Increase in Inflation Due to the Effect of Interest Rates in Indonesia

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Abstract

Inflation in Indonesia from 2000-2008 was relatively unstable, with inflation instability in Indonesia. The goal of this study is to examine a number of variables that affect monetary inflation. To determine how monetary factors influence inflation in Indonesia, we use multiple linear regression model estimates using time series data, tests of conventional assumptions, and statistical tests. We discover that interest rates play a significant role in determining inflation; rising interest rates will result in rising inflation. The key factor contributing to rising inflation is the interest rate, hence the monetary authority must work to keep interest rates stable to prevent inflation.

Keyword : Inflation, Interest Rate, Indonesia, Monetary
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Background

The 2004-2009 period occupied by the National Medium-Term Development Plan of Indonesia, the economic prospects include improving people's welfare through high-quality economic growth, strong economic growth, and stable economic conditions (Siscawati, Adelina, Eveline, & Anggriani, 2020). Inflation is expected to decrease gradually from around 7% in 2005 to 3% in 2009 to maintain monetary stability in the medium term. This estimate is based on a declining and normal inflation target, but by monitoring economic expansion, achievement of the inflation goal is accommodated by the nominal value of the relative stability of the rupiah in an average of Rp.-/USD. From an economic perspective, inflation is a country's monetary character; if the skew increases or decreases as a consequence of price fluctuations, this leads to economic turmoil (Warjiyo & Juhro, 2019).

Indonesian government policies often focus on reducing inflation. The government's attempt to create money to finance the budget deficit was a major factor in the 600% high inflation that occurred in Indonesia between 1961 and 1966 (Prasety & Setyowati, 2023). Consequently, the amount of money in circulation had a significant impact on Indonesia's inflation rate. According to the plan for the 1998-1999 fiscal year, Bank Indonesia saw inflation rising at the peak of the economic recession in 1998 by 77.6%, which led to an increase in prices, especially after the sharp depreciation of the rupiah. The devaluation of the rupiah reached a plateau in June 2008, or IDR 16,500 per US dollar (Sümer, 2023).

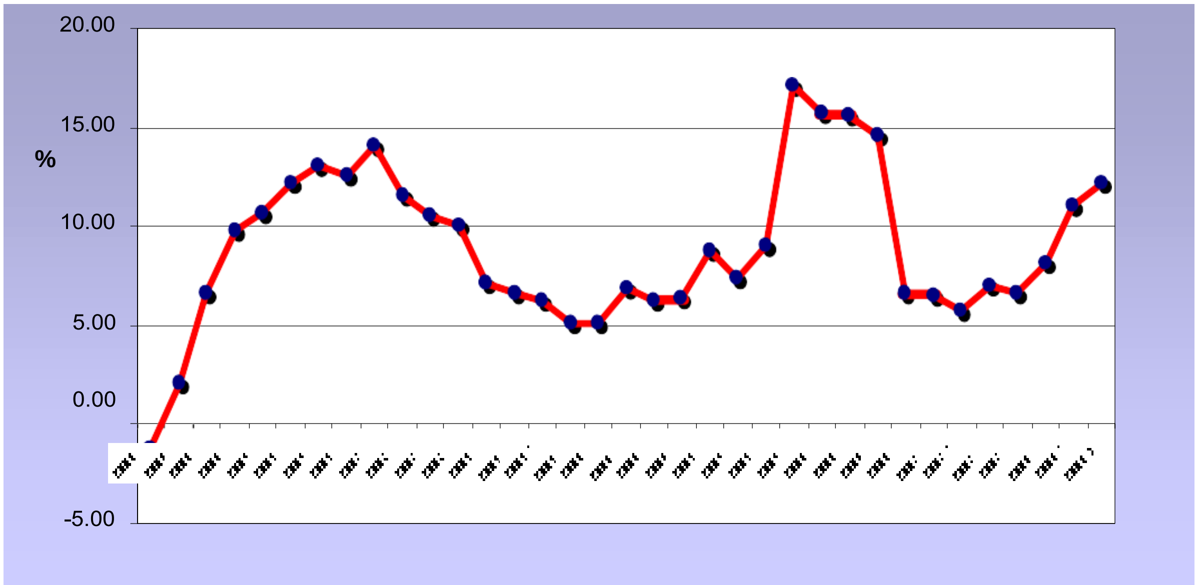

Figure 1. Inflation Chart
Source: Bank Indonesia

Bank Indonesia can influence inflation through monetary policy. Bank Indonesia hopes that Bank Indonesia's inflation target will be targeted by residents and economic players so that the inflation that occurs can be the same or close to the inflation target. When this occurs, monetary control costs can be reduced. for the central bank, Bank Indonesia is primarily responsible for keeping the monetary strata operating effectively so as to ensure that growth rates are achieved without inflation (Rahman, Ratnasari, & Wardhana, 2022).
The level of the amount of money that exceeds circulation can push up the price increase above the planned level and in the long run can hinder economic progress, when the amount of money in circulation grows by 5%, the price level there is also an increase of 5%. Or vice versa, when the circulation of money in circulation decreases by 5%, the price level will decrease by 5% (Doan Van, 2020). The monetary policy implemented by Bank Indonesia, namely the Inflation Targeting Framework, has an impact on inflation through changes in interest rates. This policy framework involves several basic elements, one of them using operational goals like interest rates, the formulation of monetary policy, a more transparent communication strategy, and increased policy coordination with the government. This program seeks to increase the monetary policy's efficiency in ensuring price stability, which in turn encourages social welfare and long-term economic prosperity (Meilianna, 2020).
Inflation that rises and cannot be predicted is very influential to be observed because of its effects on the economy which can cause inconstancy, the progress of a weak economy, the occurrence of unemployment which continues to rise. Because the problem of inflation is not a problem that is not serious and affects many fields, it is very important to prevent inflation that is already severe (Olusola, Chimezie, Shuuya, & Addeh, 2022). Monetary policy has a very influential role in managing inflation, which is necessary in order to recognize the monetary elements that influence inflation (Ghosh, Sahu, & Chattopadhyay, 2021).

Inflation is a condition in which the price level continuously increases (Elfahham, 2019). The increase in the prices of goods does not always have to be with the same percentage, it may even occur that the increase is not simultaneous. Importantly, there is an increase in the overall price of goods over a period of time. If there is an increase in the price of goods only once, even if by a significant percentage, it is not an indication of inflation (Alola, Bekun, & Sarkodie, 2019).
Interest is compensation given as a fee for using money (Zhang, Kou, & Peng, 2019). The amount of interest paid over a specific time period is the interest rate, calculated as a percentage of the loan amount. In other words, someone has to pay in return for the opportunity to borrow money (Bhutta & Hizmo, 2021). The difference among the nominal interest rate and the anticipated rate of inflation is the concept that calculates the actual interest rate (Czudaj, 2020). The government sets interest rates to control prices. When the price level is high and the money supply increases, the government can anticipate high levels of public consumption by raising interest rates (Susilawati, Falefi, & Purwoko, 2020). Inflation in Indonesia from 2000-2008 was relatively unstable, with inflation instability in Indonesia (Yunita, 2020). The goal of this study is to examine a number of variables that affect monetary inflation.

Research Methods

The data used in this study was obtained from secondary sources from Bank Indonesia (BI). The following data is used:
a. Inflation Data in Indonesia in 2000.1-2008.3.
c. Data on 3-month deposit interest rates in 2000.1-2008.3.
To determine how monetary factors affect inflation in Indonesia, we use multiple linear regression model estimates using time series data, tests of conventional assumptions, and statistical tests. The following is a linear regression model:

$$INF = \beta_0 + \beta_1 \log(JUB) + \beta_2 TSB + \beta_3 \log(Kurs) + \mu$$

Where:
INF = Inflation
JUB = Total Money Supply (M1)
TSB = Interest Rate (quarterly Deposit Interest) Exchange = Exchange Rate

In this study, the variable that is the focus is inflation. Since annual inflation data is not available in full, the data used is the annual general price index obtained from publications by Bank Indonesia. To find inflation data, the following formula is used:

$$\text{Annual Inflation Rate} = \frac{\text{CPI This Year} - \text{CPI Last Year}}{\text{CPI Last Year}}$$

Inflation data is used for quarterly data obtained from the last month's data and claimed in the form of percentage units (%).
The interest rate is the minimum level of profit expected by investors or the level of profit expected from investing in deposits. The interest rate referred to here is the weighted average deposit interest rate of various time deposits with different maturities at commercial banks, expressed as a percentage per three months (commercial bank deposits per quarter). The quarterly deposit interest rate is considered the most realistic deposit rate because depositors are generally rational people. They don't want to keep their money for too long but they also don't

want it to be too complicated to make deposits. The data is obtained from Bank Indonesia using the latest quarterly data and is expressed as a percentage.
Multiple linear regression is the analytical technique employed in this work to estimate time series data. To determine how monetary factors affect inflation in Indonesia, traditional assumption testing and statistical analysis are applied.
The estimated model to be used is as follows: INF= f {TSB}
Or with a linear regression equation model written as follows:
$INF = \beta 0 + \beta 1\ TSB + \mu$
Information:
INF = Inflation
TSB = Interest Rate (quarterly Deposit Interest)
In reality, several problems often arise when regression analysis is used to estimate a model with some data. This is a problem which in econometrics books includes testing the classical assumptions, namely whether or not there are problems of heteroscedasticity, autocorrelation, and multicollinearity. The occurrence of a deviation from the classical assumption above will cause the statistical tests (t-stat and f-stat tests) to be carried out to be invalid and statistically will cause problems with the conclusions obtained.
A statistical technique called the normality test is used to determine whether or not the observed data have a normal distribution. Researchers employ the Jarque-Bera Test, which determines if the data are normally distributed if the probability value is larger than 0.6781.
In a regression model, multicollinearity is the absence of a linear connection between the independent variables. If all or some of the independent variables in the regression model have a perfect linear relationship, the regression model is said to be multicollinear. Consequently, it will be challenging to discern how the independent variable affects the dependent variable. To detect multicollinearity, the coefficient of partial determination (r2) can be compared with the coefficient of multiple determination (R2), if r2 is smaller than the value of R2 then multicollinearity does not occur.
In the form of a linear regression model, the autocorrelation test looks to examine if there is a link between the confounding errors in period t and the confounding errors in period t-1 (previous) period. An autocorrelation problem is one where there is a correlation. Because subsequent observations correlate with one another over time, autocorrelation happens. This issue emerges not from one observation to the next but rather from residual issues (interfering mistakes). Others, this is often found in a time series data due to disturbances. To detect whether there is autocorrelation is the Lagrange Multiplier test (LM). The decision whether or not autocorrelation exists is as follows:

a. If the computed value of Obs* R-square (χ) is greater than the table value of Obs*R-square (χ) or if the probability is less than 0.05 at a certain level of confidence (α), the model has an autocorrelation issue.
b. There is no autocorrelation issue if the computed value of Obs*R-square (χ) table value of Obs*R-square (χ) or probability > 0.05 at a specific level of confidence (α).

Heteroscedasticity arises when the errors or residuals of the observed model do not have a constant variance from one constant variance from one observation to another. One of the tests used to detect heteroscedasticity is by using the White Method. The reason for using White's method is because the X2 test is a general test for the presence or absence of model specifications, because the underlying null hypothesis is that the residuals are assumed to be

homoscedastic and independent variables and the linear specification of the model is between each independent variable and the residuals are corrected for differences. If the calculated X2 value (Obs * R square) < X2 value in the table, for example the confidence level is $\alpha = 5\%$, either the probability value is larger than 5%, which indicates that the model passed the heteroscedasticity test, or it is less than 5%, which indicates that the model failed the test.
This study used the joint test (t) and partial test (F) to investigate a hypothesis. The t test is used to determine the link between inflation, interest rates, and exchange rates. In this scenario, the money supply, interest rates, and inflation of the exchange rate are being tested for a combined effect, and the F-test is used to summarize the findings of the regression of both variables. The percentage of independent factors that have an impact on the dependent variable is calculated using R-square. The R-square value spans from zero to one; the closer it is to zero, the less impact the independent factors have on the dependent variable, and the closer it is to one, the more impact they have on the dependent variable.

Results and Discussion

The interest rate shown here is the weighted average of all deposit rates currently applicable at commercial banks for deposits with different expiry durations, namely 3 months percent. (minimum bank deposit per quarter). The following graph shows how interest rates on 3-month futures deposits changed from 2000 to 2008.

Table 1. Interest Rate (%)

Quarterly Years	I	II	III	IV
2000	12.40	11.69	12.84	13.24
2001	14.86	15.00	16.16	17.24
2002	17.02	15.85	14.36	13.63
2003	12.90	11.55	8.58	7.14
2004	6.11	6.31	6.61	6.71
2005	6.93	7.19	8.51	11.75
2006	12.19	11.70	11.05	9.71
2007	8.52	7.97	7.44	7.42
2008	7.26	7.49	9.45	

Source: Bank Indonesia, data processed

According to the table 1 above, interest rates have fluctuated since 2000. From 2001 to 2004, they increased, reaching their highest point in the fourth quarter of 2001 (17.24%) before falling to their lowest point in the first quarter of 2004 (6.11%). Below is how Figure 1 illustrates the evolution of interest rates

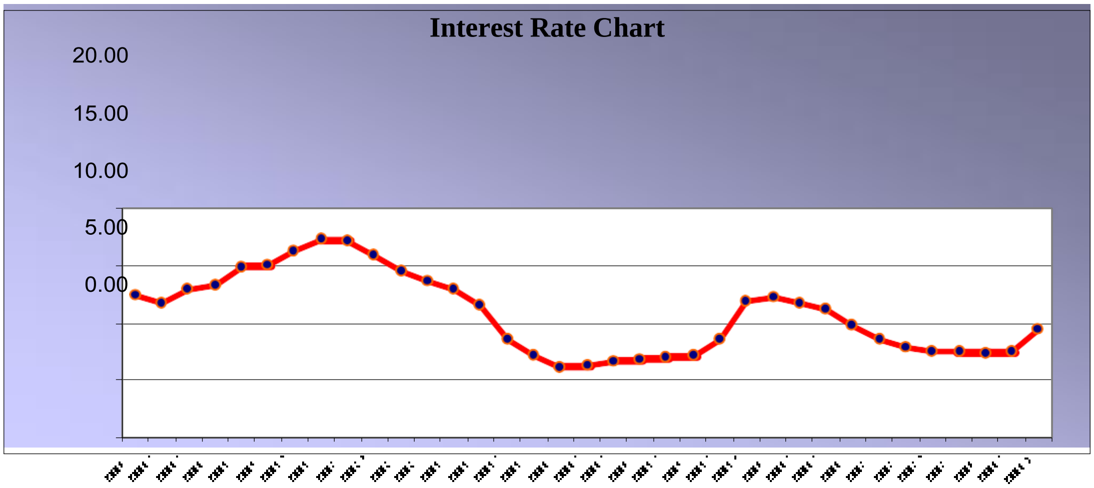

Figure 1. Interest Rate Chart

The value that represents the cost of the US dollar in rupiah units each year is known as the US dollar (US$) exchange rate for the rupiah. From 2000.1 to 2008.3, the following is how the value of the US dollar relative to the rupiah changed. The value of the rupiah fluctuated, with the second quarter of 2001 seeing its highest depreciation at IDR 11,440 against the US dollar. The rupiah started strengthening and had a very stable year in 2002. Between 2000.1 and 2008.3, the rupiah averaged Rp 9,256. Table 2 shows the level of change as follows:

Table 2. Rupiah Exchange Rate against the US Dollar (Rupiah)

Quarterly Years	I	II	III	IV
2000	7590	8735	8780	9595
2001	10400	11440	9675	10400
2002	9655	8730	9015	8940
2003	8908	8285	8389	8465
2004	8587	9400	9155	9270
2005	9468	9761	10310	9830
2006	9075	9300	9235	9020
2007	9118	9054	9145	9419
2008	9217	9225	9378	

Source: Bank Indonesia, data processed

Following are the findings from data processing and variable research on the impact of monetary factors on inflation in Indonesia:

Table 3. Inflation equation estimation

Constant	Coefficient of money supply	Coefficient ofTSB	Coefficient of Kurs	R^2	Adjusted R^2	F	DW	S.E.of Regressions
-	6.23740	0.87331	18.5873	0.64567	0.61138	18.8299	0.89373	2.467238

247.35 7	8 (4.2539 1)	1 (5.1221 9)	6 (3.0095 8)	4	4	9	1	

Source: Bank Indonesia, data processed

Note: The number in brackets under the estimated coefficient is the value of the t statistic.

By contrasting these data with the outcomes of the LM test's autocorrelation test, where prob*R-squared = 10.34511 > 0.05, it can be shown that this model is autocorrelation-infection with Durbin Watson 0.893731.

Table 4. Autocorrelation Test

F-stat.	5.200059	Prob. F(2,29)	0.0118
Obs*R-sq.	9.238656	Prob. Chi-Sq. (2)	0.0099

Time gap models often have problems because they violate the autocorrelation prerequisites. An autoregressive model can be used to solve this problem. (AR) or Autoregressive Integrated Moving Averages (ARIMA). This is the model that will be used after the researchers try to simulate using AR(1) as a means to disrupt the autocorrelation. By examining the autoregressiveness based on the chorelogram, which shows the theoretical behavior of the autocorrelation and partial autocorrelation functions, an appropriate model using AR(1) was found. The results of the corelogram are presented in table 5

Table 5. The corelogram result

<table>
<tr><td>. |****</td><td>|</td><td>. |****</td><td>|</td><td>1</td><td>0.504</td><td>0.504</td><td>9.6849</td><td>0.002</td></tr>
<tr><td>. |**</td><td>|</td><td>. | .</td><td>|</td><td>2</td><td>0.267</td><td>0.017</td><td>12.485</td><td>0.002</td></tr>
<tr><td>. |*.</td><td>|</td><td>. | .</td><td>|</td><td>3</td><td>0.146</td><td>0.007</td><td>13.351</td><td>0.004</td></tr>
<tr><td>. |*.</td><td>|</td><td>. |*.</td><td>|</td><td>4</td><td>0.181</td><td>0.136</td><td>14.719</td><td>0.005</td></tr>
<tr><td>. | .</td><td>|</td><td>.*| .</td><td>|</td><td>5</td><td>0.018</td><td>-0.172</td><td>14.733</td><td>0.012</td></tr>
<tr><td>. | .</td><td>|</td><td>. |*.</td><td>|</td><td>6</td><td>0.056</td><td>0.116</td><td>14.871</td><td>0.021</td></tr>
<tr><td>. | .</td><td>|</td><td>. | .</td><td>|</td><td>7</td><td>0.063</td><td>0.020</td><td>15.054</td><td>0.035</td></tr>
<tr><td>. | .</td><td>|</td><td>.*| .</td><td>|</td><td>8</td><td>-0.014</td><td>-0.129</td><td>15.064</td><td>0.058</td></tr>
<tr><td>.*| .</td><td>|</td><td>.*| .</td><td>|</td><td>9</td><td>-0.199</td><td>-0.176</td><td>17.037</td><td>0.048</td></tr>
<tr><td>**| .</td><td>|</td><td>.*| .</td><td>|</td><td>10</td><td>-0.256</td><td>-0.132</td><td>20.436</td><td>0.025</td></tr>
<tr><td>.*| .</td><td>|</td><td>. |*.</td><td>|</td><td>11</td><td>-0.144</td><td>0.098</td><td>21.560</td><td>0.028</td></tr>
<tr><td>.*| .</td><td>|</td><td>.*| .</td><td>|</td><td>12</td><td>-0.153</td><td>-0.090</td><td>22.883</td><td>0.029</td></tr>
<tr><td>.*| .</td><td>|</td><td>. | .</td><td>|</td><td>13</td><td>-0.149</td><td>-0.009</td><td>24.192</td><td>0.029</td></tr>
<tr><td>.*| .</td><td>|</td><td>.*| .</td><td>|</td><td>14</td><td>-0.180</td><td>-0.099</td><td>26.197</td><td>0.024</td></tr>
<tr><td>.*| .</td><td>|</td><td>. | .</td><td>|</td><td>15</td><td>-0.126</td><td>-0.014</td><td>27.220</td><td>0.027</td></tr>
<tr><td>.*| .</td><td>|</td><td>. |*.</td><td>|</td><td>16</td><td>-0.094</td><td>0.091</td><td>27.822</td><td>0.033</td></tr>
</table>

The correct model to use is AR.(1) to avoid autocorrelation problems in the model. Considering the correlogram's findings, the autocorrelation coefficient (ac) slowly decreases to zero, while the partial correlation coefficient (pac) decreases to zero after lag 1.

The normality test checks for a normal distribution of the residual or interaction variables in a linear regression model. The test that the researchers employed is the Jarque-Bera test. The statistical probability value JB = 0.786127 >, where = 0.05, shows that the distribution of the data utilized is accurate given the processing of the data. To determine multicollinearity, partial determination factors (r2) and values (R2) can be compared. The multicollinearity test's findings are as follows:

Table 6. Multicollinearity Test Results

No	Regression Models	R-square value
1	Main Regression Model Inf = f {log(JUB), TSB, log(Exchange)}	0.763631
2	Auxiliary regression model I Log(JUB) = f{TSB, log(Exchange rate)}	0.450628
3	Auxiliary regression model II TSB = f{ Log(JUB), log(Exchange rate)}	0.478419
4	Auxiliary regression model III log(Exchange rate)= f{ Log(JUB),TSB}	0.142470

There is no r2 value in the table that exceeds R2, which leads to the conclusion that there is no multicollinearity disorder. The Lagrange Multiplier (LM) test was used in this study to find the lack of autocorrelation. The options for whether to use autocorrelation using this method are as follows:

The model has autocorrelation problems if the calculated value Obs* R-square () > Obs*R-square() table value or probability is 0.05 at the confidence level

*R-Square or probability > 0.05 at a certain level of confidence. which are given. Implicit indicates that there is no autocorrelation problem if the calculated value of Obs*R-square is the value from the Obs table. Following are the results of the autocorrelation test using the LM correlation test:

Table 7. Autocorrelation Test Using The LM Correlation

F-stat.	0.047752	Prob. F(2,27)	0.9535
Obs*R-sq.	0.119842	Prob. Chi-Sq. (2)	0.9418

The correlation test and LM autocorrelation test findings The outcomes of the data processing described above may be used to obtain the probability value of chi-square = 0.9418> 0.05 (= 5%), and Consequently, it may be said that the model doesn't have autocorrelation. To ascertain if the interference error (e) in the linear regression model is the same kind from one observation to the next, the heteroscedastic test is utilized. This test for determining heterosexuality in research is based on the White Method. The following are the outcomes of the data processing:

Table 8. Heteroscedasticity Testing

F-stat.	0.637274	Prob. F(3,30)	0.5969
Obs*R-sq.	2.036924	Prob. Chi-Sq. (3)	0.5648
Scaled explained SS	3.686962	Prob. Chi-Sq. (3)	0.2973

Assumes one unit analysis is equal to 5%. This model is heteroscedastic if the calculated X2 value (Obs* R Squered value) is greater than the X2 table value. Or, assuming this model is susceptible to heteroscedasticity, the Obs* R square probability value is 5%. As can be shown from the above data processing, this model is free from heteroscedasticity if the probability value of Obs* R square = 0.5648 > 0.05 (= 5%). The following findings were attained based on the regression results of all variables which were tested using the F and t-tests in this study:

Table 9. Hypothesis testing and regression Results

	Coeff.	Std. Error	t-Stat.	Prob.
C	-88.73156	65.72101	-1.350125	0.1874
LOG(JUB)	4.475462	2.588469	1.729000	0.0944
TSB	1.028217	0.234439	4.385854	0.0001
LOG(KURS)	3.494366	6.420177	0.544279	0.5904
AR(1)	0.600226	0.126810	4.733259	0.0001

To ascertain how Indonesian inflation is impacted by the money supply, interest rates, and exchange rate, use the regression equation Inf = C(1) + C(2)*LOG(JUB) + C(3)*TSB +C(4)* LOG(EXCHANGE) + [AR(1)=C(5)]. And based on table 4.7 we can get the regression equation: INF = -88.73156 + 4.475462*LOG(JUB) + 1.028217*TSB + 3..494366*LOG(EXCHANGE) + [Ar(1)=0.641521]

The above-mentioned equation shows that interest rates have a positive and noticeable impact on inflation, whereas the quantity of money in circulation (M1) has no discernable impact on inflation. It also shows that the exchange rates of the US dollar and Indian rupiah have no discernible impact on inflation. The table shows that the amount of money in circulation is variable, the level of significance is above 0.05, and the variable interest rate is below 0.05.

From the table above, the value of t is calculated. Because each variable is known, a decision can be made using it as a stove. Can be concluded that:

At the 0.05 level, the variable amount of money in circulation (JUB) is insignificant, indicating that it has no impact on inflation.

A significant interest rate variable (TSB) of 0.05 indicates that the amount of money in circulation affects inflation.

At the 0.05 level, the exchange rate variable (KURS) is not significant, indicating that inflation is not affected by the amount of money in circulation.

To determine if there is a cumulative impact, the results of the independent variable regression analysis are compared with the dependent variable, which includes the total quantity of money in circulation, interest rates, and inflation rate.

The table above reveals that F is calculated at 23.42232 with a probability of 0.000000 less than the value α = 5%, so that the amount of money in circulation, interest rates and rupiah interest rates combined greatly affect inflation. R-square is used to measure the number of presentations of independent factors influencing variables. The R-square value is 0.763631, which means that the presentation size of the variable amount of money in circulation, The impact of interest rates and rupiah interest rates on inflation is 76.36%, with other factors that were not considered in the regression model having an impact on the remaining 23.64%.

The money supply is irrelevant on inflation, which means that an increase in the amount of circulating cash does not result in an actual increase in inflation. It can be observed from the number of regression equations, it is possible that the amount of money in circulation is 0.0944 not significant at the level $\alpha < 0.05$.

Keynes' claim that a rise in the money supply does not always lead to a change in prices supports this fact. When the economy encounters substantial unemployment, the amount of money in circulation in use rises without raising prices. Keynes also stated that price increases were not only driven by an increase in the amount of money in circulation but also by an increase in production costs. Although the amount of money in circulation does not change, when manufacturing costs increase, prices rise. With a regression coefficient of 1.03, interest rates are significant and positive, which suggests that when they rise by 1%, inflation will rise by 1.03%.

The partial test on the regression equation in the observation time range, the probability of the exchange rate being 0.5904 demonstrates that, at the level of < 0.05, the exchange rate variable has no significant impact, which implies that the depreciation of the currency against the US dollar is significantly impacted inversely on rising inflation. The effect of currency exchange rates on prices is short-term, but prices set exchange rates, rather than high rates of currency determining prices.

Domestic money may be processed in a foreign currency, but other foreign currencies are depressed so that the use of purchasing power parity is not possible. The conclusion of this study results from examining that the US dollar exchange rate does not affect Indonesia's inflation. The US dollar has the ability to suppress the rupiah exchange rate, although it does so less frequently when compared to other foreign currencies. As a result, if the rupiah is pressured against the US dollar, only some goods will see an increase in price rather than prices as a whole. Meanwhile, due to the slowdown in the economic progress of developed countries such as the United States, one of the reasons was the increase in oil prices, which was followed by increases in the prices of other commodities. Therefore, despite the decline in the dollar exchange rate but the prices of foreign goods have risen, the cost of imported goods has increased.

Conclusion

This study's overall money spread has no substantial impact on inflation. The 3-month deposit interest rate is significantly impacted favorably on inflation. In other words, inflation rises when interest rates rise. Since the exchange rate component has less of an influence on inflation, a drop in the rupiah's value in relation to the US dollar does not always translate into a rise in prices. When the rupiah is pressured against the US dollar, the price of specific goods will rise, but not prices generally, since the rupiah exchange rate can be repressed by the US dollar, but it is not necessarily suppressed in other foreign currencies.

Suggestion

Because interest rates have a significant impact on inflation, monetary policy decisions must be able to attempt to keep interest rates stable. Future research should be able to add more independent variables that match inflation, so that the information collected is more accurate to reduce the inflation rate.

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