TESTING THE DYNAMIC RELATIONSHIP OF INFLATION AND INTEREST RATES : FISHER EFFECT TESTING

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ABSTRACT

This paper aims to investigate the testing of the dynamic relationship between inflation and interest rates, commonly known as the Fisher Effect, in both developed and developing countries. Testing The Fisher Effect is performed using dynamic models that include testing cointegration, testing with Error Correction Model (ECM), and testing with Autoregressive Distributed Lag (ADL). The use of dynamic models is chosen because the change of an economic variable no in a manner instantly causes the change of another economic variable at the same time, however, there is a time lag. The empirical test results show that: (1) the Fisher Effect occurs in developed countries and developing countries, both in the short term and in the long term, which means that the expected inflation affects positively the nominal interest rate in developed countries and developing countries, both in the short term and long term, (2) the determination of the nominal interest rate by commercial banks this month is influenced by inflation information in the previous month, or in other words, there is a time lag in the effect of inflation on interest rates.

Keywords : Dynamic Relationship; Inflation; Interest Rate; Fisher Effect

ABSTRAK

Tulisan ini bertujuan untuk menyelidiki pengujian hubungan dinamis antara inflasi dan suku bunga, yang biasa dikenal dengan Fisher Effect, baik di negara maju maupun negara berkembang. Pengujian Fisher Effect dilakukan dengan menggunakan model dinamis yang meliputi pengujian kointegrasi, pengujian dengan Error Correction Model (ECM), dan pengujian dengan Autoregressive Distributed Lag (ADL). Penggunaan model dinamis dipilih karena perubahan suatu variabel ekonomi tidak secara instan menyebabkan perubahan variabel ekonomi lain pada waktu yang bersamaan, namun terdapat jeda waktu. Hasil uji empiris menunjukkan bahwa: (1) Fisher Effect terjadi di negara maju dan negara berkembang, baik dalam jangka pendek maupun jangka panjang, artinya ekspektasi inflasi berpengaruh positif terhadap suku bunga nominal di negara maju dan negara berkembang , baik dalam jangka pendek maupun jangka panjang, (2) penetapan suku bunga nominal oleh bank umum bulan ini dipengaruhi oleh informasi inflasi bulan sebelumnya, atau dengan kata lain terdapat jeda waktu pengaruh inflasi pada suku bunga.

Kata Kunci : Hubungan Dinamis; Inflasi; Suku bunga; Efek Fisher

INTRODUCTION

The interest rate is the cost of using borrowed funds. The interest rate is one of the important economic variables in a country's economy. The level of investment in a country is very dependent on the interest rate because the high or low interest rates will

affect the size of the capital costs borne by investors, which in turn will affect the investment decisions that will be taken by investors (Mankiw, 2007: 288-289). The level of investment in a country will affect national income and the level of availability of employment in that country. The lower the interest rate, the higher the investment level. The higher the level of investment, the higher the national income and the greater the number of jobs, so that prosperity is higher and unemployment is lower.

Another important economic variable is inflation. Inflation is the level of increase in prices of goods and services in general. The higher the inflation, the lower the people's purchasing power for goods and services because the higher the inflation, the less goods and services people can buy with a certain amount of money. High and uncontrolled inflation can have a negative impact on a country's economy. Inflation and interest rates are two economic variables that are interconnected with one another. To control inflation, the central bank can adopt a monetary policy in which one of the instruments is the interest rate. On the other hand, in setting the nominal interest rate, commercial banks always pay attention to the inflation rate, or in other words, inflation affects the determination of the nominal interest rate.

One theory or hypothesis that explains the relationship between inflation and interest rates is Fisher's hypothesis (Dogan et al al., 2020; Ongan And Gocer, 2020; Ongana And Gocerb, 2020; Fair et al., 2020; Mishkin, 1992; Jareño and Tolentino, 2012). Fisher stated that the nominal interest rate moves one-for-one with changes in the expected rate of inflation. The one-to-one relationship between expected inflation and the nominal interest rate is referred to as the Fisher Effect (Mankiw, 2007: 92, 94). If each change in expected inflation causes a change in the nominal interest rate with the same change in value, then the strong version of the Fisher effect occurs. However, if a change in expected inflation causes a change in the nominal interest rate where the value of the change in inflation is not the same as the nominal interest rate, then a weak version of the Fisher effect occurs.

This paper intends to investigate the testing of the dynamic relationship between inflation and interest rates in developed and developing countries. The reason for studying dynamic relationship testing is because changes in an economic variable do not immediately cause changes in other economic variables at the same time, but there is a time lag . By examining the test of the dynamic relationship between inflation and

interest rates , this study seeks to answer two questions, namely (1) does the Fisher effect occur in developed and developing countries, both in the short and long term , and (2) whether the nominal monthly interest rate This is influenced by the previous month's inflation information, or in other words there is a time lag in the effect of inflation on interest rates.

LITERATURE REVIEW

Theories of Interest Rates

In general, there are two main theories that discuss interest rates, namely the theory of loanable funds and the theory of liquidity preferences. According to the theory of loanable funds, the interest rate is the price for the use of loanable funds (Mankiw, 2007: 66). The interest rate is determined by the supply and demand for loanable funds. Savings is the supply of loanable funds. In this case, households lend their savings to investors or save them in a bank which then lends the funds to other parties. Investment is request to fund loan. In this case, investors borrow funds from the public directly by selling bonds or indirectly by borrowing from banks.

In his classic book The General Theory, Keynes describes his views on how interest rates are determined. Keynes's explanation is called the theory of liquidity preference, because it states that interest rates adjust to balance the supply and demand for the economy's most liquid asset (money). The theory of liquidity preference asserts that the interest rate is one of the determinants of how much money people want to hold (Mankiw, 2007: 292-293). The reason is that the interest rate is an opportunity cost for those who hold money, namely costs that must be borne for holding some assets in the form of money, thereby losing the opportunity to earn interest if the money is saved in the form of deposits or used to buy bonds. The implication is that when interest rates rise, people just want to hold less money. According to the theory of liquidity preference, the supply and demand for real money balances determines the interest rate that will appear in the economy, that is, the interest rate adjusted to balance the money market. Adjustments occur because when the market is not in equilibrium, people try to adjust their portfolios of assets and, in the process, change interest rates.

Nominal Interest Rate and Real Interest Rate

Economists refer to the interest rate paid by banks as the nominal interest rate, while the increase in purchasing power is called the real interest rate (Mankiw, 2007:

91). If i represents the nominal interest rate, r represents the real interest rate, and π represents inflation, then the relationship between the three variables can be written as:

$$r = i - \pi$$

The real interest rate is the difference between the nominal interest rate and the inflation rate.

Fisher Effect

If we rearrange the real interest rate equation above, we can see that the nominal interest rate is the sum of the real interest rate and inflation:

$$i = r + \pi$$

The equation above is called the Fisher Equation , taken from the last name of the economist Irving Fisher (1867-1947). The above equation shows that interest rates can change for two reasons: because real interest rates change or because inflation rates change. Once we have separated the nominal interest rate into its two parts, we can expand this equation to develop a theory that explains the nominal interest rate. As it is known that the real interest rate adjusts to balance saving and investment. The quantity theory of money suggests that the rate of growth of money determines the rate of inflation. Fisher's equation then asks us to add the real interest rate to the inflation rate to determine the nominal interest rate. According to Fisher's equation, a 1 percent increase in the inflation rate will lead to a 1 percent increase in the nominal interest rate. The Fisher effect is a one-for-one relationship between the inflation rate and the interest rate (Mankiw, 2007: 92).

The nominal interest rate cannot adjust for actual inflation, because actual inflation is not known when the nominal interest rate is set. Nominal interest rates can only adjust to expected inflation (Mankiw, 2007: 94). Therefore, the Fisher effect is expressed by:

$$i = r - \pi^{e}$$

In the above equation, i is the nominal interest rate, πe^{is} the expected inflation and r is the real interest rate expected at the time the agreement is made by the lender and borrower. According to the Fisher equation, a 1 percent increase in the expected rate of inflation will lead to a 1 percent increase in the nominal interest rate. Thus, according to Fisher's equation above, the nominal interest rate i moves one-to-one with changes in the expected inflation rate π^{e}. The one-to-one relationship between expected inflation

and the nominal interest rate is referred to as the Fisher Effect (Mankiw, 2007: 94). If each change in expected inflation causes a change in the nominal interest rate with the same change in value, then the strong version of the Fisher effect occurs. However, if a change in expected inflation causes a change in the nominal interest rate where the value of the change in inflation is not the same as the nominal interest rate, then a weak version of the Fisher Effect occurs.

RESEARCH METHOD

Statistical Analysis Techniques

Analysis techniques commonly used to examine the dynamic relationship between inflation and interest rates are data stationarity analysis, cointegration analysis, Error Correction Model (ECM) analysis and Autoregressive Distributed Lag (ADL) analysis. The stationarity analysis of the data is basically only an initial analysis to detect stationary data on inflation and nominal interest rates, which will be used as a basis, justification and complement for subsequent analyses. After testing the stationarity of the data, further analyzes are carried out using dynamic models which include cointegration analysis, Error Correction Model (ECM) and Autoregressive Distributed Lag (ADL).

Data Stationarity Test

The data stationarity test is necessary because to carry out regression analysis with time series data, the assumption of stationary data is required. In addition, the data stationarity test is needed because the results of the data stationarity test will be used as a basis, justification and complement for subsequent analyses. The data stationarity test that is often used is the Augmented Dickey-Fuller Test or commonly known as the unit root test with the hypothesis:

Ho : $\varphi = 1$ (data not stationary)

H1 : $\varphi < 1$ (stationary data)

With the equation: $X_t = \varphi X_{t-1} + \mu_t$

Cointegration Test

Cointegration analysis was carried out with the aim of knowing whether there is a long-term relationship (or balance) between one variable and another (Westerlund, 2005; Sjölander et al. , 2017, Omay et al., 2015). In the context of testing the Fisher Effect, what is being tested is the long-run relationship between inflation and nominal

interest rates. Two variables that are not stationary before differentiation but stationary at the first level of differentiation, cointegration is likely to occur, which means that there is a long-term relationship between the two. Cointegration testing in this study uses the Johansen test.

Error Correction Model (ECM)

Error Correction Model (ECM) analysis is performed to find out whether there is a short-term or long-term relationship between inflation and the nominal interest rate, after correcting errors for short-term imbalances. The ECM approach was introduced by Sargan, developed by Hendry, and popularized by Engle and Granger . The ECM equation used in testing the dynamic relationship between inflation and interest rates was developed by Engle Granger.

Autoregressive Distributed Lag (ADL) Model

Autoregressive Distributed Lag (ADL) model was carried out with the aim of knowing whether this month's interest rate is affected by this month's inflation, the previous month's inflation or the previous month's interest rate.

RESULTS AND DISCUSSION

Testing the Dynamic Relationship between Inflation and Interest Rates in Developed Countries

Research that examines the dynamic relationship between inflation and interest rates, among others, was conducted by Anari And Kolari (2016) , Westerlund (2008) , Westerlund (2005), Mankiw (2007:92), and Wallace and Warner (1993). Research by Anari and Kolari (2016) uses inflation data and annual interest rates for the period 1960-2015 in the United States. The research results of Anari and Kolari (2016) using a dynamic model found that the Fisher Effect occurs in the United States, both in the short and long term, which means that there is a positive correlation between inflation and interest rates in both the short and long term in the United States. during the period 1960-2015.

Westerlund 's research (2008) uses quarterly inflation and interest rate data from 1980 to 2004 in 20 countries that are members of the OECD (Organization for Economic Co-operation and Development), namely Australia, Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Switzerland, United Kingdom, United States, Denmark, Ireland, Luxembourg, New Zealand and

Sweden. By using a dynamic model, the results of Westerlund's research (2008) show that the Fisher effect occurs both in the short and long term, which means that inflation is positively correlated with nominal interest rates in both the short and long term in the 20 developed countries .

Westerlund's research (2005) uses monthly inflation data from January 1980 to January 1999 in 14 developed countries namely Australia, Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Switzerland, England and United States . The results of Westerlund's research (2005) using a dynamic model found that the Fisher Effect occurs both in the short and long term in these 14 developed countries, which means that inflation is positively correlated with nominal interest rates in both the short and long term of these countries. the forward .

Mankiw (2007:92), using data on nominal interest rates (as measured by the three-month deposit rate) and inflation (as measured by the consumer price index) starting in 1954 to 2005 shows that the Fisher Effect occurs in the United States . These results prove that empirically high inflation leads to high nominal interest rates in America. Meanwhile, Wallace and Warner's (1993) research attempted to investigate whether the Fisher Effect occurred in the United States both in the short and long term by using a dynamic model. The data used by Wallace and Warner (1993) are data on inflation and nominal interest rates in the United States from 1948 to 1990. The results of Wallace and Warner's (1993) research show that inflation and nominal interest rates are cointegrated. In general, by using a dynamic model, Wallace and Warner's (1993) study found that there is a positive relationship between inflation and nominal interest rates in both the short and long term in the United States .

Testing the Dynamic Relationship between Inflation and Interest Rates in Developing Countries

Empirical testing of the dynamic relationship between inflation and interest rates in developing countries was carried out, among others, by Bayat and Tasar (2018), Fajar (2010), and Setiawan (2009). Bayat and Tasar's research (2018) uses inflation and interest rate data for the period January 2000 to January 2016 in five developing countries, namely Indonesia, Brazil, India, Turkey, and South Africa. The results of Bayat and Tasar's research (2018) show that the Fisher Effect occurs in Indonesia and Brazil, but does not occur in India, while the results in Turkey and South Africa cannot

be confirmed. Thus, it can be concluded that by using data for the period January 2000 to January 2016, there is a significant dynamic relationship in both the short and long term in Indonesia and Brazil.

The results of Fajar's research (2010) used quarterly inflation and interest rate data from the first quarter of 1986 to the second quarter of 2010 in Indonesia. By using a dynamic model, the results of Fajar's research (2010) show that the Fisher Effect occurs in Indonesia, both in the short and long term, which means that there is a positive correlation between inflation and interest rates, both short and long term, in Indonesia during the period 1986-2010.

Meanwhile, Setiawan's research (2009) aims to examine the dynamic relationship between inflation and interest rates in Indonesia. By using rate data nominal interest and inflation Indonesian monthly start month January 1996-February 2008, cointegration test results show that there is a long-term relationship between the inflation rate and the nominal interest rate in Indonesia. The results of testing with the Error Correction Model (ECM) show that in short term and long term, inflation and nominal interest rate have a significant relationship because after being done correct error on the short-term imbalance, the relationship between inflation and nominal interest rate is still significant.

Furthermore, in Setiawan's research (2009), the results of testing with the use of Autoregressive Distributed Lag (ADL) show that the level of monthly nominal interest is not influenced by inflation in this month, however, influenced by inflation in the previous month and nominal interest rate in the previous month. Three results of testing (cointegration testing, testing with ECM, and testing with ADL) show that The Fisher effect occurs in Indonesia during the period January 1996-February 2008. In other words, the research results of Setiawan (2009) show that expected inflation has a positive effect on the nominal interest rate, both in the short term and in the long term.

Another interesting finding discussed in Setiawan's (2009) research is that the monthly nominal interest rate is not influenced by inflation in this month, however, influenced by the previous month's inflation and the previous month's nominal interest rate. These findings show that a reaction to the change of economic variable to another economic variable does not happen instantly, however, needs time lag. According to

Gujarati (2009: 622-623), there are three main reasons why lags occur, namely (1) psychological reasons, (2) technological reasons, and (3) institutional reasons.

1. Psychological reasons

Due to the force of habit, economic actors will not make instant changes from habits because the change process will result in an immediate loss of use (immediate disability). Based on this reason, commercial banks will not change the nominal interest rate immediately when there is a change in inflation because the change process will cause the bank to lose its immediate use in both collecting and distributing public funds so banks need time to make changes to the interest rate. the nominal interest rate in response to changes in inflation. The results of this study indicate that inflation in the previous month had a significant positive effect on the nominal interest rate this month. These results indicate that the determination of the nominal interest rate this month is influenced by inflation information in the previous month, and is not affected by inflation this month. Psychologically, banks will have expectations that the inflation rate will be high this month when inflation was high in the previous month. This caused inflation in the previous month to have a significant positive effect on the nominal interest rate this month.

2. Technological reasons

Technological reasons related to the problem of inflation and nominal interest rates are reasons related to the availability of information. The occurrence of a time lag in the effect of inflation on nominal interest rates can be caused by the unavailability of sufficient and relevant information that can be used by economic actors (commercial banks) for decision-making. Setiawan's (2009) research period was from January 1996-February 2008. During most of this research period, particularly from mid-1997 to around the end of 2003, the Indonesian economy was in a state of crisis, which was marked by changes in economic variables (especially exchange rates, JCI, inflation, and interest rates) that are so fast and difficult to predict. Uncertain economic conditions reoccurred from early 2007 to February 2008 due to an increase in world oil prices which were already very high and very difficult to predict. In general, this research period is full of uncertainty. This causes banks to need time to increase (decrease) nominal interest rates in response to rising (decreasing) inflation.

3. Institutional reasons

Institutionally, in order to maintain macroeconomic stability, Bank Indonesia as the central bank influences the level of nominal interest rates at commercial banks through monetary policy instruments such as political discounting, open market operations through the SBI and SBPU mechanisms, and policies regarding reserve requirements. In general, during the study period, Bank Indonesia's policy as the central bank was more aimed at maintaining exchange rate stability by playing with the interest rate variable. Therefore, changes in the nominal interest rates of commercial banks at one time do not automatically reflect changes in expected inflation at that time.

CONCLUSION

There are two important conclusions that this paper produces, namely (1) the Fisher effect occurs in developed countries and developing countries, both in the short and long term, which means that expected inflation affects the nominal interest rate in developed and developing countries, both in the short and long term, (2) the determination of the nominal interest rate by commercial banks this month is influenced by inflation information in the previous month, or in other words there is a time lag in the effect of inflation on the nominal interest rate.

The results of this study have implications for economic actors, especially commercial banks, namely commercial banks need to pay attention to the previous month's inflation in determining this month's nominal interest rate. The limitations of the studies that have been conducted related to testing the Fisher Effect are not dividing the research period into periods of economic crisis and not an economic crisis so that it cannot be known separately whether the Fisher Effect applies during the economic crisis and when there is no economic crisis, and also it is not known how the impact of the economic crisis on the occurrence of the Fisher Effect. Therefore, the next research is suggested to divide the research period into periods of economic crisis and periods of non-economic crisis.

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