

Review Article

Do Investment and Inflation Matter for the Indonesian Economic Growth? A Threshold Autoregression Model

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Abstract: This study aims to explore and analyze the effect of inflation threshold on economic growth in Indonesia using quarterly data collected between 1990 and 2017. The benefits obtained are being able to identify whether there might be an optimal inflation rate, where the side effects of inflation on economic growth are stable or the same when the positive effect of the inflation rate is maximized. The model used is the Threshold Autoregressive (TAR) model and the estimation technique of the Conditional Least Squares (CLS) model. The estimation results estimate that the inflation threshold level is at 1.21% per three months for the observed data, this is estimated to be relatively high compared to that obtained for developing countries. Moderate inflation may not be harmful to economic growth in Indonesia and supports the idea that monetary policy efforts must be more actively directed at the investment sector. Inflation has a negative and significant effect on economic growth in Indonesia. The Granger Causality test shows that there is a long-term causal relationship between inflation and economic growth. Thus the government is expected to have a strategy to reduce the inflation rate threshold effect so that economic growth continues to increase.

Keywords: Inflation, Investment, Economic Growth, TAR Model.

INTRODUCTION

As a developing country, Indonesia aspires to become a newly developed country shortly. To achieve such noble aspiration, the government has to ensure the high sustainable growth of the national economy for the next few years. High economic growth is one indicator of success in economic development. With the high economic growth, it is expected that the welfare of the citizens also increases and they become more prosper living in the country. However, to have sustainable economic growth, there have many macroeconomic factors contributing to it that the government should control.

Among the determinants of the stability of economic growth, according to Silvia *et al.*, (2013), is inflation. In an economic perspective, inflation is a monetary phenomenon in a country where price fluctuations tend to result in economic turmoil. The other side of the phenomenon of inflation in Indonesia is not just a short-term phenomenon and that occurs only situational, but as is common in other developing countries, inflation in Indonesia is more of a long-term

inflation problem because there are still structural obstacles in the country's economy. Thus, reforming the inflation problem in Indonesia is not enough to be done using monetary instruments which are generally short-term, but also by making improvements in the real sector (Atmadja, 2004).

Studying the effects of inflation on economic growth continues to be an important topic in economic literature (Risso and Carrera, 2009). It has a real economic effect. If a government intends to improve economic performance, inflation should be controlled through monetary policy. Therefore, investigating how the inflation rate affects economic growth is directly related to the optimal design of the monetary policy.

From a macroeconomic perspective, economic growth is commonly measured by the Gross Domestic Product (GDP) (Mankiw, 2003). It measures the flow of income and expenditure in the economy over some time. Economic growth is related to the process of increasing the production of goods and services in the economic activities of the community. To more

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accurate measures of economic growth is based on the value of GDP on constant prices as it represents the real growth that occurs due to additional production. To support the development of the economy, economic growth should be sustained over a longer period. As for economic development to grow rapidly, it requires considerable funding sources. The government must seek development funding sources from available alternatives, both from domestic sources and from abroad (Klot, 2004).

The presence of new investments will enable the creation of new capital goods so that they can absorb new production factors, namely creating new jobs or employment opportunities that will absorb labor, which in turn will reduce the number of unemployed. Thus, it will add new output and income to the production factor, which will increase national output so that economic growth can occur. Investment along with other components of aggregate demand plays an important role not only in economic growth but also in creating jobs, increasing capacity and technological capabilities, encouraging economic development.

Furthermore, investment plays a major role in determining the competitiveness of the national products in the domestic and foreign markets and can reduce poverty and improve people's welfare. The problem that arises is how difficult it is for Indonesia to raise funds through foreign investment. This is not a tiny problem because there are still many Indonesian economic variables that are relatively unstable as a characteristic of developing countries against the decision of foreign investors to invest their capital in Indonesia. Besides, there is a phenomenon of the interest of domestic fund owners to invest their capital abroad because they are considered more promising than investing their capital domestically (Sirwardiningsih, 2010).

The sustainability of economy is one of the targets to improve the economy of a country. This can be achieved through the enhancement of macroeconomic stability. In 2010, Indonesia recorded the highest percentage of investment by 213.59%. This is probably influenced by the increase in the rate of economic growth and the decline in inflation in 2010. From 2007 to 2016, investment experienced the lowest value in 2009, reaching -47.65%. This condition is likely due to the high-interest rates in Indonesia, as well as the lack of improvement in the Indonesian economy which resulted in investors investing low interest in 2009. The very high increase in inflation occurred in 2008, this is likely to occur due to the increase in raw material production prices (increased production costs), imported goods, unstable economic conditions, and instability in non-economic factors such as political chaos in a country. Meanwhile, the lowest inflation of 3.75% occurred in 2012 caused by the political and

economic conditions of a country that were stable or even better condition than the previous year.

On the other hand, the highest GDP was recorded in 2007 at 6.34%. This is probably influenced by the increase in investment in 2007 and the decline in inflation in 2007. The lowest GDP occurred in 2009 which was 4.62%, resulting in investment declining but the rate of inflation growth did not increase. This is different from the theory where when investment experiences a decline, inflation should increase, but in reality, it is not following the theory. Interest rates were high in Indonesia, as well as the lack of improvement which results in investors investing in low interest in 2009.

Based on these economic phenomena, this study intends to explore the causal effects of inflation and investment on the Indonesian economic growth. The findings of this study are hoped to shed some lights for the policy-makers to design a proper macroeconomic policy to promote economic growth in the country. The finding of the study is also hoped to be useful for enriching the existing empirical evidence as it has been relatively scarce, considering the huge potentiality of the Indonesian economy to grow.

The rest of this study is structured in the following sequences. Section 2 provides a relevant literature review. Section 3 provides an empirical framework and data, followed by discussing the findings of the study. Finally, Section 5 concludes the paper.

LITERATURE REVIEW

Phiri (2013), in his research, investigated the effects of inflation thresholds on economic growth in Zambia. In the study, the Threshold Autoregressive (TAR) model and Conditional Least Square (CLS) were used. The study was able to identify whether the optimal inflation rate might have side effects on economic growth. In this case, research is estimated at an inflation threshold level of 22.5% for observed data. He found that economic growth in Zambia can be stimulated even at a high level of inflation.

Papadamou *et al.*, (2017) used a model of estimation proposed Diana and Sidiropoulos (2004) and Geronikolaou *et al.*, (2016) that took into account a simple monetary game model that assumes fixed capital is in the short term. Therefore, the output of the economy is given by a short-term production function. From a monetary policy perspective, the best response to public investment policy is to increase the level of independence to reduce the impact on the dynamics of inflation. From the perspective of fiscal policy, an independent central bank can provide the necessary conditions to carry out a long-term public investment plan, because long-term growth will not be damaged by adverse inflation inertia.

Mahembe and Odhiambo (2016) examined the causal relationship between foreign direct investment (FDI) and economic growth in SADC countries during the period 1980-2012 using the Granger causality test based on the VECM framework for middle-income countries, while for low-income countries were tested using the framework of VAR. The results from Granger panel causality for low-income countries did not show evidence of causality in either direction. However, for a panel of middle-income countries, there was evidence of unidirectional causal effect running from GDP to FDI, and not vice versa. Therefore, the study concluded that FDI lead growth hypothesis did not apply to SADC countries. This applies, regardless of whether causality is expected in the short term or the long run. However, economic growth is found to affect FDI inflows into the SADC region and not vice versa. These findings suggest that SADC policy-makers should focus on policies and strategies that encourage economic growth to effectively attract FDI inflows to this region.

Farooq and Ahmed (2018) explored the welfare inflation costs by documenting the impact on the relationship between capital expenditure made by companies and stock prices in emerging markets during the period between 2009 and 2014. The model included the dummies industry (IDUM) and year dummies (YDUM), following the previous by Foucault and Frésard (2012). The findings suggest that there was an influence of inflation on the informativeness of stock prices. Inflation reduces the accuracy of stock prices, thus causing investment sensitivity to be lower for stock prices.

Next, Wimanda (2014) used a method proposed by Hansen (2000) where the threshold was based on minimum SRR. The SSR value will differ from one model to the other model. For example, models using quarterly data will give different results than those using monthly or annual data. Besides, if the study uses new data, the results can be different. The results of the study showed that the impact of money growth on inflation grew at less than 9.8%, which higher than the impact of exchange rate depreciation on inflation. However, this study did not explain the reason why higher money growth has little impact on inflation. Thus, empirical work in the future must be sought more clearly the reasons underlying the asymmetrical impacts observed.

In their study, Amidu *et al.*, (2016) explored the relationship between private housing investment and economic growth in the UK. The findings of the study have revealed new evidence of long-term and short-term relationships between private housing investment and economic growth perspectives from the United Kingdom, thus contributing to the broader literature on transportation between housing markets and macroeconomics. In particular, the results also suggest

that the implementation of policies that impede private housing investment ultimately leads to severe short-term dislocations in the economy due to falling aggregate investment. On the other hand, policies that encourage private housing investment will reduce volatility in economic performance.

Gupta and Singh (2016) tried to fill the existing gaps in the literature by studying the causal relationship between FDI and GDP in the context of BRICS Countries using the VECM and Granger causality techniques and concluded that the degree of the causal relationship was nothing to do with the uses of a different regression model. Cambazoglu and Karaalp (2014) analyzed the impact of FDI and international trade on economic growth in Turkey for the post-liberalization period (1980-2010). Using the autoregression vector model with four variables, namely real GDP growth, real FDI, real import volume index, and real export volume index found the relationship between economic growth, FDI and exports. The results obtained are to explain the relationship between FDI and international trade regarding economic growth for Turkey, which has implemented export growth strategies since 1980, and has implemented many regulations to attract foreign capital.

Azam and Ahmed (2015) validated the endogenous growth model by examining the impact of human capital and FDI on the economic growth of ten Commonwealth of Independent Countries (CIS). Using the linear regression models based on growth theory and panel data collection covering the period from 1993 to 2011, their findings supported the research hypothesis by confirming that the development of human capital is important for economic growth. Similarly, FDI has been found to have a facilitating role in promoting growth in the former Soviet Republic now consisting of an independent Central Asian economy. Even though there were country-specific differences in the CIS, the investment climate in the host country should be enriched through appropriate policies. Improving domestic conditions not only improved the performance of multinational companies but also allowed the host economy to reap greater benefits from FDI inflows. In addition, the findings also indicate that investment in education and health is very necessary. Therefore, an increase in the level of education and health must be the main goal to go hand in hand with other factors to stimulate economic growth.

Zulkhibri and Abdul Rani (2016) determine the predictive content of the term spread on inflation and economic growth. He found that an efficient bond market can also play an important role in spreading monetary impulses through the relevant monetary transmission. Finally, Risso *et al.*, (2013) estimated the long-term relationship and the threshold effect between inflation and economic growth in Mexico. They

concluded that the inflation rate harms economic growth in a country.

EMPIRICAL FRAMEWORK

This study uses the threshold autoregression approach to explore the effect of inflation on economic growth in Indonesia. In its basic form, the nonlinear growth inflation is assumed and analyzed using the following regression function proposed by Phirri (2013):

$$Y_t = \beta_{i1} X_t I.\{\tau \leq \pi^*\} + \beta_{i2} X_t I.\{\tau > \pi^*\} + \epsilon_t \quad (1)$$

Where Y_t is the economic growth, X_t is the threshold inflation; $\tau \leq \pi^*$ = estimated threshold; I (.) and βI are the slopes of autoregressive; and ϵ_t is the error term.

Certain econometric problems related to the estimation of the threshold model, inference methods need to be developed to determine whether the threshold effect is statistically significant. The conventional null hypothesis test of a linear model against alternative threshold models has nonstandard distribution as unidentified threshold parameters below the zero linearity hypotheses (Chan and Tsay, 1998). This causes the standard asymptotic distribution of the F-statistics should be used rather than the Chi-square. Hansen (2000) shows the circumvention of this problem through estimation techniques known as conditional squared methods (CLS). As a step before the estimation procedure, it must be determined whether the inflation threshold exists, that is, if the coefficient parameters differ from each other, namely $\beta_{i1} \neq \beta_{i2}$. This hypothesis can be tested by conventional F-test statistics that show RSS_0 as the number of squared residuals for linear models, the F-test of the null hypothesis of the linear model is based on (Phirri, 2013):

$$F = [RSS_0 - RSS(\tau)] / RSS(\tau) \quad (2)$$

Hansen (2000) has shown that conventional F-tests have non-standard asymptotic distributions since threshold parameters are not identified under the non-linearity hypothesis, namely $\beta_{i1} \neq \beta_{i2}$. Hansen (2000) uses the bootstrap method to approach the asymptotic distribution of F-statistics. Given the effect of the existing threshold, both offer considerations with whether the inflation threshold is statistically significant, namely $\pi^* \neq \tau$. A statistical probability ratio (LR) is used to test the null hypothesis $\pi^* = \tau$ and the statistics generated are calculated as follows:

$$LR(\tau) = [RSS(\tau) - RSS(\tau^*)] / RSS(\tau) \quad (3)$$

To establish an asymptotically valid confidence interval for threshold parameters, Hansen

(2000) shows the inverse of the likelihood ratio (LR) statistic associated with the threshold parameter. A bootstrap method is used to simulate the asymptotic distribution of the likelihood ratio (LR) test by reaching the first-order asymptotic distribution so that the p-values built from bootstrap are valid asymptotic. The asymptotic likelihood ratio (LR) distribution is used to form valid asymptotic confidence intervals about estimated threshold values (Lee and Wong, 2005). Therefore, building trust intervals is a natural product of the estimation method (Hansen, 2000).

One of the most important tasks for empirical analysts is to find evidence that each determined relationship is found between inflation and economic growth more than correlation, and indeed there is a causal relationship in the background (Juhasz, 2008). Granger (1969) causality theory is used as a means of examining the direction of causality between the paired combinations of time-series variables used in this study. Granger (1969) starts from the premise that the future cannot cause both current and past. in terms of the past which helps in other time-series predictions X_t and if this information contained in there is another time series used in the prediction, then T is said to cause X_t (Granger, 1969). The vector autoregressive (VAR) model provides a natural framework to test Granger the VAR regression causality is as follows:

$$Y = \sum ki = \alpha_{11} Y + \sum ki = \alpha_{12} X + \mu_1 \quad (4)$$

$$X = \sum ki = \beta_{11} X + \sum ki = \beta_{12} Y + \mu_2 \quad (5)$$

From the regression equation above, Time series Y fails to Granger — the cause of X if it regresses Y to Y and lags X, the coefficient of lag X is zero. If not, Y is said to be the cause of X granger. Granger causality is related to whether lagging X values do or do not correct the Y explanation obtained from values only lagging behind Y itself. The null hypothesis is defined as: $H_0: \alpha_2 = 0$ or $\beta_2 = 0$. The null hypothesis explained above there is no granger causality tested through X^2 -test statistics. Granger causality test applies asymptotically (Toda and Phillips, 1993) as a criterion only when there is sufficient cointegration concerning causal effect variables being tested.

FINDINGS AND DISCUSSION

Before the study reports the findings of the effects of inflation and investment on the economic growth of Indonesia, the study reports first the finding form the unit root test based on the Augmented Augmented Dickey-Fuller (ADF) and Phillips Peron (PP) tests in Table 1. All variables analyzed in this study were non-stationarity at level, I(0) and become stationary after being differentiated in first order I(1) at the 1% level of significance.

Table1. Findings of Unit Root Tests

Variable	Level		First Difference		Remark
	ADF	PP	ADF	PP	
LGDP	-1.4105 [0.5745]	-1.6331 [0.4623]	-4.1426*** [0.0013]	-11.5704*** [0.0000]	I(1)
LINV	-1.5357 [0.5118]	-1.2875 [0.6334]	-4.5336*** [0.0003]	-15.2233*** [0.0000]	I(1)
INF	1.6256 [0.9995]	2.0255 [0.9999]	-4.5404*** [0.0003]	-7.0158*** [0.0000]	I(1)

Note: *** indicates significance at the 1% level.

After ensuring that all variables were non-stationary at the level and become stationary after taking first different, thus this fulfilled the necessary and sufficient for further testing the long-run

equilibrium among variables using the cointegration approach. Table 2 reports the findings from the Johansen cointegration test based on trace statistics and Max-Eigen statistics.

Table2. Findings of the Johansen Cointegration Test

Hypothesis	Trace stats.	Prob.	Max-Eigen stats.	Prob.
None	48.94***	0.0000	29.60***	0.0005
At most 1	19.34***	0.0029	16.51***	0.0054
At most 2	2.82	0.1096	2.82	0.1096

Note: *** indicates significance at the 1% level.

As illustrates in Table 2, inflation, investment, and economic growth were found to have two cointegrating vectors both based on trace statistics and Maximal Eigen Statistics at the 1% level of significance. Our findings indicate the presence of long-run equilibrium among variables. To predict a variable in the model, we could rely on other variables at those variables were moving together towards long-run equilibrium.

the regime of behavior between investment, inflation, and economic growth. Only at a very high level of inflation (above the inflation rate of 1.21% per three-months), there was a negative effect of direct foreign investment on economic growth, as indicated by the negative coefficients on investment in the regime that was lower than the estimated regression results. At moderate and low inflation rates (below the inflation rate of 1.21%) where the side effects of inflation begin to materialize, on economic growth and investment were positively correlated with economic growth. Overall, it must be noted that the coefficient signs of variables in the lower regime were in line with conventional growth theories. The resistance of the results is ensured through errors calculated and corrected for heteroscedasticity and on tests for normally distributed errors through the Jarque-Berra (JB) test.

Next, Table 3 reports the findings from the Conditional Least Squares (CLS) model based on the Threshold Autoregression Approach (TAR). To find the optimal threshold in the model, according to Hansen (2000), the smallest and largest number of 5% of the data needs to be eliminated to allow easier calculations by setting a search range to select the boundary between the inflation thresholds. Table 3 provides evidence of

Table3. Findings of Conditional Least Squares based on TAR Approach

Independent variable	Dependent variable: LGDP	
	β_{1i}	β_{2i}
LINV	-0.19* (0.08)	0.32*** (0.00)
INF	0.00 (0.50)	0.01*** (0.00)
From observation	19	78
Threshold value	1.21% (inverse logarithm – 0.0083%)	
LR(λ)	8.99 [0.0111]	
JB statistics	p-value = 0.000	

Note: *** and * indicate significance at the 1% and 10% levels, respectively.

To identify the causality relationship between variables, the pairwise Granger causal analysis in then tested. The null hypothesis (H_0) of no causality relationship was tested against the alternative

hypothesis (H_1) of the presence of a causal relationship (Gujarati, 2009). Table 4 reports the findings of Granger causal relationships among variables.

Table4. Granger Causality Test

Null Hypothesis	F-Statistics	P-value
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LINV – LGDP	1.4817	0.2137
LGDP – LINV	3.6204 ^{***}	0.0086
INF – LGDP	2.7393 ^{**}	0.0330
LGDP – INF	6.0465 ^{***}	0.0002
INF – LINV	1.8523	0.1251
LINV – INF	2.4550 [*]	0.0508

Note: ^{***} and ^{*} indicate significance at the 1% and 10% levels, respectively.

As observed from Table 4, the study found unidirectional causality running from economic growth to investment, indicating the important role of economic growth to attract investment in the country. The investment was in turn found to have a unidirectional causality with the inflation, indicating the importance of investment in determining the inflation rate. Finally, the inflation was found to have a bidirectional causal relationship with inflation, implying both inflation and economic has a causal effect on each other. Thus, this further indicates that to promote economic growth, it needs to control for inflation. On the other hand, to ensure the price stability, the economic growth also plays a significant role. The findings of this study are in harmony with those of Azam and Ahmed (2015) on the importance of investment in an economy, Mahembe and Odhiambo (2016) on the positive contribution of investment of economic growth, and Majid (2007) on the effect of inflation on the Indonesian economic growth.

CONCLUSION

Motivated by the lack of empirical evidence assessing the relationships between investment, inflation, and economic growth in Indonesia, this study explored and analyzed the effect of inflation thresholds, investment on economic growth over the period 1990 to 2017 using the Threshold Autoregression Approach (TAR). The study found that that Indonesia's economic growth in the forecast has an inflation threshold of 1.21% per quarter, this is according to the data estimated to be relatively high compared to that obtained for developing countries. The study found that inflation was not harmful to economic growth in Indonesia, supported the idea that monetary policy efforts should be more actively directed at the investment sector to target the predetermined inflation rate.

Based on the cointegration test, the study found a long-term causal relationship between inflation, investment, and economic growth, showing the existence of a long-run equilibrium among the variables. Finally, the Granger causality test revealed that inflation and economic growth have a bidirectional causal relationship, while investment caused unidirectional economic growth and inflation. Our findings confirmed the impotence of controlling inflation to promote economic growth in Indonesia.

Further studies on this issue are hoped to cover a longer and more frequent data and incorporate more variables into analysis to provide more comprehensive and robust findings so that they could be used as references by policy-makers in designing a policy to further promote economic growth in the country.

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