbf{0.316194Y_{t-4}} + \epsilon_t$…………………..........(19)

$X3_{,t} = 0.045784 + \mathbf{0.160660Y_{t-1}} + 0.350296Y_{t-2} + 0.259421Y_{t-3} + 0.090673Y_{t-4} + \epsilon_t$……………………....(20)

$X4_{,t} = 0.895938 + \mathbf{0.698631Y_{t-1}} + 0.054386Y_{t-2} - 0.102855Y_{t-3} - 0.028788Y_{t-4} + \epsilon_t$……………………...(21)

$X5_{,t} = 0.793513 + \mathbf{0.889929Y_{t-1}} - 0.227822Y_{t-2} + 0.173161Y_{t-3} - 0.137743Y_{t-4} + \epsilon_t$..........................(22)

This model assumes that the current value of inflation is influenced by the value of inflation in the previous 4 periods (lag 1 to lag 4). The coefficients in the model indicate the degree of dependence between past and current inflation and how inflation in period t is affected by inflation in the previous period. For each inflation series, the optimal lag length of the variables is determined based on the Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (SBIC), and Hannan-Quinn Information Criterion (HQ) by looking at the smallest value or lag that gets an asterisk (*) on the criteria at most (Levin & Piger, 2021).

Table 4. Autoregressive Test Results of Variables Before and After the COVID-19 Pandemic

AR Variable Estimation Results Before COVID-19				
Variables	**Persistence**	**Optimal Lag (ϱ)**	**Order (h)**	**Category**
Inflation	0.369856	AR(2)	0.59 Month	Low
Majadi	0.105047	AR(1)	0.12 Month	Low
Perum	0.120994	AR(2)	0.14 Month	Low
Kes	0.331618	AR(2)	0.50 Months	Low
Pddk	0.204694	AR(2)	0.26 Month	Low
Tkjk	0.584293	AR(1)	1.40 Month	Low
AR Variable Estimation Results After COVID-19				
Variables	**Persistence**	**Optimal Lag (ϱ)**	**Order (h)**	**Category**
Inflation	0.382003	AR(4)	0.62 Month	Low
Majadi	0.191268	AR(1)	0.24 Month	Low
Perum	0.316194	AR(4)	0.46 Month	Low
Kesh	0.16066	AR(1)	0.19 Month	Low
Pddk	0.698631	AR(1)	2.32 Months	Low

Journal of Ecohumanism
2024
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Tkjk	0.889929	AR(1)	8.09 Months	High

Based on Table 4, the AR coefficient for headline inflation before the pandemic is 0.369856, which indicates a low inflation persistence rate. In other words, changes in inflation in the previous period only affect about 36.99% of current inflation. The length of time it takes to return to the normal or average rate of inflation is 0.59 months. This means that if there is a disturbance in inflation, only about 59% of the disturbance will be absorbed within a month, after which inflation stabilizes at its average value. After the pandemic, the AR coefficient slightly increased to 0.382003, which is still relatively low (below 0.80), and the length of time to return to the normal level remains at 0.59 months.

The AR coefficient for inflation in processed food, beverages and cigarettes is 0.105047 before the pandemic, which indicates that inflation persistence is very low. That is, changes in inflation in the previous period only affect about 10.5% of current inflation, and the rest is unrelated to past inflation. The time taken to return to the normal or average level is 0.12 months, which indicates that inflationary disturbances in this commodity are quickly absorbed and return to the average level in a very short time. After the pandemic, the AR coefficient increased slightly to 0.191268, which is still relatively low, indicating that despite the slight change in inflation persistence, the influence of past inflation on current inflation remains very limited. The length of time it takes to return to normal levels also increases slightly to 0.24 months, but is still very fast compared to other sectors that experience higher persistence.

The AR coefficient for housing, water, electricity, gas and fuel commodities was 0.120994 before the pandemic, indicating that inflation persistence in this sector is very low. That is, price changes in the previous period only affect about 12% of current inflation. The length of time it takes to return to normal or average levels is 0.14 months, which reflects the very rapid price adjustment after an inflationary disturbance. After the pandemic, the AR coefficient increased slightly to 0.316194, which is still relatively low (below 0.80). This suggests that despite a slight increase in inflation persistence, inflation in this sector remains less influenced by past prices. The length of time it takes to return to normal levels is 0.46 months, which is longer than the pre-pandemic period.

The AR coefficient for inflation in health commodities is 0.331618 before the pandemic, which indicates that the persistence of inflation in this sector is quite low, with the effect of past inflation on current inflation only about 33%. The length of time it takes to return to normal or average levels is 0.50 months, which suggests that inflationary disturbances in health commodities are fairly quickly absorbed, although it takes longer compared to some other sectors. After the pandemic, the AR coefficient decreased to 0.16066, which is lower, indicating that changes in inflation in the previous period have less influence on current inflation. The length of time to return to the normal level is also reduced to 0.19 months, which is faster compared to the period before the pandemic.

Before the pandemic, the AR coefficient for inflation in education, recreation and sports commodities was 0.204694, which indicates that the persistence of inflation in this sector is quite low. This means that about 20.5% of the change in inflation in the previous period affects current inflation, while the rest is less affected by past inflation. The length of time it takes to return to normal or average levels is 0.26 months, which suggests that the sector is relatively quick to adjust prices and return to normal levels following inflationary disturbances. However, after the pandemic, the AR coefficient increased significantly to 0.698631, which is higher but still below the 0.80 threshold for high inflation persistence. This suggests that the education, recreation and sports sector is more affected by previous period inflation after the pandemic. The length of time taken to return to normal levels also increased significantly to 2.32 months, which is much longer compared to the pre-pandemic period.

Prior to the pandemic, the education, recreation and sports sectors were able to return to normal levels within a short period of time (0.26 months) as price fluctuations were more short-term and often influenced by seasonal factors or specific policies that could be regulated by the government or service providers. For example, changes in tuition fees or recreational ticket prices can usually be adjusted quickly based on policy or market demand. After the pandemic, there is a significant change in inflation persistence for this sector,

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with a much higher AR coefficient (0.698631) and a much longer adjustment time (2.32 months).

Before the pandemic, the AR coefficient for inflation in transportation, communication, and financial services commodities was 0.584293, indicating that the persistence of inflation is moderate, where about 58.4% of past inflation affects current inflation. The length of time it takes to return to normal or average levels is 1.41 months, which suggests that this sector can adjust prices relatively quickly after an inflationary disturbance, although it takes longer than some other sectors that adapt more quickly. However, after the pandemic, the AR coefficient increased significantly to 0.889929, indicating that the persistence of inflation in this sector is high. This means that almost 89% of the previous inflation affects the current inflation. The length of time taken to return to normal levels also increased dramatically to 8.09 months, which is much longer compared to the pre-pandemic period. These major changes reflect the significant impact of the COVID-19 pandemic on the transportation, communication and financial services sectors.

Discussion

General Inflation Variables Before and After the COVID-19 Pandemic

Although there is a slight increase in the AR coefficient, it shows that inflation persistence does not experience significant changes despite the large disruption due to the pandemic. Inflation in West Sumatra Province continues to have a relatively quick return to normal levels after price fluctuations or disturbances. This is because other factors that can support the low persistence of inflation are effective monetary policy and the nature of West Sumatra Province's economy which is more influenced by external factors, such as commodity prices or energy price policies, which are often easier to readjust after a disturbance. Therefore, despite major disruptions such as the COVID-19 pandemic, inflation in West Sumatra Province tends to return to normal levels quickly.

Overall, the results in West Sumatra Province show that inflation persistence is low and under control, both before and after the pandemic. This study indicates that, although the COVID-19 pandemic provides a large disruption, its long-term effect on inflation persistence is relatively limited in West Sumatra Province. The results of this study are in accordance with previous research that examines the persistence of inflation in the regional scope (Saidu et al., 2023) , Purwanti et al., 2022, Apergis, 2024) although this result can also be different from other studies because inflation persistence can vary depending on local economic characteristics and monetary policy responses to inflation such as studies conducted (Caporale et al., 2022, Bhardwaj, 2022) .

Inflation Variables of Food, Beverages, Cigarettes, and Tobacco Commodities Before and After the COVID-19 Pandemic

Despite significant disruptions due to the pandemic, inflation in these commodities can still return quickly to normal conditions. This is because the increased persistence of Food, Beverages, Cigarettes, and Tobacco commodities after the pandemic is due to changes in consumption patterns, economic factors, new habits formed during the pandemic, and the psychological and social impacts of the global health crisis. The habits formed during the pandemic, coupled with external factors such as inflation and uncertainty, created a more stable demand for these products even though the situation has started to improve.

Inflation persistence in similar commodities may vary depending on regional policy factors and market responses. In the case of West Sumatra, the low inflation persistence in food and beverage commodities is in line with the research results which found that regions with more open markets and responsive to price fluctuations tend to have lower inflation persistence. The result of this study is in line with the findings from (Duran & Dindaroğlu, 2021, Suriani & Ridzqi, 2019) .

Inflation Variables of Housing, Water, Electricity, Gas and Fuel Commodities Before and After the COVID-19 Pandemic

The sector is still relatively quick to adjust prices and return to average levels, although it takes a little more time after the pandemic. This is because price disturbances in this sector are quickly absorbed and returned to the average due to relatively effective monetary and government policies and rapid adjustment of

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producers and consumers to energy and fuel prices. Despite the change in AR coefficients after the pandemic, the low persistence of inflation suggests that price changes in this sector are not heavily influenced by the previous period's inflation. This result is not in line with the study results from (Huaccha, 2023, Santos, 2023) with the finding that pent-up demand from the post-pandemic recovery has caused global energy fuel prices to increase, leading to high inflation persistence, and the housing division shows a high degree of persistence.

Health Commodity Inflation Variables Before and After the COVID-19 Pandemic

The health sector experienced reduced resistance to price changes after the pandemic. Critical factors include tighter price controls on medicines, increased supply of healthcare or vaccinations that lowered treatment costs, and faster normalization of healthcare facilities after major disruptions. The COVID-19 pandemic also triggered a rapid response from the government to lower the cost of healthcare and medicines, which helped the sector to return to normal levels faster. This suggests that while the pandemic disrupted health sector prices, the sector returned to average levels more quickly after the pandemic.

This is because inflation in the health sector tends to be influenced by government policy factors, medical labor costs, drug prices, and broader cost inflation, such as energy costs or medical raw materials. The sector is also affected by price policies that can be controlled by the government, such as hospital tariffs or medicine prices. Before the pandemic, despite price fluctuations in the health sector, the sector showed a low degree of persistence, which can be explained by the government's policy of controlling health costs and the existence of a relatively quick price adjustment mechanism in the sector. That health sector inflation takes 0.50 months to return to normal levels suggests that despite some disruptions, the sector is quite stable in the short term, thanks to regulatory and policy factors that can mitigate the impact of price spikes. This finding is not supported by the findings of (Azwar, 2017, Iskandar & Subekan, 2018) which shows a high level of inflation persistence in the health sector in the period before the COVID-19 pandemic.

Inflation Variables of Education, Recreation, and Sports Commodities Before and After the COVID-19 Pandemic

Rising costs in the education and recreation sectors, especially those related to education and stricter health protocols, may extend the time for price adjustments. While government policies may have helped these sectors to resume operations, price and tariff adjustments in these sectors have taken longer to return to normal conditions, reflecting the long-term impact of the disruptions caused by the pandemic.

This is due to the COVID-19 pandemic which has caused major disruptions to the education sector (e.g., transition to online learning affecting school and university operating costs) and the recreation and sports sector (e.g., restrictions on events or sports causing a decrease in income). This result is in line with the results of the study (Purwanti et al., 2022) with the finding that education, recreation, and sports commodities have low inflation persistence rates.

Inflation Variables of Transportation, Communication, and Financial Services Commodities Before and After the COVID-19 Pandemic

Before the pandemic, the transportation, communication, and financial services sectors tended to have more moderate inflation persistence. This is due to the presence of factors that are more easily adjusted to market changes, such as transportation tariffs and communication costs that can generally be adjusted quickly based on demand and operating costs. In addition, flexible pricing policies in the communications and financial services sectors allow for faster price adjustments. However, after the pandemic, there are significant changes in inflation persistence in these sectors, with higher AR coefficients and longer adjustment times.

This is due to the COVID-19 pandemic which has caused major disruptions to the transportation sector (e.g., travel restrictions leading to a sharp drop in demand), communications sector (e.g., increased infrastructure costs to support remote working and learning), and financial services (e.g., economic uncertainty and tighter monetary policy). Slower and more lasting price adjustments are possible because these sectors are more affected by government policies, social restrictions, and high economic uncertainty.

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For example, higher transportation fares may occur as a result of additional costs for sanitation and health protocols, while communication and financial services costs may be affected by greater macroeconomic influences and tighter inflation control policies. The transportation sector is heavily impacted by travel restrictions, which cause a drastic drop in demand, and when demand recovers, price adjustments are slower. The same applies to the communications and financial services sectors, which experience economic uncertainty and more lasting price adjustments due to the influence of monetary policy and social restrictions. The results of these findings are not in line with studies (Santos, 2023 , Purwanti et al., 2022) with a research period after the COVID-19 pandemic.

Conclusion

The conclusion of this research can be made based on the results and discussion, namely:

The estimation results show that inflation persistence is low with a return to normal time of 0.59 months. This is due to various factors including local economic stability, government policy intervention, local production diversity, and more stable and conservative consumption patterns. All these factors help speed up the recovery from rising inflation and reduce its impact in the long run, creating conditions for lower and more manageable inflation. Persistence of General Inflation (Inflation) before the pandemic with a persistence coefficient of 0.369856 (optimal lag AR(2)), Inflationary disturbances can be absorbed quickly. General inflation was in quadrant 3 (low persistence and low inflation) before the pandemic. Inflation persistence is low with a coefficient of 0.369856, and average inflation is 3.01%.

Although the persistence of inflation in West Sumatra after the pandemic is relatively low with a coefficient of 0.382003 and a short time to return to the natural rate (0.62 months), there is a slight increase in post-pandemic inflation. This increase is due to the unevenly distributed demand recovery, external disturbances such as import dependency, and greater global uncertainty. However, overall, West Sumatra can be said to be quite successful in managing inflation with appropriate policies, as well as rapid adaptation of economic sectors and responsiveness to changes in post-pandemic economic conditions. The estimation result shows that the persistence of General Inflation (Inflation) after the pandemic inflation persistence slightly increased to 0.382003 (lag AR(4)), with a return time of 0.62 months, still relatively low.

The persistence of controlled inflation in all commodity group variables in West Sumatra before the pandemic can be explained by government policy factors, the availability of local resources, the interconnectedness of economic sectors, and the relatively stable socio-economic structure of society. In addition, the existence of policies that regulate the prices of essential goods, as well as the ability of regional infrastructure to support efficient distribution, also contribute to maintaining the stability of prices of goods and services in West Sumatra Province. The estimation results show that the inflation persistence of all commodity group variables before the pandemic is at a controlled and low inflation persistence level (AR coefficient <0.80).

The low inflation persistence in commodities such as food, housing, health, education, and recreation in West Sumatra after the pandemic is due to several key factors, such as government policies that regulate the prices of essential goods and services, the availability of abundant local natural resources, and the steady economic recovery in these sectors. In contrast, the Transportation, Communication, and Financial Services sector shows higher inflation persistence due to fluctuations in global fuel prices, increased post-pandemic demand, and the influence of monetary policy on the financial sector. The estimation result shows the inflation persistence of commodity groups after the pandemic at a low level of inflation persistence except for transportation, communication, and financial services commodities.

Implications

Based on data analysis and discussion, the suggestions in this study are as follows

Local governments and Bank Indonesia need to optimize coordination through the Regional Inflation Control Team (TPID) to keep headline inflation under control. Focus on stabilizing food prices and

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commodities for transportation, communication, and financial services, which are the main contributors to inflationary disturbances. Applicable steps that can be taken include providing incentives for local farmers to optimize agricultural yields, monitoring food prices and ensuring that government subsidies for certain commodities are targeted and effective to prevent uncontrolled price spikes, improving road infrastructure for ease of distribution.

The government can strengthen food reserves and ensure smooth distribution to prevent price fluctuations, especially in the processed food sector. Empower MSME players and local industries to produce cheaper and higher quality goods, so as to reduce inflationary pressure in this sector.

Local governments need to increase the health sector budget by increasing subsidies for medicines or low-cost medicine distribution programs to ease the cost of medical care for people in need, as well as strengthening facilities and access to health services so that potential inflation due to disruptions in health costs can be minimized.

The government needs to encourage education subsidy programs to increase access to cheap education and subsidies for public schools and scholarships for underprivileged students. Implementation of policies that encourage tourism and the creative economy, such as organizing regional and international scale events, to stimulate the economic recovery of this sector with cheap and affordable entertainment programs such as local cultural festivals or sports that can be enjoyed by the community without high costs.

The government needs to improve the condition of transportation infrastructure to ensure more efficient logistics costs, so as to reduce inflation in the transportation sector as well as establish a rapid response team for natural disasters such as landslides, floods, and others that can disrupt the flow of transportation and supply distribution.

Suggestions

Based on the limitations of this study, suggestions for future researchers are as follows:

Research that uses longer time series can provide more detailed analysis.

Further research needs to go deeper to the level of specific sub-commodity groups.

Future research can use more complex models and include many external variables such as monetary policy, global price fluctuations, other macroeconomic factors.

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