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When Inflation Hurts Growth: Dynamic Panel Threshold Evidence Of Inflation's Nonlinear Economic Impact

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Abstract

This study examines the impact of inflation on Indonesia's economic growth and identifies the inflation threshold affecting the economy. Using an Error Correction Model, results show that inflation and exchange rate depreciation significantly reduce short-term growth. In contrast, the population has a positive and significant impact only in the long term. The inflation threshold is estimated at 8.36% by using Dynamic Panel Threshold; inflation above this threshold harms growth, whereas inflation below it tends to support economic activity. Policy recommendations include coordinated actions between the government and Bank Indonesia to tighten monetary conditions, consider interest-rate adjustments as inflation approaches 5%, and implement stronger measures if inflation exceeds 8.36% to preserve macroeconomic stability and growth.

Keywords: inflation; economic growth; dynamic panel threshold

INTRODUCTION

High and significant economic activity with a low inflation rate is the main object of macroeconomic policy. The existence and natural relationship between level inflation and economic growth have always been debated. Although the debate about the relationship between these two variables is still open, intensive research on this topic has begun to condense to the conclusion that inflation affects medium and long-term economic growth (Ho & Saadaoui, 2022; M. S. Khan & Senhadji, 2001; S. Khan & Pazir, 2023).

Empirical research results on the relationship between inflation and economic growth are grouped into four categories (Akinsola & Odhiambo, 2017). First, inflation does

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not affect economic growth (Cameron et al., 1996; Munyeka, 2014; Niken et al., 2023; Sidrauski, 1967) Second, inflation positively affects economic growth (Benhabib & Spiegel, 2009; Talha et al., 2021) Third, inflation reduces economic growth (Gillman & Harris, 2010; Hung, 2024; Liang, 2023; Mamo, 2012). The last is that inflation affects economic growth with certain level conditions, such as Vinayagathasan, who found that the threshold was 5.43 percent, where an inflation rate above that number would harm economic growth while the inflation rate was above that threshold. Then the number up the threshold will not have a significant effect on economic growth (Runganga, 2020; Vinayagathasan, 2013).

The government needs to keep inflation low since inflation is negatively related to economic growth (Batrancea, 2021; Cili & Alkhaliq, 2022). But how low is ideal inflation? Is the smaller, the better? Several studies have found that inflation at a certain level positively affects economic growth.

Central Bureau of Statistics (BPS) released that current inflation has decreased significantly compared to the previous period. Annual inflation stood at 2.72 percent, lower than before, even the weakest in the last 20 years. This low inflation rate and a decline in economic growth are where the Indonesian Minister of Finance assumes that the most optimistic economic growth rate will only reach 2 percent. It is even possible that Indonesia's economic growth rate will get a negative number by the end of 2020. Thus, unlike most studies outside the pandemic, the relationship is positive.

From the data above, it can also be seen that the inflation rate is not much different from the economic growth rate in Indonesia. In fact, from 1990 to 2014, inflation in Indonesia was above the economic growth rate. In this case, economic growth occurs due to increased prices in the market. Some theories say inflation has many determinants, like population and exchange rates. The bigger the population, the higher the inflation rate. When an explosion in the population happens, demand for goods and services increases, making the price more expensive. The population constantly grows yearly, which means the inflation rate will rise.

On the other hand, an open economy allows others to influence one country's economy. In 1998, when Indonesia had to pay international debt, the demand for the dollar rose so high that it caused a monetary crisis. The exchange rate of the rupiah was depreciated to the lowest value ever. The depreciation was causing a higher inflation rate, not only from the demand-pull inflation side but also from the cost-pust inflation side. Discount policies in raising interest rates have failed to recover the situation. Indonesia

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has gotten worse in hyperinflation, has a low exchange rate, and is also harmful to economic growth.

For this reason, it is necessary to research how inflation affects economic growth in Indonesia, especially during the pandemic. This research will be conducted within the scope of the economy in Indonesia from 1991 to 2023, and the results will be necessary to help the government make some decisions about economic growth in Indonesia. Several studies have explained the relationship between inflation and economic development, but they differ.

Khan and Senhadji looked at the effect of inflation and economic growth in 140 industrialized and developing countries using the nonlinear least square method (NLLS). By taking the variables of GDP development, CPI index, gross domestic investment, and population growth, it is found that inflation hurts economic growth (M. S. Khan & Senhadji, 2001).

Mubarik conducted a study to see the correlation between economic growth and the inflation rate in Pakistan. The study used threshold analysis using data on GDP, Consumer Price Index, population growth, CPI, and investment growth for the 1973-2000 period. This study found that an inflation rate above 9 percent hurts economic growth (Mubarik, 2005). Munir and Mansur studied the correlation between inflation and GDP growth in Malaysia using variables of GDP development, gross fixed investment, and FDI for 1970-2005. The study found that the inflation rate above 3.89% harms economic growth. On the other side, when the inflation rate is below that number, inflation has a positive effect to economic growth (Munir (Munir & Mansur, 2009). The same thing was also found in Gilman and Harris' research. Analysis in 13 countries to see the effect of inflation on population growth was carried out using the maximum likelihood estimation technique using data on economic growth, inflation, and the amount of money demanded from 1990-2003. They found a robust negative relationship between inflation and economic growth. The author recommends inflation targeting as the main point of monetary policy, which is matched with fiscal policy to keep the country from a budget deficit (Gillman & Harris, 2010).

In the UK, same study was by Ozdemir in 2010 investigating the relationship between inflation and economic growth in 1957-2006. The data used in this study are quarterly GDP and CPI data processed in vector autoregressive fractionally integrated moving averages (VARFIMA). The author also sees that inflation uncertainty positively affects the inflation rate itself, where this uncertainty is the most crucial determinant of economic growth (Ozdemir, 2010). Kremer et al. also examined the relationship between

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inflation and economic growth in 124 industrial and non-industrial countries. This study uses the dynamic panel threshold model to collect GDP per capita, inflation rate, and open trade data from 1950 to 2004. The result is that the 2-17 percent inflation rate positively affects industrialized and non-industrialized countries. Inflation rate above 17 percent has insignificant and negative impact for economic growth (Kremer et al., 2013).

With the same idea, Thanh looked for effect the inflation rate to economic growth in Vietnam. Using the two-stage least square (2-SLS) and generalized Moment (GMM) method, this research used GDP per capita, CPI, gross domestic investment, population growth, and inflation rates data from 1986 to 2013. Research found number of threshold of inflation level above 7 percent could harm the growth in Vietnam (Thanh, 2015).

In a country, inflation dramatically affects the economy's stability because the inflation rate affects domestic production and weakens exports. Inflation also reduces people's purchasing power because the value of money decreases (Lay, 2020). Inflation usually occurs faster than the rise in wages for workers. The outlook for economic development will worsen if inflation cannot be controlled safely. Inflation can further reduce productive investment, facilitate exports, and slow economic growth (Song et al., 2021; Todaro & Smith, 2011).

In economic theory, the government plays an essential role in controlling inflation, but the result could be different. According to the history of Indonesia, high inflation can harm the economy, so it is essential to prevent it. Hyperinflation brings Indonesia to a crisis period and destroy all sectors for a long time. This study examines the influence of inflation on economic growth in Indonesia and the threshold of inflation that can affect the economy.

METHODOLOGY

This study was carried out in Indonesia, using time series data for 1990-2023 on macroeconomic variables. Data on inflation and economic growth was obtained from the Central Bureau of Statistics (BPS).

Table 1. Definition of Operational Variable

Data/Variable	Definition of operational variable	Data Source
Inflation	Inflation is the rate of changing of price in an annual period (percent)	BPS

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Economic growth	Economic growth data using GDP based on current price values in the current year (percent	BPS
Population	The number of total population in Indonesia in annual period (people)	BPS
Exchange Rate	Value of exchange between Rupiah and Dollar in a yearly period (Rp/US$)	BPS

The analysis tool used the Granger Causality test to answer the research problem. This test can identify whether a variable has a two-way relationship. The data is tested to find out whether the variables in question have an influencing relationship.

This study applies the dynamic panel threshold model, as shown by Kremer et al. I (Kremer, Bick, and Nautz, 2013). The dependent variable is the GDP per capita growth rate, while the independent variable is inflation. As a threshold variable, inflation is divided as exogenous into two. Slope β_1 when inflation is below the threshold and the slope β_2 when inflation exceeds the threshold.

The regression method threshold applied is a model of non-dynamic panel data. The data used is a balanced panel with the structure $\{y_{it},\ x_{it},\ q_{it}$: 1 i n, 1 t T}. The dependent variable is indicated by y_{it} for the individual I and time t in the form of a switch; it is an independent variable in the form of a matrix, while it is a threshold variable in the form of a scalar. Thus, the regression model threshold for panel data can be denoted as follows:

$$y_{it} = \mu_i + \beta_1' x_{it}\, I\,(q_{it} \le \gamma) + \beta_2' x_{it}\, I(q_{it} > \gamma) + e_{it} \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

$$Growth = \beta_0 + \beta_1 Inf_t + \beta_2 POP_t + \beta_3 KURS_t * D_t(Inf_t - k + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where economic growth and inflation are written as follows: Yt: real GDP, GROWTHt: economic development, POPt: population growth rate, k: threshold level of inflation, KURS: exchange rate, INFt: inflation, and Ut: error term.

DATA ANALYSIS AND DISCUSSION

A causality test results reflect the relationship between variables. The first step is determining the lag value. The amount of inaction is selected using the information

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criteria, namely the information criteria akaike info criterion (AIC). The regression results for getting the AIC value are as follows.

Table 2. The result of regression to determine lag in Granger causality

Description	AIC Value	Result
Lag 1	5.954452	
Lag 2	5.854573	The least value
Lag 3	5.935106	

Source: Authors' calculations

Based on the AIC value, the smallest AIC value was chosen, at lag 2. Thus, the Granger causality test was then carried out at lag 2. The results are as follows.

Table 3. The result of Granger causality in lag 2

Description	F=Statistic	Prob.
Inflation does not granger cause growth	1.07926	0.3552
Growth does not granger cause Inflation	7.66040	0.0025

Source: Authors' calculations

Based on Table 3, there is a one-way relationship where the inflation rate affects economic growth. No effect of economic growth on inflation was found. Thus, it is evident that economic growth is the dependent variable, which is influenced by the inflation rate as the independent variable. Munir and Mansur also found the relationship between inflation rate and economic growth to be nonlinear. This means the government should pay attention to inflation (Munir & Mansur, 2009). This substantial gain can be evident in low inflation from deciding fiscal and monetary policies.

Inflation is one indicator that influences a country's economy, especially in Indonesia, a developing country. Inflation is a leading indicator of macroeconomics to get an accurate picture and release some policies. Monetary policy is assumed to be an excellent policy to control the money supply in Indonesia so the inflation rate will be under control. Since it influences economic growth, the inflation rate is an important topic. Then, the big question is what rate inflation is. Meanwhile, based on its origin, inflation is divided

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into two. The first is inflation from within the country (domestic inflation), arising from a state financing and spending deficit. To solve this deficit, the government usually prints new money. In addition, domestic inflation can be caused by crop failures, natural disasters, or during an economic crisis, and so on. The second is inflation originating from abroad (foreign inflation). Inflation from abroad can occur when the country of origin of imported goods experiences inflation so that the selling price in the country also increases.

In a country, inflation dramatically affects the economy's stability because the inflation rate affects domestic production and weakens exports. Inflation also reduces people's purchasing power because the value of money decreases. Inflation usually occurs faster than the rise in wages for workers. The outlook for economic development will worsen if inflation cannot be controlled safely. Inflation can further reduce productive investment, facilitate exports, and slow economic growth.

Since the inflation rate can harm the economy, which happened in 1998 in Indonesia, the government paid serious attention to controlling it. Bank Central is the institution that monitors the growth of the money supply because it will cause a change in the inflation rate. The inflation threshold will notice that inflation hurts economic growth if the rate exceeds its threshold band (Loi & Abou-Zaid, 2016).

Based on the results of the Granger causality test, it is known that there is a one-way relationship where the inflation rate affects economic growth. No effect of economic growth on inflation was found. Thus, it is evident that economic growth is the dependent variable, which is influenced by the inflation rate as the independent variable

Stationarity Test

Since the stationary test was the first step in the Error Correction Model (ECM), the model added variable control, namely population and exchange rate.

Table 4. The result of the Stationary Test

Variables	Unit Root Value	MacKinnon Critical Value			ADF-Test Statistics
		1 %	5%	10%	
Economic Growth	Level	-3.661661	-2.960411	-2.619160	-3.936639*
Inflation	Level	-3.661661	-2.960411	-2.619160	-5.582308*
Population	First Diff	-3.670170	-2.963972	-2.621007	-5.256721*
Exchange Rate	First Diff	-3.670170	-2.963972	-2.621007	-5.187837*

Source: Authors calculations

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To determine whether a series has a unit root, it is necessary to compare the ADF t-statistical value with the table ADF. If the t-count value of the ADF statistic is more significant than the critical value of MacKinnon, then the data can be said to be stationary and vice versa. Data that is not stationary at the level will then be continued with testing at the first difference level and the(second difference second difference). The test results show that it is stationary at the level and stationary in the process of the first derivative of the data (first difference).

Cointegration Test

A cointegration test is needed to determine a cointegration relationship and see the long-term relationship between economic growth variables, inflation, population, and the exchange rate. Since all variables have passed to the same degree, namely the level level, the cointegration test can be carried out using the Engel-Granger (EG) cointegration test.

The cointegration test is applied to determine the possibility of long-term and short-term relationships between variables. The cointegration test used in this study is the Engle-Granger cointegration test. In this test, the residuals from the regression equation will be obtained. The residual results are then tested using Augmented Dickey-Fuller (ADF). If the statistical value is greater than the critical value, then the long-term relationship in the model is proven to exist, and vice versa. The results are as follows.

Table 5. The result of the Cointegration Test

Residual	Unit Root Value	MacKinnon Critical Value			ADF-Test Statistics
		1 %	5%	10%	
ECT	Level	-3.661661	-2.960411	-2.619160	-5.977251*

Source: Authors calculations

Table 5 explains that the ECM model in this study is valid and conintegrated. The coefficient value reinforces results with a negative sign and is significant at the critical value level of 1 percent. The fulfilment of the ECM requirements encourages the next stage of testing, namely the ECM model test.

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Table 6. The result of Long Term Regression

Dependent Variable: GROWTH (Economic growth)				
Variable	**Descriptions**	**Coefficient**	**Std. error**	**t-stat**
C	Intercept	-2.344626***	0.060249	-4.417190
INF	Inflation	-0.226534*	0.025234	-8.977398
POP	Total Population	0.065389*	0.031725	2.061148
KURS	Exchange Rate	-0.000641*	0.000212	-3.019400
Summar				
R^2	0.818380			
R^2 *adjusted*	0.798921			
f-test	0.000000			

Source: Authors calculations

From Table 6, all of the variables used show a significant influence, where the population positively affects economic growth, while exchange rate and inflation have a negative effect. This result indicates that increasing the population by 100,000 people causes economic growth to increase by 0.065 percent. On the other hand, if the exchange rate increases by Rp. 1,000, economic growth will decrease by 0.64 percent. If the inflation rate increases by 1 percent, economic growth will decrease by 0.22 percent.

In the short term, the balance of economic variables is more fragile, meaning there is a difference between the targets of financial actors and the events that occur. Therefore, the imbalance in the model needs adjustment to return to a state of balance. Adjustments in the balance can be made through the ECM model. Using the ECM model, the ECT (will be obtained Correction Term) symbolizes the return of the variable to the equilibrium point.

Error Correction Model Results

Economic growth is analyzed using the Error Correction Model to see the influence of the independent variables on short-term economic growth. This model will also illustrate how much time (lag) is needed to affect economic growth in Indonesia. The results can be seen in Table 6 below.

Based on the results of processed data, it is known that this model has been good in representing economic growth in Indonesia. This is evident from Table 5, where the ECT value has a relatively low coefficient of -1.139346. Furthermore, two independent

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variables significantly affect economic growth: inflation and exchange rates. Meanwhile, the number of residents does not significantly affect economic growth in the short term.

Table 7. The result of Short Term Regression

Dependent Variable: D(GROWTH) (Economic growth)				
Variable	**Descriptions**	**Coefficient**	**Std. error**	**t-stat**
C	Intercept	-1.027644**	0.088918	-5.439963
D(INF)	Inflation	-0.140167*	0.018305	-9.842324
D(POP)	Total Population	.448247****	0.613628	0.730487
D(KURS)	Exchange Rate	-0.000894*	0.000346	-2.585568
ECT(-1)	Error Correction Term	-0.139346*	0.018824	-6.052415
Summary				
R^2	0.672433			
R^2 *adjusted*	0.667422			
f-test	0.000000			

Source: Authors calculations

Inflation and exchange rates have a negative influence on economic growth. If the rupiah exchange rate against the dollar increases by Rp1,000, economic growth will decrease by 0.89 percent. If the inflation rate rises by 1 percent, economic growth will also fall by 0.18 percent.

Table 8. The Result of Dynamic Panel Threshold

Dependent Variable: INF (Inflation)				
Variable	**Descriptions**	**Coefficient**	**Std. error**	**t-stat**
INF < 8.3599999 –16 obs				
C	Intercept	-0.209025****	2.106597	-0099224
INF	Inflation	1.305430*	0.442021	2.953324
8.3599999 <= INF –14 obs				
C	Intercept	6.194851*	1.013050	6.115046
INF	Inflation	-0.244547*	0.043806	-5.582442
Summary				

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R^2	0.653159			
R^2 *adjusted*	0.613139			
f-test	0.000004			

Source: Authors calculations

Note: * probability 1%
** probability 5%
*** probability 10%
**** not significant

DISCUSSION

Within a country, inflation dramatically affects the economy's stability because the inflation rate affects domestic production and supports economic growth. Inflation also reduces people's purchasing power because the value of money decreases. Inflation usually occurs faster than the rise in wages for workers. The outlook for economic development will worsen if inflation cannot be controlled safely. Inflation can further reduce productive investment, facilitate exports, and slow economic growth.

The threshold calculation lets us know how much the inflation rate suits a country. As is known, empirical research results on the relationship of inflation with economic growth can be grouped into four categories (Akinsola & Odhiambo, 2017).

One of the economic development targets is to increase the regional economic growth rate. According to constant prices, regional economic growth is measured by Gross Domestic Income (GDP) growth. The GDP growth rate will show the process of increasing output per capita in the long term. Emphasis on "process" is essential because it contains elements of dynamic change or development (Mankiw et al., 1995). Therefore, understanding the indicators of economic growth will usually be seen within a certain period, for example, annually. These aspects are relevant to be analyzed so that the economic policies implemented by the government to encourage economic activity can be assessed for their effectiveness, especially in reaching economic growth.

The obtained findings show evidence concerning a nonlinear relationship between economic growth and inflation rate in transition economies in the long term. This study's inflation threshold is 8,36 percent. The result means the inflation rate above this number will harm economic growth. Conversely, if the inflation rate is below this, it can support economic activity. It's far above the result of Thanabalasing (Vinayagathasan, 2013), which only gets a threshold of 5.43 percent, at a 1 percent significance level. Inflation will

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hurt economic growth when it exceeds 5.43 percent, but has no effect if the number is below this level.

In Turki, an investigation by Aydil found that the threshold for the influence of inflation on economic growth is 7,97 percent. An inflation rate above this threshold hurts economic growth, while an inflation rate below this threshold positively influences economic growth (Aydın et al., 2016). This study is relevant to some research in Africa (Ndoricimpa, 2017), Vietnam (Tung & Thanh, 2015), and also Uganda (Matte, 2019). The research also relates to some studies in developed countries (Fei et al., 2019) and developing countries (Bick, 2010). The lowest threshold so far is in Korea. This study showed that the inflation threshold is a base for economic growth, and inflation is positively related to economic development (Nguyen et al., 2020).

This research shows that the inflation threshold is lower than before, from 9,57 percent to 8,36 percent. The pandemic caused Indonesia's activity economy to go down, and this caused aggregate demand to slow. So, the inflation threshold is reduced by about 1,21 percent. Based on this study, we suppose that Bank Indonesia and Tim Pemantauan dan Pengendalian Inflasi Daerah (TPID) should be aware when the inflation rate touches 5 percent and pay more attention when it is more than 8,36 percent. So, the policy of Bank Indonesia to release inflation targetting ±3 percent can be accepted. The results also show that the government is too careful when targeting inflation.

CONCLUSION

In the study, we found that inflation has a negative effect on Indonesia's economic growth. Specifically, if inflation increases by 1 percent, economic growth will decrease by 0.14 percent under ceteris paribus conditions. Evidence of a threshold effect was also found in the relationship between inflation and economic growth with a value of 8.36. This study successfully proves that inflation has a negative effect on economic growth if it exceeds the threshold, but has no effect if the value is below the threshold.

Therefore, when the government wants to lower the inflation rate, it should coordinate with Bank Indonesia, the central bank, to minimize the money supply. In this case, the Central Bank of Indonesia can minimize inflationary pressures from the monetary side through higher interest rates. Inflation targeting is assumed to be a part of the policy that successfully controls the inflation rate and has a multiplier effect on reaching economic growth.

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