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On Nonlinear Relationship between Inflation and Economic Growth: A Study of ASEAN-5 Countries Period 2000–2016

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Abstract

Money (inflation) has played a vital role in economic growth. However, the nexus between them has always drawn mesmerizing debates. From the thoughts of Classical and Keynes which argued the existence of money neutrality, to the level of empirical studies which find either positive or negative correlation between inflation and economic growth. Recent studies concerning the debatable relationship have evolved it into a hypothesis whether the relation is nonlinear with a threshold or a point where the link switches. This study aims to re-examine the causality between inflation and economic growth in ASEAN-5 countries period 2000Q1–2016Q4. The results based on Threshold Vector Autoregression model indicate the presence of a nonlinear relationship between the two variables.

Keywords: threshold; inflation; economic growth; threshold VAR

Abstrak

Uang (inflasi) memiliki peran penting dalam pertumbuhan ekonomi. Namun, hubungan di antaranya selalu menjadi topik perdebatan yang menarik perhatian. Dari pemikiran Klasik dan Keynes yang memiliki keyakinan berbeda terhadap sifat netral uang hingga di tataran studi empiris yang menemukan hubungan positif maupun negatif antara inflasi dan pertumbuhan ekonomi. Hal ini telah memotivasi beberapa penelitian baru untuk mengembangkan suatu hipotesis mengenai adanya relasi yang nonlinear dengan titik balik (threshold). Penelitian ini bertujuan untuk menguji kembali hubungan inflasi dan pertumbuhan ekonomi dalam wilayah ASEAN-5 periode 2000Q1–2016Q4. Hasil estimasi berdasarkan model Threshold Vector Autoregression, membuktikan adanya hubungan nonlinear pada kedua variabel tersebut.

Kata kunci: ambang batas; inflasi; pertumbuhan ekonomi; threshold VAR

JEL classifications: E30; E31; E5

1. Introduction

The question of whether inflation can positively or negatively affect economic growth is still ambiguous. This started due to the assumption of money neutrality that had become a debatable topic between the thoughts of Classical and Keynes. In classical dichotomy, money does not have any effect on real sectors, such as job opportunity and output. Keynes,

who believed that a careless present would lead to a reckless long run, disagreed the dichotomy and argued that money does have an important role which effects job opportunity and real output. Therefore, the role of money (inflation) in economic growth has always become an interesting discussion that still attracts attention

The classical view pioneered by Adam Smith explained that the output of the economy is determined by factors of production, namely, land, labor, and capital. Savings are an important factor to boost economic growth, but it has no direct relationship to output. In short run, output and labor

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are determined by the production function. Savings are nothing but a part of the consumable output. If the savings increase, the interest rate will decrease. Increased savings will affect the accumulation of capital and subsequent investments. Increased investment encourages output growth. Conversely, a decrease in savings will increase interest rates and reduce investment growth which in turn will suppress output growth.

On the other hand, in classical economic theory, the quantity of money is also not stated explicitly on the relationship between inflation and economic growth. Under equilibrium conditions, adjustments in the money supply create a proportional change in the price level but do not alter output and employment. In other words, money is neutral to real variables in the long run and is known as money neutrality. In a simple classical model, it is illustrated that the relation between output and price is expressed as $M.V = P.Y$ where LHS denotes the amount of money handed over by the group of buyer's expenditure to the group of sellers to obtain the number of goods and services they produce. While RHS is a multiplication between the real output and the price (i.e., nominal income). Rewrite the simple model regarding growth, $\pi = p \equiv m + v - y$. It is clear that inflation is always equal to the growth of the sum of money plus the growth of velocity of money minus output growth. Thus, if money growth increases (m) then inflation will increase as well, vice versa. However, this relationship applies when the velocity of money (v) is constant. In normal short-term conditions, v and y are changing but not too large. Therefore, high inflation is not caused by changes in velocity of money and output growth but because of the growth of money supply (m).

The correlation between inflation and economic growth is more visible in the Keynesian model than the Classic model. He criticized the classical approach (i.e., Quantity Theory of Money) that separates the role of money in the economy and as-

sumes the velocity of money is constant (dichotomy) (see Galí 2008, pp. 4–8). In Keynes's proposed economic model, some classical supposition regarding the capacity that money beholds in the economy is not limited to functioning as transactions but also as store of value, speculative, and precautionary motive. In the Keynesian approach, the role of money in the economy is integrated by adding a demand equation to money. Demand for money is determined by disposable income and the real interest rate. The output is determined by the interaction between capital and labor through the production function. In the labor market, equilibrium conditions are determined by conditions where the real wage equals the marginal productivity of labor. Unlike the classical approach that considers the price to be flexible, the Keynesian approach of price and wage are rigid (price/wage rigidity) (a more detailed discussion provided in Galí 2008, pp. 41–94). In the short run, the relationship between money supply (m) and economic growth depends on the effectiveness of monetary policy transmission to output and other economic factors. If price increases (inflation), it will push the nominal interest rate to increase. Rising interest rates will lead to increased cost of funds resulting in investment spending. Since investment is part of the aggregate demand (AD), the AD is pressed down so that the output of the economy declines, and vice versa. Therefore, the relationship between inflation and economic growth is negative. The negative inflationary relationship to economic growth has been discussed in some research, such as Boyd & Champ (2006), Stockman (1981), Dornbusch & Frenkel (1973), and Feldstein (1982). Boyd & Champ (2006) argued that inflation also negatively affects real return on assets. Increased inflation is disadvantageous to savers because it reduces return from savings. Conversely, borrowers benefit because high inflation lowers the cost of funds. Investors are also not interested in investing because real returns are decreased with

inflation and thus hinder investment and economic growth.

Tobin (1965) demonstrated based on the theoretical model argued that inflation can positively affect economic growth. In Lucas (1973), as long as money is substituted perfectly, it is asserted that inflation should be low. This is to encourage economic growth by making the price and wages of workers more flexible. In general, the three views on inflation above can be concluded that inflation should not be too high, or moderate and stable to support economic growth.

In the recent research-based policy discussion concerning inflation - economic growth relationship, the topic of the debate has shifted and developed into a hypothesis whether the alliances of the two economic indicators in the medium term is non-linear with a threshold (see: Gillman & Kejak 2005). Notably, Fischer (1993) was the first to identify it in the macroeconomic study. The research showed that when inflation was at a low rate, it was found that inflation-economic growth had a positive relationship (Ghosh & Phillips 1998; Sarel 1996; Bruno & Easterly 1998). In the most recent literature, there is a relatively large number of research studies which examined and assessed the non-linearity relationship between inflation and economic growth and its threshold in the medium term (see: Khan & Senhadji 2001; Munir & Mansur 2009; Kremer, Bick & Nautz 2013; Omay & Kan 2010; and Thanh 2015). They yielded a similar result, indicating that there is non-linearity effect of inflation and growth. Empirically, they have demonstrated that a negative relationship would occur when the rate of inflation is high, and would slightly have a positive correlation with output when inflation is still at a low level. In other words, there is a certain limit that shows an inverse link between the two economic indicators. This border is known as the threshold level, where output response varies, depending on the position of the inflation level. If inflation is to be below

this limit or breakpoint determined by the threshold, then inflation will have a positive relation with output, and else-wise if inflation crosses that threshold level.

In general, most of these studies focus on industrialized countries or the single country. In developing countries, a similar study comparing the relationship between the two variables in a region of different economic levels, as far as the author's knowledge, is still very few.

This research is aimed to identify the inflation-economic growth relationship and the threshold level in the ASEAN-5 countries. In performing this analysis, in the first step, we conduct a re-examination of the relationship based on the new existing data. By comparing the best model (between a linear and a nonlinear model), the test result is expected to be able to recognize whether the result is persistent with the data and previous studies or otherwise. Additionally, if the estimation result has demonstrated nonlinearity, then stage two needs to be performed to identify the level of threshold inflation for each ASEAN-5 country. As for each country's economic situation depend on the role of government and its central bank's policy, possessing the knowledge, and clear understanding about the level of inflation threshold is prior in reaching a tremendous economic growth which is expected to be done. Through this estimation result, the correlation between variables and the different threshold level can be distinguished, as each country's economic characteristic differ from one another.

The result of this study shows that there does exist a nonlinear relationship between inflation and economic growth in the ASEAN-5 country member. Our results seem to support previous empirical studies which conclude that the relationship between inflation and economic growth is non-linear. The next step is to estimate the parameter of the TVAR model

and identifying its inflation threshold level for each country of ASEAN-5. The results of this study show that the level of threshold obtained varies among the countries in the region. The different level of threshold occurred as a result of the various relations between inflation-economic growth variables in each country of the ASEAN-5.

2. Literature Review

Theoretically, economic researchers have overcome to different conclusions regarding the relationship between inflation and economic growth. Due to money neutrality, the classic thoughts believe that there is no relation among the two. Yet, the Keynesians believe that in the long-run, money do effect economic growth. Moreover, empirical studies have determined various results, where it vary markedly from one research to another depending certain factors. These factors such as: economic condition (money supply, exchange rate, labor, interest rate), models and samples used.

Fischer (1993) was the first to identify the possibility of a nonlinear relationship between inflation and economic growth. His study was a panel of 101 countries consisting of developing and industrial countries for period 1965-1990. By using spline regression, Fischer demonstrated that inflation level between threshold 15–40% have a negative and significant correlation to economic growth and inflation below the threshold 15% is not statistically significant. This nonlinear relationship result which high inflation does not create economic growth was also found in Khan and Senhadji (2001). They employed an unbalance data panel to find the threshold level of inflation for 140 countries in the period 1960–1998. Unlike Fischer (1993), the sample was divided into three groups, which were industrial countries, developing and all countries. By using a panel test conditional least square, the threshold

obtained for industrial countries was 1–3%, developing countries group 11–12%, and all countries had a threshold of 8–12%. Despite inflation is not an exogenous variable in the output-inflation regression, the coefficient estimation may be biased which means that the endogeneity problem in this research has not been solved.

Omay & Kan (2010) using Panel Smooth Transition Regression method that solved nonlinearity and endogeneity for six industrial countries identified that there holds a negative and statistically significant relationship between inflation and economic growth when it reaches above the critical level of 2.52% threshold. Vinayagathan (2013) chose 32 sample countries in the Asia region for period 1980–2009. The result in this study demonstrated a nonlinear relationship between inflation and economic growth with a 5.43% threshold for the group of countries. Thus far, this research do not identify the causalities among variables, yet only the correlation.

In an empirical study done by Thanh (2015), ASEAN-5 (Indonesia, Malaysia, Philippines, Thailand, and Vietnam) were used as sample countries through PSTR method for period 1980–2001. The empirical result show the existence of a negative and statistically significant relationship between inflation and economic growth when inflation exceeds the threshold level 7.84%, that is the level where inflation starts to be a barrier to economic growth for ASEAN-5 countries. Thus, is this level applicable to Indonesia and the other ASEAN countries?

Through the abbreviated exposition above, it can be known that different and various threshold levels exist based on samples and methods chosen. Chowdhury & Ham (2009) stated that an economic structure and the mechanism of monetary transmission between one country to another is different, then the level of threshold rely on the stage of development of its own country. Therefore, this research will try to fill that gap by re-examining the

nonlinearity between inflation-output in ASEAN-5 and identifying the threshold level for each sample country. ASEAN-5 is known to be the strongest economy through its GDP rate in the region. As far as the researcher's knowledge, this subject might not have been done using this specific method and sample. By knowing the threshold level for each country, ASEAN-5 is expected to preserve its economic strength in the global growth.

3. Method

This research used secondary data in the form of time series period 2000–2016 with ASEAN-5 countries (Indonesia, Malaysia, Philippines, Thailand, and Singapore). These countries are known to be the biggest economies in the Southeast Asia region, which remain in the top list GDP ranks according to data acquired. This quarterly data was taken from IFS (International Financial Statistic). The data consist of economic growth, lending interest rate, and inflation. Lending rate data is used as a proxy for medium and long-term investment.

In the literature, there is no standard approach for testing non-linear relationships between inflation and economic growth. Some studies use non-linear models because the conclusions in some existing research results are conflict (some researchers report the relationship between inflation and economic growth is positive or negative, others say there is no relationship) (see: Balke 2000; Khan & Senhadji 2001; Munir, Mansur & Furuoka 2009; Thanh 2015). Based on this approach, the rejection of the null hypothesis that the model is linear implies the presence of threshold on the relationship between inflation and economic growth. According to Balke (2000), the inflation threshold is an unobserved variable which can be endogenized and treated as a regime switching. The existence of this nonlinearity testing with the threshold between infla-

tion and economic growth can be captured in TVAR model.

TVAR model is an extension form of the univariate threshold model by Tong (1983) which is used to capture the nonlinear phenomena in a multivariate time series. From previous empirical results, there remain evidence with regard to the simultaneous and dynamic two-way relation between inflation and growth. This causation experience a regime change to positive or negative, which assumed to be the result based on certain factors in a country. These factors vary from one country to another in view of the fact that each country holds its own economic character which happen to be divergent to each other. Hence, an additional variable to capture the relationship between inflation and economic growth is essential. The additional variable cause the model to become multivariate. Moreover, it allows the identification of a threshold or a point that separates two economic behaviors in the same period and captures the response of variables when shock occurs in each regime. Therefore, the method used in this study is threshold VAR.

To detect an inflation threshold effect on economic growth, we used the multivariate TVAR model and treated the threshold as an endogenous variable in the system of equations. In this study, a multivariate TVAR model consisting of three variables, i.e., inflation, economic growth, and lending rate. Following Balke (2000), the threshold effect of inflation on economic growth is used by the following model.

$$Y_t = (B_1 Y_t + B_2(L)Y_{t-1} + B_3(L)Y_2)I_t(C_{t-d} > \gamma) + u \quad (1)$$

where:

Y_t : Vector of endogenous variable of PDB, interest rate of credit, inflation in period t;

C_t : Lag inflation threshold variable (-1);

I_t : Function indicator that has a value of 1 if the lag

of the threshold INF_{t-1} variable is lower than the critical value threshold γ , and 0 if otherwise;
 $B_1(L), B_2(L), B_3$: Lag polynomial matrix;
 U_t : Structural Error term.

C_{t-d} is the threshold variable that determines which regime the system is in, and $I_t[C_{t-d} > y]$ is an indicator function that equals 1 when $[C_{t-d} > y]$, and 0 otherwise. Threshold variable is a function of inflation rate. As in a VAR model, in the TVAR model, all variables are endogenous, including economic growth variables. Therefore, if there were to be a shock to output, lending rate and inflation can be determined whether the economy is below or above the threshold.

This methodology has allowed us to give contribution in a different aspect. Through this model replication of Balke (2000) we are able to distinguish varying applications in each ASEAN-5 country. By using the variable inflation as the threshold, this paper has also managed to attempt its contribution to output growth.

3.1. Analysis on linear Impulse Response Function

Regime changes that occur in dynamic relationships cause the relationship of variables PDB, lending rate, and inflation to have behavioral changes in response due to shock on the same variable, at a certain period. IRF analysis has a function to recognize the effect of one variable change to another variable dynamically. This is done in the presence of shock (one or two standard deviations of the variable) given to one of the endogenous variable. IRF is performed to track the effect of current and future shock experienced by a variable on the value of all variables, to characterize a dynamic structure. Briefly, the impulse response analysis was conducted to measure how long the effect of shock on the research series response.

Since the TVAR model divides the model into two regimes, the upper and lower regime, the effect of shock also differs on each regime in the VAR threshold model. Nonlinear analysis of IRF focuses on asymmetric responses of research variables to positive or negative shocks by one or two standard deviations. We used the results of the comparison of the sum of squared residuals (SSR) values between linear and nonlinear models to detect the nonlinearity relationship between inflation and economic growth. Given the results taken from previous results, the next step is to estimate the value of the inflation threshold based on the TVAR model.

4. Results and Analysis

Table 1 shows estimation results of threshold inflation level in the ASEAN-5 countries which are under analysis. The estimation results indicate that the threshold value of each country is varied. In Indonesia, inflation will be positively associated with economic growth if inflation is below the 5.26% threshold level, and has a negative relationship if it passes that limit. In other words, there will be an economic slow-down if the rate of inflation exceeds its threshold level. Then, Malaysia has a threshold value of 2.39%; the Philippines 3.32%; Thailand 2.29%; and Singapore 1.16%. Different estimations of threshold signify that the threshold level found by Vinayagathan (2013) and Thanh (2015) using the panel data method cannot be implemented in each country in this research. Furthermore, in the analysis of nonlinear IRF, it can be concluded that there are different output responses in each regime in the event of an instant shock. The magnitude of the response is also not the same between countries towards other countries. Shocks have a greater impact on output growth when inflation is in the upper regime than the lower regime. This is consistent with the results of Balke (2000). The existence of

different inflation threshold value in each country took place probably because the different effectiveness of monetary policy in affecting the economic growth.

Figure 1 exhibits that the estimated results for each ASEAN-5 country have indicated different threshold levels. The horizontal line that crosses each graphic is the threshold line. If the inflation level moves up and crosses that line, the level of economic growth tends to move down. Whereas, when the price level indicator is within below the threshold, has no negative effect and tends to push the inflation rate to the same direction as output growth.

4.1. Policy Implications

With the existence of knowledge about nonlinearity relationship and inflation threshold level, it is likely to provide guidance to the government and central bank in maintaining the inflation rate. By maintaining the level so as not to exceed the threshold limit, the economic growth of each country can be achieved optimally. Furthermore, the threshold value can be used as a parameter that assesses the performance of the government in controlling the economy of the country. If the actual inflation exceeds its threshold limit, it means that the central bank's performance along with the government has not been maximized. Conversely, when inflation is below the threshold it is considerably good, as policymakers have achieved more optimal economic growth.

4.2. Nonlinear Impulse Response Function

To find out more about the dynamic elements contained in the Threshold VAR model, an impulse response is performed. Through this analysis, it

is possible to find out how the variables in this research react to shocks on themselves or other endogenous variables through simultaneous dynamic equations. However, what will be explained in this research is only limited on how the output variables react in the event of shock lending rates and inflation. Unlike the IRF analysis on linear model analysis, the evaluation in this nonlinear model is slightly more complicated.

In this nonlinear model, the sample is divided into two regimes, named lower and upper regime. Through the nonlinear impulse response function, it shows the effect of output due to shocks that happen to each ASEAN-5 country in two different regimes. The IRF analysis is expected to measure the average effect due to uncontrollable shock and also to see that there are different influences or responses in each regime.

Based on the nonlinear IRF analysis in this research results we can observe that there are differences in behavioral relationships of variables in each country. The difference in the act depends on which regime the inflation lie at. Shock tends to have a more considerable influence on output growth when the economy is in the upper regime. The result is in line with the results of Balke (2000). The distinction in the interaction of the relationship between lending rate shock and inflation shock on output at the lower or upper regime has shown an asymmetric character.

By looking at Figure 2, it is clear that a contractive shock through lending rates create a negative response to some countries when inflation is in the lower regime. This happens in Malaysia, Thailand, and Singapore. With this shock at a time when the economy is likely to run moderate, the economic growth rate becomes slower. As the lending rate is inversely proportional to the amount of credit disbursed to the public, this condition is in line with the identification of Avdjiev & Zeng (2014). In their

Table 1: Threshold Estimation on ASEAN-5 Countries

Countries	Threshold Variables	Threshold Estimations
Indonesia	inf_{t-1}	5.26%
Malaysia	inf_{t-1}	2.39%
Filipina	inf_{t-1}	3.32%
Thailand	inf_{t-1}	2.29%
Singapura	inf_{t-1}	1.16%

Source: Research Results

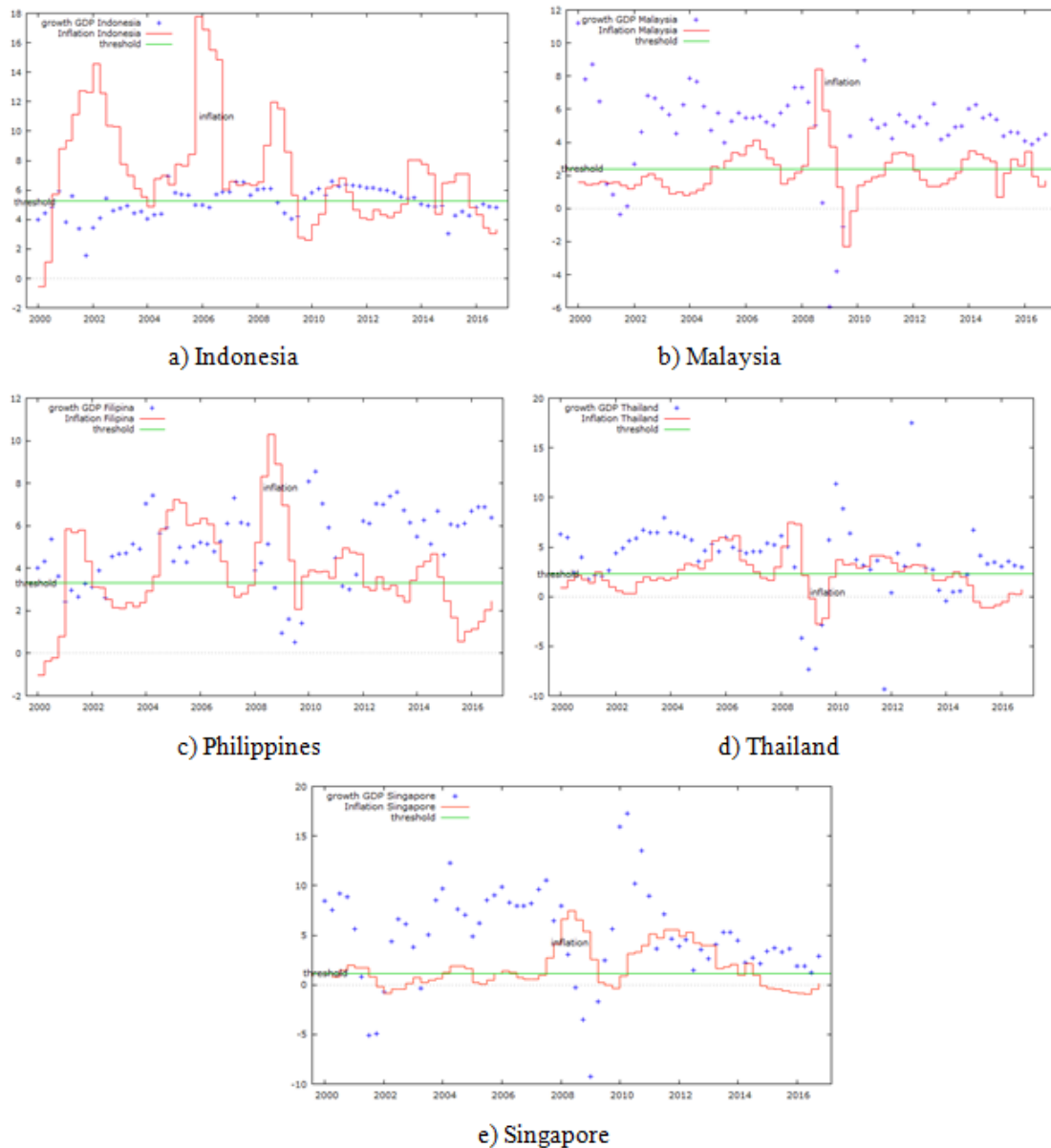


Figure 1: Threshold Position in ASEAN-5 Country

Source: Research Results

research, the shock of credit disbursed is more effective in promoting aggregate demand when the economy operates with moderate growth rates or recessions rather than when the economy runs intensively quick.

However, the situation is different with the output response conditions that occurred in Indonesia and Philippines. In Indonesia, this shock lending rate makes a positive response during the lower regime period shown on the IRF graphic. This is alleged because people in Indonesia still have high purchasing power so that this shock can balance the pattern of consumption or public investment. Therefore, in this period, the implementation of policies that control the rate of the money supply can be applied even though inflation is in the lower regime. Meanwhile, in the Philippines, it shows that shock serves as a stimulus of growth only momentarily, which after two quarters will be followed by a negative response.

The existence of a lending rate shock when the economy is in the upper regime has given a variation of response to the ASEAN-5 region. For Malaysia and Thailand, a positive reaction is indicated at the beginning of the period. This is likely because the shock serves as a controller to the economy when it motions too fast. Despite this shock, the output is increasing but only temporarily. After the third to the fifth quarter, output declines. Therefore, the government should re-implement loose monetary policy since the third quarter during the upper regime. While in Indonesia, Philippines, and Singapore, the positive shock lending rate may create the cost of capital to become more expensive. This allows output to decrease as an indication of the negative output response since the first quarter. This implies that the government can anticipate in the event of shocks to lending rates that bring more declination in output increase since the beginning of the period.

Expansive inflationary shock can act as a stimulus to economic growth when the country reside in the lower regime, which is in line with Tobin (1965). This inflation shock contributes to the economy when the inflation rate is below the threshold. In this research, this occurs in the Philippines and Thailand. The magnitude of this positive shock gradually moves back to the balance point in the second quarter. This positive relationship is also shown in the Phillips curve, where inflation occurs as a result of a wage boost that induces an increase in demand for goods and services during 'normal' economic conditions. Meanwhile, positive inflation shock creates a decline in the economic growth in Indonesia, Malaysia, and Singapore, both in lower and upper regimes. However, the size of the output response to such shock is greater during the upper regime. This is due to people's sensitivity to price changes is much higher in the upper regime than below. However, rising prices will slow down the economy, but with the initial low inflation rate (lower regime), might not have too much effect in reducing the economy than the adverse rate.

This IRF analysis provides information on how the effects of output due to different shocks vary in each country. Furthermore, in addition to the different output responses in each country, there is a different response between the upper regime and the lower regime. Through this analysis, the behavior of the dynamic relationship of inflation - economic growth is shown clearly and can be understood more easily.

5. Conclusions

The role of money in economic growth has become an important concern to economists since the past period. This raises various interesting debates. Especially, the question of whether inflation can positively or negatively affect economic growth is still

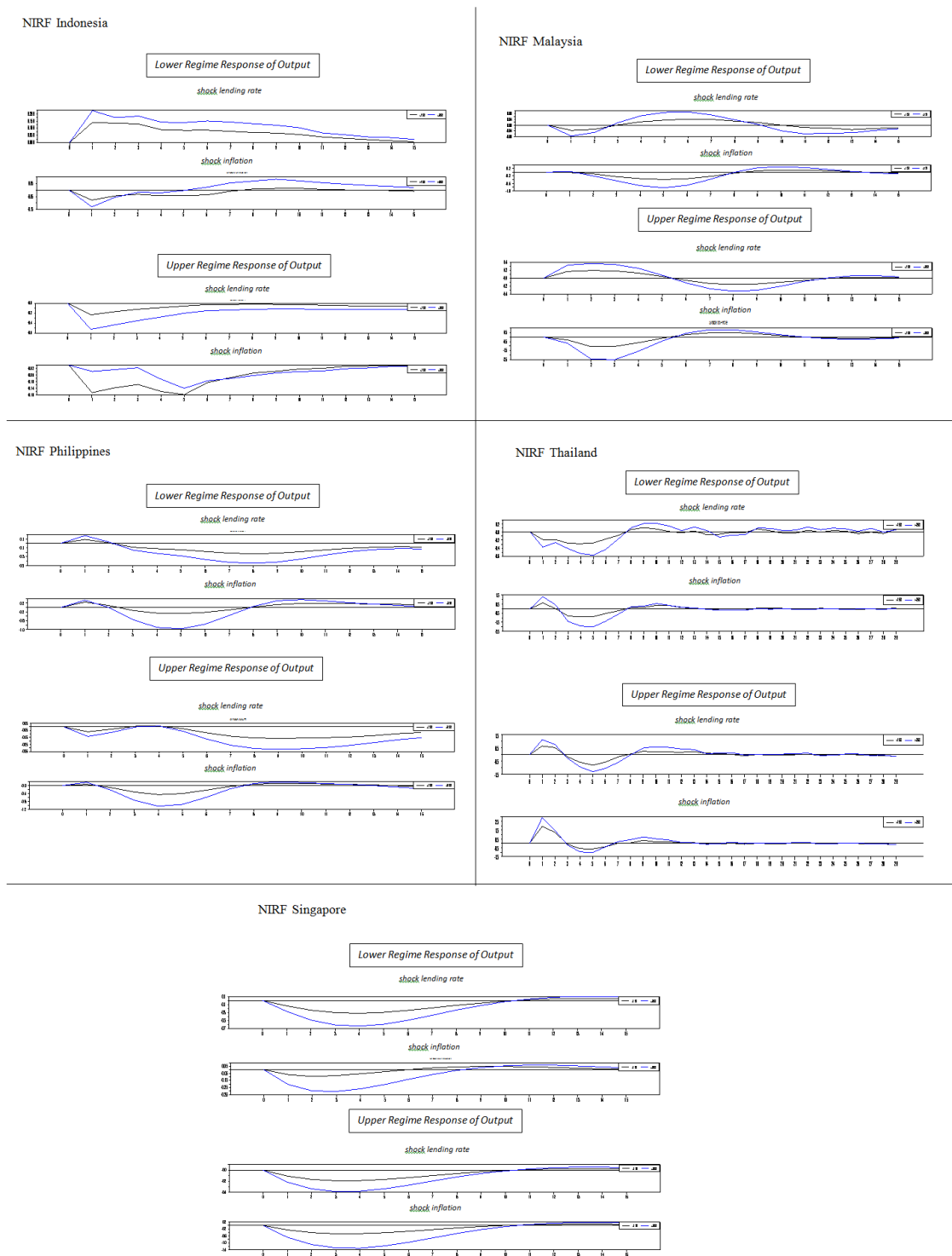


Figure 2: Output Responses towards Shock in ASEAN-5 Countries
Source: Research Results

unclear. Classical understanding through a classical dichotomy explains the neutral nature of money to economic growth. Then, the existence of the role of money in output began to be recognized after Keynes denied the dichotomy. Money is expected to have the power of value or price stability, and the existence of economic growth so that people's welfare is achieved. On the empirical ground, various approaches have been employed by researchers. However, the results and recommendation conflict among studies. This disagreement has led some researchers to investigate the existence of nonlinearity in the relationship of the two important economic indicators. This study attempts to re-examine the nonlinearity in the ASEAN-5 in the period 2000–2016. We followed the methodology suggested by Balke (2000) to identify whether the inflation-output causality is nonlinear or not in the country under investigation. By comparing linear and TVAR model, the results show that the hypothesis stating the existence of a nonlinear relationship between inflation and economic growth cannot be rejected. The nonlinear relationship between the two variables in our study provide additional empirical evidence to Phillips' asymmetrical curve. This nonlinearity nexus with threshold means that the role of inflation on output can be positive, and can sometimes turn into negative. The threshold divides the model into two regimes. At a time when inflation is in the upper regime, the economic growth response indicates a slowdown. Meanwhile, when inflation is still in the lower regime, then the movement of inflation tends to be in line with economic growth even though the threshold value of each country is varied.

However, this study have some limitations where further researchers might be able to overcome the issues. Firstly, this study only estimate one threshold with two regimes. Thus, it is also possible to estimate more than one threshold (i.e., two thresholds with three regimes). This is useful for policy makers to be able to set a target inflation based on

the range between the two thresholds. Moreover, the connection of inflation and economic growth to other economic variables are very extensive, so the usage of more than three variables can be done in further research.

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