E-ISSN : 2549-3280 P-ISSN : 2549-5933
INTEGRATED JOURNAL OF BUSINESS AND ECONOMICS
Email: ijbe.feubb@gmail.com
Laman: http://ojs.ijbe-research.com/index.php/IJBE/index

The Effect of Inflation and Exchange Rate on Macroeconomics in Indonesia

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Abstract

This research aims to examine whether there is a simultaneous effect of macroeconomic factors and how they influence the movement of inflation and exchange rates. exchange rate affects inflation through the theory of Exchange Rate Pass-Through Effect. The variables studied and suspected of influencing inflation are interest rates, money supply, exports, imports, government spending, unemployment, and exchange rates. While the variables studied and suspected of influencing the exchange rate are the difference in interest rates between domestic and foreign interest rates, trade balance, public debt, inflation and exchange rates MYR/USD, THB/USD, PHP/USD, SGD/USD. The research period is from 2004-2017. The research method used is the Two-Staged Least Square model. The results found that there was no simultaneity between inflation and the exchange rate after adding the control variable. Significant factors that partially affect inflation are exports, imports, government spending, unemployment, and the rupiah exchange rate. Meanwhile, interest rates and money supply partially have no significant effect. In terms of the IDR exchange rate, significant factors that partially affect IDR are the difference in interest rates between Indonesia and the US, government debt, trade balance, MYR, THB, and SGD. Meanwhile, PHP and inflation have no significant effect on the IDR.

Article Info

- **Received** : 1st December, 2021
- **Revised** : 5th April, 2022
- **Published** : 30th June, 2022
- **Pages** : 102-114
- **DOI** : 10.33019/ijbe.v6i2.417
- **JEL** : B22, E31
- **Keywords** : *Inflation, Exchange Rate, Macroeconomic Variables, 2SLS*

1. Introduction

According to the Purchasing Power Parity theory (PPP) and the Law of One Price (LOP), movements in the inflation rate can affect the exchange rates movements (Bahmani-Oskooee & Nasir, 2015). The LOP stated that the price of the same type of goods if traded in two different countries will have the same value in the country's currency. According to Vogel (2011), PPP describes the differences in the price level between different countries. The relative differences in the national price of a country will determine the changes in the exchange rate. So the percentage change in exchange rates is the same as the differential relative price between the home country and abroad (Humphrey, 1979). On the other hand, the effect of the exchange rate on inflation can be explained by Exchange Rate Pass-Through Effect (ERPT). ERPT is the impact of exchange rate volatility on a country's domestic inflation through the import channel. According to Besimi (2004), the changes in the exchange rate can affect inflation through two channels, namely ERPT and the current account of the balance of payments.

Research conducted by Qurbanalieva (2013), found that only in the long-run exchange rate can affect the price level. Research conducted by Edwards, (2006), showing that the exchange rate affects inflation, especially for countries that embrace inflation rate targeting policies. Research which was conducted by Noor (2011) showed that inflation and exchange rate do not have causal relationships.

In the Neoclassical Theory with the small open economy model, the exchange rate is elastic to interest rates differential between foreign and domestic interest rates. Mankiw (2016) & Parkin (2012) added that in a competitive market, the size of export and import which reflect on trade balance can influence the magnitude of the exchange rate. The balance of trade influences currency exchange rates through its effect on the supply and demand for foreign exchange (Lioudis, 2019). Public debt is also thought to affect the exchange rate. If the public debt is large, it will make the government tax collection bigger and the people will flee their funds abroad, which will increase foreign currency demand (Churchman, 2001). The government's interest in paying off debts that are also obtained from abroad will increase foreign exchange demand, which in turn depreciates the exchange rate. This is confirmed by Cubillos-Rocha, Gomez-Gonzalez, & Melo-Velandia (2019); (Loaiza-Maya et al., 2015); (McAleer & Nam, 2005) who showed that the contagion effect occurs in countries in the same region, for example, Brazil, Chilean, Colombian and Mexican and 5 ASEAN countries.

This research develops both the case studies and the variables studied based on the previous studies above. The author's research is divided into three, namely: i) investigating the relationship between inflation and the exchange rate after adding several control variables; ii) investigate the factors that influence inflation; iii) investigate the factors that affect the exchange rate. The author adds the movement of exchange rates in 4 ASEAN countries as one of the factors that are thought to affect the Rupiah exchange rate (IDR) based on the history of the contagion effect in the 1997 Asian crisis. The first issue and the addition of the exchange rates of 4 ASEAN countries: Malaysian Ringgit (MYR), Thai Baht

(THB), Philippine Peso (PHP) and Singapore Dollar (SGD) are the difference and innovation of this research compared to previous research.

2. Literature Review

There are several previous studies that concerning the relationship between inflation and exchange rates. However, the results are different and cannot be concluded in one result. Studies conducted by Maryatul, (2016) showed that the exchange rate has a positive and significant effect on inflation and BI Rate. In line with studies conducted by Savoie-Chabot & Khan (2015) showing the results that exchange rates have a large influence on consumer prices. Depreciation in the Canadian dollar has driven high inflation in Canada. Research conducted by Abdurehman & Hacilar (2016) showed that the inflationary change in Turkey does not affect the exchange rate. It occurs possibly because of certain factors such as transaction cost, government restriction, product specialization or other factors. Contrary to the research conducted by (Achsani et al., 2010), showed results that there is a strong correlation between the movements of inflation with real exchange rates. For Asia, there is a significant one-way causal relationship, but in the non-Asian region, the causal relationship seems to be in the opposite direction.

Concerning factors affecting inflation, the were some previous studies before. Mpofu (2011) showed that the money supply has a positive effect on inflation, while interest rates have a negative effect on inflation. Al-Qenaie (2016) showed that high inflation is associated with low money growth. Bayo (2012) also revealed that interest rates and money supply have a positive effect on inflation. According to Mehrara, Soufiani, & Rezaei (2016), the impact of government spending is significant on inflation in the tight money policy regime, while the expansionary regime is not significant. In Nigeria, government spending is a major factor causing inflation (Amuka et al., 2016). For the export variable, several previous studies have shown significant positive results on inflation (Choudhry, Hasan, & Ali, 2015; Kiganda, Obange, & Adhiambo, 2017). While the long run 1% increase in exports and imports cause a 0.63% and 0.57% increase in the CPI (inflation) (Ahmed et al., 2018). According to Siyan, Adegoriola, & Adolphus (2016), unemployment and inflation are one-way relationships in the long run. Islam et al., (2017) added that unemployment has a negative effect on inflation.

Concerning factors that determined the exchange rate, there were some previous studies before. Khan (2014) stated when the money supply rises, the exchange rate will depreciate, interest rates have a negative effect on the exchange rate and import exports do not have a significant effect on the exchange rate. Abdoh et al., (2016) showed different results, they showed that exports have a significant effect on changes in exchange rates, while interest rates and inflation have no effect. According to Li, Pan, & Wang (2019), the balance of payments has a negative correlation to the exchange rate. Vámos (2013) also added that high public debt will affect the exchange rate. High public debt will make the exchange rate depreciate (Galstyan & Velic, 2017; Neaime, 2015; (Ouma, 2016).

3. Research Methods

The author takes case research in Indonesia from 2004 to 2017 using monthly time series data. This period was chosen because there was a double shock, namely in 2008 when the global crisis occurred and in 2014 when world oil prices rose. For 4 ASEAN countries, the authors take the exchange rates of Malaysian Ringgit (MYR), Thai Baht (THB), Philippine Peso (PHP) and Singapore Dollar (SGD). The four countries are in the same region and tend to have the same movement as Indonesia.

This research uses 2SLS which is a development of OLS regression.

The 2SLS model in this research is as follows:

$$\mathbf{INF} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\mathbf{r} + \boldsymbol{\alpha_2}\mathbf{LOG(MS)} + \boldsymbol{\alpha_3}\mathbf{LOG(X)} + \boldsymbol{\alpha_4}\mathbf{LOG(M)} + \boldsymbol{\alpha_5}\mathbf{LOG(G)} + \boldsymbol{\alpha_6}\mathbf{LOG(U)} + \boldsymbol{\alpha_7}\mathbf{ER} + \boldsymbol{\varepsilon t} \quad (3\text{-}1)$$

$$\mathbf{ER} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}(\mathbf{r} - \mathbf{r_f}) + \boldsymbol{\beta_2}\mathbf{LOG(Debt)} + \boldsymbol{\beta_3}\mathbf{LOG(NX)} + \boldsymbol{\beta_4}\mathbf{MYR} + \boldsymbol{\beta_5}\mathbf{THB} + \boldsymbol{\beta_6}\mathbf{PHP} + \boldsymbol{\beta_7}\mathbf{SGD} + \boldsymbol{\beta_8}\mathbf{INF} + \mathbf{vt} \quad (3\text{-}2)$$

Where ER is the exchange rate; INF is inflation; r is the interest rate; MS is the money supply; X is export; M is import; G is government spending; U is unemployed; (r-rf) is the difference between domestic and foreign interest rates; Debt is public debt; NX is net exports that reflect the trade balance; MYR is Malaysian Ringgit; THB is Thai Baht: PHP is Philippine Peso; SGD is Singapore Dollar; and β is coefficients and $\boldsymbol{\varepsilon t}$ is error terms.

4. Results

4.1. Identification Test

Table 4-1: Result of Order Identification Test

Equation	Value of K-k	Condition	Value m-1	Identification
3.1	15-6 = 9	>	1	Overidentified
3.2	15-7 = 8	>	1	Overidentified

Source: Author

From table 4-1, it is known that the two models have overidentified equations because of the value of K - k> m-1, meaning that they meet one of the requirements to be estimated using the Two-Stage Least Square (2SLS) method.

4.2. Hausman Test

Based on the result of the simultaneous Hausman test in Equation 3-1 is 0.7907 and Equation 3-2 is 0.9024 where both equations have prob values> 0.05. It means there is no simultaneity between the two equations. Thus, the 2SLS test cannot be continued and only used the OLS multiple linear regression test.

4.3. The Classical Assumptions Test

[1] Normality Test

The Jarque-Berra statistical prob value of 0.1848 where the prob value> 0.05, so it can be concluded that the residuals in Equation 3-1 are normally distributed. Similar results were obtained in Equation 3-2, Jarque-Bera prob statistic value of 0.055> 0.05. Thus, it can be concluded that the residuals of Equation 3-2 also follow the normal distribution.

[2] Multicollinearity Test

Multicollinearity test result showed that there was a correlation of more than 0.80, so it can be said that in Equation 3-1, multicollinearity symptoms were found. Thus, further treatment must be carried out using the differential method. After treatment, multicollinearity test result show that there was no correlation whose value is more than 0.90. Thus, it can be said in Equation 3-1 that has been freed from the problem of multicollinearity. Next, a multicollinearity test was carried out on Equation 3-2.

The results of the correlation analysis show that there was no correlation whose value was more than 0.80. Thus, it can be said in Equation 3-2, has been freed from the problem of multicollinearity.

[3] Heteroscedasticity Test

In Equation 3-1, the results of the Breusch-Pagan test obtained obs * R-square of 0.0000 which is smaller than the significance of 0.05. It means in Equation 3-1, heteroskedasticity symptoms exist. Thus, further treatment must be carried out with the differential method. Heteroskedasticity results with the Breusch-Pagan test after being handled by the differential method obtained obs * R-square results of 0.4571, which is greater than the significance of 0.05. That means in Equation 3-1, is free from the symptoms of heteroscedasticity.

Next, the same test is carried out for Equation 3-2. Heteroscedasticity results with the Breusch-Pagan test in Equation 3-2 obtained obs * R-square results of 0.0828 which was greater than the significance of 0.05. That means in this equation the symptoms of heteroscedasticity do not exist.

[4] Autocorrelation Test

Based on t Result of Breusch-Godfrey Serial Correlation LM Test of Equation 3-1, the value of Obs * R-Square is 0.000 <0.05, so it can be said that in Equation 3-1, the autocorrelation symptoms occur so that further handling must be done with the differential method. The autocorrelation test results after handling the differential method are as follows: the Obs * R-Square value after handling with the differential method of 0.8032 > 0.05, so it is said that the autocorrelation symptoms can be resolved.

Next, the autocorrelation assumption test is performed in Equation 3-2. Based on t Result of Breusch-Godfrey Serial Correlation LM Test of Equation 3-2, the value of Obs * R-Square of 0.000 <0.05, so it is said that in this Equation 3-2, autocorrelation symptoms occur so that further handling must be done with the

differential method. The autocorrelation test results after handling the differential method are as follows: Obs * R-Square value after handling with the differential method is 0.9321> 0.05, so it is said that the autocorrelation symptoms can be resolved.

4.4. Statistic Test

[1] F-Test

In the F test (simultaneous regression) in the two equations with 95% confidence level, obtained the probability value of F in Equation 3-1 and 3-2 is 0,000 <0.05, so that H_o is rejected. It means that all independent variables simultaneously affect the dependent variables (inflation and exchange rate).

[2] t-test

Table 4-2: Result of t-test of Equation 3-1

Variable	Coefficient	t-Statistic	Prob
C	-2316.158	-7.140334	0.0000
R	-22.36426	-0.323455	0.7468
LOGMS	0.126580	0.071031	0.9435
LOGX	81.84718	3.196021	0.0017
LOGM	-57.92336	-3.036473	0.0028
LOGG	86.73885	4.857411	0.0000
LOGU	245.4531	6.481983	0.0000
ER	-0.002581	-2.057217	0.0413
R-squared	0.425707		
F-statistic	16.94338		
Prob (F-statistic)	0.000000		

Source: Output of EViews

Based on table 4-2, the multiple linear regression equation of Equation 3-1 is as follows:

$$INF = -2316.158 - 22.36426r + 0.126580 \log ms + 81.84718logx - 57.92336logm + 86.73885logg + 245.4531logu - 0.002581ER + e_i$$

Table 4-3: Result of t-test of Equation 3-2

Variable	Coefficient	t-Statistic	Prob
C	-71847.73	-3.361025	0.0010
R_Rf	11155.30	2.088466	0.0387
LOGDebt	5299.248	3.038139	0.0029
LOGNX	-298.0991	-2.510633	0.0133
MYR	2537.009	6.010933	0.0000
THB	138.5993	2.378468	0.0188
PHP	-71.38613	-1.899719	0.0597
SGD	142.0551	7.572315	0.0000
INF	5.674347	1.279844	0.2029
F-statistic	183.1570	R-squared	0.917933
Prob (F-statistic)	0.000000		

Source: Output of EViews

Based on table 4-3, the multiple linear regression equation of Equation 3-2 is as follows:

$$ER = -71847.73 + 11155.30r - r_f + 5299.248logdebt - 298.0991lognx + 2357.009MYR + 138.5993THB - 71.38613PHP + 142.0551SGD + 5.674347inf + e_i$$

4.5. Coefficient of determination

R^2 in equation 3.1 is 0.425707, this means that 42.57% of the dependent variable, which is inflation, can be explained by 7 of the independent variables, namely r, logms, logx, logm. Logg, logu, and exchange rate. While the rest (100% - 42.57% = 57.43%) is explained by other variables outside the research. Furthermore, the value of R^2 in equation 3.2 is 0.917933, this means that 91.79% of the dependent variable variation, which is the exchange rate, can be explained by 8 of the independent variables ($r-r_f$), logdebt, lognx, MYR, THB, PHP, SGD and inf. While the rest (100% - 91.79% = 8.21%) is explained by other variables outside the research.

4.6. The Effect of Interest Rate on Inflation

Based on the OLS results, the authors get the result that interest rates have a negative effect on inflation, but the effect is not significant. This contradicts in theory which explained that the interest rate affects inflation, but the author's result was supported by several previous studies and some facts. Mishkin & Schmidt-Hebbel (2001) found evidence that in emerging market countries, interest rates failed in reducing high inflation.

4.7. The Effect of Money Supply on Inflation

Based on OLS results, the money supply is positively related to inflation but has no significant effect. This is not in line with the existing theories. According to David Ricardo's theory, the amount of money in circulation or the quantity of money in circulation will affect the price level. Lin Liu & Yunhui Jin in Wang (2012) thought that the increase in money supply did not lead to inflation because the money supply was absorbed in the process of monetization.

4.8. The Effect of Export on Inflation

Based on the OLS, the result showed that export has a significant positive effect on inflation, and consistent with theory also several recent studies. One of them was studies conducted by Mukit (2014) showed that export was the most influential factor affecting inflation compared to imports. Kiganda et al., (2017) also revealed that export has a positive significant effect on inflation.

4.9. The Effect of Import on Inflation

Based on the OLS, the result showed that import has a significant negative effect on inflation and has a consistent result with several previous studies. According to Dexter et al., (2005) imports could affect domestic inflation through the competition of domestic goods and services. When the demand is higher than the supply of domestic output, the prices of goods and services is expected to rise.

4.10. The Effect of Government Expenditure on Inflation

Based on the OLS result, government spending has a significant positive effect on inflation. The author's findings were consistent with some previous studies and find the fact that fiscal expansion can cause inflation when financed by public debt and money creation (M. S. Mohanty & Zampolli, 2009; Wildavsky, 2003). Government spending is only good for short-run solutions to the economic crisis, while the increase in government expenditure during the slump will worsen the economy (Amuka et al., 2016).

4.11. The Effect of Unemployment on Inflation

Based on the results of the authors, the unemployment rate is significantly positively related to inflation. The authors' findings contradict the existing theory, which is the Phillips Curve Theory, where unemployment is negatively related to inflation. In Nigeria, there was a positive relationship between unemployment and inflation (Ademola & Badiru, 1981).

4.12. The Effect of Exchange Rate on Inflation

Based on the OLS test results, the authors get the result that the exchange rate is negative significantly affect inflation. When the IDR exchange rate rises against U$D (depreciation), inflation decreases. To confirm this, we pay attention to the core inflation component which is more influenced by fundamental (not seasonal) factors.

4.13. The Effect of Interest Rate Differential on Exchange Rate

Based on OLS results, the differential in interest rates between Indonesia and U.S. have a significant positive effect on the IDR exchange rate. If the interest rate differential gets bigger, the IDR will move up against U$D (depreciate). Some of the results of previous studies are in line with the results of the study of the authors. According to Ntirabampa & Iraya (2019), the exchange rate volatility was caused by other additional factors besides interest rate differentials.

4.14. The Effect of Public Debt on Exchange Rate

Based on OLS results, public debt has a significant positive effect on exchange rates. When public debt increases, the IDR against U$D will also increase (depreciate). This was following existing theories and some previous research and the facts that exist. According to the Keynesians theory, external debt has neither short run nor long-run negative effects on the economy (Kouladoum, 2018).

4.15. The Effect of Trade Balance on Exchange Rate

Based on OLS results, the trade balance has a significant negative effect on the exchange rate. If there is an increase in the trade balance (surplus), the IDR exchange rate will decrease to U$D (appreciated). This was consistent with the theory and several previous studies. Nick K (2019) expressed similar things when demand was high, prices rise, and the currency appreciates.

4.16. The Effect of MYR, THB, PHP, and SGD on Exchange Rate

Based on OLS results, MYR, THB, and SGD have a significant positive effect on the IDR exchange rate. When depreciation occurs in MYR, THB, and SGD, IDR will also depreciate, and vice versa. The authors' findings were supported by several research findings and facts. In the case of the 1997-1998 Asian crisis, depreciated the IDR, eroded bank capital, and reduced financial intermediation (Thorbecke, 2019).

For PHP based on OLS results, it has no significant effect on the exchange rate. This finding was consistent with several studies. There are different movements between IDR and PHP. According to Klyuev & Dao (2016) after the Asian Financial Crisis, IDR became more volatile by a very wide margin.

4.17. The Effect of Inflation on Exchange Rate

Based on OLS results, inflation does not have a significant effect on the exchange rate. It proved that PPP does not hold in the short run and long run. In the short run, PPP doesn’t exist due to price stickiness, long pass-through processes, and other adjustments. In the long-run PPP doesn’t exist due to various factors including non-traded goods.

5. Conclusion and Suggestion

Based on the research results, interest rates have a negative effect on inflation, but the effect is not significant. The money supply is positively related to inflation but has no significant effect. An increase in the money supply should be responded to by banks by mobilizing deposits and channelling them in the form of credit so that investment could develop rapidly (Wardhono et al., 2013). Export has a significant positive effect on inflation. Inflation can also occur due to high export demand which drives up prices. In Indonesia, for example in the increase in inflation in 2008, there was an increase in exports due to high world demand which ultimately led to a jump in commodity prices on the world market.

Based on the research result, government spending has a significant positive effect on inflation. Imports are said to reduce inflation when used to overcome the scarcity of a country's domestic needs. In the Keynesian approach, an increase in government spending and tax cuts will increase disposable income and aggregate demand. Based on the research results, the unemployment rate is significantly positively related to inflation. The phenomenon that occurs in Indonesia was when

the unemployment rate was high, the inflation rate also remains high (Astuti, 2016).

Based on the research results, the exchange rate is negative significantly affect inflation. The structural improvement in the character of Indonesia's inflation also has a positive effect, such as consistent monetary policy, an increasingly competitive market's structure, and distribution of goods and logistics of goods. Based on research results, the differential in interest rates between Indonesia and U.S. The fluctuation of differential interest rate between Indonesia and the U.S. from 2004 to 2017 was more caused by the movement of rising and falling interest rates in Indonesia (BI rate).

Based on research results, inflation does not have a significant effect on the exchange rate. This is in accordance with the PPP theory, that PPP does not hold in the short run and long run. The public, especially investors, need to pay attention to changes in exchange rates because the sensitivity of the stock market to changes in exchange rates is very large. Considering that Indonesia's imports of raw materials are still large, the movement of the exchange rate greatly influences stock returns. It is necessary to pay attention to changes in macro-monetary variables such as exports, imports, government spending, unemployment rates, developments in interest rates in the US, the amount of public debt and changes in the exchange rate of neighboring countries such as Malaysia, Thailand, and Singapore. Because changes in these variables have an impact on inflation and exchange rate movements.

6. Acknowledgment

Thank you to the Department of Economics Faculty of Economics and Business Brawijaya University for supporting us in completing this research.

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