

FLEXIBLE INFLATION TARGETING AND INFLATION PERSISTENCE IN INDONESIA: THE TRADITIONAL UNIVARIATE AND FRACTIONAL INTEGRATED UNIVARIATE APPROACHES

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Abstract

Purpose of the study: The high degree of inflation persistence will impact the Indonesian economy. The purpose of this study is to determine the degree of inflation persistence in Indonesia following the adoption of a flexible Inflation Targeting Framework (ITF).

Methodology: Traditionally integrated univariate and fractional approach will be carried out in this research. The inflation variables used are core inflation, administered price inflation, volatile inflation, and general inflation. The data used is from 2014M1 to 2019M2.

Main Findings: After data analysis, the researchers found that high persistence behaviors are found, especially in the core, administered, and volatile inflation, following the flexible adoption of the ITF. The time it takes for inflation to return to equilibrium is 1 to 8 months for each group.

Applications of this study: The result is important for the highest authorities in improving their policy. Structural improvements through monetary policy based on inflation expectations, increasing the transparency of food prices, and synergy with Central as well as Regional Inflation Control is suggested for the authorities.

Novelty/Originality of this study: This study presents a different perspective of research within the inflation topic. It takes the recent policy implementation of a country and analyses its effect. To the best of the authors knowledge, this research is the first to explain the effect of the Inflation Targeting Framework on Indonesia's inflation condition.

Keywords: *Inflation Persistence, Flexible Inflation Targeting, Indonesia, Traditional Univariate, Fractional Integrated.*

INTRODUCTION

Discourse on inflation fluctuation remains a topic of discussion that often occurs in various countries. Several studies have been conducted to study the behavior of inflation developments, as it may affect the economic development of a country (Ayd, Esen & Bayrak, 2016; Zubaidi, Slesman & Wohar, 2016). The behavioral development of inflation stems from major changes or shocks to the economy, originating domestically, and from abroad. The research conducted by Krznar and Kunovac (2010) explains that inflation fluctuations are derived from substantial changes in economic shocks, which play a role in providing price information (Ball & Romer, 2003) as signals for future price formation. Fluctuating conditions of inflation behavior will make inflation permanent or enduring for a long period.

The Central Bank's policy of addressing ongoing inflation fluctuations can be implemented by controlling price stability. The Central Bank, as an anchor to monetary policy, aims for such conditions to achieve inflation stability (Cuestas & Harrison, 2010; Eduardo et al., 2008; Tule et al., 2019). The policy framework was developed to stabilize prices through the implementation of inflation targets (IT), which in turn could reduce the persistence of inflation (Kanellopoulos & Koutroulis, 2016; Tillmann, 2012). Bank Indonesia, as the Central Bank of Indonesia, is tasked with maintaining the inflation stability by strengthening the inflation framework in the form of a Flexible Inflation Targeting Framework (ITF) (Warjiyo et al., 2019).

The flexible ITF policy is expected to stabilize inflation and reduce the persistence of inflation in the country. Therefore, this study aims to determine the degree of persistence of inflation in Indonesia using an autoregressive approach and integrated fractions in each inflation group (core, administered, volatile, and general inflation) under a flexible Inflation Targeting Framework (ITF) paradigm. Based on the result obtained from this research, it is expected that authorities take an important note in improving their policy. Therefore, at the end of this research, the authors will give practical suggestions on policies that need to be implemented to improve the macroeconomic situation of Indonesia.

LITERATURE REVIEW

Inflation persistence is defined as the process of inflation rate back to equilibrium aftershock (Geronikolaou et al., 2019; Wu & Wu, 2018; Marques, 2004). Therefore, the persistence of inflation is defined as the velocity of inflation back to equilibrium level after experiencing various types of shock (Fuhrer, 2011). Inflation, which is also defined as the rate of change in price levels, tends to remain constant (inflation tends to be persistent) in the absence of economics "force" to move it from the current level. Inflationary response delays, or what is known as an inertial inflation response in the face of shocks, will cause the autocorrelation between inflation in the T period (π_t) and inflation in the previous period (π_{t-1}).

(T-)), which is also known as positive serial correlation (Batini & Nelson, 2001). On the other hand, persistence is also referred to as the phenomenon of the return of inflation to an average value (reverse-meaning process) (Dias & Marques, 2005). Therefore, the longer the inflation moves towards the equilibrium value, the higher the level of persistence.

Three groups characterize inflation, which is the core, the administered, and the volatile inflation. Core inflation refers to goods or services whose development is based on economic factors, such as inflation expectations, exchange rate, and supply and demand balance (Bermingham, 2010; Gamber et al., 2015). On the other hand, administered inflation is goods or services whose development is subject to government regulations, such as electricity and fuel (Ackley, 1959; Fritzer, 2010). The volatility of inflation relates to goods or services that are very volatile due to temporary shocks such as harvest season (Ellison & Yates, 2007).

Research conducted by Arimurti and Trisnanto (2011) found that in Jakarta, the capital city of Indonesia, there is a high level of persistence that comes from various commodity groups. In such cases, Half-Life is between 3-12 months. The same is found by Vaona & Ascari (2012) that economically backward area displays greater persistence of inflation. Moreover, higher persistence is associated with lower competitiveness levels occurring in the retail sector. Another finding by Balcilar et al. (2016) at South Africa concludes that the persistence of inflation is higher at a high inflation regime with 70 months half-life inflation persistence during 10 months for a low inflation regime. On the other hand, research conducted by Gil-Alana (2012) in the state of Angola using a fractional approach in a model I (d) finds a low level of persistence due to the implementation of monetary policy.

Although Inflation Targeting Framework is notably gaining success in some countries (Tilmann, 2013; De Mendonça and Souza, 2012; Gerlach and Tilmann, 2012), monetary policy is indeed affects the effectiveness of such approach. While Gil-Alana (2012) has mentioned one of the monetary policy effects on inflation targeting, other researches such as Wu and Wu (2018), Dastgerdi, and Yusof (2016) asserted that floating exchange rate regimes reduce the effect of inflation targeting. Meanwhile, other researches have successfully documented tightening monetary policy is proven to be effective in controlling inflation in Nigeria (Tule et al., 2020).

METHODOLOGY

Time-series data for the period 2014 January-2019 December is used in the study. 2014 is selected as this was the year when flexible ITF was implemented. The variables used are core, administered, volatile, and general inflation. The data is obtained from Bank Indonesia, which includes core, administered, and volatile inflation to observe in detail the persistence of inflation in Indonesia.

The Traditional Univariate Model of Persistence

The univariate autoregressive or univariate AR model is often used in measuring inflation persistence (Gil-Alana, 2012; Marques, 2004; Tule et al., 2019). The level of persistence is measured from the sum of the lag coefficients on the dependent variable. Research conducted by Gil-Alana (2012) and Marques (2004) explains that the univariate AR model is a good measure of inflation persistence. With order p , it is written as follows:

$$\pi_t = \mu + \sum_{j=1}^K a_j \pi_{t-j} + \varepsilon_t \quad (1)$$

or

$$\pi_t = \mu + \sum_{j=1}^K a_j L^j \pi_t + \varepsilon_t \quad (2)$$

where:

π_t	= inflation rate at time t
μ	= constant
$\sum_{j=1}^K a_j$	= number of AR coefficients
ε_t	= error term

Equations (1) and (2) are measures of inflation persistence which function by adding up the coefficients of AR, $[\rho \equiv \sum_{j=1}^K a_j]$. The persistence calculation includes the lag element in the model, $[\sum_{j=1}^K a_j \pi_{t-j}]$ and $[\sum_{j=1}^K a_j L^j \pi_t]$. The selection of the best lag is made through Akaike Information Creation (AIC) or Schwarz Bayesian Information Criterion (SBIC). The inflation persistence level is high if the value is close to 1. On the other hand, if the value is close to 0, the inflation persistence value is low.

Furthermore, the univariate AR model can be used to find the half-life, which shows the measurement of the time needed to absorb 50% of the shocks that occur before returning to equilibrium. The half-life model can be written as follows:

$$h = \frac{\rho}{1-\rho} \quad (3)$$

where:

- h = time needed to absorb 50% of shocks before returning to equilibrium.
- ρ = results of the estimated degree of persistence of AR.

Therefore, equation (3) can indicate the time needed for inflation to reach equilibrium.

The Fractional Integrated Univariate Model of persistence

The use of an integrated fractional model in measuring the persistence can accommodate significant changes in the long-term and describes the long-term and short structure of correlation (Gil-Alana, 2012; Hosking, 1981). On the other hand, the parameters used in the model are easier in the long and short-term (Hosking, 1981). The occurrence of a shock to the economy, which is not permanent but has a long-term impact, can be minimized by the integrated models fractionally. This approach has been used in several studies to examine the persistence of inflation (Canarella & Miller, 2017a; 2017b). The inflation persistence model with fractionally integrated concepts is as follows:

$$\pi_t = a + \gamma Trend + \varepsilon_t \tag{4}$$

and transformed into a fractionally integrated model

$$(1 - L)^d \pi_t = a + \gamma Trend + \varepsilon_t \tag{5}$$

where d is a parameter estimator. One of the binomial expansions, polynomial $(1 - L)^d$ in equation (5) can be formulated with the concept d as follows:

$$(1 - L)^d = \sum_{j=0}^{\infty} \varphi_j L^j = \sum_{j=0}^{\infty} \binom{d}{j} (-1)^j L^j = 1 - dL + \frac{d(d-1)}{2} L^2 - \dots \tag{6}$$

with the simplified form of inflation persistence:

$$(1 - L)^d \pi_t = \pi_t = d\pi_{t-1} + \frac{d(d-1)}{2} \pi_{t-2} - \dots \tag{7}$$

Therefore, the equation can be detailed as follows:

$$\pi_t = a + \gamma Trend + d\pi_{t-1} + \frac{d(d-1)}{2} \pi_{t-2} - \dots + \varepsilon_t \tag{8}$$

Equations (1) to (8) indicate that the value of function d to assess the persistence of inflation (Gil-Alana & Carcel, 2018; Tule et al., 2019). The high value of d illustrates high diligence. Thus, when the d value is high or close to 1, this indicates the occurrence of high inflation persistence. In contrast, a low or close value of 0 indicates low inflation persistence.

RESULTS AND DISCUSSION

Preliminary Analysis

The implementation of Flexible ITF from 2015 to 2019 shows consistency of inflation within the target range, with a downward and controlled trend in line with the target due to structural improvements such as the role of reasonable inflation expectations together with anchor inflation targets. Also, Bank Indonesia policies that synergize with the Central and Regional Inflation Control Teams (TPIP and TPID) have been able to reduce inflation fluctuations in the country.

A statistical description of the development of the inflation data from 2015 to 2019 can be seen in Table 1. Average general inflation reaches 0.332, while the average inflation development in core, administered, and volatile inflation is 0.292, 0.412, and 0.406, respectively. On the other hand, the standard deviation of inflation, in general, reached 0.438, corresponding to 0.143, 1.194, and 1.299 for core, administered, and volatile inflation. These figures indicate proper data distribution in the study.

Table 1: Descriptive Statistics

	GENERAL	CORE	ADMINISTERED	VOLATILE
MEAN	0.332	0.292	0.412	0.406
MEDIAN	0.250	0.265	0.250	0.280
STD. DEV	0.438	0.143	1.194	1.299
SKEWNESS	1.887	2.201	1.544	0.366
KURTOSIS	9.808	11.125	11.330	2.614
OBS.	70	70	70	70

The inflation rate recorded in December 2019 was 2.72% (YOY), a decrease compared to 2018 figures 3.13%, in the range of $3.5\% \pm 1\%$. This is due to the reduced volatility of food inflation, accompanied by a reduction in the inflation of administered price. The stability of core inflation is due to deflation in gold jewelry, despite the increase in general inflation, which can support the achievement of inflation targets. Volatile food inflation only fluctuates when a seasonal pattern occurs, as the increase is always reappearing at the end of each year. On the other hand, the same conditions in the administered price group improved in line with the historical pattern. The source of improvement in the administered price group is the cost of transportation and cigarette prices. Concerning to changes in inflation patterns in each group, it is recommended that monetary policy should synergize with macroprudential and fiscal policy to reduce inflation pressure and persistence.

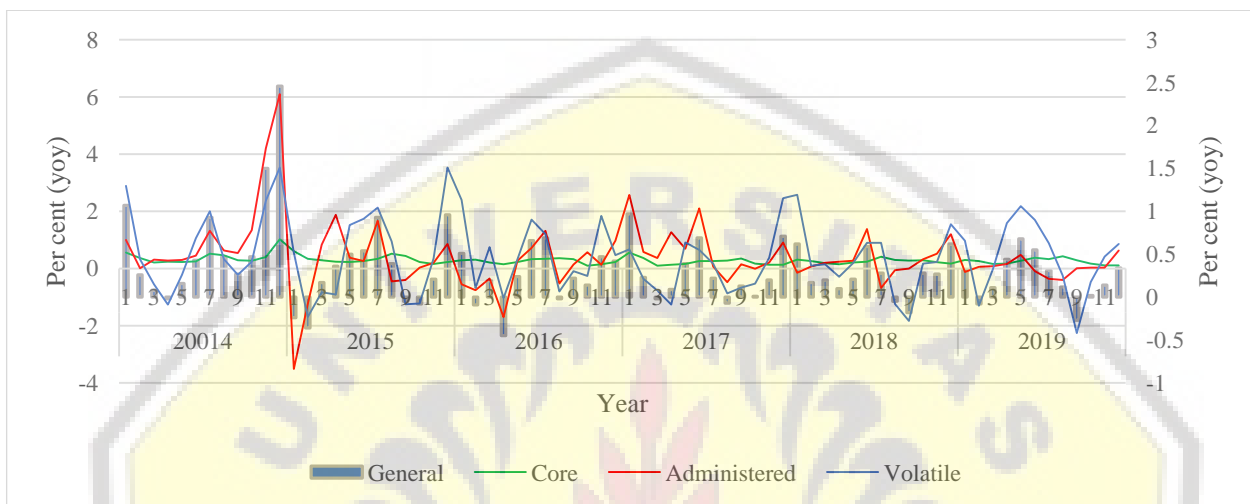


Figure 1: Inflation Development in Indonesia

Source: Bank Indonesia, 2020

Results of the Traditional and Fractional Integration Approaches to Persistence

The results of the analysis of inflation persistence in Indonesia from 2015 to 2019 using these two approaches show a high persistence phenomenon, with a value close to 1. The results can be seen in table 2.

The assessment results of diligence levels using a traditional approach indicate a high degree, and the value of resistance to inflation with a full sample indicates high persistence. The high persistence value in the full sample using three methods, namely OLS, Bootstrap, and scrolling regression, is 0.752, 0.734, and 0.71, respectively. A persistence value close to 1 indicates a high persistence.

Analysis of core inflation calculations by using three methods to generate d values in OLS, bootstrap, and Rolling regression shows values of 0.853, 0.852, and 0.745, which are close to 1 and thus demonstrating high persistence. The administered inflation value in OLS, bootstrap, and rolling regression is 0.612, 0.598, and 0.531, which are also close to 1 and, therefore, also exhibit high persistence. The same results are also seen at volatile inflation with the values of 0.889, 0.867, and 0.758 for OLS, Bootstrap, and rolling regression, respectively, which are also close to 1. The result of the volatile food diligence, which is also close to 1, again confirms the occurrence of high persistence.

Table 2: Results of the Persistence Test

Inflation	Traditional Approach			Fractional Approach	Integrated
	OLS	Bootstrap	Rolling Regression		
Inflation Full Sample /General Inflation	$\sum_{j=1}^K a_j \pi_{t-j}$	0.752	0.734	0.710	d 0.812
Core Inflation	$\sum_{j=1}^K a_j \pi_{t-j}$	0.853	0.825	0.745	d 0.722
Administered Prices	$\sum_{j=1}^K a_j \pi_{t-j}$	0.612	0.598	0.531	d 0.562

Volatile Inflation	$\sum_{j=1}^K a_j \pi_{t-j}$	0.889	0.867	0.758	<i>d</i>	0.785
Half-life						
Inflation Full Sample		±3 months	±2months	±2months		
Core Inflation		±5 months	±4months	±2months		
Administered Prices		±1 month	±6months	±1month		
Volatile Food		±8 months	±6months	±3months		

The result of a fractionally integrated approach to the degree of persistence also demonstrates a high level. This high degree of persistence can be seen at the inflation with a full sample, which reaches the value of 0.812, close to 1. The same result is also found in core inflation, with a value of 0.722. The results of persistence for the administered price inflation and the volatile food inflation are 0.562 and 0.782, also approaching a value of 1 and thus demonstrate high persistence.

The calculation of persistence with the traditional approach was made to determine the time required by inflation to absorb 50% of the shock and return to equilibrium. The general inflation value with a degree of persistence of 0.752 indicates that it will take ± 3 months to absorb 50% of the shock and return to equilibrium. Meanwhile, core inflation takes ± 5 months to absorb 50% of shocks and return to equilibrium. Unlike the administered price inflation, which takes ± 3 months to achieve equilibrium by absorbing 50% of the shock, volatile food inflation takes a long time to do this, requiring ± 8 months.

The results of the analysis relating to traditional integrated approaches and fractions show that the development of the inflation in Indonesia is high in persistence. The time required for each category to achieve equilibrium by absorbing 50% of the shock varies, as the result of each component has different indicators.

The policy implemented by Bank Indonesia to reduce the volatility of inflation that has high persistence properties can be based on structural enhancement in the inflation character by implementing a consistent monetary policy in anchor inflation expectations. On the other hand, increasing the transparency of food prices is also necessary to influence the decline in inflation trends.

Bank Indonesia, as a monetary policymaker, needs to strengthen synergies with the central Inflation Control Team (TPIP) and the Regional Inflation Control Team (TPID) to reach the inflation target through a comprehensive mix of monetary, fiscal, and sectoral policies, both at the central and regional levels. Duties and authorities for coordination are shown in table 3.

Table 3: Duties and Powers of Inflation Control Coordination Team

Inflation Type	Duties and Authorities
Core Inflation	Monetary Policy Policy for demand-side management and exchange rate stability.
	Fiscal and Sectoral Policy Policies for increasing economic capacity.
Administered Prices Inflation	Fiscal Policy Setting the level and timing of price adjustments, such as fuel, electricity, and toll rates.
Volatile Food Inflation	Sector Policy Focusing on the smooth supply and distribution of food that is vulnerable to shocks.

Table 3 shows that inflation control in Indonesia requires a fusion of policy due to a comprehensive range of inflation volatility sources. The source of inflation doesn't only focus on increasing the exchange rate and price, but also the supply and demand.

Coordination among all authorities to achieve the inflation rate in control is a must. This is because inflation is commonly found to be exogenous in many topics related to macroeconomics. It includes bank profitability (Sultan et al., 2020), bank performance (Jun Quan et al., 2019), the stock market (Alam, 2020), and many aspects of economics and finance that can easily be found in the scattered venue of publication.

CONCLUSION

Based on the results of the analysis of traditionally integrated and fractional approaches of the inflation behavior in Indonesia, it is found that there is a high level of inflation persistence. In each type of source of inflation, namely core, administered, and volatile, there are varying levels of persistence and half-life inflation. This is due to the different

indicators of each inflation type. The policies that Bank Indonesia needs to implement include structural improvements through monetary policy based on inflation expectations and increased transparency of food prices. Bank Indonesia also needs to strengthen its synergy with the Central Inflation Control (TPIP) and the Regional Inflation Control Team (TPID) in the context of the monetary, fiscal, and sectoral combined policy, both at the central and regional levels.

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AUTHORS CONTRIBUTION

Zainuri: conceptualization, methodology, writing – original draft, investigation; Muhammad Iqbal Fasa: writing – review & editing, resources; Roymon Panjaitan: software, investigation; Fauzul Hanif Noor Athief: writing – review & editing, presentation.

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