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The Effect of Interest Rates, Exchange Rates and Output Gap on Inflation in Five ASEAN Countries: A Panel Data Evidence

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Abstract. Almost every country, both developed and developing ones, faces stability problems and economic growth problems. One of the issues that receives special attention in each country is inflation. Inflation is seen as a crucial variable for potential economic conditions where sustainable economic growth is the main goal of every country. Unstable inflation can be influenced by macroeconomic variables, including interest rates, exchange rates, and output gaps. Observing how the determinants affect inflation, we hypothesize that interest rates and exchange rates have a negative and significant effect on inflation while the output gap has a positive and significant effect on inflation. To explore our goals, we use panel data consisting of ASEAN countries including Indonesia, Malaysia, Singapore, Thailand and the Philippines. The panel data analysis method allows us to study the dynamics of changes with time series by using the Fixed Effect Model. The data used in this study are secondary data for 2000–2019 obtained from the World Bank and Global Economic Data, Indicators, Charts & Forecasts. The results showed that the variables Interest Rate, Exchange Rate and Output Gap together had a significant effect on inflation. Interest Rates and Exchange Rates have a negative and significant effect on Inflation in the five ASEAN countries. Meanwhile, the Output Gap has a positive and significant effect on inflation in the five ASEAN countries. Indonesia and the Philippines have the highest inflation estimates. Indonesia is the country with the highest inflation with an average inflation of 6.76 %.The lowest inflation intercepts and estimates were in Singapore. The inflation rate over the past 20 years in Singapore has tended to fluctuate with an average of 1.53 %.

Key words: inflation; interest rates; exchange rates; output gap.

JEL E4, E31, F2, F31

1. Introduction

The economic stability of a country is a benchmark for sustainable economic development. Correspondingly, the problem of economic stability is also a classic problem, especially for developing countries [1]. Almost every country, both developed and developing, faces stability problems and economic growth problems [2].

One of the issues that receives special attention in individual countries is inflation. Its ever-increasing development provides obstacles to economic growth in a better direction [3]. Inflation tends to occur in developing countries as well as countries in ASEAN [4].

Inflation is seen as a crucial variable for potential economic conditions, where sustainable economic growth is the main goal of every nation [5, 6]. Domestic failures or shocks will cause price fluctuations in the domestic market and end up with inflation in the economy.

The year-over-year rate of inflation continues to fluctuate due to erratic rises and decreases over time, after a major contraction occurred in 1998. Around the

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end of 1999, Bank Indonesia (BI) adopted inflation targeting as part of its approach to monetary policy [7]. In 2005 the Indonesian state had a high inflation rate of 17.1 percent because the world oil price increased.

In addition, Malaysia saw an increase in inflation of 3.5 percent, followed by Singapore's inflation rate of 1.3 percent, after which inflation in Thailand and the Philippines was 5.8 percent and 6.7 percent, respectively. Then in 2008 there was a global economic crisis centered in the United States. This crisis has had a considerable impact on the global economy, especially for countries that have very close economic ties with the United States.

In this regard, the five ASEAN countries also felt the impact, although not as much as the monetary crisis of 1998. The deepening global economic slowdown and the decline in global commodity prices [8; 9] and encouraged the decline in export growth of household consumption, investment, and imports in five ASEAN countries.

This study aims to analyze the effect of Interest Rates, Exchange Rates, and the Output Gap on inflation in five ASEAN countries. Observing how the determinants affect inflation, we hypothesize that interest rates and exchange rates have a negative and significant effect on inflation while the output gap has a positive and significant effect on inflation.

The hypothesis of the study: Interest rates and exchange rates have a negative and significant effect on inflation and the output gap has a positive and significant effect on inflation.

To explore our goals, we use panel data consisting of ASEAN countries including Indonesia, Malaysia, Singapore, Thailand, and the Philippines. The rest of the research is structured as follows, a literature review in the form of relevant previous articles discussing inflation, methodology, discussion, and final conclusions.

2. Literature Review

Unstable inflation developments can be influenced by macroeconomic variables [10], one of which is the interest rate variable. Carvalho et al. [11] in their study mentioned that the difference in inflation rates among countries is then often considered to come from the credibility of the government, the quality of monetary policy institutions, practical arrangements in the Central Bank. In terms of controlling inflation, it is likely to require more than a tight and vigilant monetary policy [12; 13].

According to McLeay et al. [14] and Smets [15] interest is one way for monetary authorities to control the money supply which will later maintain a balance of price levels. According to the findings of Islam et al. [16] the government's monetary policy can address the problem of high inflation in Malaysia, these policies include raising bank interest rates, selling securities in open markets, raising reserve ratios, and regulating consumer credit.

The next factor affecting inflation is the exchange rate. The exchange rate is an important macro variable in the economy because the exchange rate is used to measure the economic level of a country [17]. Exchange rate volatility have significant effect on trade [18] and another factor that can lead to inflation is the gap between excess aggregate demand that is not offset by aggregate supply in an economy. This gap is called the output gap.

The output gap is defined as the percentage difference between actual output and potential output [19; 20]. According to Baharumshah et al. [21] high and unstable inflation is very important to pay attention to considering its impact on the economy which can cause uncertainty for economic actors in making decisions that will ultimately disrupt a country's economy.

Research of Lim & Sek [22] discusses the factors that affect inflation in two groups of countries (high inflation group and low

inflation group). Related results show that GDP growth and imported goods and services have a significant long-term path to inflation in low-inflation countries. The results of the study also show that the money supply, government spending, and GDP growth are the determinants of inflation which have a long-term impact on high inflation in countries experiencing inflation. Even in the short term, none of these variables has proven to be a significant factor in countries with high inflation. However, the money supply, imports of goods and services, and GDP growth are significantly related to inflation in countries with low inflation.

The paper researched by Khan & Gill [23] focuses on the determinants of inflation in Pakistan using four prices indicators, namely CPI, WPI, SPI, and GDP Deflator for the long term (period 1971–1972 to 2005–2006). Found that the depreciation of the exchange rate and increase in the value of imports contributed to increases in the CPI, WPI, SPI and GDP deflator.

Paper researched by Nguyen et al. [24] uses a simple macroeconomic inflation model to investigate empirically CPI inflation in Vietnam during the period 2001 to 2009. Using a time series estimation technique, this article finds that inflation persists and the money supply, interest rate, oil prices and rice prices have the strongest influence on CPI inflation.

The paper researched by Mohanty & John [25] attempts to identify the determinants of inflation in India. Identified domestic inflation determinants such as crude oil price, output gap, fiscal policy and monetary policy, and their relationship with inflation are studied in the structural vector automatic regression model (SVAR). It was found that the dynamics of inflation in India has changed over time with various determinants showing significant time variations in recent years, especially after the global financial crisis.

This paper provides an empirical analysis of the dynamics of inflation in factors Ghana uses boundary tests and other econometric approaches. In this article it is found that the real output, nominal exchange rates, broad money supply, nominal interest rates and fiscal deficits play a dominant role in inflation process in Ghana [26].

In the study conducted by Alexander et al. [27] investigated the main determinants of inflation in Nigeria for the period 1986–2011. Cointegration results show long term balance between the rate of inflation and its determinants. The estimated VAR results show that the fiscal deficit, exchange rates, imports of goods and services, the money supply and agricultural products have long-term influence on the inflation rate in Nigeria. Only loan interest rates affect inflation in the short and long term.

The literature described above has shown the determinants of variables that can influence inflation but with some of the variables we studied were not used in these studies. In addition, our research explores the effects affecting inflation in five ASEAN countries. From the points stated above we therefore formulate this hypothesis:

H0: Interest rates and exchange rates have a negative and significant effect on inflation and the output gap has a positive and significant effect on inflation.

3. Methodology

3.1. Data Types and Sources

The variables used in this study consisted of independent variables and dependent variables. The independent variables are interest rates, exchange rates and output Gap, while the dependent variables are inflation.

The data used in this study are 2000–2019.

The study covers five ASEAN countries Indonesia, Malaysia, Singapore,

Thailand, the Philippines. The choice was made because the five countries are major countries in ASEAN, the founder of ASEAN and one of the five ASEAN countries is a developed country according to the IMF, Singapore with an inflation rate below 5 percent per year.

Meanwhile, the other four countries Indonesia, Malaysia, Thailand, and the Philippines are still developing countries with relatively high inflation rates in Indonesia and the Philippines of 3 percent to 10 percent, while Malaysia and Thailand have relatively low inflation rates of 1 percent to 5 percent.

The data used in this study are secondary data issued by certain institutions obtained from Bank Indonesia, Global Economic Data, Indicators, Charts & Forecasts (Ceic), ASEANstats, World Bank, Central Statistics Agency (BPS Indonesia) as well as literature studies through journals, papers, articles, and others related to this research.

3.2. Model Specifications

The analysis technique used in this study is the estimation of panel data regression. Panel data regression analysis is a combination of cross-sectional data and time series data so that it has space and time dimensions [28].

The cross-section data is the five ASEAN countries, and the time series data is the time series in 2000–2019.

The following is the regression equation in this study as follows:

$$Inf = \beta_0 + \beta_1 SK_{it} + \beta_2 NTR_{it} + \beta_3 GDPGAP_{it} + \varepsilon_{it}, \quad (1)$$

where: Inf = Inflation in country i year t; SK_{it} = Interest Rate in country i year t; NTR_{it} = Country currency i year t; GDP_{it} = Output Gap in country i year t; β_0 = Intercept or Constant; β_1, β_2, β_3 = Regression Coefficient; ε_{it} = Error Term.

4. Research Results

4.1. Inflation Trend in Five ASEAN Countries

Inflation is an economic condition in which prices in general (basic necessities) increase. Inflation is one of macroeconomic factors in looking at the economic stability of a country [29].

The inflation rate differs from one period to another, and between countries it also differs. Sometimes the inflation rate is very low, reaching 2 percent or 3 percent. and sometimes experiencing high inflation. The inflation rate fluctuates greatly over time indicating that a country's economy is unstable. The importance of controlling inflation is based on the consideration that high inflation will have a negative impact on the social and economic situation of the people while countries that have low inflation have good monetary stability.The movement of inflation in the Five ASEAN countries from 2000–2019 can be seen in figure 1.

The economies in the five ASEAN Countries in the research period always fluctuated from year to year. The country that has the highest average inflation rate is Indonesia with an average inflation of 6,758 percent. while the country that has the lowest average inflation rate is Singapore with an average inflation of 1.53 percent during the observation year, the average of inflation in the five ASEAN countries is 3.29 percent per year.

In Figure 1, 2005 and 2008 were the years when the average inflation in five ASEAN countries experienced the highest level such as Indonesia in 2005 the inflation rate was 17.1 percent, an increase from the previous 6.4 percent in 2004. The cause of the increase in inflation this year is the increase in fuel oil (BBM) prices both through direct and follow-up impacts. Supply and distribution disruptions, high inflation expectations and rupiah depreciation have also exacerbated pressures.

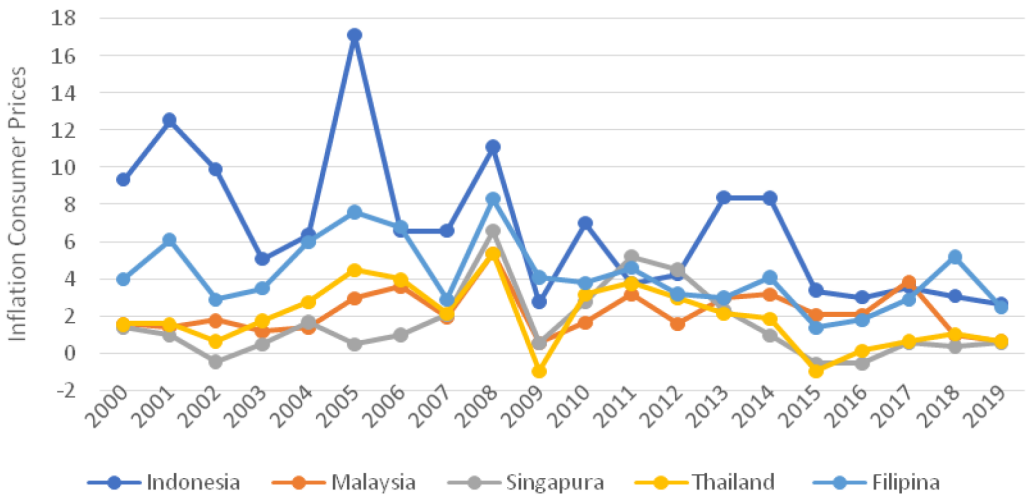

Figure 1. Inflation Rate in Five ASEAN Countries

Source: Worldbank, Inflation Consumer Prices (data processed)

In addition, several other adminsteredprices policies such as cigarette prices, toll tariffs and PAM also increased prices. Meanwhile, the other four countries with the highest inflation rates after Indonesia are the Philippines and Thailand with inflation rates of 6.7 percent and 5.8 percent. Meanwhile, Malaysia and Singapore have inflation rates of 3.5 percent and 1.3 percent.

Then in 2008 inflation began to increase again which previously fell in 2006 and 2007 in five ASEAN countries. This year there was a global crisis that had an impact onthe decline in world food and oil prices [30].

Singapore experienced deflation in 2008 of 5.6 percent because of the Monetary Authority of Singapore (MAS) adopting an unconventional monetary policy during the global financial crisis, which involved the appreciation of the Singapore dollar to maintain the country's competitiveness and curb inflation. Currency appreciation, coupled with reduced demand, contributed to deflation in 2008 [31].

Meanwhile, Indonesia experienced an inflation rate of up to 11.1 percent in 2008. The source of inflationary pressure in Indonesia comes from the high spike in global commodity prices, especially oil and food commodity prices [32]. This condition also has an impact on imported commodities and even encourages government policies to adjust subsidized fuel prices [33]. Then the highest inflation rate was also in the Philippines at 8.0 percent, this inflation increased from the previous year of 3.9 percent. This increase was due to the subsequent supply shock malaysian inflation also increased from 2.4 percent in 2007 to 4.4 percent in 2008 due to the drastic increase in oil prices due to the smuggling of subsidized petrol and diesel oil, thus reducing the financial burden on the government to increase oil prices. Meanwhile, Thailand experienced a decline in inflation from 3.2 percent to 0.4 percent in 2008.

The inflation rate in ASEAN countries during 2012–2016 experienced inflation with different turmoil, in 2012 the highest inflation occurred in Singapore at 4.60 percent, Indonesia experienced inflation of 4.30 percent. Meanwhile, the country experienced low inflation of 1.2 percent. Among the five ASEAN countries, Indonesia in 2013 and 2014 was

the country with the highest inflation rate. The high inflation rate in 2013 and 2014 was 8.4 percent and 8.36 percent. The cause of high inflation is because the government raises subsidized fuel prices, which causes a domino effect on the increase in prices of necessities.

Meanwhile, inflation of neighboring Indonesia in 2014 was relatively low compared to Indonesia's inflation. Singapore experienced inflation about 2.30 percent lower than last year's 2.40 percent. Inflation in the country reached 3.30 per cent, an increase compared to the previous year which reached 2.10 per cent. Meanwhile, inflation in the Philippines stood at 4.40 percent. Thailand experienced inflation of 2.30 percent [34].

In 2015–2016 ASEAN countries that tend to be able to suppress and control inflation include Malaysia, the Philippines, and Indonesia. Meanwhile, in 2016 the country that was at the level of deflation, namely Singapore. For deflation in Singapore, the amount of deflation in 2014 was 0.1 and in 2015 it was 0.6 percent. In contrast to Thailand, which can control the inflation rate, from initially experiencing the highest deflation in ASEAN in 2015, which was 0.9 percent to experiencing inflation of 1.1 percent in 2016. This deflation can threaten a country's economic growth. The investors will not be interested in investing. In addition, entrepreneurs are also less likely to develop their business. This is due to the low incentives obtained. These conditions can lead to the creation of no new jobs. Then the country with the highest inflation rate is Indonesia with the same inflation rate of 3.0 percent. Inflation in Indonesia continues to decline every year. This shows that Indonesia is ready to compete with other ASEAN countries [35].

In 2019 ASEAN countries experienced a decline in inflation from 2.6 percent in 2018 to 2.1 percent in 2019. Almost all countries experienced a decrease in inflation, but not Singapore which actually experienced an increase. Singapore recorded an increase in inflation from 0.5 percent in 2018 to 0.6 percent.

The relatively low inflation increase was caused by price increases in the domestic transportation sector. Inflation in the Philippines has decreased from 6.6 percent in 2018 to 1.5 percent in 2019. This decrease in inflation was caused by a decrease in rice prices due to its abundant stocks. Meanwhile, Malaysia's inflation was recorded at 0.7 percent, up slightly from 1 percent in 2018. This decline is more due to the deflationary trend that has continued to occur from 2018 to the first quarter of 2019, as well as the decline in prices in the transportation sector.

The next country, Thailand, recorded stable inflation between 2018 and 2019 of 0.4 percent. Thailand's inflation rate is stable due to low world oil prices. Indonesia's inflation in 2019 was recorded at 2.7 percent or lower than 2018 inflation of 3.1 percent. This inflation rate is still within the government's target range of 2.5 to 4.5 percent. This achievement also continues the achievements that have been continuously in the target range for the last 4 years.

Low inflation in Indonesia is attributable to maintained domestic demand and appreciation of the rupiah exchange rate, as well as low inflation of administered prices.Low inflation is also attributable to the success of policies implemented by the government and bank Indonesia in controlling food prices.

4.2. Interest Rate Trend in Five ASEAN Countries

The interest rate is one of the monetary policy instruments implemented by raising and lowering the interest rate. This change in interest rates will affect changes in the amount of demand and supply of money in the domestic market. High interest rates will

encourage people to keep money in the bank instead of investing. When interest rates are relatively high in a country compared to other countries, it results in capital flows from countries with low interest rates to high interest rate countries. This capital flow will have an impact on increasing the exchange rate to countries with high interest rates.

To measure the comparison of the actual interest rate in one country with another country, the real interest rate is usually used, which is an interest rate that has been adjusted to the rate of inflation.

Interest rates in five ASEAN countries fluctuate each year. The highest interest rate in Indonesia was 10.85 percent in 2003 and in 2010 the interest rate was at minus 1.7. Meanwhile, Malaysia had an interest rate that was in a high range in 2009 of 11.78 percent and in 2005 Malaysia experienced an interest rate of minus 2.6. Then Singapore had a high interest rate in 2008 of 6.86 percent. This interest rate hike was due to the financial crisis that made the central bank raise interest rates so that the inflation rate in this country fell or stabilized and in 2007 Singapore experienced an interest rate at minus 0.55 (Figure 2).

Meanwhile, Thailand's highest interest rate in 2000 was 6.41. This increase was due to the Thai state in the phase of restoring the economy after the 1997 crisis and in 2005 Thailand experienced an interest rate at minus 0.4. Furthermore, the Philippines has an interest rate that is in the range between 1.0 percent – 6.42 percent in the period 2000 to 2019, with the highest interest rate in 2001 at 6.42 percent.

This increase is because the inflation rate this year is high, making the government raise interest rates so that inflation falls. High real interest rates can be beneficial for investors because the yield obtained is higher than the real estate value but will instead have a negative impact on creditors [36]. High interest rates also affect the business world, especially in the midst of slowing economic growth.

4.3. Exchange Rate Trend in Five ASEAN Countries

The exchange rate is the value of a country's currency expressed in the value of another country's currency. The weakening or strengthening of the exchange rate in a country depends on economic indicators. Changes in the exchange rate will have an

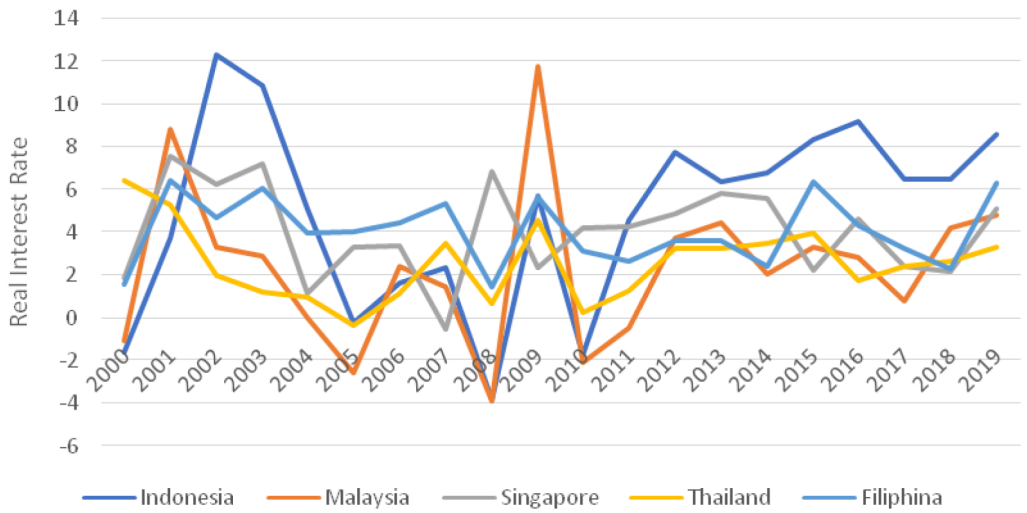

Figure 2. Interest Rates in Five ASEAN Countries

Source: Worldbank, Real Interest Rate (data processed)

impact on the price of domestic products, simply depreciation of the value of the currency, the price of imported goods becomes more expensive, so that the domestic people only have a choice of goods of national production.

Thus, the demand for domestic goods grew too high but the growth of inventory was not comparable so that prices increased. The exchange rate system in Indonesia uses a free-floating exchange rate system on August 14, 1997 [37], then the Thai state exchange rate system is floating bath according to the market mechanism on July 2, 1997 and the Philippines exchange rate system floats the peso on July 11, 1997.

Furthermore, Malaysia initially used a fixed exchange rate system, but on July 21, 2005, Malaysian state banks ended the fixed exchange rate system against the US Dollar and switched to a floating exchange rate system [38]. Singapore implemented its floating exchange rate in 1981.

Based on the data obtained, the exchange rate movements of the five ASEAN countries using exchange rate stability in the form of an index for the 2000–2019 period can be seen in figure 3.

Based on figure 3, it is explained that the lowest REER value in Indonesia was 82,212 in 2001 and the highest REER value was 124.85 in 2010 while the lowest REER value in Malaysia was 92,519 in 2017 and the highest REER value was 111.17 in 2002.

Furthermore, the lowest REER value in Singapore was 101.61 in 2006 and the highest REER value was 125.39 in 2013. then the lowest REER value in the country Thailand was 95,252 in 2004 and the highest REER value was 131.05 in 2019. Furthermore, the last REER value was the lowest in the Philippines at 94,565 in 2004 and the highest REER value at 136.35 in 2013. If the REER is above 100, it means that the exchange rate is above the actual value (*over value*), where the importer will be happy because the country's exchange rate is cheap but this condition is not favorable for exporters.

An increase in the Real Effective Exchange Rate below 100 indicates that the value of exports is more expensive and the value of imports is cheaper, the increase shows a decrease in trade competitiveness, and vice versa. Unstable exchange rate movements will interfere with decision-making in reducing selling prices and

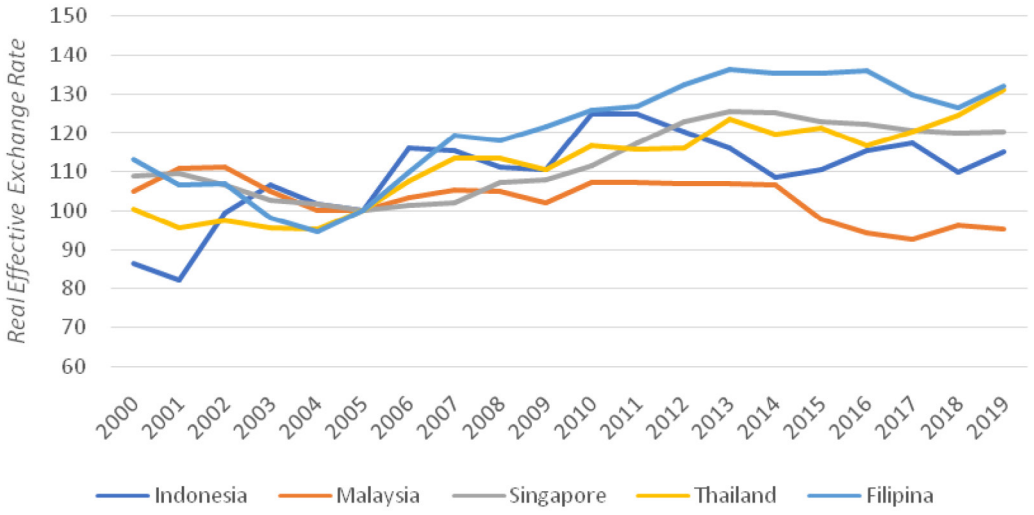

Figure 3. Exchange Rates in Five ASEAN Countries

Source: Ceic, Real Effective Exchange Rate (data processed)

will result in financial sector instability, decreased output and increased inflationary pressures [39].

The impact of the real exchange rate against inflation and economic growth can be seen through direct and indirect exchange rate transmission. Direct transmission of the exchange rate to inflation through changes in the prices of imported goods.

Meanwhile, indirect transmission is through aggregate demand, exports and imports as well as domestic demand such as consumption, investment and government spending.

4.4. Output Gap Trend in Five ASEAN Countries

The output gap is the difference between the actual output and the pontesial output. Actual output is the true value of economic output, while potential output is the optimum value of economic output that can be considered permanent and sunstainable in the medium term without shocks and inflationary pressures. Thus, the output gap can provide an idea of the existence of excess demand or excess supply in the economy. Actual output describes aggregate demand while potential output is said to be aggregate supply.

Based on Figure 4, the actual GDP data is the real GDP in the Five ASEAN Countries because this GDP describes economic growth from year to year and the potential GDP data is an estimate using the HP Filter method.

In the period from 2000 to 2019 the output gap has always undergone fluctuating changes in the five ASEAN countries. The development of the output gap in Indonesia in the past five years has experienced a negative output gap of 0.003 to 0.022 which indicates that the inflation rate in Indonesia has decreased. Meanwhile, Malayasia experienced a positive output gap during 2014 to 2019, which was 0.01 to 0.02.

Then in the country, the country experienced a negative output gap in 2016 to 2019, which was 0.01 to 0.15. Furthermore, Thailand had a negative output gap in 2014 to 2019, except for 2018 which had a positive output gap of 0.024, andthe last one was the Philippines which had negative output in 2014 to 2015, and in 2016 to 2019 experienced a positive output gap of 0.02 to 0.04. This negative output gap makes

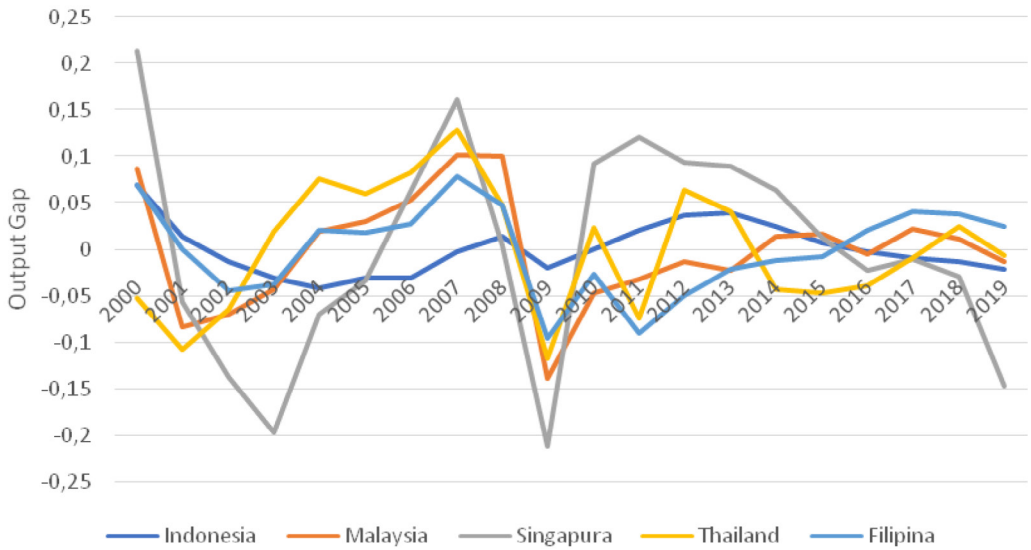

Figure 4. Output Gap in Five ASEAN Countries

Source: Worldbank (2019)

supply tend to overdo it so that the price level in general decreases or deflation [40].

Meanwhile, the output gap is positive, indicating an excess of demand so that the price level in general increases or inflation. This excess demand includes the demand for imported goods so that the trade balance can experience a deficit which will eventually make the exchange rate depreciate.

4.5. Regression Result Analysis

Before making an estimate, according to Tinungki et al. [41], it is necessary to choose a regression method, first by conducting a Chow test, namely comparing Pooled Least Square (PLS) with Fixed Effect Model (FEM).

Based on the results of the Chow test, the inflation model shows the probability value is 0.000, meaning that the best model chosen for the inflation model is the Fixed Effect Model because the chi-square probability value is less than the 5% significance level. The next test is to choose the best model between the Fixed Effect Model and the Random Effect Model by conducting a Hausman Test (Table 1).

Based on the Hausman test results, the Chi-Square probability value on the inflation model is 0.0295, meaning that the best model is the Fixed Effect Model. The test results have the same selection results in each test so there is no need for LM testing so that the selected model is a Fixed Effect Model. The following are the model estimates, which can be seen in Table 2.

Based on the results of the selection of panel data regression estimates that have been carried out with the Chow Test and Hausman Test, the most appropriate model

Table 1. **Chow Test and Hausman Test**

Test	Statistics	Probability
Chow Test	20.807832	0.0000
Hausman Test	8.982708	0.0295

Source: Data Processed EViews 9 (2021)

Table 2. **Panel Data Regression Estimation Results (Dependent Variables: INF)**

Variables	Coefficient	Std. Error	t-Statistics	Prob.
C	9.282481	1.782189	5.208471	0.0000
SB?	-0.201364	0.063851	-3.153671	0.0022
NTR?	-0.047510	0.015802	-3.006617	0.0034
GDPGAP?	6.407782	2.653291	2.415032	0.0177
Fixed Effects (Cross)				
_INDONESIA – C	3.683244			
_MALAYSIA – C	-1.760993			
_SINGAPORE – C	-1.572268			
_THAILAND – C	-1.444212			
_FILIPINA – C	1.094229			
R-squared	0.528086	Mean dependent var		
Adjusted R-squared	0.492180	S.D. dependent var		3.473989
S.E. of regression	1.925738	Sum squared reside		2.566221
F-statistics	14.70728	Durbin-Watson stat		341.1791
Prob(F-statistic)	0.000000			1.789675

Source: Data Processed Eviews 9 (2021)

used in this study is the Fixed Effect Model. The following is the regression equation of the Fixed Effect Model:

$$INF = 9.2825 - 0.20136\ SB - 0.04751\ NTR + + 6.4078\ GDPGAP$$

$$(1.782189)\ (0.063851)^{**}\ (0.015802)^{**}\ (2.653291)^{**}$$

A constant value of 9.282481 indicates that if the independent variables *Interest Rate* (*SB*), *Exchange Rate* (*NTR*), and *Output Gap* (*GDPGAP*) are *0* then the amount of inflation produced by each of the five ASEAN countries is *9.282481.*

The Interest Rate variable yields a regression coefficient value of –0.201364 with a probability of 0.0022 indicating a negative and significant relationship of 0.0022 < α = 0.05. That is, if the variable interest rate rises by 1 percent, then relative inflation will fall by 0.1364 and vice versa assuming that other variables are constant.

The *Exchange Rate* variable produces a regression coefficient value of –0.047510 with a probability of 0.0034 indicating a negative and significant direction of 0.0034 <= 0.05. This means that if the Exchange Rate variable increases by 1 percent, then the amount of relative inflation decreases by 0.047510, and vice versa assuming that other variables are constant.

The *Output Gap* variable produces a regression coefficient value of 6.407782 with a probability of 0.0177 indicating a positive and significant direction of 0.0177 <= 0.05. That is, if the Output Gap variable is relatively increased by 1 percent, then Inflation will increase by 6.407782 and vice versa assuming that other variables are constant.

Based on the F-statistical test in table 2, the Prob (F-Statistic) value is 0.0000 < 0.05. While the critical F value (F_table) α = 0.05 with = 3–1=2 and = 100 – 3 = 97 $df_1 df_2$ is 3.09. Then $F_{statistik} > F_{tabel}$ with a value of 14.70728 > 3.09. It can be concluded that the *Interest Rate*, *Exchange Rate* and *Output Gap* together affect the inflation variables.

Based on the results of the regression t table at the level = 0.05 and *df* = 100 –3 = 97 t-table of 1.66071, it is known that the t-statistical value of the Interest Rate variable is –3.153671, the t-statistical value is smaller than the t-table value of 1.66071 which means that some interest rate variables have a negative and significant effect on inflation.

The exchange rate variable has a t-statistical value of –3.00617, the statistical value is smaller than the t-table value of 1.66071 which means that the exchange rate has a negative and significant effect on inflation. While the output gap variable has a t-statistic of 2.415032, the statistical value is greater than the t-table value of 1.66071 which means that the output gap has a positive effect on inflation.

4.6. Classical Assumptions

To obtain good estimation results, the secondary data must first pass the classical assumption test, namely the Heterochedasticity Test (Table 3), the Multicollinearity Test and the Autocorrelation Test (Table 4).

Based on the results of heterochedasticity testing, it shows the probability of an interest rate of 0.5888 > an alpha level of 0.05 then based on the results of the exchange rate shows a probability of 0.1118 > an alpha level of 0.05. and gdpgap has a probability of 0.3334 > alpha level of 0.05. therefore the results of all variables show no heteroskedasticity.

Autocorrelation is the residual relationship of one observation with the residual of another observation. To find out whether there is autocorrelation used the *Durbin Watson Test method.*

When viewed from table 2, in the model used, namely the *Fixed Effect Model*, it shows the Durbin Watson test value of

Table 3. **Heteroskedasticity Test Results**

Variables	Coefficient	Std. Error	t-Statistics	Prob.
C	2.913226	0.978160	2.978272	0.0037
SB	0.018239	0.033625	0.542421	0.5888
NTR	-0.013907	0.008662	-1.605494	0.1118
GDPGAP	1.421953	1.462190	0.972482	0.3334

Source: Processed Data Eviews 9, 2021

Table 4. **Multicholinearity Test Results**

	SB	NTR	GDPGAP
SB	1.000000	0.107677	-0.306984
NTR	0.107677	1.000000	0.018130
GDPGAP	-0.306984	0.018130	1.000000

Source: Processed Data Eviews 9, 2021

1.789675 with k: 3 then obtained the dL value: 1.6131, *dU* value: 1.7364, 4-*dL* value: 2.3869 and 4-*dU* value: 2.2636, meaning that the *dU value* < *DW* < 4-*dU* so that the model is free and does not experience autocorrelation problems.

From the results of the *Correlation Matrix* in table 4, it can be seen that the correlation matrix coefficient between free variables is smaller than 0.80 so that there is no linear relationship between variables or there is no multicoliniearity problem.

4.7. Individual Analysis

Individual Analysis is an effect of the Fixed Effect Model (FEM). The heterogeneity generated by each city describes the existence of other factors or variables that belong to one country that are not owned by another. In other words that the state has an advantage over other variables beyond the independent variables in the model.

Based on Table 5, the interception results show the Fixed Effect Model (FEM) estimation coefficient, the interception values show that the five ASEAN countries have different inflation rates equal to the interception values of each country.

Indonesia has a higher intercept value than the other four countries, namely 12.9657 with an estimated INF of 6.75 percent. Then the second highest interception value after Indonesia is the

Table 5. **The Interception Value of Each Individual (State)**

No	Country	Average Inflation	Interception Value	INF estimates
1	Indonesian	6.758	12.9657	6.7576
2	Malaysia	2.16	7.5214	2.1606
3	Singapore	1.533	7.7102	1.5336
4	Thailand	2.016	7.8382	2.0165
5	Philippines	3.842	10.3767	3.8421

Sources: Excel Processed Data, 2021

Philippines at 10.3767 with an estimated INF of around 3.84 percent. Next is Singapore with an intercept value of 7.7102 and the lowest estimated INF in the Five ASEAN Countries, which is around 1.53 percent.

5. Discussion

5.1. The Effect of Interest Rates on Inflation

Based on the results of regression estimation using the fixed effect method in table 2, the Interest Rate variable has a probability value of 0.0022 which is less than = 5 % (0.05). This shows that individually, the independent variable (*Interest Rate*) has a negative and significant effect on inflation in the Five ASEAN Countries. The value of the variable coefficient of interest rates is -0.201364 which can be said that the higher the interest rate, the relatively lower the inflation rate in the five ASEAN countries.

When the inflation rate is high, in which the general price of goods and services increases, the central bank must make policies to reduce inflation. It is very difficult to assess real interest rate levels when inflation expectations move quickly [42].

According to Coibion et al. [43] when the inflation rate is high, to control it, the central bank raises interest rates so that the inflation rate decreases. When interest rates rise, loans become expensive because the costs also go up.

This condition will suppress public demand for loans, so that the loan amount decreases. If the demand for loans decreases, the money supply in the community will also decrease. This means that people have less money to spend. In other words, people's purchasing power towards goods and services is low. As a result, they will buy less goods and services.

The low purchasing power of the people will in turn lead to a decrease in demand for goods and services in general [44]. In a fixed supply or consistent supply, there will certainly be a decrease in the level of demand, so the price of goods and services in the market will fall [45]. With the decline in the price level of goods and services in general, it will automatically reduce the inflation rate [46].

The negative effect of interest rates on inflation is in accordance with the hypothesis put forward by the authors.

5.2. Effect of Exchange Rate on Inflation

Based on the results of regression estimation using the fixed effect method in table 2, the *Exchange Rate* variable has a probability value of 0.0034 which is less than = 5 % (0.05). This shows that individually, an independent or independent variable (*Exchange Rate*) has a negative and significant effect on inflation in the Five ASEAN Countries.

The value of the variable coefficient of the exchange rate is –0.047510 which can be said that the lower the exchange rate or depreciation against the USD, the inflation rate in the Five ASEAN Countries is relatively increasing.

An important factor weighing on financial stability is the right choice of inflation target. Because inflation affects the extent to which central banks take into account exchange rate movements in implementing monetary policy [47].

When a country's currency appreciates (its value increases relative to other currencies), domestic goods become expensive compared to foreign goods assuming constant domestic prices in both countries [48]. Then when the currency depreciated, domestic goods became cheap compared to foreign goods. Exchange rate instability will have an impact on a country's trade activities and economic activities [49].

Depreciation of the value of a country's currency against the currency of another

country will lead to an increase in the cost of importing goods such as consumer goods, capital goods and an increase in industrial raw materials that cannot be produced domestically [50]. Or it can be called import inflation, which is inflation that occurs domestically due to the influence of price increases from abroad. An increase in the cost of imported raw materials leads to a shortage of manufactured goods. To cover the increase in import costs, domestic producers will increase the prices of their manufactured goods so as to increase prices at the domestic price level, this is a reflection of the inflation rate [51].

This is in line with research conducted by Islam et al. [16] which states that there is a relationship between there is a close relationship between the real exchange rate and the inflation rate, where the depreciation of the real exchange rate will encourage an increase in the inflation rate.

The negative effect of Exchange Rate on inflation is in accordance with the hypothesis put forward by the authors.

5.3. Effect of Output Gap on Inflation

Based on the results of regression estimation using the fixed effect method in table 2, the *Output Gap* variable has a probability value of 0.0177 which is less than = 5 % (0.05). This shows that individually, the independent variable (*Output Gap*) has a positive and significant effect on inflation in the Five ASEAN Countries. The value of the Output Gap variable coefficient is 6.407782 which can be said that the higher the Output Gap, the higher the inflation rate in the five ASEAN countries.

This is in line with generally accepted economic theory. Negative output gap in a given year, the central bank may consider implementing loose monetary policies, such as lowering interest rates and increasing the money supply, so that loans increase and ultimately increase economic growth.

Then if the output gap is positive, it is usually indicated by excessive demand so that prices tend to experience significant increases or too high inflation rates [52]. Economic conditions with positive output Gap are usually called over-heating. If the economy is over-heating, the saving–investment balance would be expected to have deteriorated [53].

When the output gap is positive, the monetary authority slows economic growth by raising interest rates and slowing the growth of the money supply, thereby slowing credit growth which in turn will slow overall growth.

Therefore, when the economy is in a booming state, the demand for production factors will increase and this will ultimately drive the inflation rate. On the other hand, when the economy is in recession, the demand for production factors is relatively small and will then lower the inflation rate.

This is in line with research conducted by Poon & Lee [3], which state that the output gap is positively related to inflation. However, the findings of Asfuroglu [54] found that the output gap does not affect inflation. Other findings by Nishizaki et al. [55] and Yang [56] output gap negatively affect inflation.

The positive effect of Output Gap on inflation is in accordance with the hypothesis put forward by the authors.

6. Conclusion

Interest rates have a negative and significant effect on inflation in the Five ASEAN Countries. This is because if interest rates are low, the demand for loans increases, meaning that more money will be spent, so the economy grows, and the inflation rate increases.

In addition, the exchange rate has a negative and significant effect on inflation in the five ASEAN countries. This is

because the depreciation of the exchange rate against other currencies will cause imported goods to increase and may increase the price of goods in the country.

Meanwhile, the output gap has a positive and significant effect on inflation in the five ASEAN countries. This is due to excessive demand for goods or services so that prices tend to experience significant increases or too high inflation rates.

The research confirmed the hypothesis of the research. Based on interception values, Indonesia and the Philippines have the highest inflation estimates with Indonesia's estimates at 6.75 percent and the Philippines at 3.84 percent, respectively. This is because inflation in the last 20 years shows that Indonesia is the country with the highest inflation with an average inflation of 6.76 percent. High inflation was caused by inflation in 2005 which reached 17.1 percent.

Meanwhile, the lowest inflation intercepts and estimates were in Singapore at 1.53 per cent. The value of this coefficient is the lowest value when compared to the other five ASEAN countries. The inflation rate over the past 20 years in Singapore has tended to fluctuate with an average of 1.53 per cent.

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Влияние процентных ставок, обменных курсов и разрыва в объеме производства на инфляцию в пяти странах АСЕАН: данные панели

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Аннотация. Почти каждая страна, как развитая, так и развивающаяся, сталкивается с проблемами стабильности и экономического роста. Инфляция является одним из вопросов, которому уделяется особое внимание в каждой стране. Инфляция рассматривается как важнейшая переменная для потенциальных экономических условий, где устойчивый экономический рост является главной целью каждой страны. Нестабильная инфляция может зависеть от макроэкономических переменных, включая процентные ставки, обменные курсы и разрывы в выпуске. Наблюдая за тем, как детерминанты влияют на инфляцию, мы предполагаем, что процентные ставки и обменные курсы оказывают негативное и значительное влияние на инфляцию, в то время как разрыв в выпуске оказывает положительное и значительное влияние на инфляцию. Для подтверждения нашей гипотезы мы используем панельные данные, состоящие из стран АСЕАН, включая Индонезию, Малайзию, Сингапур, Таиланд и Филиппины. Метод панельного анализа данных позволяет изучать динамику изменений с временными рядами с помощью модели фиксированного эффекта. Данные, используемые в этом исследовании, являются вторичными данными за 2000–2019 гг., полученными от Всемирного банка и глобальных экономических данных, индикаторов, диаграмм и прогнозов. Результаты показали, что переменные «Процентная ставка», «Обменный курс» и «Разрыв выпуска» вместе оказали значительное влияние на инфляцию. Процентные ставки и обменные курсы оказывают негативное и значительное влияние на инфляцию в пяти странах АСЕАН. Между тем разрыв в объеме производства оказывает положительное и значительное влияние на инфляцию в пяти странах АСЕАН. Мы показываем, что Индонезия и Филиппины имеют самые высокие показатели инфляции. Индонезия является страной с самой высокой инфляцией на уровне 6,76 %. Самые низкие показатели инфляции и оценки были в Сингапуре. Уровень инфляции за последние 20 лет в Сингапуре, как правило, колебался в среднем на уровне 1,53 %.

Ключевые слова: инфляция; процентные ставки; обменные курсы; разрыв в объеме производства.

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Journal of Applied Economic Research

REVIEW on article
The Effect of Interest Rates, Exchange Rates and Output Gap on Inflation in Five ASEAN Countries: A Panel Data Evidence

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1. Relevance of the topic of the article	8	0 – 10
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Ariodillah Hidayat, S.E., M.Si <ariodillahhidayat@fe.unsri.ac.id> Sen, 6 Feb 2023, 12.20
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Good morning,

Dear Editor

Journal of Applied Economic Research,

Thank you for your good information. Based on previous information regarding the improvement of several points including resea hypotheses, abstracts, literature, author information, we hereby inform you that we have corrected the article in accordance with instru editor and herewith we are attaching the draft of the article again.

Thank you for the input, we are waiting for further good news.

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The Effect of Interest Rates, Exchange Rates and Output Gap on Inflation in Five ASEAN Countries: A Panel Data Evidence

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Now everything is fine. We plan to publish your article in the 1st issue for 2023.

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Thank you for the good news, we will wait for further information

THE EFFECT OF INTEREST RATES, EXCHANGE RATES, AND FOREIGN DIRECT INVESTMENT ON FINANCIAL STABILITY IN INDONESIA

by Bortolomeus Azel

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Bartolomeus Azel Winpor
Ariodillah Hidayat

THE EFFECT OF INTEREST RATES, EXCHANGE RATES, AND FOREIGN DIRECT INVESTMENT ON FINANCIAL STABILITY IN INDONESIA

Abstract

Objective: The purpose of this study is to analyse the effect of interest rates, exchange rates, and foreign direct investment on the financial stability of banks in Indonesia.
Research Design & Methods: This study uses secondary data in the form of time series data from 2007 to 2021. Data sources come from publications and dynamic statistics of the World Bank and International Monetary Fund (IMF). The analysis technique used is multiple linear regression analysis with the Ordinary Least Squares (OLS) method.
Findings: The findings show that interest rates have a significant negative correlation with banking stability, while exchange rates and foreign direct investment have a significant positive correlation. Rising interest rates can reduce demand for credit and economic activity, while exchange rate depreciation can help improve financial stability by improving competitiveness of exports. Foreign direct investment also plays an important role in providing banks with stable long-term capital flows, helping to overcome liquidity challenges, and increasing the diversity of bank income. Policy responses to foreign direct investment during the global crisis and the COVID-19 pandemic showed significant differences, with an emphasis on incentives and stimuli to support post-pandemic economic recovery.

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Implications/Recommendations: Monetary and banking authorities need to work together to closely monitor and manage interest rate policy, thus maintaining a balance between supporting economic growth and the stability of the banking. Indonesian banks need to improve their foreign exchange risk management. Policies should support sound foreign investment while addressing potential risks.
Contribution: This study makes an important contribution to understanding the complexity of the interaction between interest rates, exchange rates, and foreign direct investment, and their effects on the financial stability of banks in Indonesia. The findings of this study provide valuable insights for policymakers, monetary authorities, and banking industry players in designing effective economic policies and maintaining the stability of the financial sector. In addition, this research can also provide a foundation for further research in this field, which can further contribute to the development of theory and practice related to financial stability in developing countries.

Keywords: interest rate, exchange rate, foreign direct investment, financial stability.
JEL Classification: E42, E43, G21.

1. Introduction

Globalisation and technological advances have had a significant impact on the financial industry, leading to a more integrated financial system as well as diversification of financial products with higher stability (Jaumotte, Lall & Papageorgiou, 2013). However, these changes can also lead to instability in the financial system (Laeven, Levine & Michalopoulos, 2015). Analysis of the causes of financial system instability is essential to predict potential hazards and anticipate their impact on the economy. Instability in the financial system can hinder the process of effective allocation of funds, affect monetary policy, disrupt the intermediation function, and cause public distrust (Pistor, 2013). Therefore, efforts to avoid or reduce the risk of financial system instability are essential to maintaining economic growth.

In the financial world, maintaining the stability of the financial system is a top priority for all countries (Platonova *et al*., 2018). Financial stability has recently become a concern for central banks and governments in an effort to prevent a crisis in the financial sector. In general, the financial system can be said to be stable if it can maintain real sector and financial system activities through allocation of sources of funds and good absorption of economic shocks, and can support economic growth and economic mechanisms in pricing (Beck, Degryse & Kneer, 2014). Past financial crises, such as the global financial crisis of 2008, have revealed how important it is to pay

attention to the stability of the financial system as a precaution against widespread and prolonged economic decline (Bordo & Meissner, 2016).

The global financial crisis led to a worldwide reduction in confidence in the market. The global crisis of 2008 was felt not only in the United States but also in all countries in the global market. They were forced to sell their assets on financial markets due to the withdrawal of foreign investors' funds and declining confidence. These shocks in financial markets can disrupt financial stability (Creel, Hubert & Labondance, 2015). Therefore, the management and maintenance of stability in the financial system has become a major focus of economic policy and financial regulation. Babar *et al*. (2019) support the idea that financial stability can be achieved through operational efficiency of the financial system, control of financial risks, and efforts to minimise the impact of systemic crises.

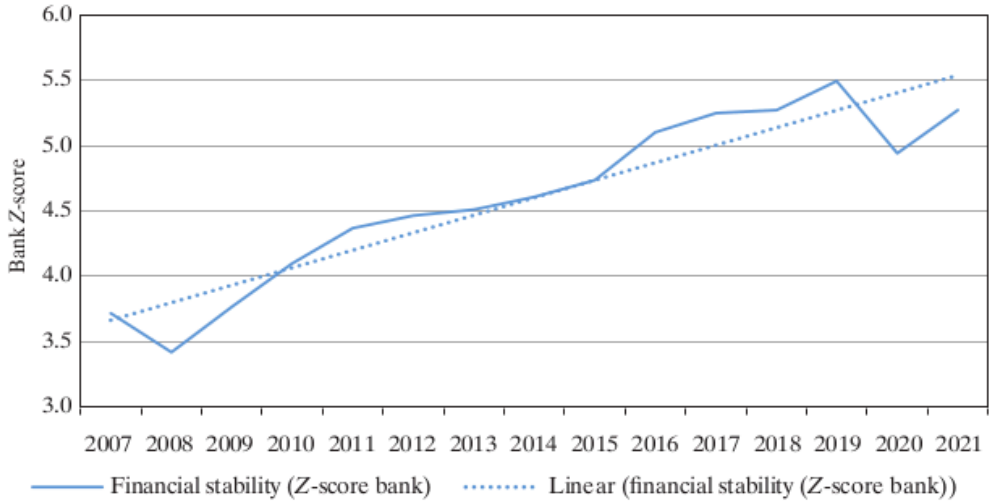

Fig. 1. Movements in Financial Stability in Indonesia

Source: World Bank (2007–2021).

In addition to the global financial crisis of 2008, the most recent global crises namely the COVID-19 pandemic and the war in Ukraine demand serious attention from countries around the world to prevent a continuing crisis (Allam, Bibri & Sharpe, 2022). Financial institutions, including banking institutions, must have strong resilience to shocks caused by the COVID-19 pandemic, and must also be prepared for upcoming challenges (Ghosh & Saima, 2021). Previous crises have significantly affected financial

mobility in many countries, with depositors more likely to be anticipatory and withdraw funds, and financial intermediary partners reducing the amount of funds disbursed (Elnahass, Trinh & Li, 2021).

Indonesia is one of the countries that is highly dependent on commodity exports, such as crude oil, natural gas, and coal. This dependence on commodity exports makes the Indonesian economy vulnerable to fluctuations in world commodity prices that can affect the stability of the financial market (Hidayat *et al*., 2023). Financial stability in Indonesian banks experienced an upward trend during the 2007–2021 period, as shown in Figure 1. This indicates an improvement in financial stability, despite the impact of the global financial crisis of 2008 and the COVID-19 pandemic in 2020. The COVID-19 pandemic has affected the economy as a whole, including declining business performance, declining revenues, and increased credit risk and economic uncertainty (Flögel & Gärtner, 2020). The decline in bank *Z*-scores reflects significant pressure on the banking sector and indicates potential systemic risks that could disrupt financial stability (Klomp, 2014). However, towards 2021, there were signs of recovery and improvements in banking stability over time. This can be explained by the policies taken by financial and monetary institutions to overcome the negative impact of the pandemic (Elnahass, Trinh & Li, 2021). Despite signs of recovery, it points to a more significant improvement in banking stability, Thus, careful monitoring of banking stability and an in-depth assessment of the vulnerability of the banking sector in the midst of the COVID-19 pandemic remain important priorities (Siregar, Gunawan & Saputro, 2021).

By investigating the complex interactions between interest rates, exchange rates, and foreign direct investment, and their effect on Indonesia's financial stability, this study is expected to contribute significantly to the economic literature. This research allows decision-makers to better understand how fluctuations in interest rates and exchange rates, as well as the magnitude of foreign direct investment, can shape the framework that affects a country's financial stability. In contributing to economic literature in Indonesia, this research fills knowledge gaps that have not been previously explored by in-depth analysis by looking at the movement of variables. In addition, the study has the potential to provide a more holistic view of ways of managing and maintaining financial stability in complex situations, and the interdependence between those variables.

2. Literature Review

Monetary policy is expected to play a more active role in maintaining Indonesia's financial stability. Stabilisation can be achieved by controlling the money supply, interest rates, and exchange rates. Explanation of financial stability issues is only undertaken by monetary authorities when they affect the outlook for price stability and economic activity (Vredin, 2015). According to Fahr *et al.* (2013), both standard and non-standard monetary policies initially maintain stability in the financial system, overcoming dysfunctional financial markets, as well as opening up blocked monetary transmission processes.

Financial stability is important because instability brings various adverse impacts such as inefficient allocation of funds, which occurs as a result of ineffective intermediation, and which can disrupt economic growth (Phelan, 2016). A low level of public confidence in the financial system can make investors withdraw their funds, thereby increasing liquidity risks (Abdel Megeid, 2017). The cost of economic recovery due to a crisis is higher if it is a crisis that has a systemic impact and the recovery is prolonged.

After the financial crisis financial stability became one of the important issues for economists and policymakers because of its far-reaching socioeconomic impact (Saha & Dutta, 2021). Although financial stability is very important, there is no unanimously agreed definition of the term. However, Phan *et al.* (2021) citing financial stability as an attribute of the financial system that addresses financial imbalances resulting from the system or from adverse and unanticipated external events. A stable financial system is able to absorb internal and external shocks (economic and non-economic) through built-in automatic stabilisers, thus protecting the economy and other financial systems from disruption.

When measuring financial stability, this study uses bank *Z*-scores as a proxy for these variables. This is because the data is complete, available, and easily obtained (Ahamed & Mallick, 2019). The bank *Z*-score is also widely used as a measure of financial stability (Vo, Nguyen & Van, 2021). According to Mare, Moreira and Rossi (2017), bank *Z*-score is a comprehensive measure based on accounting information that combines indicators of solvency, profitability, and variability of revenue. This combination of information aims to provide a fairer estimate of vulnerabilities in the banking sector. A high bank *Z*-score indicates a lower risk of bankruptcy and higher financial stability. Anarfo, Abor and Osei (2020) state

that the bank *Z*-score is able to illustrate the profitability of the default banking system in a country.

As yet, there is no accurate and definitive definition of financial stability. First, where the causes are interconnected, the bankruptcy of an institution can lead to the failure of the banking system in general (systemic crisis) (Battiston *et al*., 2016). Secondly, it occurs when shocks affect many actors and cause simultaneous failures that destabilise the entire economy (Oatley *et al*., 2013). According to the Financial Services Authority (Otoritas Jasa Keuangan, 2023), financial system stability refers to conditions in which the financial system is stable, is able to allocate funds effectively, and can absorb and handle shocks to keep the real sector and the financial system running well.

According to Morozova and Sahabutdinova (2013), stability in the financial system refers to the ability of the financial system to withstand shocks and reduce barriers in the financial intermediation process. Whereas, according to Warjiyo and Juhro (2020), financial system stability can affect or be affected by monetary policy through several factors, such as interest rates, exchange rates, liquidity, bank credit, and corporate decisions. According to Fink *et al*. (2016), bank *Z*-scores calculate the probability of default for a bank or banking system, and are used by certain authors to describe financial stability in the banking industry.

3. Research Methods

The data used in this study is quantitative data in the form of a time series collected by taking secondary data, namely data in the form of publications from one institution relevant to this study. The source of data in this study comes from publications and dynamic statistics of the World Bank and the International Monetary Fund (IMF) (see Table 1). The data period used annual data from 2007 to 2021.

This study used quantitative analysis techniques using calculation methods with multiple linear regression estimation techniques Ordinary Least Squares (OLS). Monetary variables are used as independent variables, and financial stability as a dependent variable, so the functions of this study are formed as follows:

$$BZS = f(SB, NT, FDI). \tag{1}$$

From the above function, a regression equation can be formed for this research model, which is as follows:

$$BZS = \alpha + \beta_1 SB_t + \beta_2 NT_t + \beta_3 FDI_t + \varepsilon. \quad (2)$$

BZS is financial stability, β_1, β_2, β_3 are the coefficients of the independent variable, *SB* as the interest rate variable, *NT* as the exchange rate variable, and *FDI* as the foreign direct investment variable, α as the constant, and ε is the standard error.

Table 1. Variable and Data Source Description

Variable	Notation	Measurement Variable	Formula	Data Sources
Bank *Z*-score	*BZS*	*Z*-score bank data	$Z = \frac{ROA + \left(\frac{Equity}{Total\ assets}\right)}{ROA}$	World Bank
Interest	*SB*	annual interest rate	$EAR = \left(1 + \left(\frac{Interest\ rate}{n}\right)\right)^n - 1$	IMF
Exchange rate	*NT*	nominal exchange rate	$\frac{LCU}{US\$}$	World Bank
Foreign direct investment	*FDI*	net FDI	*FDI Capital inflow – FDI Capital outflow*	World Bank

Source: World Bank and IMF (2023).

4. Results and Discussion

4.1. Interest Rate Movements in Indonesia

Interest rate movements in Indonesia experienced a downward trend, however, on the other hand, the variable of bank stability showed an upward trend. This indicates that there is a negative correlation between the two variables (Fig. 2). A very significant reduction in interest rates occurred in 2009, the global financial crisis that occurred in 2008 was caused by the subprime mortgage crisis in the United States (Simorangkir & Adamanti, 2010). This crisis then spread throughout the world and affected many countries, including Indonesia. As a result, interest rates fell and Indonesia's economic growth, which in 2008 was 6.01%, fell to 4.63% in 2009 with downside risks especially if the global economic downturn was greater than expected. During the global crisis, Indonesia's benchmark interest rate was lowered significantly in response to deteriorating economic conditions (Taylor, 2011). Measures were taken to stimulate economic activity, minimise the risk of investment decline, and facilitate access to credit (Di Maggio *et al.*, 2017).

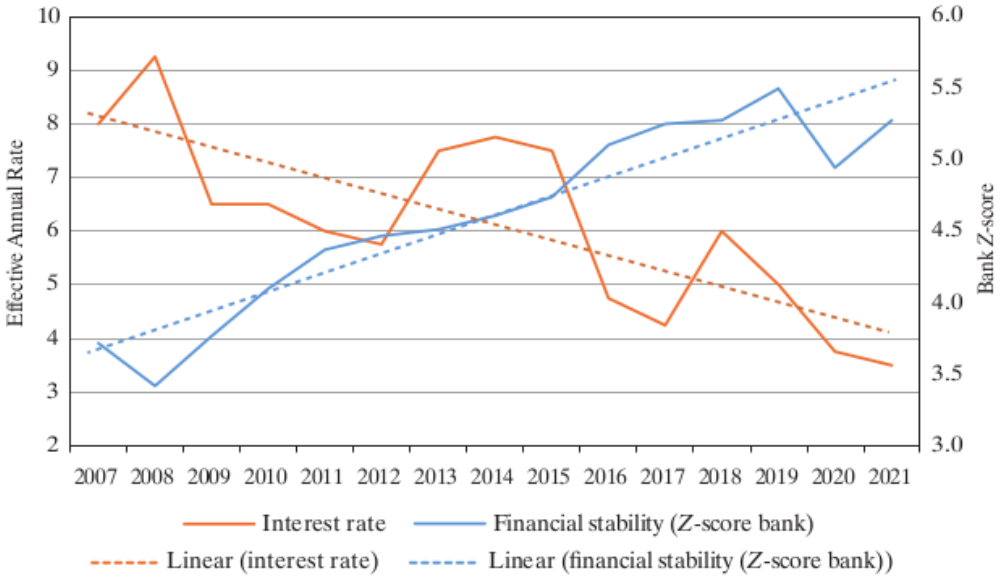

Fig. 2. Interest Rate Movements in Indonesia
Source: World Bank and IMF (2007–2021).

In 2018, Bank Indonesia raised its benchmark interest rate six times from 4.50% to 6.00%. This was done to maintain rupiah stability against higher American interest rates. The weakening rupiah exchange rate against the dollar to reach Rp 14,000 in 2018 was one of the reasons for Bank Indonesia to raise interest rates. Since 2018, the benchmark interest rate in Indonesia has always shown a decline. Inflation that remains under control and within the target range set by Bank Indonesia provides room for the central bank to adjust interest rates (Juhro, 2022). The interest rate cut after the COVID-19 pandemic was also an effort to ameliorate financial risks arising from global uncertainty (Song & Zhou, 2020). Low interest rates can reduce potential interest expenses for companies and households, thereby minimising the risk of default or bad loans that can disrupt the stability of the financial system.

4.2. Exchange Rate Movements in Indonesia

Indonesia currently uses a free-floating system. This means that the position of the exchange rate against foreign currencies (in particular the USD) is determined by market mechanisms and forces. In a free-floating system, the laws of supply and demand will apply (Liu, 1990). Exchange rate fluctuations will depend on the conditions of demand and supply of the national currency in the foreign exchange market. When inflation occurs,

the local currency has low purchasing power against foreign currencies, so imported goods will be more expensive.

Figure 3 shows fluctuations in the exchange rate with an upward trend, with the highest increase in 2020. The main causes of depreciating exchange rates were, disruptions to the global economy caused by the COVID-19 pandemic which caused foreign capital withdrawals from emerging markets including Indonesia, falling world oil prices that harmed the Indonesian economy as an oil producer, and trade balance deficits and government policy responses that affected investor perceptions (Aloui, 2021). When compared to the variable movement of banking stability, there is a trend in line with the exchange rate, which shows a positive trend.

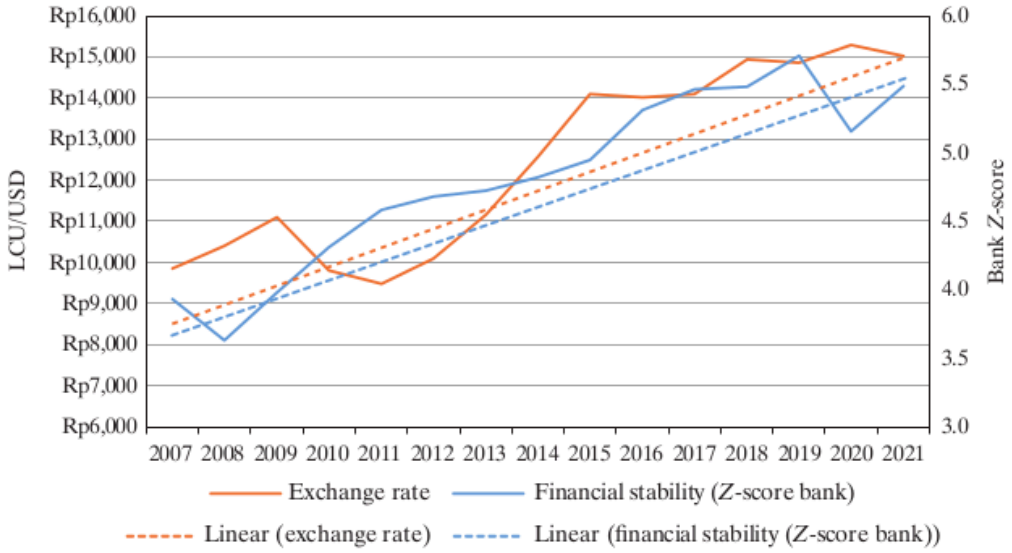

Fig. 3. Exchange Rate Movements in Indonesia

Source: World Bank (2007–2021).

The rupiah depreciated significantly in 2015 due to the decline in world oil prices (Husaini & Lean, 2021). The decline in world oil prices caused Indonesia's trade balance deficit to decrease and tight monetary policy from Bank Indonesia made investors more interested in investing in Indonesia (Purba, 2020). In 2020, the rupiah also depreciated, as a result of COVID-19 (Pontoh, Zahroh & Sunengsih, 2021). The spread of COVID-19 caused great volatility in global financial markets (Li, 2021). Investors tend to look for assets that are considered safer, such as the USD, causing pressure on emerging market currencies including the rupiah (Hasan *et al.*, 2021).

The decline in economic activity as well as uncertainty about the economic recovery resulted in capital outflows from Indonesia's financial markets.

4.3. Movement of Foreign Direct Investment in Indonesia

Foreign direct investment in Indonesia shows a positive upward trend, in line with the trend of banking stability. As shown in Figure 4, the decline in foreign direct investment occurred in 2016. Indonesia is a country that depends on commodity exports such as oil, gas, coal, and palm oil (Chandrarin *et al*., 2022). In 2016, there was a significant decline in global commodity prices, reducing Indonesia's export earnings and making investment in the sector less attractive to foreign investors (Christensen, 2016). However, FDI in Indonesia in 2017 reached USD 32.24 billion, up 13.2% compared to the previous year. FDI in Indonesia is concentrated in three main sectors, namely the processing, mining and quarrying industries as well as electricity, gas and clean water (Gopalan, Hattari & Rajan, 2016). In the manufacturing industry sector, the largest FDI comes from Singapore and Japan. While in the mining and quarrying sector, the largest FDI comes from Australia and the UK.

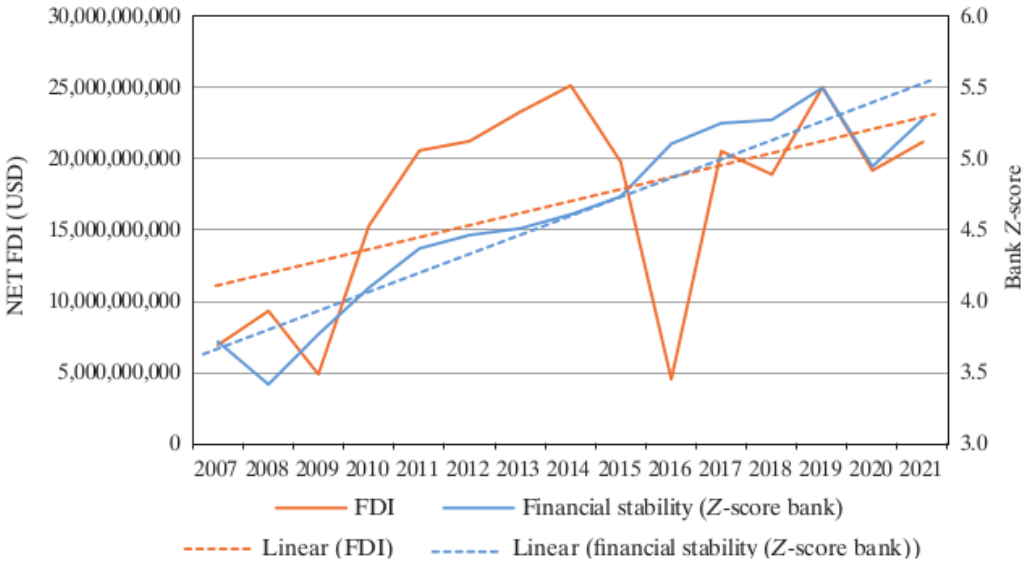

Fig. 4. Foreign Direct Investment Movements in Indonesia

Source: World Bank (2007–2021).

The COVID-19 pandemic has also had an impact on FDI in Indonesia. The long-term and uncertain impact of the COVID-19 pandemic on economic growth and investment prospects creates higher risks for investors. Uncertainty about when and how economic recovery will occur may hinder long-term investment decisions. The decline in global demand due to the impact of the pandemic on consumption and investment has had a negative impact on sectors that previously attracted foreign investment (Castañeda--Navarrete, Hauge & López-Gómez, 2021). In addition, disruptions in global supply chains due to factory closures, restrictions on the movement of goods, and logistical difficulties can affect foreign investment decisions (Liu, Lee & Lee, 2020).

4.4. Descriptive Statistics

Statistical descriptions for each variable used in this study are displayed in Table 2. The variables studied include bank *Z*-scores influenced by interest rates, exchange rates and foreign direct investment for 15 years from 2007 to 2021. The table shows the mean, median, maximum and minimum values, standard deviation, skewness, and kurtosis. The total number of observations is 15.

Table 2. Descriptive Statistics

Specification	*SB*	*NT*	*FDI*	*BZS*
Mean	1.776460	9.353589	23.43072	4.602078
Median	1.791759	9.381366	23.70789	4.607392
Maximum	2.224624	9.587557	23.94696	5.495973
Minimum	1.252763	9.079141	22.23657	3.418616
Standard deviation	0.288405	0.194892	0.589140	0.639159
Skewness	–0.375645	–0.131627	–1.133701	–0.373201
Kurtosis	2.141767	1.325869	2.710422	2.028808
Jarque-Bera	0.813124	1.795011	3.265604	0.937707
Probability	0.665936	0.407585	0.195381	0.625719
Sum	26.64691	140.3038	351.4608	69.03117
Sum Sq. Dev.	1.164487	0.531761	4.859197	5.719335
Observations	15	15	15	15

Source: Output EViews 9 (2007–2021).

Financial stability in the banking sector can be reflected by the bank *Z*-score variable, which shows the level of bank solvency in the face of crisis. The average bank *Z*-score for 15 years in Indonesia was 4.60% and the highest bank *Z*-score occurred in 2019 at 5.49%. However, the lowest bank *Z*-score occurred in 2008 with a value of 3.41%. From Table 2, it can be seen that the variable interest rate has a mean value of 1.77% with a highest value of 2.22%, and a lowest value of 1.25%. Next is the exchange rate variable which has an average value of 9.35% with a highest value of 9.58% and a minimum value of 9.07%. Then there is foreign direct investment which has an average value of 23.43% with a maximum value of 23.94%, and a minimum of 22.23%. Data variations in the variables in this study are quite diverse, as shown by different standard deviations. This indicates significant departures from the average value. Data distribution on interest rates, exchange rates, and banking financial stability has a negative tail, while FDI variables have a longer negative tail. These results indicate that there is a potential for low values or outliers on the negative side of these variables. In terms of distribution form, FDI stands out with the highest kurtosis. This reflects that the distribution of foreign direct investment data tends to be blunter than normal distribution and has a long tail.

4.5. Model Estimation Results

The results of the estimated model test using Ordinary Least Squares (OLS) are as follows:

$$\widehat{BZS} = -18.79606 - 0.715081(SB) + 1.845650(NT) + 0.316038(FDI). \quad (3)$$

Based on Table 3, it is known that the variables in the study have satisfied the classical assumptions. In addition, it is known, with a probability of less than $\alpha = 5\%$, that the variable interest rate has a negative direction, meaning that it has a negative and significant effect on banking stability, the exchange rate variable has a negative and significant effect on $\alpha = 1\%$, the variable of positive and significant foreign direct investment at $\alpha = 5\%$. From the probability *F*-statistic below $\alpha = 1\%$ shows that the three independent variables together affect financial stability.

Table 3. Regression Estimation

Variable	Coefficient	*t*-statistic	Probability
C	–18.79606	–3.395796	0.0060
BZS	–0.715081	–2.144548	0.0552*
NT	1.845650	3.699020	0.0035***
FDI	0.316038	2.400123	0.0352**
R-squared	0.848016		
Prob. (*F*-statistic)	0.000083		
Normality	Histogram-Normality Test		
Jarque-Fallow	0.319257		
Probability	0.852460		
Autocorrelation	Breusch-Godfrey		
F-statistic	0.303166		
Obs**R*-squared	0.946768		
Prob. *F*(2,9)	0.7457		
Prob. Chi-Square(2)	0.6229		
Heteroskedasticity	Breusch-Pagan-Godfrey		
F-statistic	2.125452		
Obs**R*-squared	5.504339		
Scaled explained SS	2.568008		
Prob. *F*(3,11)	0.1550		
Prob. Chi-Square(3)	0.1384		
Prob. Chi-Square(3)	0.4631		
Multicollinearity	Variance Inflation Factors		
Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	30.63730	5,815.549	–
SB	0.111183	68.24095	1.638412
NT	0.248958	4,136.168	1.675292
FDI	0.017339	1,807.920	1.066167
F table	2.769		
t-table	2.003241		

Notes: *, **, and *** indicate significance levels at levels of 10%, 5% and 1%.

Source: Output EViews 9 (2007–2021).

4.6. The Relationship between Interest Rates and Banking Financial Stability

Interest rates have a significant influence on banking stability, these two variables are negatively correlated. Interest rates are a major factor influencing performance and risk in the banking sector (Baselga-Pascual, Trujillo-Ponce & Cardone-Riportella, 2015). Rising interest rates can increase borrowing costs for consumers and companies, further reducing demand for loans and economic activity (Peltoniemi & Vieru, 2013). A decline in demand for credit has the effect of reducing the income from interest received by banks, disrupting their profit potential (Were & Wambua, 2014). At the same time, higher interest rates lead to increased credit risk for banks (Chaibi & Ftiti, 2015). Rising interest rates also cause interest payments on consumer and corporate debt to increase, making it difficult for them to meet financial obligations. This has the potential to lead to an increase in default risk and poorer asset quality in the bank's loan portfolio (Campbell & Cocco, 2015). In this situation, banks need to allocate more resources to allay higher credit risk. In addition, the negative correlation between interest rates and banking stability also has an impact on asset values. Rising interest rates tend to cause a decrease in the market value of fixed-interest assets such as bonds (Domanski, Shin & Sushko, 2017). If banks have significant bond portfolios, a drop in the value of these assets can reduce the total value of their assets as well as affect the health of capital. These results are in line with research by Köhler (2015), Fu, Lin and Molyneux (2014), and Smets (2014).

The BI7DRR (7-day reverse repo rate reference interest) policy implemented in Indonesia has had a significant impact on bank stability. The benchmark interest rate set by Bank Indonesia affects various operational and financial aspects of banks in Indonesia (Raharjo *et al.*, 2014). The BI7DRR policy may also affect liquidity conditions in financial markets (Tanjung *et al.*, 2022). Higher interest rates tend to attract funds from the real sector to the financial sector, thus affecting liquidity in the money market and capital market (Roberts, 2013). Banks need to monitor their liquidity carefully as well as taking appropriate measures to maintain their stability. Interest rate movements at home and abroad can affect BI7DRR policy. If other countries raise interest rates, or global conditions are unstable, Bank Indonesia needs to adjust interest rates to maintain domestic economic stability. During the COVID-19 pandemic, Bank Indonesia took a series of monetary policy measures to respond to significant economic impacts. One of the steps taken was the adjustment

of the benchmark interest rate, namely BI7DRR (Murdiana, Adrianto & Alfarisi, 2022). Bank Indonesia continued to monitor banking stability during the pandemic. The lower interest rate needs to be balanced with close monitoring of credit risk, liquidity, and the overall financial condition of the banking industry.

4.7. Exchange Rate Relationship to Banking Financial Stability

Based on the regression results, the exchange rate is positively correlated and significant in affecting banking stability in Indonesia. This result is in line with the rise in exchange rates shown in Figure 3, meaning that the Indonesian rupiah continued to depreciate against the US dollar. The depreciation or devaluation has had a positive effect on financial stability (Chuliá, Fernández & Uribe, 2018). In some cases, exchange rate depreciation can increase a country's export competitiveness, which can benefit the economy as a whole, including the banking sector (Zia & Mahmood, 2013). In addition, in some situations, controlled exchange rate depreciation can help improve overall economic stability by boosting export growth and reducing trade deficits (Sarno, Taylor & Frankel, 2003). However, on the other hand, exchange rate depreciation can be a problem if it is not well balanced with various other factors. Too large a depreciation can pose a risk to banks that have liabilities denominated in foreign currencies, as the value of their assets denominated in domestic currency may undergo a relative decline. This could affect the liquidity and solvency of banks (Bitar, 2021).

In a controlled floating exchange rate regime, monetary authorities attempt to keep the rupiah exchange rate within a certain range by targeted intervention in the foreign exchange market. Banks can manage their risks and business activities more effectively with a stable rupiah exchange rate (Warjiyo, 2013). In a controlled floating exchange rate regime, exchange rate stability maintained by the monetary authority is able to provide certainty to banks when planning operational policies and risk management (Bordo & Levin, 2017). Controlled exchange rate fluctuations can help banks anticipate the risk of exposure to foreign currency volatility and reduce uncertainty in international transactions. This has a positive impact on the stability of banking assets and liabilities related to foreign exchange transactions. In addition, exchange rate stability can also affect bank liquidity stability. In a controlled exchange rate regime, sudden changes in exchange rates can be better managed, and banks have a greater ability to anticipate liquidity needs (Diamond, Hu & Rajan, 2020). This helps reduce the risk of banks defaulting on their financial obligations. Banking

supervisory authorities have a clearer view of the risks associated with exchange rate fluctuations in a controlled regime. These results are in line with research by Ghosh (2015), Beck, Jakubik and Piloiu (2013), and Makri, Tsagkanos and Bellas (2014).

Based on movements in the Indonesian rupiah exchange rate during the 2008 global crisis and the COVID-19 pandemic, there were significant differences in policy decisions and responses. During the 2008 global crisis, the policy response focused on adjusting the benchmark interest rate as a means of controlling exchange rate movements. Such efforts are intended to maintain rupiah exchange rate stability against foreign currencies, especially the US dollar (Warjiyo, 2013). The main objective of the policy response during the global crisis period of 2008 was to prevent excessive depreciation of the rupiah exchange rate. Depreciation that is too rapid and sharp can encourage foreign capital outflows, which can, in turn, undermine economic and financial stability (Jongwanich & Kohpaiboon, 2013). In addition to adjusting the benchmark interest rate, the government and Bank Indonesia also took measures to control foreign capital outflows (Lindblad, 2015). This step was carried out as an effort to prevent further pressure on the rupiah exchange rate. On the other hand, during the COVID-19 pandemic, the policy response was more comprehensive and involved more policy instruments, not only the benchmark interest rate. The response included fiscal stimuli, liquidity policy, and real sector support. Bank Indonesia increased liquidity in financial markets through various mechanisms, such as adjusting liquidity regulations in the banking industry, purchasing government bonds and the like (Guofeng, 2021). This step helped to maintain liquidity and smooth transactions in financial markets. Despite the broader response, maintaining exchange rate stability remained one of the main objectives. Bank Indonesia took measures to maintain rupiah exchange rate movements in line with economic and foreign exchange market conditions.

4.8. The Relationship of Foreign Direct Investment to Banking Financial Stability

Foreign direct investment has a significant positive influence on the financial stability of banks. FDI is able to provide stable and sustainable long--term capital flows into the country, thus contributing to the strengthening of the economic and financial sectors (Bonatti & Fracasso, 2013). Foreign direct investment in Indonesia covers sectors such as manufacturing, energy, mining, technology, and infrastructure. FDI helps increase the country's foreign exchange reserves, which is one of the important indicators in

maintaining currency stability and international payments (Aizenman, Cheung & Ito, 2015). Foreign direct investment has played a crucial role in maintaining financial stability. FDI flows not only help increase investment in key sectors of the economy but also help reduce macroeconomic risks and financial instability (Mijiyawa, 2015). FDI brings in foreign capital that can be used by both companies and local financial institutions, including banks. With additional capital available, banks can overcome liquidity challenges and strengthen their capital positions. This helps banks deal with possible liquidity crises or capital shortages that could threaten financial stability. FDI is able to create relationships with foreign companies and institutional investors. Thus, allowing banks to diversify their sources of income. When banks have diverse incomes from different sectors and countries, the risk of dependence on one particular sector or market can be reduced, which ultimately increases their stability. Multinational companies are able to encourage more sophisticated risk management strategies and practices. It certainly affects risk management practices in local financial institutions, including banks. These results are in line with research by Fu, Lin and Molyneux (2014), Ozili (2018), and Dafermos, Nikolaidi and Galanis (2018).

Policy responses to foreign direct investment during the 2008 global crisis and the COVID-19 pandemic showed significant differences. In the 2008 global crisis, many countries focused on monitoring and incentives to attract FDI, especially in maintaining economic stability amid uncertain conditions. Measures such as more investor-friendly regulation and protection of intellectual property rights are used to strengthen the investment climate (Fernandez, Almaazmi & Joseph, 2020). However, the policy response during the COVID-19 pandemic has become more comprehensive and diverse. Deeper economic uncertainty can influence investment decisions, especially in affected sectors such as tourism and retail. Countries responded by providing support and flexibility to investors, by providing specific stimulus and incentives given to key sectors in need of economic recovery (Stern & Zenghelis, 2021; Rudenko *et al.*, 2022). The focus on digital technology, health, and infrastructure has become more important, as efforts to revive post-pandemic economic growth.

5. Conclusions and Recommendations

Based on the results of the study, it was found that interest rates, exchange rates, and foreign direct investment (FDI) have a very strong influence on financial stability in Indonesia. An increase in interest rates could destabilise

the banking industry and overall economic activity. A stable exchange rate plays an important role in maintaining asset stability, liquidity, and risk management in banking. With the adoption of a controlled floating exchange rate regime, the Indonesian monetary authorities seek to keep the rupiah exchange rate within a controlled range and minimise adverse fluctuations. On the other hand, FDI flows can strengthen economic stability through contributions to foreign exchange reserves, additional capital, and help mitigate macroeconomic risks, with cooperation in the investment sector encouraging more sophisticated risk management strategies and practices. In addition, there are differences in terms of monetary policy responses taken by the monetary authorities and the Indonesian government between the financial crisis of 2008 and the COVID-19 crisis of 2020.

Uncontrolled interest rate policy as well as significant fluctuations in interest rates can create major challenges to banking stability. Monetary and banking authorities need to work together to closely monitor and manage interest rate policy in order to maintain a balance between supporting economic growth and the stability of the banking sector. Indonesian banks need to encourage improved management of their foreign exchange risks. If the exchange rate has a significant influence on a bank *Z*-scores, fluctuations in the exchange rate can have an impact on the bank's financial stability and health. More effective foreign exchange risk management can help banks reduce their exposure to exchange rate risk. Sudden fluctuations in foreign capital flows are capable of causing turmoil in financial markets and exchange rates, which negatively affect macroeconomic stability. Therefore, it is necessary to maintain a balance between supporting sound foreign investment and maintaining the availability of policy instruments needed to overcome any potential risks that may arise.

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THE EFFECT OF INTEREST RATES, EXCHANGE RATES, AND FOREIGN DIRECT INVESTMENT ON FINANCIAL STABILITY IN INDONESIA

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