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Capital Flow Management Within Macroeconomics Stability Framework in Indonesia (2008 – 2022)

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ABSTRACT

Indonesia is an EMDEs (Emerging Market and Developing Economies) country, and adopting an open economy causes foreign capital flow, especially FDI (Foreign Direct Investment) and PI (Portfolio Investment) can be free flows, and its movements are unpredictable. The movement of capital flows will affect the money supply transmitted to monetary and macroeconomic variables. This study aims to determine the response and contribution of macroeconomic variables to FDI and PI, as well as examining the causality between macroeconomic variables, FDI and PI. This research used the Vector Error Correction Model Granger Causality. The results show that exchange rate and inflation shocks significantly impact FDI and PI. While the results of Granger causality, changes in macroeconomic variables cause changes in FDI and PI. This research recommends that stakeholders continue implementing policy mix and monetary policy to improve exchange rates and inflation stability. In addition, the management of capital flows is still considered because the potential risks posed to the economy are quite large.

Keywords: Exchange Rate; Foreign Direct Investments; Granger Causality; Inflation; Portfolio Investment

INTRODUCTION

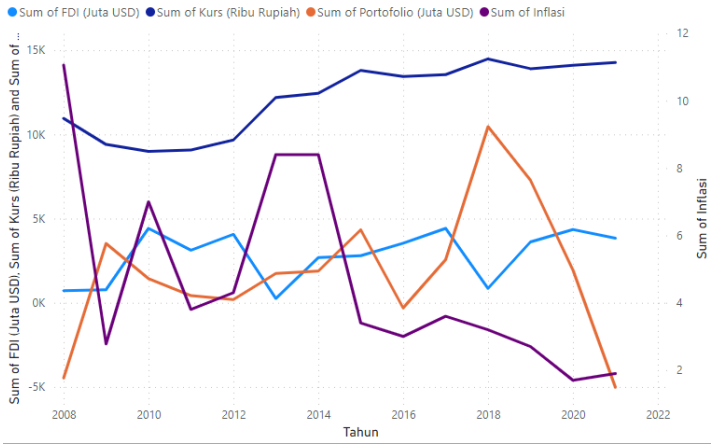
Indonesia is one of many countries which has the largest economy in ASEAN and even the world. Indonesia is included in the EMDEs country (Emerging Market and Developing Economies) or developing countries with GDP growth, rapid per capita income, increased liquidity of debt and equity markets, and financial infrastructure. According to the International Monetary Fund (IMF, 2022), capital flows have greatly benefited economic development and growth for every country, especially developing countries. According to Yap and Aldaba (2009), the capital flow that plays the biggest role in a country's economy is the form of FDI (Foreign Direct Investment) and PI (Portfolio Investment). Capital flows are the main source of concern for macroeconomic and financial market stability.

In addition to bringing positive impacts to developing countries such as Indonesia, the movement of capital flows becomes a primary source of concern for macroeconomic stability and financial markets. This is because the high volatility of capital flows has the potential to influence the volatility and pressure on macroeconomic variables such as exchange rates and inflation, which will subsequently affect monetary stability and the financial system. Bank Indonesia (2021) states that the movement of capital flows can drive an increase in the volatility of exchange rates, inflation, and foreign exchange reserves, where these variables are fundamental variables under the authority of Bank Indonesia.

According to the new theory of economic growth, the flow of FDI is considered to drive economic growth in a country (Sharmiladevi, 2020). FDI shows an increasing trend compared to other investments due to the macroeconomic performance in developing countries, including Indonesia, which tends to be stable. Whereas PI moves are very volatile and have high volatility. According to Atyantodito and Firmansyah (2020), developing portfolio capital flows can be risky because large-scale PI can cause high volatility in exchange rates, over/undervalued asset prices, and the risk of a banking crisis.

The study results of Jongwanich (2019) show that capital flows impact real exchange rates, especially portfolio capital flows which result in excessive currency appreciation. Movements of capital flows that are not managed properly can also affect monetary and financial stability, one of which is inflation. Capital flows can pressure inflation when foreign monetary policy is looser, and indirectly domestic interest rates will be higher than foreign interest rates. On the other hand, inflation can describe the sensitivity of an economic country, which affects the level of trust and decision-making in investing in Indonesia (Listika et al., 2019).

Figure 1. Movement of Capital Flow in Indonesia in 2008 (Q1) – 2022 (Q2)



Source: Bank Indonesia (2022), data processing

During the observation period in Figure 1, FDI, exchange rates, and inflation fluctuated but tended to remain stable compared to the movement of portfolio investment, despite shocks in certain periods such as in 2013 and 2018. FDI showed an increasing trend compared to other investments. This is due to the relatively stable macroeconomic performance in developing countries, including Indonesia. At the same time, portfolio investment moves very fluctuatively and has high volatility. The highest portfolio investment in 2018 amounted to 10,456 million USD and experienced shocks during the global financial crisis and the Covid-19 pandemic.

The unpredictable movement of capital flows poses challenges for central banks in developing countries in maintaining financial system stability (Warjiyo, 2016). Policies related to the management of capital flows and exchange rates are needed because domestic and global economies are becoming more integrated, and the rapid inflow of capital will complicate macroeconomic management, especially in monetary and exchange rate policies. From the perspective of capital outflow, it puts pressure on the domestic currency, which can enhance competitiveness and lead to an increased demand for foreign exchange, resulting in the depreciation of the exchange rate of the rupiah. On the other hand, capital inflow contributes to the appreciation of asset prices and excessive risk-taking. Moreover, capital flows can exert pressure on inflation when foreign monetary policies are more lenient, indirectly causing domestic interest rates to be higher than foreign interest rates.

Uncertain and difficult-to-predict global economic conditions led to movements in capital flows, especially FDI. Investment portfolio moves quickly put pressure on macroeconomic variables, especially on value-exchange rates and inflation. Thus, an appropriate policy response from Bank Indonesia is needed to control the movement of capital flows and maintain monetary and financial system stability.

This study aims to examine how FDI, PI, exchange rates, and inflation impact each other in Indonesia. It is considered how these factors interact with each other and whether they cause changes in one another. This research uses time series data from 2008 Q1 – 2022 Q2 to fulfill data adequacy requirements in time series regression analysis. The data source comes from Indonesian Economic and Financial Statistics published by Bank Indonesia. Bank Indonesia is the monetary authority in Indonesia which provides relatively complete and reliable macroeconomic data.

LITERATURE REVIEW

Foreign Direct Investment (FDI)

FDI is a reflection or depiction of the desire of a country's residents, who have already invested in their own economy, to make direct investments in another country in the form of business development (IMF, 2022). FDI capital flows can directly affect exchange rates. Capital and financial inflows to a country with an open economy and a floating exchange rate can increase the supply of foreign currency, resulting in an appreciation of the domestic currency's exchange rate. Conversely, if there is a withdrawal of capital flows or capital outflows, this will increase the demand for foreign currency, leading to a depreciation of the domestic currency's exchange rate. In a free-floating exchange rate system, exchange rates are determined by market demand and supply forces.

Portfolio Investment (PI)

Portfolio investment refers to investments that replace the ownership of passive capital such as bonds, stocks, or other financial assets, without involving control over the issuers of the securities or active management by the investors (Simarangkir & Hayati, 2020). According to Onuorah and Akujuobi (2013), foreign portfolios are defined as aspects of international capital flows consisting of the transfer of financial assets such as cash and bonds across international borders to earn profits, indicating that this occurs when investors purchase foreign companies, government bonds, and short-term securities or bills.

Exchange Rates

The exchange rate is the price or value of a country's currency expressed in terms of another country's currency (Ramadhani & Nugroho, 2019). The exchange rate is defined as the amount of domestic currency required to obtain one unit of foreign currency (Sukirno, 2016). The exchange rate is also a key consideration for investors when investing in Indonesia, as exchange rate stability reflects economic stability, which is attractive for investment. According to Krugman et al. (2018), the appreciation of a currency will increase the domestic currency's return on foreign currency deposits, while the depreciation of a country's currency will decrease the domestic currency's return. Therefore, the exchange rate is an important aspect of foreign investment, as investors pay attention to its value relative to foreign currencies.

Inflation

Bank Indonesia defines inflation as the general and continuous increase in the prices of goods and services over a specific period. Inflation can be defined as a process of rising prices within an economy (Sukirno, 2016). Inflation also indicates the magnitude of demand and supply in the market (Wiyatno & Do, 2021). According to Mishkin (2008) and Teoh et al. (2021), inflation, characterized by a prolonged increase in prices, leads to a decrease in the value of money, impacting individuals, entrepreneurs, and governments alike. An increase in the price of just one or two items cannot be called inflation unless it causes a rise in the prices of most other goods (Mankiw, 2008).

Previous Studies

According to Arintoko and Insukindro (2017), dynamic foreign capital mobility proves the existence of cointegration and the significance of FDI and PI in the long term towards macroeconomic variables, namely inflation, output levels, interest rates, and the current account. The exchange rate has a relationship with the main macroeconomic variables in Indonesia.

Domestic and global variables influence PI (Atyantodito & Firmansyah, 2020). In addition, PI plays a role in Indonesia's financial market, which impacts asset prices, bank loans, and exchange rates. Portfolio capital flows have a relatively small impact on increasing economic growth. The positive effect of portfolio inflows on growth is partly due to central bank intervention in the money market. Meanwhile, Bank Indonesia, as the central bank, does not apply an exchange rate target and conducts foreign exchange operations to maintain volatility. In the short term, exchange rates do not react strongly to shocks from portfolio inflows that could depress growth.

Meanwhile, the study by Ridho et al. (2020) indicates that in the long run, FDI does not significantly affect the exchange rate, PI significantly influences the exchange rate, and the interest rate has a significant negative effect on the exchange rate. In the short term, there is a significant positive influence of FDI and interest rates on the exchange rate. However, PI does not significantly affect the exchange rate.

Rafi and Ramachandran's study (2018) on emerging market countries shows that exchange rate movements respond quite significantly to shocks from PI, compared to foreign direct investment. The response to exchange rate movements increased significantly. Variations in shocks to foreign PI flows have a significant impact on exchange rate volatility. The forms of PI are stock prices, demand deposits, and interest rates also influence exchange rate volatility. Syarifuddin’s (2015) research on bond, equity, growth, exchange rate, VIX, and interest rate to PI using GARCH and the Panel in ASEAN found that exchange rate fluctuation did not have a significant effect on PI. Exchange rates affect the entry of bonds, foreign equity, and PI in Indonesia.

The research by Waqas et al. (2015) in South Asia (China, India, Pakistan, and Sri Lanka) found a relationship between macroeconomic factors and the volatility of foreign PI significantly. Thus, the volatility of PI is lower than international trade and is associated with higher interest rates, currency depreciation, foreign direct investment, low inflation, and higher GDP growth in the destination country. Thus, this study shows that foreign portfolio investors focus on the country’s macroeconomic stability.

Ndubuisi (2017), in his research, looks at the impact of macroeconomic variables on FDI using VECM Granger Causality, indicating that there is a long-term relationship between macroeconomic variables and FDI. There is bilateral causality between FDI and the exchange rate and unidirectional causality between inflation and FDI in the short term. According to Madesha et al. (2013), based on Granger Causality test results show that there is a causality relationship between two direct relationships in term the length of the exchange rate and inflation in Zimbabwe in 1980-2007.

Hypothesis Development

Based on the theoretical framework that has been outlined, the hypotheses in this study are as follows. It is suspected the FDI variable affects the exchange rate and inflation variables, the PI variable affects the exchange rate and inflation variables, the exchange rate and inflation variables affect the FDI variable, the exchange rate and inflation variables affect the PI variable, there is a causal relationship between the FDI, the exchange rate, and inflation. It is suspected that there is a causality between the PI variable, exchange rate, and inflation.

RESEARCH METHOD

This study uses quantitative research types and secondary data sources. This research was conducted in Indonesia using time series data for 2008.Q1 - 2022.Q2. The data used comes from Indonesian Economic and Financial Statistics (SEKI). The data used

consists of capital inflow data in the form of FDI, PI, exchange rates, and inflation. This research used Vector Error Correction Model (VECM) or the derivative model of the Vector Autoregression because the assumptions used are the same as those in the VAR model. In this study, VECM is used to model the relationship between variables, which is then analyzed based on the structure of the model. In this model, additional analysis is required by Impulse Response Function and Forecast Error Variance Decomposition analysis is needed to find out the characteristics of VECM and how the response generated by shocks from FDI, PI to exchange rates, inflation, and exchange rate shocks, inflation to PI, and FDI—in addition, using the Granger Causality analysis tool to determine the causal relationship between FDI, exchange rates, and inflation, as well as PI, exchange rates, and inflation.

VECM has an absolute requirement that all variables must be stationary in the same order first difference, and there is cointegration. In this study, the VECM model is formulated with the following equation:

$$\Delta y_t = \alpha e_{t-i} + \beta_1 \Delta y_{t-i} + \beta_2 \Delta y_{t-i} + \cdots + \beta_p \Delta y_{t-p+i} + \varepsilon_t$$
$$\text{where: } e_{t-i} = y_{t-i} - (\varphi + \omega X_{t-i})$$

Explanation:
Δy_t = derivative first, the dependent variable
Δy_{t-i} = derivative first the dependent variable with the lag
e_{t-i} = error obtained from the regression equation between Y and X at the lag
ε_t = residual
α = coefficient matrix cointegration
β_1 = variable coefficient matrix the i-dependent, where i = 1,2,…,p

In this study, there are two Vector Error Correction Model with the following equations:

The first model is FDI, exchange rate, and inflation:

$$\Delta FDIt = \alpha et-i + \beta 1 \Delta FDIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$
$$\Delta KURSt = \alpha et-i + \beta 1 \Delta FDIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$
$$\Delta INFt = \alpha et-i + \beta 1 \Delta FDIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$

The second model is PI, exchange rate, and inflation:

$$\Delta PIt = \alpha et-i + \beta 1 \Delta PIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$
$$\Delta KURSt = \alpha et-i + \beta 1 \Delta PIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$
$$\Delta INFt = \alpha et-i + \beta 1 \Delta PIt-i + \beta 2 \Delta KURSt-i + \beta 3 \Delta INFt-i + \varepsilon t$$

Based on the VECM conditions, where all variables must be stationary at the same order in first differences, with all residuals having a mean value of zero or being white noise, constant variance, and no correlation among dependent variables. Stationarity tests can be conducted using the Augmented Dickey-Fuller (ADF) test to determine the presence or absence of unit roots in the variables. The existence of cointegration in the model must also be considered as a condition for the VECM method. If there is no cointegration among variables, the Standard VAR can be applied, but if cointegration exists, then the VECM method is applied. The order in carrying out VECM analysis is by stationarity or unit root test, optimum lag test, cointegration test, VECM estimation, Granger Causality, IRF, and FEVD.

RESULTS

Unit Root Test

The stationarity test is conducted using the unit root test or ADF unit root test. This test is performed to avoid spurious regression, which indicates a statistically significant relationship between two or more variables that do not exist. If the data is stationary, the time series data can be considered stable, and the resulting estimators are consistent and unbiased (Gujarati & Porter, 2009). In the ADF test for testing stationarity, the assessment is based on the p-value Z (t). A dataset is considered stationary if the p-value is < α = 0.05 and non-stationary if the p-value is > α = 0.05. The following are the results of the stationarity test at the level.

Table 1. Unit Root Test Results

Variable	Level		First Difference	
	Critical Value Mc. Kinon* (5%)	Probability	Critical Value Mc. Kinon* (5%)	Probability
FDI	-2.924	0.0000 < 0.05	-2.925	0.0000 < 0.05
PI	-2.924	0.0000 < 0.05	-2.925	0.0000 < 0.05
INF	-2.924	0.1543 > 0.05	-2.925	0.0000 < 0.05
KURS	-2.924	0.6887 > 0.05	-2.925	0.0000 < 0.05

Source: Data processing, 2023

Based on Table 1, the stationarity test results at the level and level first difference, variables FDI, PI, exchange rates, and inflation are stationary at the level first difference. That is indicated by a probability value of 0.0000 below the 5% significance level, which indicates that the data is stationary, and its fluctuations are around a constant average value. The stationarity test for each variable in the study at the level, starting from inflation (INF), exchange rates (KURS) of the Dollar against the Rupiah, foreign direct investment (FDI), and portfolio investment (PI), shows that the INF with an ADF probability value of 0.1543 > 0.05 and the KURS of the Dollar against the Rupiah with an ADF probability of 0.6887 > 0.05 indicates that these variables are not stationary at the level.

In the unit root test at the level, if there are variables that are non-stationary, an ADF test is conducted at the first difference level. It is then tested using the stationarity test mechanism at the level to observe the statistical values of the ADF. Subsequently, another ADF test is performed. Based on the results of the stationary test at the first difference in Table 1, the variables FDI, PI, exchange rates, and inflation are stationary. This is indicated by the probability values of 0.0000, which =h are below the 5% significance level, suggesting that the data is stationary, with fluctuations centered around a constant mean.

Optimum Lag Test

The optimal lag test is used to determine the lag length to be used in the VECM model. The optimal lag can be determined based on several criteria, including SBIC (Schwartz Bayesian Information Criteria), HQIC (Hannan-Quinn Information Criteria), AIC (Akaike Information Criteria), LR (Likelihood Ratio), and FPE (Final Prediction Error).

Table 2. Lag Optimum Test Results

1st model: FDI, Exchange Rate, Inflation								
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-981.33				2.70E+12	37.144	37.187	37.256*
1	-969.15	24.35	9	0.004	2.40E+12	37.025	37.196	37.471

1st model: FDI, Exchange Rate, Inflation								
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
2	-953.79	30.72	9	0.000	1.90E+12	36.785	37.085	37.565
3	-938.99	29.60	9	0.001	1.50E+12	36.566	36.995	37.681
4	-926.33	25.33*	9	0.003	1.4e+12*	36.427*	36.985*	37.877
2nd model: PI, Exchange Rate, Inflation								
0	-1020.3				1.20E+13	38.613	38.656	38.725*
1	-1003.6	33.402	9	0.000	8.80E+12	38.323	38.494*	38.769
2	-996.5	14.101	9	0.119	9.50E+12	38.396	38.696	39.177
3	-986.39	20.227	9	0.017	9.20E+12	38.354	38.783	39.469
4	-970.62	31.54*	9	0.000	7.3e+12*	38.099*	38.656	39.548

Source: Data processing, 2023

Based on AIC, LR, and FPE criteria, HQIC in the first model has an optimal lag of 4 (marked with *). In this model, the optimum lag four is selected. The optimum lag four can be interpreted as a reaction of any variables to changes in other variables requiring an optimal time interval of 4 periods or quarters. Changes in the current variable are affected by changes in the previous four periods or quarters (1 year). Based on most criteria in the second model, the optimum lag chosen is lag 4. The optimum lag length of four can be interpreted as the reaction of a variable to changes in other variables requiring an optimal time interval of 4 periods or quarters where changes in the current variable are affected by changes in the previous four periods or quarters (1 year).

Cointegration Test

The cointegration test aims to determine the relationship between variables in the long term. The null hypothesis is that there is no cointegration equation. If the trace statistic is greater than the critical test value at $\alpha = 0.05$, then there is cointegration. This test can also identify the number of cointegration equations. The second model's cointegration test is conducted using the Johansen cointegration method.

Table 3. Johansen Cointegration Test

1st model: FDI, Exchange Rate, Inflation					
Maximum of Rank	Parms	LL	Eigenvalue	Trace Statistic	5% Critical Value
0	30	-959.4	-	45.265	29.68
1	35	-946.3	0.3848	19.034	15.41
2	38	-937.3	0.2844	0.964*	3.76
3	39	-936.8	0.0177		
2nd model: PI, Exchange Rate, Inflation					
0	30	-1010.2	-	44.509	29.68
1	35	-991.42	0.5014	6.929*	15.41
2	38	-988.12	0.1150	0.336	3.76
3	39	-987.95	0.0062		

Source: Data processing, 2023

In hypothesis, H_0 maximum rank of 0 indicates no cointegration, and H_a shows a minimal cointegration equation (1). In this model, H_0 received two cointegration equations (shown with an asterisk). Table 3 shows that there are two inner cointegration equations critical value of 5% as indicated by the value of the trace statistic > critical value of 5%, 19.0335 > 15.41. Table 3 shows that one inner cointegration equation critical value of the trace statistic indicates 5%> critical value of 5%, 44.5086 > 29.68. The eigenvalues shown in the last row are used to calculate the statistical trace in the row above.

VECM Estimation Test

In the VECM model, the estimation results at the top show short-term equations for each endogenous variable, observed based on the chi-square probability values. Based on the chi-square probability values for the four variables, it indicates high significance as they approach 0, demonstrating that the Error Correction Model (ECM) with all dependent variables (FDI, exchange rate, and inflation) has adequate statistical explanatory power. To determine the presence of long-term equations, one can look at the coefficients ECT_ce1 and ECT_ce2 because there are two cointegrations that meet the stability criteria, namely being negative (having absolute values below one) and significant.

In the first model, _ce1 and _ce2 represent two cointegration equations to ensure the long-term relationship between FDI, exchange rates, and inflation. Based on the VECM results, the first equation with the dependent variable FDI shows no long-term relationship between exchange rates and inflation on FDI because only in equation _ce1, there is a negative and significant coefficient.

In the short term, at lag 3, changes in FDI with respect to its own changes have a p-value of 0.038 < 0.05. Changes in exchange rates at lag 2 have a significant impact on changes in FDI with a p-value of 0.001 < 0.05, and changes in inflation at lag 2 have a significant impact with a p-value of 0.001 < 0.05. This means that the variables of exchange rate and inflation have a short-term relationship with changes in FDI.

$$\Delta FDI_t = -0.6701674 - 0.262FDI_{t-3} - 1.311KURS_{t-2} + 541.1INF_{t-2} + \varepsilon t$$

Based on the estimation results in the first model, it can be concluded that there is no long-term relationship in each equation. In the short term, there is a relationship between exchange rates, inflation, and FDI itself to FDI, as well as FDI and exchange rates themselves to exchange rates. As the estimation results in the second model, it can be concluded that there is a long-term relationship between exchange rates and inflation with Portfolio Investment (PI). In the long term, there is a relationship between inflation and PI, and vice versa, as well as inflation and exchange rates.

In the second model. _ce1 represents one cointegration equation to ensure the long-term relationship between changes in PI, exchange rates, and inflation. Based on the VECM results, the first equation with the dependent variable PI shows a long-term relationship between exchange rates and inflation on PI because, in equation _ce1, there is a negative and significant coefficient. However, in the short term, as shown in Table 4.8, at lag 3, inflation is significant with a p-value of 0.000 < 0.05, where only the inflation variable has a short-term relationship with PI. The inflation rate of a country can cause the inflow and outflow of PI. High (low) inflation in a country can lead to the outflow (inflow) of PI because the level of investment risk will increase.

$$\Delta PI_t = -0.614 - 1{,}699INF_{t-3} + \varepsilon t$$

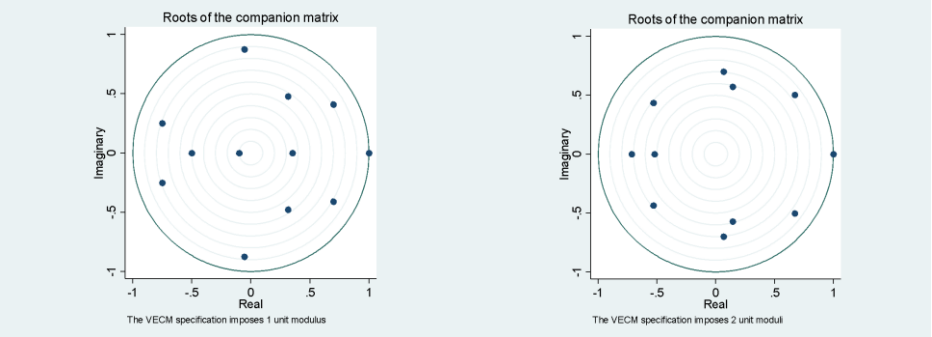
Based on the estimation results in the model (2), it can be concluded that there is a long-term relationship between exchange rates and inflation with PI. In the long term, there is a relationship between inflation and PI, as well as between inflation and exchange rates.

VECM Stability Test

The VECM model can be considered stable if it has a maximum of K-r unit module, where K is the number of endogenous variables and r is the number of ranks in the VAR matrix (Enders, 2015). Based on the stability test of the first and second VECM models, the first

model has a maximum of 1 modulus unit, which has a total of 3 endogenous variables and a VAR rank of 2; therefore, the maximum number of moduli for VECM stability requirements is 1 (= 3-2), obtained by subtracting the number of cointegrating relationships from the number of dependent variables. According to the stability test of the VECM, Model 1 is stable because there is only one modulus, indicating that the model meets the VECM stability requirements. The stability test of the two VECM models can be seen in the graph below.

Figure 2. Graph of Model Stability Test

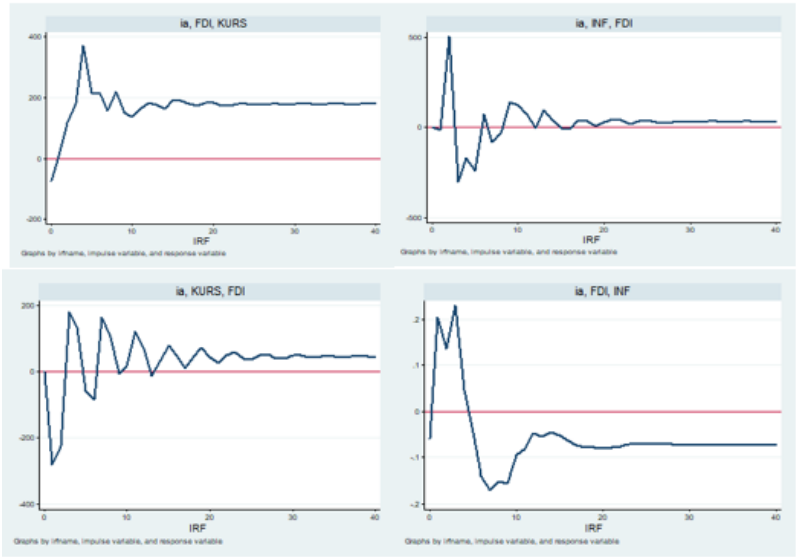


Based on the stability test of the second VECM model, which has a total of 3 endogenous variables and a VAR rank of 1; therefore, the maximum number of moduli for VECM stability requirements is 2 (= 3-1). Thus, according to the stability test of the VECM, Model 2 is considered stable because it has only 2 moduli, satisfying the VECM stability requirements.

Impulse Response Function

The estimation results of VECM can be used to understand the response and the time it takes for a variable to respond to shocks or disturbances from other variables. The response function to shocks aims to understand how each variable responds to a specific shock of one standard deviation or standard error. The given responses will indicate the influence of the shocks in the dependent variable on the independent variable. IRF analysis is used to analyze information in the long term.

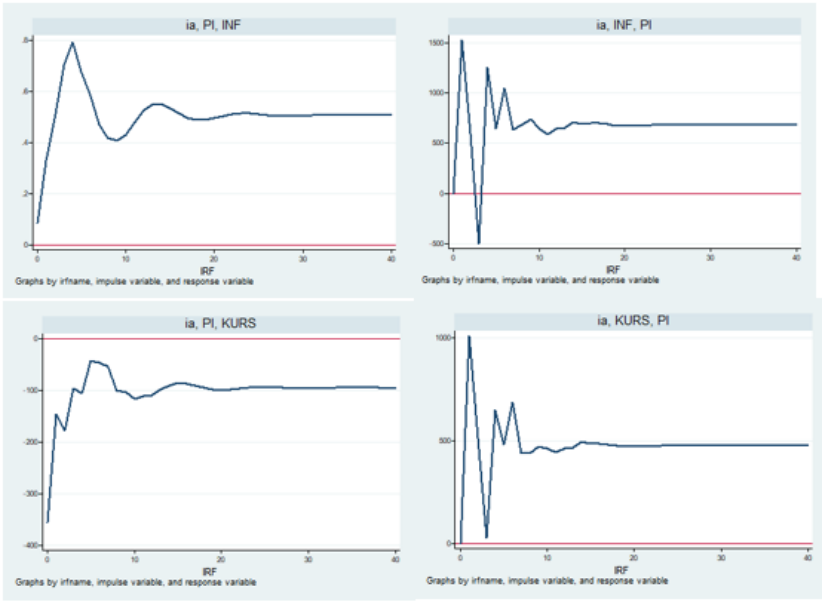
Figure 3. IRF Model 1



Source: Data processing, 2023

In the first model, IRF is used to see the effects of FDI on exchange rates and inflation. In addition, it also looks at the effect of inflation and exchange rate variable shocks on Foreign Direct Investment.

Figure 4. IRF Model 2



Source: Data processing, 2023

The second model was carried out by IRF analysis to see the effect of PI shock on inflation and exchange rate variables. In addition, we also see the influence of shock inflation and exchange rate variables against PI. In the short term, the movements of the variables FDI, PI, exchange rates, and inflation mostly contributed to the variables themselves. In the long run, the movement of exchange rate variables is mostly contributed by FDI and inflation, while the movement of inflation is contributed by PI and inflation itself.

Variance Decomposition

Variance decomposition analysis or Forecast Error Variance Decomposition (FEVD) analysis is an analytical step used to measure the extent of contribution or composition of the influence of one variable on another before and after a shock. In this research, FEVD uses Cholensky Forecasted Error Variance Decomposition model. In the short term, the movements of the variables FDI, PI, exchange rates, and inflation mostly contributed to the variables themselves. In the long run, the movement of exchange rate variables is mostly contributed by FDI and inflation, while the movement of inflation is contributed by PI and inflation itself.

Granger Causality Test

Granger causality analysis aims to see the causal relationship between endogenous variables. The causal relationship can be tested using the Granger-Wald causality test to see the causal relationship between FDI, PI, exchange rate, and inflation variables.

Table 4. Granger Wald Test Model 1 Causality Test

Equation	Excluded	Chi2	df	Prob > chi2
d.FDI	d.KURS	20.91	4	0.000
d.FDI	d.INF	11.789	4	0.019
d.FDI	All	31.448	8	0.000

d.KURS	d.FDI	8.652	4	0.070
d.KURS	d.INF	10.010	4	0.039
d.KURS	All	24.443	8	0.002
d.INF	d.FDI	2.046	4	0.727
d.INF	d.KURS	3.663	4	0.453
d.INF	All	6.355	8	0.608

Source: Data processing, 2023

Overall, in the first model in equation (1), there is a causality relationship between exchange rates and inflation to FDI. In equation (2), overall, there is a causality between FDI and inflation to exchange rates. However, in equation (3), there is no causality relationship between FDI and exchange rates to inflation.

Table 5. Granger Wald Test Model 2 Causality Test

Equation	Excluded	chi2	df	Prob > chi2
d.PI	d.KURS	10.134	4	0.038
d.PI	d.INF	16.834	4	0.002
d.PI	All	27.882	8	0.000
d.KURS	d.PI	2.468	4	0.650
d.KURS	d.INF	13.488	4	0.009
d.KURS	All	16.675	8	0.034
d.INF	d.PI	3.319	4	0.506
d.INF	d.KURS	4.548	4	0.337
d.INF	All	7.727	8	0.461

0987650-UYTRELSource: Data processing, 2023

Overall, in the second model, in equation (1), there is a causality relationship between exchange rates and inflation to Portfolio Investment (PI). In equation (2), overall, there is causality between PI and inflation to exchange rates, and in equation (3), there is no causality relationship between PI and exchange rates to inflation.

Based on the Granger causality test in each model, it can be concluded that in the model (1), there is a one-way causality of changes in exchange rates with changes in FDI, changes in inflation with changes in FDI, and changes in inflation and changes in exchange rates. In model (2), one-way causality exists in (a) changes in exchange rates with changes in PI, changes in inflation and changes in PI, changes in inflation, and changes in exchange rates. In this study, it can be concluded that changes in inflation and changes in exchange rates in Indonesia cause flows of FDI and PI in Indonesia. Meanwhile, changes in inflation in Indonesia lead to changes in exchange rates.

DISCUSSION

FDI, Exchange Rate, and Inflation

In the long-term ten-year response to inflation shock, FDI is negative, whereas when there is an inflow of capital in the form of FDI, the domestic inflation rate will fall. Furthermore, this result aligns with research conducted by Anwar et al. (2016), Ndubuisi (2017), and Olanrewaju (2021), which found that the response of FDI is negative to inflation shocks. In the long term, the weakening and tendency of the FDI response to become positive towards inflation shocks may reflect that controlled or moderate inflation increases can encourage the inflow of FDI. In the short and long term, exchange rate variables/rates respond positively to shock FDI. Every increase in capital inflows is in the form of FDI, causing the appreciation of the dollar against the rupiah or the depreciation

of the rupiah. Within two years, inflation will respond negatively to FDI shocks. Until the tenth year, the FDI response weakened, tending to be positive shock inflation because there was a balance point of 0. In the short term, the variable FDI shows a fluctuating response that tends to be negative. Over time, the response will weaken and tend to be positive shock inflation variable shocks. FDI responds to shock on a negative exchange rate/exchange rate variable of one standard deviation. After that, it fluctuates from the first quarter;/ to the third quarter and readjusts to its balance point from the third quarter. Then the response fluctuates in the seventh year of the second quarter to the tenth year showing a positive response but getting weaker. FDI response to the exchange rate shock is quite large, so exchange rate fluctuations in Indonesia must be maintained to attract capital flows.

PI, Exchange Rate, and Inflation

Inflation response to shock given by the PI in the start-to-finish period is permanently positive. The inflation response weakened when entering year 7, quarter two, until the end of the period or tenth year. Either in the short or long term, the domestic inflation rate will increase when there is an increase in portfolio investment. The exchange rate response to the PI shock at one standard deviation is negative in the first quarter to the tenth year and begins to weaken as we enter the twentieth quarter. Thus, in the short and long term, the shock given by the PI variable will be negatively affected by the exchange rate. PI responds positively to exchange rate shocks from the first quarter to the tenth quarter. The exchange rate response shocks from PI is quite large in the short term, while the long-term response remains positive and permanent. Thus, portfolio investment will increase when the dollar exchange rate against the rupiah appreciates (the rupiah exchange rate against the dollar depreciates). PI's response to shock the inflation variable is quite large in the short-term starting in the first quarter but can adjust again in the third quarter. In the long term, inflation variable shocks will be responded to positively by PI. shows that when inflation rises, the demand for PI will increase. This result contradicts with the research by Wardhono et al. (2020), which shows that inflation and portfolio investment have a negative relationship. However, these results are supported by the research of Reflina (2022) and Istiqomah (2013), which indicate a positive relationship between inflation and portfolio investment. This outcome may occur in Indonesia during the study period because the increase in inflation in Indonesia during the research period remained controlled or within investor tolerance limits, thus still encouraging the demand for portfolio investment in Indonesia. This is supported by data showing that the average inflation rate in Indonesia remained around 2-3%.

Granger Causality

In the first model, causality exists between exchange rate and inflation causing FDI changes. These results are supported by research (Tan et al., 2021) that there is a causality between the stability of the Yen currency and FDI inflows in China. Changes in exchange rates/exchange rates of appreciation or depreciation can describe the condition of a country's economic stability. Because of these conditions, investors become interested in investing in Indonesia so that FDI will come in. A country's inflation rate can cause the flow of FDI in and out. High (low) inflation in a country can cause FDI to go out (in) because the inflation rate causes production costs and prices to increase, which causes people's purchasing power to fall and affects the higher level of investment risk, which causes losses to their assets.

In the second model, exchange rate and inflation cause changes in PI flows. It shows a one-way causality between exchange rate and inflation to changes in PI, but not reverse. According to research by Waqas et al. (2015) and Kurdiansyah et al. (2021), changes in and out of PI are caused by changes in exchange rates that appreciate or depreciate because exchange rate movement can affect the price and value of domestic assets, so

when the Rupiah appreciation (depreciation) of domestic asset prices will be higher so that PI will in (out). High (low) inflation in a country can cause PI to be out (in) because the level of investment risk will be higher. The dependent variable of inflation shows that there is a one-way causality between changes in inflation and changes in exchange rates. Under the PPP theory, exchange rate changes occur due to differences in price levels in a country that will affect exchange rates.

CONCLUSION

Based on the VECM and Granger Causality analysis that has been done, it can be concluded that the shock caused by the exchange rate and inflation affects the entry and exit of FDI and PI. That is, the economic stability of a country, especially the exchange rate and inflation, is one of the indicators for investors to invest in Indonesia, investment capital flows, which have a large response to exchange rate shocks and inflation in Indonesia during the study period.

Based on the research results that have been described, it is recommended to stakeholders, particularly Bank Indonesia, to always maintain macroeconomic stability, especially the exchange rate, by continuing to implement macroprudential policies in the policy mix because shock arising from the exchange rate and inflation variables will potentially affect the size of capital flows into Indonesia. On the other hand, district/city governments can increase the capacity of MSMEs to encourage exports so that investors are interested in investing up to the regional level.

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