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THRESHOLD EFFECT IN THE RELATIONSHIP BETWEEN INFLATION RATE AND ECONOMIC GROWTH IN INDONESIA

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ABSTRACT

This paper investigated the linear and nonlinear relationships between inflation and economic growth in Indonesia using provincial data from 1994 to 2019. The linear model revealed that inflation has a significant negative effect on economic growth, while the nonlinear model revealed that inflation would negatively affect economic growth only after exceeding a threshold value of 9.59 percent. Excluding a high inflationary structural break, we found an inflation threshold of 5.22 percent. Furthermore, we found that the threshold of inflation rate in the eastern regions of Indonesia was higher than that of the western regions, namely 9.64 percent and 5.75 percent, respectively. These findings have significant implications for inflation targeting and management both at the national and regional levels.

Keywords: Economic growth; Inflation; Threshold effect; Indonesia.
JEL Classifications: O47; E31; C33.

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I. INTRODUCTION

The Indonesian economy experienced massive deterioration in 1998; inflation soared to 77.63 percent and economic growth plunged to minus 13 percent, following an external shock, namely the Asian financial crisis in 1997-1999 (see Juhro *et al*., 2021). At the time, hyperinflation did not occur because of the economic stabilization policies of the Indonesian government, supported by the International Monetary Fund (IMF) (Utari *et al.,* 2016). After this economic crisis, inflation-controlling policies began to emerge since the last two decades. One of such inflation-controlling policies in Indonesia is the implementation of the Inflation Targeting Framework (ITF) policy. The ITF is a framework, whereby monetary policy is directed towards achieving an inflation target that is determined in the future (Widaryoko, 2013). ITF policies have been implemented since the 1990s in New Zealand, Israel, Canada, England, Sweden, Finland, Australia, and Spain (Warjiyo and Juhro, 2016). Meanwhile, the developing countries, such as those in Latin America, Eastern Europe, and Asia started to implement the framework only after it was successfully implemented in developed countries (Warjiyo and Juhro, 2016).

Each country that implement the ITF must announce its inflation target to the public. In Indonesia, the agency authorized to do so is the central bank of Indonesia, Bank Indonesia. The goal of Bank Indonesia is to achieve and maintain stability in the value of Indonesia's currency, the rupiah (see Juhro and Iyke, 2019). There are two aspects to be considered to achieve the goal:[1] (a) first, stability of the currency in relation to goods and services; (b) second, stability in relation to the currencies of other countries. The first is reflected in the inflation rate, while the second is reflected in the rupiah exchange rate against foreign currencies.

Utari *et al.* (2016) stated that, at the regional level, the source of inflation pressures is highly dependent and influenced by the characteristics of each region. According to them, inflation in Java tends to be below the national inflation rate, while at the same time, regions outside Java have rates higher than the national rate, especially those in *Kawasan Timur Indonesia* (Eastern Region of Indonesia), such as Kalimantan, Sulawesi, Maluku, Papua, Bali and Nusa Tenggara. The differences reflect the sources of price pressure characteristics, such as the quality of logistics infrastructure, local food production capabilities, administered price policies in the regions and market structures (Utari *et al*., 2016).

Hence, inflation-controlling policies must consider the inflation characteristics of each region and the trade off to economic growth. Since output growth varies across regions, then the growth of money should vary across regions as well. The theory on the relationship between inflation and economic growth described by Mankiw (1987) suggests that when inflation falls too low in a short space of time, the economy will grow and get overheated causing inflationary pressures and a reduction in economic growth. The consequency, optimal inflation targeting (inflation threshold) is necessary to maintain an optimal economic output. This is illustrated through the demand for money function as follows:

$$M_{(t)}/P_{(t)} = kY_{(t)} \quad (1)$$

[1] https://www.bi.go.id/id/fungsi-utama/moneter/Default.aspx

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where $M_{(t)}$ is outside money at time t; $P_{(t)}$ is the price level at time t; k is a constant; $Y_{(t)}$ is level of output.

The relationship between inflation and economic growth has been implicitly addressed by classical, Keynesian, neo-keynessian, endogenous theory but inconclusively—inflation can have a negative, positive, or neutral effect on economic growth (Arsyad, 2015). Some studies also produced different conclusions about how the relationship between inflation and economic growth. First, inflation has no effect on economic growth (Cameron *et al.,* 1996; Dorrance, 1963; Sidrauski, 1967). Secondly, inflation has a positive effect on economic growth (Mallik and Chowdurry, 2001; Shi, 1999; Tobin, 1965; Behera and Mishra, 2017). Finally, inflation is negatively related to economic growth (Levin and Renelt, 1992; Andres and Hernando, 1997; Barro, 1996; De Greorgio, 1992; Friedman, 1956; Gylfason, 1998; Stockman, 1981; Gillman and Haris, 2010; Widaryoko, 2013; Bittencourt *et al.,* 2014).

Fischer (1993) studied the non-linear relationship between inflation and economic growth in 1993. Using the spline regression method and a dataset on 93 developed and developing countries over the period from 1965 to 1990, Fischer (1993) showed that a high inflation rate (of above 40 percent) has a more significant and negative impact on economic growth than a low inflation rate. Khan and Senhadji (2001) studied the relationship between inflation and economic growth in 140 countries from 1960 to 1998. They classified the countries into industrialized and developing countries and found that the inflation threshold value for industrialized countries was around 1-3 percent, while for developing countries, it was around 11-12 percent. Gylfason and Herbetsson (2001) found that inflation over 10-20 percent per year is generally detrimental to growth in 170 countries from 1960 to 1992. Burdekin *et al.* (2004) examined the relationship between inflation and economic growth from 1965 to 1992 and concluded that inflation (around a threshold of 20-40%) has a positive effect on growth in developing countries and has a negative effect when inflation rate exceeds 50 percent. Drukker *et al.* (2005) examined 138 countries from 1950 to 2000 and found a threshold inflation rate of 19.16 percent, below which inflation has no effect on economic growth and above which inflation has a negative effect on economic growth. Pollin and Zu (2005) examined 80 countries over the period 1961-2000 and found that inflation rate of around 3-5 percent is favorable to economic growth. Kremer *et al.* (2009) examined a sample of 124 countries over the period from 1950 to 2004 and concluded that the threshold value of inflation for industrialized countries was around 2 percent, while that for non-industrial countries was 17 percent. Omay and Kan (2010) analyzed the relationship between inflation and economic growth using the Panel Smooth Transition Regression (PSTR) model and a panel dataset for six industrialized countries and found that there was a statistically significant negative relationship between inflation and economic growth for the inflation rates above the critical threshold level of 2.52 percent, which was endogenously determined. Hwang and Wu (2011) studied the relationship between inflation and economic growth in China from 1986 to 2006 using a provincial-level panel data and found that China's inflation threshold was 2.5 percent. Vinayagathasan (2013) found a threshold inflation rate of 5.43 percent for 32 ASEAN countries over the period from 1980 to 2009. Carrera and Nelson (2013) examined panel data from 72

countries, including Indonesia, from 1961 to 2000 and found an inflation threshold of 13 percent in the relationship between inflation and economic growth. Thanh (2015) used the Panel Smooth Transition Regression (PSTR) model to estimate the threshold value of inflation rate and its effect on economic growth in ASEAN-5 countries for the period 1980-2011 and found that inflation rate above 7.84% impeded economic growth in the ASEAN-5 countries. Mallick and Sethi (2019) found inflation threshold value of 4.77 percent for India using threshold VAR analysis and a dataset covering the period from 2006 to 2015.

In general, the threshold regression studies to found a non-linear relationship between inflation and economic growth. When below the threshold value, inflation will positively affect or will not affect economic growth, but when above the threshold value inflation will negatively impact economic growth. But threshold values reported in these studies were different either due to the varying periods, statistical methods or economic characteristics of each country studied.

Table 1.
Indonesian Literature on Inflationary Threshold Effect on Economic Growth

This table presents several studies that focused on examining the threshold effect of inflation on economic growth in Indonesia using various statistical methods. Source: Compiled by the authors from various studies.

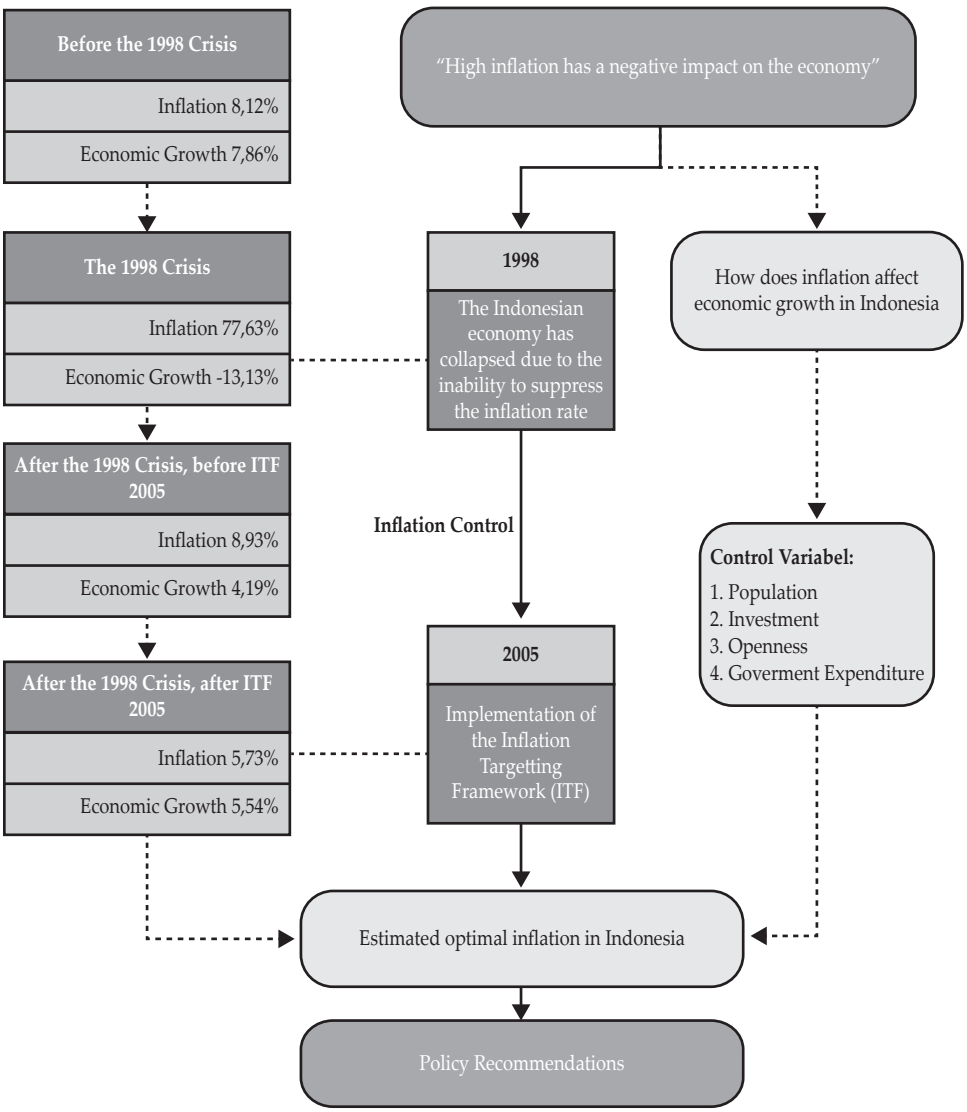
Researcher and Year	Method of Analysis	Timespan of Research	Threshold
(1)	*(2)*	*(3)*	*(4)*
Chowdurry and Siregar (2004)	Granger causality and quadratic regression	1970-1996	25.18%
Chowdhury and Ham (2009)	Threshold Vector AutoRegression (TVAR)	1972-2007	8.5-11%
Widaryoko (2013)	Multiple time series regulations, using the hansen and khan senghaji methods	1970-2102	7.11 and 9.53%
Winarno (2014)	Dynamic panel threshold	2002-2012	4.62%
Aziz and Nasruddin (2016)	Panel Regressions	2010-2016	4.64%
Galih and Safuan (2017)	Threshold VAR	2010-2016	5.26%

The inflation thresholds found in various studies for Indonesia can be divided into two groups. First, the average inflation threshold was 9 percent, based on Chowdurry and Ham (2009) and Widaryoko (2013). This inflation rate was relatively high because the data series included inflation in 1998. Second, the average inflation threshold was 5 percent, based on the studies of Aziz and Nasrudin (2016), Winarno (2014), Galih and Safuan (2017). This inflation rate was lower because the data series did not include inflation in 1998. Chowdurry and Siregar (2004) found a threshold value of 25.18 percent, which was relatively high and was possibly driven by the statistical method (i.e., the quadratic regression) and the data series from high inflationary periods.

Several economic theories and empirical findings stated that high inflation threatens the economy (see Chowdurry and Ham, 2009; Widaryoko, 2013), even though the relationship between the two variables is highly debatable. There are

three significant conclusions related to inflation and economic growth: inflation has positive, negative, and no effect on economic growth. Motivated by the debatable nature of this relationship, we re-examined the relationship from the provincial context using Indonesian data.

Figure 1.
Flow of Research Framework



The Indonesian case demands attention because the country has a history of high inflationary pressures, which severely hindered the countries growth prospects (Widaryoko, 2013). The ITF, as mentioned earlier, was induced by these

inflationary pressures in Indonesia. In practice, inflation control in Indonesia creates a dilemma because when inflation is reduced to a low level, economic growth declines, while when inflation is high, investment and productivity suffer. We illustrate this dilemma in Figure 1. The left side of the figure shows the inflation conditions before the ITF implementation after the 1998 crisis. Inflation was around 8.93 percent and the economy was in a stable condition (not experiencing an economic crisis). In comparison, economic growth after the 1998 crisis was 4.19 percent. Following the implementation of the ITF, inflation fell to 5.73 percent, but the economic growth was just 5.54 percent, which increased only by 1.35 percent. This condition contradicted the theoretical view that low and stable inflation could boost the economy.

Therefore, an in-depth study is in order to determine the influence of inflation on economic growth and to establish the optimum inflation rate that should be enforced in Indonesia to ensure optimal economic growth. The flow of thought in this research can be seen in Figure 1. Accordingly, we test the hypotheses that: (1) Inflation does not always harm economic growth in Indonesia; and (2) The inflation thresholds of the western and eastern regions of Indonesia are different.

The paper proceeds as follows. We explained our data and predictive regression model in Section II. Section III discusses our main findings. Finally, our conclusions are outlined in Section IV.

II. DATA AND METHODOLOGY

A. Data

Based to data availability, our study used 26 years (i.e., from 1994 to 2019) of panel data on 26 provinces in Indonesia. Data on all variables used in this study are sourced from Statistics Indonesia or Badan Pusat Statistik. We used the variables Gross Domestic Regional Product (GDRP) per capita growth as a proxy for economic growth, inflation, growth in the ratio of government spending, population growth, investment growth, and growth in openness in our empirical analysis. GDRP per capita growth was obtained by dividing the GDRP by the number of residents in the middle of the year. Inflation data was only available at the city level, namely a sample of the Cost of Living Survey (or *Survei Biaya Hidup*). Provincial inflation rates were obtained based on inflation rates weighted by each city.

The Indonesia's Consumer Price Index (CPI) is the most often used index to measure inflation and is calculated using the modified Laspeyres formula. The average commodity price is based on an arithmetic average, while for for some commodities, such as rice, cooking oil, gasoline, etc., the average is based on the geometric average. Starting in January 2014, CPI is presented using the 2012 base year = 100 and covers 82 cities consisting of 33 provincial capitals and 49 major cities throughout Indonesia. Previously, the base year was 2007 = 100 and only covered 66 cities. Dynamic changes and differences in price have caused inflation rates to vary.

In compiling the CPI, consumer price data were obtained from 82 cities, covering between 225 and 462 goods and services grouped into seven expenditure groups, namely: food ingredients; processed food, beverages, cigarettes, and tobacco; housing, water, electricity, gas, and fuel; clothing; health; education,

recreation, and sports; transportation, communication, and financial services. Each group consists of several sub-groups, and in each sub-group there are several commodities. Furthermore, these commodities have several qualities or specifications. The quantity, type, specifications, and quality of goods and services selected to be included in the CPI calculation were the most consumed and purchased commodities during the Cost of Living Survey period. The survey also determined the significance of goods and services relative to the overall CPI basket. Each group of these commodities has a different weight according to its level of significance.

Investment growth comes from the growth of gross fixed capital formation. The variable economic openness is calculated from the total value of exports plus imports per province divided by the total GRDP of each province.

B. Empirical Model

The analytical models employed to answer the research objectives were the panel fixed effect and threshold fixed effect models, both estimated by Ordinary Least Squares (OLS). The method for finding the threshold was developed by Hansen (1999) and is limited to the panel fixed effect model. The endogeneity problems hinder the extension of the method to include random effects (Hansen, 1999).

Our empirical specifications follow those by Widaryoko (2013), with various variable modifications according to data availability at the provincial level in Indonesia. Inflation is the threshold variable in the model. However, in the analysis, all variables are seen as having non-linear influences on economic growth. Based on the information on the threshold value of inflation, policymakers would have more complete information on how inflation and other variables affect economic growth when the threshold value is exceeded or not. The following panel fixed effect model is used to examine the linear relationship between inflation and economic growth:

$$Growth_{it} = \alpha_{i0} + \alpha_1 Inf_{it} + \alpha_2 Pop_{it} + \alpha_3 Inv_{it} + \alpha_4 Open_{it} + \alpha_5 Gov_{it} + \mu_{it} \quad (2)$$

Similarly, the following panel threshold fixed effect model is used to examine the non-linear relationship between inflation and economic growth:

$$\begin{aligned} Growth_{it} = \beta_{i0} &+ (\beta_1 Inf_{it} + \beta_2 Pop_{it} + \beta_3 Inv_{it} + \beta_4 Open_{it} + \beta_5 Gov_{it}) * I(Inf_{it} < \gamma_L) \\ &+ (\beta_6 Inf_{it} + \beta_7 Pop_{it} + \beta_8 Inv_{it} + \beta_9 Open_{it} + \beta_{10} Gov_{it}) * I(\gamma_L < Inf_{it} < \gamma_U) \\ &+ (\beta_{11} Inf_{it} + \beta_{12} Pop_{it} + \beta_{13} Inv_{it} + \beta_{14} Open_{it} + \beta_{15} Gov_{it}) * I(Inf_{it} > \gamma_U) \\ &+ \varepsilon_{it} \end{aligned} \quad (3)$$

Equation (3) assumes two threshold levels of inflation. In both Eqs. (2) and (3), $Growth_{it}$ is GDRP per capita growth, Inf_{it} is inflation, Pop_{it} is population growth, Inv_{it} is investment growth, Gov_{it} is government spending growth, $Open_{it}$ is the growth of openness, α_i and β_i are parameters of the models, ε_{it} is the residual term, and γ_L and γ_U are the lower and the upper threshold levels of inflation, respectively.

Panel threshold regression analysis is the development of multiple linear regression analysis, which essentially divides the unit of estimation into two or more regimes. There are two ways of estimating the model—we can use the OLS estimator when the threshold value is known and the conditional least squares estimator when the threshold value is unknown. The principle of the conditional least squares estimator is to find the threshold and the value of the slope parameters simultaneously. Hansen (1997) recommended that the chosen model is a model with a minimum residual sum of squares values. In this study, the threshold value was not known, and hence we used the conditional least squares estimator to estimate the threshold model.

III. EMPIRICAL FINDINGS

Table 2 shows the descriptive statistics of the variables during the study period, i.e., from 1994 to 2019. The average economic growth per capita was 3.00 percent, with a minimum value of -27.85 percent and a maximum of 32.71 percent. The average inflation was 9.80 percent, with a minimum value of -1.83 percent and a maximum of 97.79 percent. The average investment growth was 5.66 percent, with a minimum value of -9.87 percent and a maximum of 89.71 percent.

Table 2.
Descriptive Statistics of Variables

The following table presents descriptive statistics of the variables. All variable units are in percentage. GDRP denotes gross regional domestic product.

Variable	Number Observation	Average (%)	Standard Deviation (%)	Minimum Value (%)	Maximum Value (%)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Growth of GDRP Percapita	676	3.00	4.86	-27.85	32.71
Inflation	676	9.80	14.47	-1.83	97.79
Investment	676	5.66	11.19	-89.87	89.71
Population	676	1.76	1.31	-3.69	9.36
Openness	676	1.47	19.28	-57.29	149.45
Government expenditure	676	1.07	8.42	-23.99	60.20

The average population growth was 1.76 percent, with a minimum value of -3.69 percent and a maximum of 9.36 percent. The average growth of economic openness was 1.47 percent, with a minimum value of -57.29 percent and a maximum of 149.45 percent. The average growth ratio of government expenditure was 1.07 percent, with a minimum value of -23.99 percent and a maximum of 60.20 percent.

A. Panel Fixed Effect Model Results

This study primarily aimed to examine the effects of inflation and other control variables on economic growth in Indonesia using panel data and the fixed effect model. The fixed effect model is preferred to the random effect model since provincial and period effects on economic growth are unlikely to be random.

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The results are reported in Table 3 and indicate that inflation has a significant negative effect on economic growth in Indonesia only with the complete data[2]. An increase in inflation by 1 percent will significantly cause a decline in Indonesia's economic growth by 0.12 percent, which is in accordance with the findings of Friedman (1956), De Greorgio (1992), Barro (1996), Andres and Hernando (1997), Gylfason (1998), and Gillman and Harris (2010). Gokal and Hanif (2004) state that inflation could hinder the optimization of goods and services production because of the high production cost, which will reduce output. Our finding is consistent with this reasoning.

Table 3.
Estimates of the Linear Fixed Effect Model

This table shows estimates of the linear fixed effect model with: (a) the complete data, and (b) high inflationary years eliminated from the data. Years, such as 1998, 2005, and 2008, which recorded extreme inflation were removed from the analysis in column (3).

Variable	Complete Data	Without 1998, 2005, 2008 Data
	Coefficient	Coefficient
(1)	(2)	(3)
Constant	5.087***	4.597***
	(15.69)	(16.87)
Inflation	-0.116***	-0.041
	(-6.13)	(-1.27)
Investment Growth	0.125***	0.151***
	(5.10)	(5.07)
Population Growth	-0.835***	-0.963***
	(-7.86)	(-6.95)
Openness Growth	0.033**	0.034**
	(2.55)	(2.35)
Government Spending Ratio to GDRP Growth	-0.218***	-0.197***
	(-3.23)	(-3.18)
***R*-squared**		
Within	0.5099	0.4368
Between	0.7592	0.8387
Overall	0.5278	0.4874
F-statistic	74.59	33.35
Prob	0.0000	0.0000

*,**, and *** denote significance at the 10%, 5%, and 1% levels respectively, robust *t*-statistics are in parenthesis

The theory put forward by Harrod and Domar's theory in Todaro and Smith (2009) explains that a country's leading strategy to grow in stages of reaching takeoff is mobilization of savings or investment funds. This condition will accelerate economic growth. Our estimates suggest that investment growth has a significant positive effect on economic growth in Indonesia at the 1 percent level. An increase in investment by 1 percent will significantly increase economic growth

[2] The complete data mean using all data, from 1994 to 2019 and high inflationary years eliminated from the data. Years, such as 1998, 2005, and 2008, which recorded extreme inflation were removed from the analysis

by 0.13 percent based on the complete data and by 0.15 percent if the years 1998, 2005, and 2008 are excluded from the data.

Population growth has a significant negative effect on economic growth at the 5 percent level. An increase in population by 1 percent will significantly lead to a decline in economic growth by 0.84 percent based on the complete data and by 0.96 percent if the years 1998, 2005, and 2008 are excluded from the data. This finding is consistent with Drukker *et al*. (2005), and Gillman and Harris (2010).

Edwards (1997) stated that economic openness would stimulate economic growth through increased productivity, competition, and technology imitation. We find that the growth of openness has a significant positive effect on economic growth at the 5 percent level. An increase in openness by 1 percent will significantly lead to an increase in economic growth in Indonesia by 0.03 percent based on the complete data and by 0.96 percent if the years 1998, 2005, and 2008 are excluded from the data. This finding is consistent with Vinayagathasan (2013).

Our estimates suggest that government spending will reduce private investment and in turn slow down economic growth. This proves that most government expenditures at the regional level in Indonesia are not related to long-term investments that can increase capital stock. Government expenditures are, instead, for consumptive purposes, such as payment of employee salaries, and hence government spending causes a reduction in economic growth in the long run.

B. Panel Threshold Fixed Effect Model Results

The linear model estimates show that Indonesia's inflation harms economic growth when using the complete data, but has a neutral effect on economic growth when excluding high inflationary periods. Hence, in line with recent research, the estimates suggest that the relationship between inflation and economic growth is likely not linear. The threshold fixed effect model for panel data developed by Hansen (1999) can be used to assess whether the relationship between inflation and growth is indeed nonlinear. This model allows us to calculate the inflation threshold and to assess the relationship between inflation and growth during periods of high and low inflation at both the national and regional levels. To ensure the robustness of the results, we constructed several model variants with control variables, and examine whether the results are consistent across these models. Our robustness checks also entail using the national level data and splitting the data into Eastern and Western regions. Furthermore, we took into account the possible effects of different economic conditions. To summarize, we analyzed at least three conditions: (i) overall timespan of 1994-2019 for all regions of Indonesia; (ii) separate estimates for Eastern and Western regions of Indonesia for the overall period of 1994-2019; (iii) excluding high inflationary periods like 1998, 2005, and 2008.

Table 4 reports the threshold values of inflation obtained from the threshold fixed effect model. For the complete data (i.e., from 1994 until 2019), we found a single threshold value of 9.59 percent and double threshold values of 5.18 and 9.57 percent. The hhreshold values of 9.57 and 9.59 percent may be cause by the high inflation recorded in 1998. We find support for this argument when excluding

years with high inflation, such as 1998, 2005, and 2008; we found only a single threshold value of 5.22 for this sample period.

Table 4.
Test Results of Threshold Value for Indonesia

This table presents the estimated inflation threshold values for Indonesia based on the complete data and the data that excludes high inflationary periods. *,**, and *** denote significance at the 10%, 5%, and 1% levels respectively, result with robust standard error

Data	Single Threshold	Probability	Double Threshold	Probability
(1)	*(2)*	*(3)*	*(4)*	*(5)*
Complete data (1994-2019)	9.59	0.0070***	5.18 & 9.57	0.0030***
The 1998 data is omitted	5.22	0.0080***	3.98 & 5.22	0.1530
The 2005 data is omitted	9.45	0.0280**	5.18 & 7.01	0.0010***
The 2008 data is omitted	9.52	0.0090***	-	-
The 1998, 2005, 2008 data is omitted	5.22	0.0070***	-	-

The thresholds found in this study are not much different from those found in the previous research conducted by Chowdury and Ham (2009), Widaryoko (2013), Aziz and Nasrudin (2016), and Galih and Safuan (2017). Our findings supported Chowdury and Ham's (2009) claim that the ITF is a policy to keep inflation at a certain level, namely 3-5 percent for the long term and 4-10 percent for the short term.

The inflation threshold value found in Table 4 applies to the Indonesian regions as a whole. The next question is do the threshold values for the western and eastern regions differ? Several studies found that the inflation rates in the eastern region are relatively higher than those in the western region. In Table 5, we find evidence in support of the previous studies—the inflation threshold value for the eastern region is higher than that for the western regions.

Because we found two threshold values, we divide the analysis into three categories, namely: (1) when inflation is low or less than 5.18; (2) when inflation medium or between 5.18 percent and 9.57 percent; (3) when inflation is high or more than 9.57 percent.

Table 5.
Threshold Test Results for Indonesian Regions

This table presents the threshold test results for the relationship between inflation and economic growth in two Indonesian regions based on the complete data from 1994 until 2019. The two regions are western and eastern regions of Indonesia. *,**, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Data	Single Threshold	Probability
(1)	(2)	(3)
Eastern Regions	5.75	0.0640*
Western Regions	9.64	0.0020***

Table 6.
Panel Threshold Fixed Effect Model Results

This table shows how inflation and other control variables affect economic growth in Indonesia using the complete data from 1994 until 2019 and the panel threshold fixed effect model. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Robust *t*-statistics are in parenthesis. We also reported *R*-squared, *F*-statistic, and Prob(*F*-statistic) for the panel threshold fixed effect model.

Variable	Independent is Growth of Gross Domestic Regional Product		
	Low Inflation (≤ 5.18%)	**Moderate Inflation (5.18% < Inf ≤ 9.57%)**	**High Inflation (> 9.57%)**
(1)	*(2)*	*(3)*	*(4)*
Inflation	0.133	0.081	-0.122 ***
	(0.96)	(1.09)	(-7.84)
Investment Growth	0.064 *	0.137 ***	0.098 ***
	(1.71)	(3.02)	(3.34)
Population Growth	-1.094 ***	-1.210 ***	-0.377 ***
	(-7.69)	(-9.72)	(-3.81)
Growth of Economics Openness	0.045 ***	0.043	-0.002
	(3.97)	(1.26)	(-0.18)
Growth in the Ratio of Government Expenditure to GDRP	-0.133 **	-0.341 ***	-0.144 ***
	(-1.99)	(-4.28)	(-2.99)
R-squared			
Within	0.5679		
Between	0.7793		
Overall	0.5838		
F-statistic	73.71		
Prob(*F*-statistic)	0.0000		

Table 6 shows that inflation does not affect economic growth when it is below the threshold value of 5.18 percent and between 5.18 and 9.57 percent. When inflation is above the threshold of 9.57 percent, inflation has a negative and significant effect on economic growth at the 5 percent level. Compared with panel fixed effect model results in Table 3 which concludes that inflation harms economic growth regardless of the level of inflation, the panel threshold fixed effect model results provides a better conclusion: inflation negatively affects economic growth only when exceeding 9.57 percent. However, when separating the areas of the analysis into western and eastern regions, we found inflation above the threshold would negatively affect economic growth.

Investment growth has a significant positive effect on economic growth in low, medium, and high inflation conditions. This is consistent with estimates from the linear model. Population growth harms economic growth in Indonesia in all inflation conditions. Similarly, government expenditure has a negative effect on Indonesia's regional economic per capita growth, consistent with estimates from the linear model. We find interesting results for the growth of economic openness. Under low and moderate inflationary conditions, economic openness has a positive effect on economic growth at the 1 percent level. Meanwhile, when inflation is high (exceeding 9.57 percent), economic openness does not affect

economic growth. On the one hand, when inflation is high, domestic economic competitiveness weakened. Prices of goods in the country tended to be more expensive than those abroad and hence the tendency to import is higher. On the other hand, because the inflation conditions are high, people's purchasing power will decrease. Meanwhile, exports tended to fall because production is hampered due to rising domestic prices and therefore economic openness will not affect economic growth when inflation exceeded 9.57 percent.

IV. CONCLUSION

In this study, we find that inflation has a negative effect on Indonesia's regional economic per capita growth within a linear model. Specifically, if inflation increases by 1 percent economic growth reduces by 0.12 percent, all things equal. We find evidence of threshold effects in the relationship between inflation and economic growth. The threshold values of inflation are 9.59 percent for the full sample period, and 5.18 percent and 9.57 percent when excluding high inflationary periods. We document that the threshold level of inflation differs across regions with the eastern region's threshold value higher than the western region's by 3.89 percent. We show that inflation has a negative effect on economic growth if it exceeds a threshold of 9.59 percent. Below this threshold, inflation has no effect on economic growth.

Our findings suggest that policymakers in Indonesia, such as Bank Indonesia and regional inflation monitoring and control teams should continue to coordinate efforts to control price fluctuations both at the national and regional levels. This is important given that high and volatile inflation can harm the economy. The policies of Bank Indonesia to achieve the inflation target of ±5 percent have been right on target. Under normal conditions (without relatively high inflation), the inflation threshold was in the range of 5 percent. But, it is recommended that Bank Indonesia untighten the inflation limits for Indonesia's eastern regions to push the opportunity for economic growth. Subekti (2011) stated that the improvement in the conditions of provincial infrastructure and the competitiveness of local products would reduce inflation volatility. The development of economic growth centers in Indonesia's eastern regions is expected to increase that in the eastern regions. Mallick and Sethi (2014) argued that core inflation should be employed in empirical studies instead of headline inflation, because it can eliminate economic fluctuations. Core inflation is a component of inflation whose movement tends to remain persistent. Limitation of this study is its use of headline inflation in the search for the inflation threshold values. Further research should use core inflation to establish the threshold values.

REFERENCES

Andres, J., & Hernando, I. (1997). Does Inflation Harm Economic Growth? Evidence from OECD. *Working Paper No. 6062.* Cambridge, MA: National Bureau of Economics Research.

Arsyad, L. (2015). Ekonomi Pembangunan. Yogyakarta (ID): UPP STIM YKPM.

Aziz, E.B., & Nasrudin. (2016). Estimation Threshold Inflation in Indonesia. *Journal of Applied Economic Sciences*, 7, 1376-1383.

Barro, R.J. (1996). Inflation and Growth. *Federal Reserve Bank of St. Louis Review.* 78. 153–169.

Behera, J, and Mishra A. K. (2017). The Recent Inflation Crisis and Long-run Economic Growth in India: An Empirical Survey of Threshold Level of Inflation. *South Asian Journal of Macroeconomics and Public Finance*, 6, 105-132.

Bittencourt, M., Eyden, R., & Seleteng, M. (2014). Inflation and Economic Growth: Evidence from the Southern African Development Community. *ERSA Working Paper 405.*

Burdekin, R.C.K, Denzau, A., Keil, M., Sitthiyot, T., & Willet, T. (2004). When does Inflation Hurt Economic Growth? Different Nonlinearities for Different Economies. *Journal of Macroeconomics*, 26, 519-532.

Cameron, N., Hum, D., & Simpson, W. (1996). Stylized Facts and Stylized Illusions Inflation and Productivity Revisited. *Canadian Journal of Economics*, 29, 152–162.

Carrera, C., & Nelson, R.R. (2013). Is Inflation Harmful to Long-Run Economic Growth? A Nonlinear Assessment. Universidad de Piura.

Chowdhury, A., & Ham, R. (2009). Inflation Targeting in Indonesia: Searching for a Threshold. *The Singapore of Economic Review*, 54,645-655.

Chowdhury, A., & Siregar, H. (2004.) Indonesia's Monetary Policy Dilemma: Constraints of Inflation Targeting. *The Journal of Developing Areas*, 37,137-153.

De Greorgio, J. (1992). Effects of Inflation on Economic Growth: Lesson from Latin America. *European Economic Review*, 36, 417–425.

Dorrance, S. (1963). The Effects of Inflation on Economic Development. Staff Papers, *International Monetary Fund*, 1, 1–47.

Drukker, D., Proqueras, P., & Verme, P. (2005). Threshold Effects in Relationship between Inflation and Growth: A New Panel-data Approach. *Munich Personal RePEc Archive*.

Edwards, S. (1997). Openness, Productivity and Growth: What Do We Really Know?. *NBER Working Paper 5970.* National Berau of Economics Research.

Fischer, S. (1993). Inflation and Growth. *Working Paper No. 1235.* National Berau of Economics Research.

Friedman, M. (1956). *Quantity Theory of Money: A Restatement*. In M. Friedman (Ed.), Studies in the Quantity Theory of Money (pp. 3–21). Chicago, IL: University of Chicago Press.

Galih, A., & and Safuan, S. (2017). On Nonlinear Relationship between Inflation and Economic Growth: A Study of ASEAN-5 Countries Period 2000-2016. *Economic and Finance in Indonesia,* 63, 1-12.

Gillman, M., & Harris, M. N. (2010). The Effect of Inflation on Growth: Evidence from a Panel of Transition Countries. *Economics of Transition (Journal Compilation)*, 18, 697-714.

Gokal, V., & Hanif, S. (2004). Relationship between Inflation and Economic Growth. *Working Paper 2004/04.* Reserve Bank of Fiji.

Gylfason, T. (1998). Output Gains from Economic Stabilization. *Journal of Development Economics*, 56, 81–96.

Gylfason, T., & Herbetsson, T. 2001. Does Inflation Matter for Growth? *Japan and the World Economy*, 13, 405-428.

Hansen. (1997). Inference in TAR Models. Studies in Non-linear Dynamics and Econometrics, 2, 1–14.

Hansen. (1999). Threshold Effects In Non-dynamic Panels: Estimation, Testing, and Inference. *Journal of Econometrics*, 93,345-368.

Hwang, J. T., & Wu, M. J. (2011). Inflation and Economic Growth in China: An Empirical Analysis. *China and World Economy*, 19, 67-84.

Juhro, S. M., & Iyke, B. N. (2019). Forecasting Indonesian Inflation within an Inflation-targeting Framework: Do Large-scale Models Pay Off? *Buletin Ekonomi Moneter dan Perbankan*, 22, 423-436. https://doi.org/10.21098/bemp.v22i4.1235

Juhro, S. M., Iyke, B. N., & Narayan, P. K. (2021). Interdependence between Monetary Policy and Asset Prices in ASEAN-5 Countries. *Journal of International Financial Markets, Institutions and Money*, 75, 101448. https://doi.org/10.1016/j.intfin.2021.101448

Khan, M. S., & Senhadji, A. S. (2001). Threshold Effects in the Relationship between Inflation and Growth. *IMF Staf Papers*, 48, 1-21.

Kremer, S., Bick, A., & Nautz, D. (2009). Inflation and Growth: New Evidence from a Dynamic Panel Threshold Analysis. Humboldt University Berlin.

Levine, R., & Renelt, D. (1992). A Sensitivity Analysis of Cross Country Growth Regressions. *The American Economic Review*, 82, 942-963.

Li, M. (2006). Inflation and Economics Growth: Threshold Effects and Transmission Mechanisms. Departement of Economics, University of Alberta, Canada.

Mallik, G. & Chowdhury, A. (2001). Inflation and Economic Growth: Evidence from South Asian Countries. *Asian Pacific Development Journal*, 8, 123–135.

Mallick, A., & Sethi, N. (2014). Comparing the Measure of Core Inflation in India: Trimmed Mean and Structural Vector Auto-regression Approach. *International Journal Monetary Economics and Finance*, 7, 288-301.

Mallick, A., & Sethi, N. (2019). What Cause India's High Inflation? A Threshold Structural Vector Autoregression Analysis, 11, 23-43.

Mankiw, M. G. (1987). The Optimal Collection of Seigniorage (Theory and Evidence). *Journal of Monetary Economics*, 20, 327-341.

Omay, T., & Kan, E. N. (2010). Re-examining the Threshold Effects in the Inflation Growth Nexus with Cross-sectionally Dependent Non-linear Panel: Evidence from Six Industrialized Economies. *EconModel*, 27, 996-1005.

Pollin, R., & Zu, A. (2005). Inflation and Economic Growth: A Cross-country Non-linear Analysis. *Working Paper Series No. 109.* University of Massachusetts Amherst.

Romer, D. (2012). *Advanced Macroeconomics Fourth Edition*. New York (US): The McGraw-Hill Companies.

Shi, S. (1999). Search, Inflation and Capital Accumulation. *Journal of Monetary Economics*, 44, 81–103.

Sidrauski, M. (1967). Rational Choice and Patterns of Growth in a Monetary Economy. *American Economic Review*, 57, 534–544.

Stockman, A. C. (1981). Anticipated Inflation and the Capital Stock in a Cash Advance Economy. *Journal of Monetary Review*, 57, 534–544.

Subekti, A. (2011). Dinamika Inflasi di Indonesia pada Tataran Provinsi [tesis]. Bogor (ID): Institut Pertanian Bogor.

Thanh, S. D. (2015). Threshold Effects of Inflation on Growth in the ASEAN-5 Countries: A Panel Smooth Transition Regression Approach. *Journal of Economics, Finance and Administrative Science*, 20, 41-48.

Tobin, J. (1965). Money and Economic Growth. *Review*, 57, 534–544.

Todaro, M. P., & Smith, S. C. (2009). *Economic Development*. Boston (US): Pearson.

Utari, D., Cristina, R., & Pambudi, S. (2016). *Inflasi di Indonesia: Karakteristik dan Pengendaliannya*. Jakarta: BI Institute.

Vinayagathasan, T. (2013). Inflation and Economic Growth: A Dynamic Panel Threshold Analysis for Asian Economies. *Journal of Asian Economics*, 26, 21-41.

Warjiyo, P., & Juhro, S. M. (2016). *Kebijakan Bank Sentral: Teori dan Praktik*. Jakarta (ID): Rajawali Press.

Widaryoko, N. (2013). *Inflasi dan Pertumbuhan Ekonomi: Pendugaan Ambang Batas Inflasi di Indonesia* [tesis]. Bogor (ID): Institut Pertanian Bogor.

Winarno, T. (2014). The Dynamics Relationship between Inflation and Economic Growth in Indonesia: A Regional Thresholds Approach. *BNM Economics Research Workshop*.