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Optimal Price Level Under Slowing Economic Performance Using Simple Growth-Inflation Threshold Models

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Abstract

The purpose of this study was to evaluate the threshold of inflation that is tolerant of Indonesia's economic growth rate. The basic question to be answered was what level of inflation is safe enough for economic growth. To answer this question, this study used Indonesian macroeconomic data, specifically data on inflation and economic growth between 1969-2017 sourced from the Central Statistics Agency and Bank Indonesia. The data analysis method used was a threshold regression model that was repeated manually by entering an acceptable inflation simulation value based on inflation experience in Indonesia. The simulation results showed that the inflation threshold that is safe for growth is around 7 to 8 percent per year. However, the model showed that inflation of 3 percent is the optimal level for growth. One concludes that an inflation rate of around 3 percent can be used as a guide in determining the inflation target in Indonesia.

Keywords: growth, inflation, stability, threshold

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1. Introduction

One important issue in the current Indonesian economy is an economy that is not supported by sufficient economic growth. Inflation as one of the key indicators in achieving optimal economic growth (Amano, Carter, & Moran, 2012). In line with this spirit, starting in 2005 Bank Indonesia has set the Inflation Targeting Framework (ITF) as the main target of monetary policy. Various studies on ITF have been conducted in several countries (Akinsola & Odhiambo, 2017), including Indonesia. A key question that is often raised is whether inflation control efforts in a country are reliable enough to drive growth. If not done carefully, the policy to suppress prices in such a way will actually be

counterproductive. Conversely, allowing inflation to run wild will be disastrous for the economy (Balcilar, Gupta, & Jooste, 2017). As a macroeconomic indicator that is most easily read by the general public, inflation indicators are often a measure of the success of a development program. Almost every day the issues of price increases are used as raw material to be used as a discussion of the success of development. Some key commodities such as basic necessities, foreign exchange rates are of concern not only by observers and economists, but also by ordinary people. As soon as the price of basic needs rises, the analyst about the domino effect caused will be released immediately.

The performance of controlling economic stability with the main inflation variable has actually been quite successful in the last few years. This means that inflation can be ”tamed” to a level that is said to be quite safe. The realization of the inflation target may not be 100 percent in accordance with the initial target (Mosikari & Eita, 2018). However, overall, the results are quite encouraging. In other words, efforts to achieve economic stability have been quite good lately. Success in maintaining stability has not necessarily resulted in resounding economic growth. This condition then triggers a critical research question. To what level can the inflation rate be targeted so that economic growth can be further optimized. This question is important to be asked to provide an economic policy foundation that consistently supports the main development goals, namely community welfare (Carrera, 2017; Mavikela, Mhaka, & Phiri, 2018).

A number of studies on the relationship of inflation with economic growth have been carried out in various countries (Blinov, 2017). The analysis models used are quite diverse, ranging from simple linear models to complex non-linear models (Bittencourt, 2012). One modeling approach that is currently being developed is a threshold regression model that develops with various variants. This threshold regression model is quite easy to use as an analysis tool. First, this model does not need to force that a linear or quadratic relationship must occur, but it can hold some linear and some not. Second, in estimation, this model is relatively easy to apply and interpret because it is derived from a simple regression model. Third, this model is suitable for answering structural changes that occur at points that are difficult to observe (Bick, 2010).

However, the relationship between inflation and economic growth basically does not run linearly. As a consequence of complex economic activities, inflation becomes inevitable. In a relatively mild intensity, inflation can actually encourage economic growth. Or at least, the inflation did not affect growth at all. However, to a certain degree, inflation becomes very painful. The basic question to be answered is, to what level can inflation be said to be harmful to the economy (Nazir, Saeed, & Muhammad, 207).

2. Methods

This study uses a quantitative approach with secondary data sources originating from the Central Statistics Agency and Bank Indonesia. Data collected and re-verified are data from 1969 to 2017. The main data in this study is the development of inflation based on the adjusted Consumer Price Index (CPI). Furthermore, economic growth data, using data on the development of the percentage of Gross Domestic Product (GDP) at constant prices. Other control variables used are population and investment data, both of which are proxies of labor and capital as the main determinants of economic growth in accordance with growth theory. To test the non-linear relationship between economic growth and inflation, the basic analysis model used in this study is as follows:

$$\text{Growth}_t = \alpha + \beta_1 \text{Inf}_t + \beta_2 \text{Inf}_t^2 + \beta_3 \text{Pop}_t + \beta_4 \text{Inv}_t + \varepsilon_t \quad (1)$$

Equation 1 -- Standard Growth-Inflation Equation

Model (1) shows the quadratic relationship between economic growth (*Growth*) and Inflation (*Inf*). In this case, the critical coefficient evaluated is β_2 held by squared inflation. If this coefficient is significant, then the non-linear hypothesis between economic growth and inflation can be proven. Turning point from model (1) can be used as an estimation of an inflation threshold that is quite safe effect on economic growth. Model (1) assumes that the non-linear relationship pattern between economic growth and inflation is quadratic. Perhaps, this assumption is too simplistic. Therefore, as an alternative analysis model, this study also uses a threshold regression approach that accommodates changes in the regression slope in a consistent analysis model. This model is hereinafter referred to as the threshold regression model. Threshold regression models can be formulated as follows:

$$\text{Growth}_t = \alpha + \beta_1 \text{Inf}_t + \beta_2 D\left(\text{Inf}_t - k\right) + \beta_3 \text{Pop}_t + \beta_4 \text{Inv}_t + \varepsilon_t \quad (2)$$

Equation 2 -- Threshold Growth-Inflation Equation

- *Growth* = Economic growth
- *Inf* = Inflation rate
- *k* = Threshold inflation
- *Pop* = Population
- *Inv* = Investment
- *D* = 1 if Inf > k and 0 if Inf <= k
- α,β = Coefficient of regression

The regression model in equation (2) requires an inflation threshold as a priori information. Because this information was not obtained directly, a manual threshold value was simulated in such a way as to obtain the most reliable regression estimation values and meet the best model test criteria according to statistical rules. In the case of Indonesia, a feasible threshold starts with a rate of 3 percent to 10 percent. For each threshold value, a separate regression test is performed. Then a statistical evaluation is performed to determine the best regression model estimation. Threshold regression model is basically a modification of the linear regression model by expanding the possibility of a breaking point at the value of certain independent variables. This concept may be analogous to turning points in the quadratic model, but the breaking point in the threshold model still uses the linear regression model framework in variables. After the best model is determined, the next step is to interpret the results of the statistical data processing by comparing the actual data or information (Carrera, 2017). This is intended to obtain material for the recommended inflation target policy recommendations (Mavikela, Mhaka, & Phiri, 2018).

3. Results and Discussion

Indonesia's economic growth during 1969-2017 basically showed quite dynamic developments. On average, Indonesia's long-term economic growth is at around 5 percent. In the initial period (1969-1980) Indonesia's economic growth was even above 5 percent and almost penetrated double-digit growth. The next period (1981 - 1996) was a period in which the national economy experienced quite intense fluctuations before finally plunging into a severe depreciation gap in 1997-1998.

The economic crisis in 1997-1998 was an economic depression which was recorded quite strongly in the history of the Indonesian economy (Rakhmad, Warjiyo, & Handoyo, 2020). Economic growth dropped dramatically to reach the point of minus 13%. The economic crisis that was preceded by a sharp adjustment in the rupiah exchange rate has sharply evaluated Indonesia's economic fundamentals including eroding foreign exchange reserves, driving up prices due to imported inflation, unemployment problems and the state budget deficit.

After the crisis, Indonesia's economy began to rise a little. But the glory of the early era of development still seems difficult to reproduce (Soeharjoto, Tribudhi, & Hariyanti, 2020). If a long-term economic growth trend line is drawn, a downward trend line can be seen. That is, Indonesia's economic growth is relatively weak.

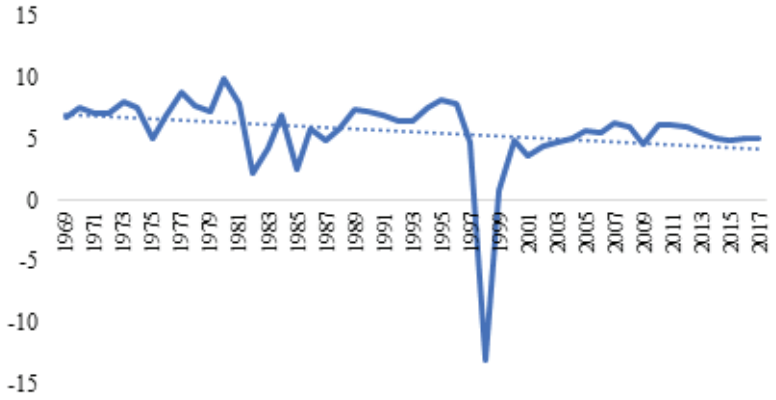

Figure 1: Economic Growth of Indonesia 1969-2017 (percent)

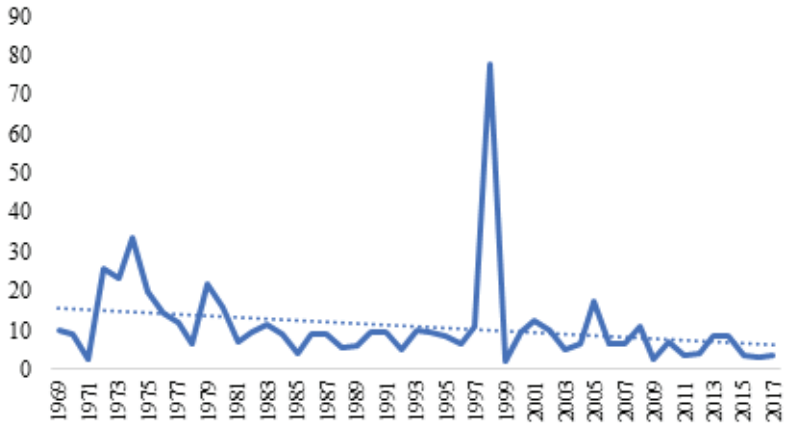

Figure 2: Inflation rate in Indonesia 1969-2017 (percent)

The economic crisis is often identified with a very high inflation rate. This condition is actually confirmed from Indonesia's macroeconomic data. During the 1997-1998 economic crisis, the CPI inflation rate almost reached the 80% level that year (see Figure 2). This fact reinforces the belief that inflation has a bad side to the economy. However, if examined in more depth, the inflation trend in Indonesia in the long run (1969-2017) also experienced a downward trend. The same thing happened in the growth trend (Figure 1). There is a tendency for the same direction of movement between economic growth and inflation in the long run. In statistical terminology, this tendency toward the same direction indicates a positive association. In short, the phenomenon of inflation may have a non-negative relationship with economic growth. The relationship between inflation and economic growth in Indonesia is highly likely to be non-linear. Therefore, empirical verification needs to be done.

The estimation results of the basic inflation-growth model using macroeconomic data from 1969-2017 can be considered as follows. The estimation results of the basic model as presented in Table 1 can be explained as follows. The first column shows the basic

linear model that links inflation with economic growth. The calculation results show that on average an increase in inflation of 1% will reduce economic growth by 0.2%. The linear model conveys a clear message: whatever the level of inflation, economic growth must be eroded.

Table 1: Estimation Result of Standard Models

	(1)	(2)
VARIABLES	Growth	Growth
Inflation	-0.201***	0.209***
	(0.0283)	(0.0680)
Inflation2	-	-0.00560***
		(0.000883)
Population	-11.00**	-4.850
	(4.172)	(3.202)
Investment	-2.456	-0.142
	(3.830)	(2.825)
Constant	102.2***	45.01*
	(30.99)	(24.40)
Observations	49	49
R-squared	0.563	0.772

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 1 column (2) gives somewhat different results. Inflation has a non-linear relationship with economic growth. The interpretation of the estimation model (2) begins by testing the significance of the squared inflation coefficient as well as the sign of the coefficient. The coefficient of squared inflation (Inflation2) turned out to be very significant and negative. This shows that the relationship of inflation and economic growth is inverted U-curve. When inflation is still low, inflation has a positive relationship with economic growth. Up to a certain point, this positive relationship turns negative. To determine the turning point that changes the direction of the relationship between inflation and economic growth, the estimation can be done using the coefficients in model (2) as the basis for optimization. The optimum value is reached when:

$$\frac{\partial \text{Growth}}{\partial \text{Inf}} = -2\beta_2 Inf + \beta_1 = 0 \tag{3}$$

Equation 3 -- Optimum Value of Inflation

The estimated value of inflation at the turning point using the formula above is 17%. This means that inflation will truly have a negative effect on economic growth if the inflation rate that occurs has reached 17%. If the inflation rate is still below that level, then inflation is still not dangerous.

The inflation-growth model estimated in Table 1 presents two different results. The first results consistently show that inflation has a negative effect on economic growth. On the contrary, the second result shows that inflation also has a negative effect on economic growth, but at a certain level (turning point).

The basic growth-inflation regression model provides a single numerical answer. Changes in the slope of the regression line that is not too extreme, may not be captured by the model. One way to overcome this problem is to apply a relatively more flexible growth-inflation threshold model. Inflation threshold is determined a priori by conducting a number of experiments to find the best results according to statistical criteria.

Threshold model estimation by using a simulation of inflation threshold values from the range of 3% to 6% can be considered in the following table. The results show that up to a range of 3% - 6%, the threshold model provides a relatively good estimation performance model. The higher the inflation limit specified, the less the coefficient of inflation (the first row of Table 2). These results indicate that the higher the threshold inflation threshold that is evaluated, the less the positive effect of inflation on growth.

Table 2: Estimation Result of Threshold Models 3% - 6%

	(1)	(2)	(3)	(4)
VARIABLES	growth	growth	growth	growth
Inflation	6.777***	2.280***	1.133***	0.724**
	(1.794)	(0.716)	(0.410)	(0.277)
D (Inf – 3)	-6.999***			
	(1.799)			
D (Inf – 4)		-2.504***		
		(0.723)		
D (Inf – 5)			-1.358***	
			(0.416)	
D (Inf – 6)				-0.952***
				(0.283)
Population	-9.304**	-8.306**	-8.587**	-8.872**
	(3.665)	(3.820)	(3.857)	(3.817)
Investment	-5.603	-5.001	-3.512	-2.535
	(3.438)	(3.511)	(3.490)	(3.456)
Constant	72.10**	74.13**	77.65**	79.85***
	(28.12)	(28.93)	(29.10)	(28.74)
Observations	49	49	49	49
R-squared	0.675	0.657	0.648	0.652

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

To reinforce the allowed threshold for inflation, the analysis model is extended to include a threshold simulation value at the 7% to 10% level. The estimation results are as follows. The calculation results show that the higher the threshold level tested, the less significant the inflation segment that has a positive effect on growth. Up to a threshold level of 7%, the positive inflation coefficient reaches a significance of up to 1 percent. When the threshold is raised to 8%, the significance is only 10%. Once the threshold is raised to 9% and 10%, then the positive inflation segment is no longer significant. At the threshold level of 8% - 10%, the effect of inflation is getting closer to the linear model, namely an increase in inflation of one percent actually worsens economic growth by 0.2 percent.

TABLE 3: Estimation Result of Threshold Models 7% - 10%

	(1)	(2)	(3)	(4)
VARIABLES	growth	growth	growth	growth
Inflation	0.497**	0.342*	0.232	0.187
	(0.210)	(0.170)	(0.144)	(0.128)
D (Inf – 7)	-0.728***			
	(0.217)			
D (Inf – 8)		-0.576***		
		(0.179)		
D (Inf – 9)			-0.468***	
			(0.153)	
D (Inf – 10)				-0.428***
				(0.138)
Population	-8.974**	-8.828**	-8.721**	-8.684**
	(3.814)	(3.853)	(3.901)	(3.896)
Investment	-1.982	-1.868	-1.740	-1.451
	(3.460)	(3.488)	(3.524)	(3.525)
Constant	80.66***	79.92***	79.34***	78.82**
	(28.70)	(29.01)	(29.41)	(29.39)
Observations	49	49	49	49
R-squared	0.652	0.647	0.640	0.641

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4. Conclusions

The basic linear and quadratic models provide extreme answers. The linear model concludes that each level of inflation on average will reduce economic growth. In contrast, the quadratic model gives a somewhat different answer: inflation is very

dangerous if it reaches a level of around 17% per year. At the lower level of inflation, the relationship of inflation versus economic growth is unidirectional. Threshold models provide a more moderate alternative answer. Inflation is relatively safe for economic growth if the economic level has not exceeded the 9% level. However, such an inflation rate is still counter-productive to growth. Threshold model estimation shows that at the threshold level%, inflation makes a positive contribution to economic growth. The rest, inflation tends to have no effect and tends to be negative.

The actual findings consistently offer more or less the same suggestion: inflation must be controlled. Controlling inflation does not mean having to eliminate inflation at the level of 0% (because this is quite impossible to achieve), but at an inflation level that is still conducive. If inflation control is directed to encourage economic growth, then an inflation range of 3% seems appropriate to be the target.

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