Sibatik Journal
Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, dan Pendidikan
E-ISSN: 2809-8544

ANALYSIS OF THE APPLICATION OF THE PURCHASING POWER PARITY THEORY TO PREDICTE THE RUPIAH EXCHANGE RATE AGAINST THE US DOLLAR

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Abstract

This study examines the validity of the Purchasing Power Parity (PPP) theory which is the basis for the relationship between currency exchange rates and differences in price levels between countries. The research innovation lies in the differentiation of inflation variables into two main components, namely Inflation GDP deflator and Inflation consumer prices, as an improvement on previous studies. The analysis was conducted by making the rupiah exchange rate a dependent variable influenced by several key variables based on the PPP theory, including Inflation GDP deflator, Inflation consumer prices, Real interest rate, and Broad money growth. The econometric approach using the VECM (Vector Error Correction Model) model reveals important findings where all independent variables show a significant influence in the long term, while only Inflation consumer prices have an effect in the short term. These findings not only confirm the limitations of the PPP theory in explaining short-term exchange rate dynamics but also provide empirical evidence of the complex exchange rate adjustment mechanism in the Indonesian economy, where structural and non-economic factors play an important role in addition to conventional economic variables.

Keywords: *Exchange Rate, Purchasing Power Parity, Inflation.*

INTRODUCTION

As international trade develops, the use of foreign exchange has also increased. The value of foreign exchange is dynamic and fluctuating, influenced by various factors such as inflation, interest rates, national income, balance of payments (BOP), supply and demand for foreign exchange, market expectations, speculation, and rumors Hamdy Hady, (2008) in (Ali and Pradapa 2010). Exchange rate stability has a positive impact in creating a conducive business climate at the global level. This stable condition ultimately contributes to increasing the economic growth of a country (Hikmaturohma, Susyanti, and ABS 2019).

MacDonald and Hallwood (1994) in (Ari and Teguh 2016) the theory of exchange rate development can be classified into several theoretical approaches. First, the monetary approach which is divided into two analysis variants, namely the monetary model with the assumption of sticky prices (sticky price monetary model) and the monetary model with the assumption of flexible prices (flexible price monetary model). Second, the approach based on the balance of payments (balance of payment approach). Third, the portfolio balance approach (portfolio balance approach). Fourth, the approach based on the doctrine of purchasing power parity (purchasing power parity approach).

A country can adopt different exchange rate systems. A fixed exchange rate system is implemented to maintain the stability of the currency value at a targeted level. In contrast, in a floating exchange rate system, the determination of the currency value is entirely determined by the mechanism of demand and supply in the foreign exchange market. There are several factors that influence the fluctuation of a free floating exchange rate system, two of which are explained in economic theory. The first factor is the inflation rate, which is

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

explained in the Purchasing Power Parity (PPP) Theory. The PPP theory explains the methodology for calculating the exchange rate between two currencies of different countries. This theory serves as an instrument to measure the purchasing power of a currency in an international context, considering that the prices of goods and services vary between countries in the world.

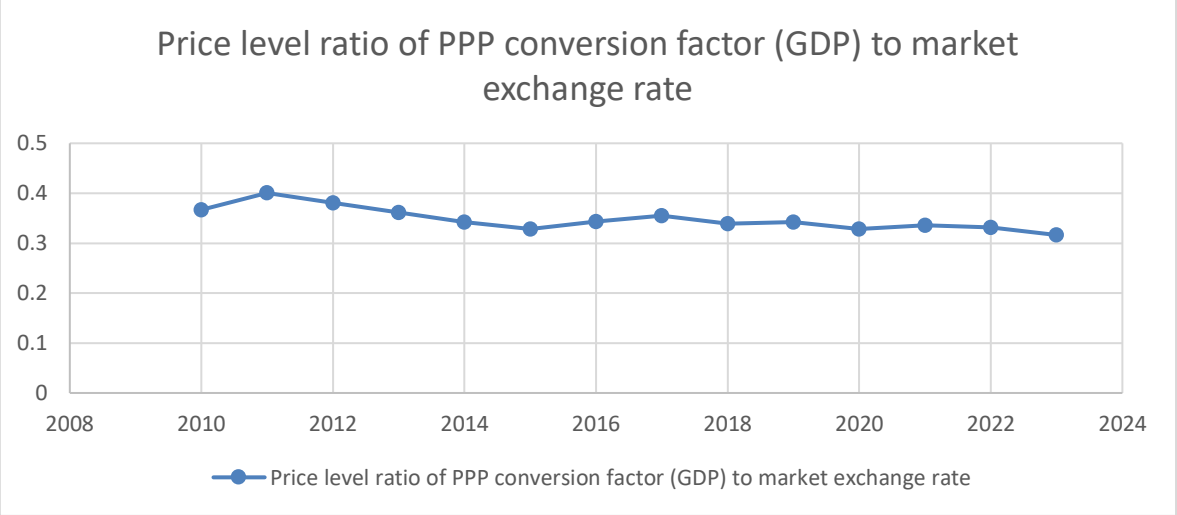

Figure 1. Graph of Price level ratio of PPP conversion factor (GDP) to market exchange rate
Source: World Bank, (2024)

Exchange rates affect inflation through two main mechanisms. First, directly through the pass-through effect, where depreciation of the exchange rate causes an increase in the price of imported goods. This mechanism occurs because the weakening of the exchange rate increases the cost of imports, so importers must increase their selling prices.(Nurrohim 2013). The increase in the price of imported goods then has a direct impact on the increase in the aggregate inflation rate. Research byGugun et al., (2025) confirms the existence of a significant causal relationship between exchange rate fluctuations and inflation rates. This finding indicates the need for the implementation of appropriate monetary policies to maintain exchange rate stability while protecting people's purchasing power. This policy is important to mitigate the negative effects of exchange rate volatility on price stability.

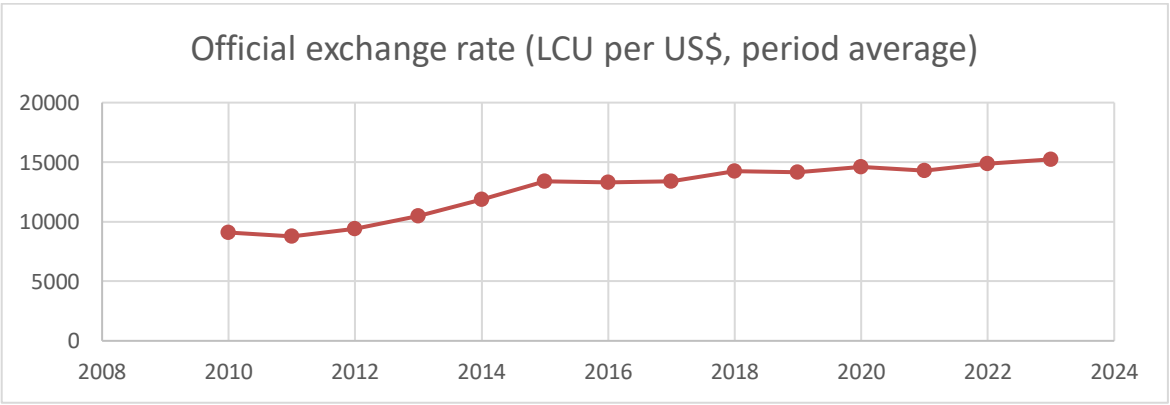

Figure 2. Official exchange rate graph (LCU per US$, period average)
Source :World Bank, (2024)

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Purchasing Power Parity (PPP) Theory is one of the fundamental theories in international finance that states that there is a proportional relationship between exchange rate movements and differential inflation rates between two countries. Conceptually, PPP theory is divided into two main variants, namely Absolute PPP This postulate states that the exchange rate is determined proportionally by the ratio of price levels between the domestic country and its trading partners. Relative PPP This variant argues that changes in the exchange rate will be directly proportional to changes in the ratio of inflation rates between the two countries. Essentially, PPP theory emphasizes the long-term correlation between foreign exchange rates and relative commodity prices. In the context of relative PPP, the rate of change in the price index (which represents the inflation rate) between two countries will show convergence when measured in the same currency Madura, (2006) in (Tamonsang and Arochman 2020).

This study empirically tests the validity of the Purchasing Power Parity (PPP) theory by developing a research model through the differentiation of inflation variables into two main indicators: (1) Inflation based on GDP deflator (annual %), and (2) Inflation based on consumer price index (annual %). This approach is a methodological innovation to overcome the gaps found in previous studies.

Based on the PPP theoretical framework, this study develops a prediction model for the Rupiah exchange rate against the US Dollar using three key variables: (1) Inflation rate, which is divided into Inflation based on GDP deflator (annual %), and Inflation based on consumer price index, (2) Real interest rate, and (3) Broad money growth.

The main problem studied in this study is to test the significance of the influence of independent variables in the PPP model on the fluctuation of the Rupiah/USD exchange rate. Specifically, this study aims to answer the question: To what extent can the variables in the PPP theory explain the behavior of the Rupiah exchange rate against the US Dollar?

LITERATURE REVIEW

Exchange rate

According to Eiteman, Stonehill, and Moffet (2010), the exchange rate is defined as the relative price of a domestic currency expressed in foreign currency units. As a fundamental macroeconomic indicator, the exchange rate plays a crucial role in determining the competitiveness of domestic commodity prices against imported products (Mishkin, 2008). Boone and Kurtz (2007) explain that a country's exchange rate is dynamic and experiences continuous fluctuations as a result of the interaction of demand and supply mechanisms in the global foreign exchange market. This phenomenon reflects the dynamics of the foreign exchange market which is influenced by various macro and micro economic factors. Furthermore,Tamonsang & Arochman, (2020)affirms that the exchange rate has strategic significance in international trade transactions. Its main function is as a price comparator that allows comparison of the relative value of various goods and services across countries, thus becoming the basis for determining international economic decisions.

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Inflation

According to Mankiw (2006), inflation is defined as a general and sustained increase in the price level of various commodities in an economy. This condition causes depreciation of the domestic currency. Conversely, deflation is a phenomenon of a general decline in the price level indicated by a negative inflation value (Murni, 2006:41). In practice, inflation measurement generally uses the Consumer Price Index (CPI) as the main indicator. This CPI calculation can be done with a monthly, quarterly, or annual frequency.(Tamonsang & Arochman, 2020). Mathematically, the inflation rate can be calculated using the following formula:

$$\text{INFn} = \frac{IHKn + IHKn - 1}{IHKn - 1} \; x \; 100\%$$

Where:
INFn : Inflation or deflation in time (month or year) (n)
IHKn : Consumer Price Index at time (month or year) (n)
IHKn : Consumer Price Index at time (month or year) (n-1)

Interest rate

Suniryah (2006:80) defines interest rates as the price that must be paid for the use of loan funds, which is generally expressed as a percentage of the principal loan per certain period. Mishkin (2008:60) emphasizes that interest rate stability is an important prerequisite for financial market stability, because it facilitates efficient allocation of funds from parties with excess funds to business actors who need productive capital, thereby encouraging macroeconomic stability. In the monetary system, interest rates function as a monetary policy tool that influences people's economic behavior, both in terms of saving and investing decisions. In Indonesia, Bank Indonesia as the monetary authority issues Bank Indonesia Certificates (SBI) - short-term debt instruments in Rupiah currency - as a means of monetary operations. Through the SBI interest rate adjustment mechanism, Bank Indonesia can control the amount of money in circulation and direct the national economy, which is known as monetary policy (Firmansyah and Nuzula 2017).

Money Supply

The money supply refers to the total liquidity in the economy that can be directly used as legal tender. In terms of classification, it consists of fiat money (coins and paper money), demand deposits (non-cash payment instruments), quasi-money (term deposits such as deposits). According to Mishkin (2008), an increase in the money supply can cause long-term price increases (inflation), future exchange rate depreciation, and the phenomenon of exchange rate overshooting in both the short and long term. Quoted from researchFatmawati & Sugiharti, (2021) in the context of the Rupiah exchange rate against the US Dollar, when the Rupiah supply is high, depreciation occurs. When the Rupiah supply is low, appreciation occurs.

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Purchasing Power Parity

The Purchasing Power Parity (PPP) Theory, first introduced by Gustav Cassel (1918), is a fundamental but controversial theory in international finance that quantitatively links inflation to exchange rates (Madura 2006). This theory functions as a tool to predict the equilibrium exchange rate when there is an imbalance in the balance of payments.

Basic Principles of PPP:

a) PPP theory states that exchange rates will fluctuate to compensate for differences in inflation rates between countries, thereby equalizing consumer purchasing power for domestic and imported products (Madura, 2006).
b) Changes in exchange rates are directly proportional to inflation differentials between countries.
c) This theory reveals the potential conflict between domestic price stability and exchange rate stability.

PPP relatively takes into account market imperfections such as:

a) Trade barriers (import duties, quotas)
b) Transportation costs cause price disparities between countries even when measured in the same currency.

According to Salvatore (2011), relative PPP states that changes in exchange rates are proportional to relative changes in the price levels of the two countries. Eiteman et al. (2010) added that relative PPP is more useful for analyzing changes in exchange rates than determining their absolute levels. Amalia (2007) explained that changes in domestic and foreign prices will affect the exchange rate. Relative PPP can identify whether a currency is overvalued or undervalued.

Conceptual Framework

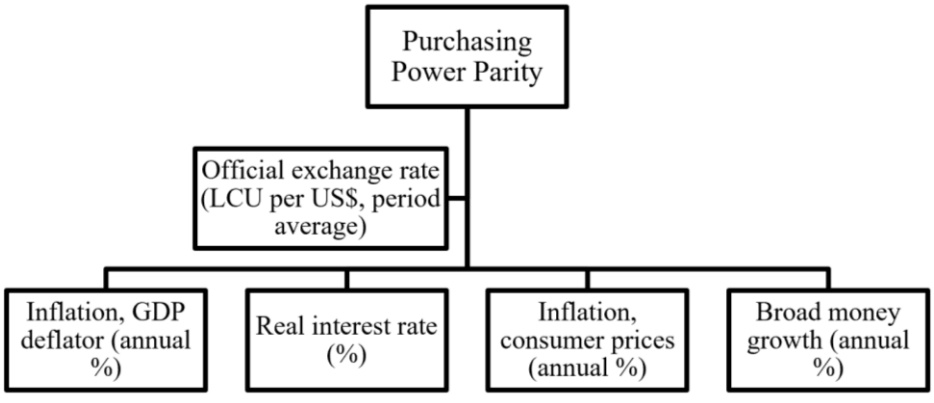

Figure 3. Framework of Thought

Previous Research

Previous research related to this topic can be used as scientific references, including:

In a study conducted by Nasution & Lubis, (2018), the effectiveness of the Purchasing Power Parity (PPP) theory in explaining the movement of the Rupiah exchange rate against

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the US Dollar is tested empirically. The study uses a regression model with the specification of the dependent variable (Y): Percentage change in the Rupiah/USD exchange rate and the independent variable (X): The ratio of Indonesia's inflation rate to the United States' inflation rate. The results of the analysis show a statistically significant positive effect between the inflation ratios of the two countries on the movement of the Rupiah/US Dollar exchange rate. This finding supports the basic proposition of the PPP theory which states that inflation differentials between countries are an important determinant in the movement of currency exchange rates.

Octafiani, (2023) Researching Purchasing Power Parity And Imbalance Trade: Implications and Impact on International Finance. Research Results shows that Purchasing Power Parity (PPP) is a useful tool for understanding differences in purchasing power among countries and provide a basis for comparison more accurate price levels. PPP can affect exchange rates and trade international. Trade imbalances can be caused by various factors, including differences in economic growth rates, changes in foreign exchange rates, policies trade, and structural factors.

Gugun et al., (2025) researching the Analysis of Purchasing Power Parity Theory of Basic Commodities (Case Study on the Impact of Exchange Rates, Monetary Policy, and Inflation in Indonesia). The results of the empirical analysis show several important findings, namely that there are statistically significant correlational relationship between exchange rate fluctuations and domestic inflation rate. Policy implications such as the need for policy formulation monetary precision. The main objective is to maintain exchange rate stability. The ultimate goal namely the protection of people's purchasing power. This research provides a practical contribution in the form of policy recommendations for monetary authorities.

Fatmawati & Sugiharti, (2021) Examining the Dynamics of the Rupiah Exchange Rate Against the US Dollar: Monetary Approach Method. Based on the results of the cointegration model estimation, it was found that the oil and gas import variables and the BI Rate had a significant influence against the Rupiah exchange rate. The amount of money in circulation (M2) has a significant effect both in long term and short term. The inflation rate does not show any significant influence. significant to the Rupiah exchange rate, both in the short and long term time frame. long term. This study confirms the importance of monetary variables and policy. interest rate (BI Rate) in determining exchange rate stability, while inflation does not become a dominant factor in the context of Rupiah–USD dynamics.

Tamonsang & Arochman, (2020) Researching the Analysis of Purchasing Model Implementation Power Parity to Predict Rupiah Exchange Rate Against US Dollar (January Period) 2016 – December 2018). The research findings show that there is an influence that statistically significant difference between the Indonesia–US inflation rate and fluctuations Rupiah/USD exchange rate. The PPP model has proven to remain relevant as a tool for predicting exchange rates, with regression results that meet all classical assumptions. This is reinforced by statistical significance of the inflation variable in explaining exchange rate changes. This study strengthens the theoretical basis that inflation disparities between

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countries are crucial determinants in the PPP model, while also confirming the predictive power of the model. in the context of the Rupiah exchange rate.

Ari & Teguh, (2016) examines the Monetary Approach of Rupiah's Exchange Rate. The research findings show that the short-term analysis of the sticky price monetary model is proven to be effective in explaining fluctuations in the Rupiah exchange rate with significant variables including the Domestic Price Index, Money Supply, Domestic Debt. Long-term analysis shows that significant factors affecting the Rupiah exchange rate include the Import Price Index, Money Supply, Gross Domestic Product (GDP), Domestic Debt, and Financial Crisis Dummy. The fiscal deficit does not show a significant effect on the exchange rate. Domestic debt (proxied by the ratio of outstanding bonds to GDP) has an effect on exchange rate depreciation in both the short and long term. This study confirms the relevance of the monetary approach, especially the sticky price model, in analyzing the Rupiah exchange rate, while emphasizing the importance of domestic debt management to maintain exchange rate stability.

Research conducted by Setiawan et al., (2021) examines The Impact of Bank Indonesia Regulation No. 17/3/2015 on Exchange Rate: Analysis Using Vector Error Correction Model (VECM). The results of the model estimation produce several findings of long-term exchange rate determinants, namely export-import activities show a significant negative correlation with the exchange rate. The inflation variable does not provide a statistically significant effect. Expansion of the money supply contributes negatively to the exchange rate. Bank Indonesia's interest rate policy has a positive effect on exchange rate stabilization. The implementation of PBI No. 17/3/2015 has been proven to have a significant positive impact on strengthening the exchange rate. These findings indicate that monetary instruments through interest rate mechanisms and money supply regulation are more effective in maintaining exchange rate stability than controlling inflation. The results of the study also emphasize the importance of an appropriate monetary regulatory framework in creating exchange rate stability, even in situations of economic turmoil.

Eniayewu et al., (2024) researching Forecasting exchange rate volatility with monetary fundamentals: A GARCH-MIDAS approach. This study finds that interest rates interest rates significantly predict exchange rate volatility in both countries, while money supply growth affects exchange rate movements only in South Africa. The results also show the long-term persistence of exchange rate volatility in both country. Thus, this study concludes that the monetary fundamentals plays an important role in determining exchange rate volatility in South Africa and Nigeria, providing useful insights for policy decision making and risk mitigation strategies in these markets.

You & Liu, (2020) researching Forecasting short-run exchange rate volatility with monetary fundamentals: A GARCH-MIDAS approach. In particular, we allows the component volatility model to distinguish exchange rate fluctuations short term of long term movements that are directly related to monetary fundamentals. Relative to more traditional time series volatility models, we found a significant improvement in the ability to predict daily volatility of exchange rate changes by combining volatility monthly monetary fundamentals as predictors into the component volatility model. In a utility-based

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comparison, we find that an investor is willing to pay a positive annual management fee of 5.72% on average to switch from reference model to the fundamental based model. Of these models, the model with the rule Symmetrical and homogeneous Taylor and interest rate smoothing obtain costs highest positive annual management.

Chaidir & Arini, (2019) examines Macro Indicator Shocks to Monetary Policy Transmission on the Exchange Rate Channel. The test results show that the monetary policy transmission process through the exchange rate channel takes about 6 months to achieve the final target of inflation control. The exchange rate response to SBI interest rate shocks shows low elasticity. The exchange rate variable is only able to explain 3.15% of the variation in inflation, lower than the contribution of the money supply variable.

Vo & Vo, (2022) researching the purchasing power parity and exchange-rate economics half a century on. In this article, we illustrate how parity works. purchasing power (PPP) and demonstrate its practical use with cross-country data. spanning 50 years since the collapse of the Bretton Woods monetary system. We find that although currency values fluctuate in the long term and the amount trade barriers, arbitrage power and reallocation of resources are sufficient to address many of these distortions in the long run. We also provide a broad survey on other important themes, both existing and emerging, in international economics that highlights the importance of the relationship between exchange rates and prices.

Nagayasu, (2021) researching Causal and frequency analyzes of purchasing power parity. Using a country panel and advanced statistical methods, we estimate spillover for all combinations of origins and destinations in the frequency band. different, and show that their relationships vary over time and multidirectional and has some validity in the short and long term.

Ong, (2024) researched Adjusting toward long-run purchasing power parity. We using the System Pooled Mean Group (SPMG) model to study the adjustment exchange rates and prices relative to PPP in 16 developed countries against the US dollar and prices for 151 years (1870–2020). SPMG model and bootstrap confidence intervals accommodate episodic cointegration and cross-country dependence. We detect consensus for PPP is relatively long term because we combine long term, allows for two-way long-term causality, and uses range data long.

Muto & Saiki, (2024) researching Synchronization analysis between exchange rates on the basis of purchasing power parity using the Hilbert transform. Using method synchronization analysis using Hilbert transform and found that the level of high synchronization almost all the time, indicating the formation of PPP. The level of synchronization does not remain high across periods with asymmetric economic events like the US real estate bubble.

Olaniran & Ismail, (2023) researched Testing absolute purchasing power parity in West Africa using fractional cointegration panel approach. Results of the cointegration test fractional confirms the existence of relative PPP for the country panel over the long term. long, while the long-run intercept estimates and cointegration vectors confirm the absence of absolute PPP for country panels.

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Moatsos & Lazopoulos, (2021) research Purchasing power parities and the Dollar- A-Day approach: An unstable relationship. This study shows that the methodology Dollar-A-Day in global poverty measurement provides a Poverty Line solution International (IPL) inconsistent when a set of consistency criteria are complete in the definition of IPL used. This article illustrates that small fluctuations in exchange rate purchasing power parity can result in inconsistent IPL. We found an inconsistency rate of 46.1% and we concluded that this is a worrying attribute of the method.

Xie et al., (2021) researching Facing up to the polysemy of purchasing power parity: New international evidence. Using the real effective exchange rate from 23 country OECD plus the euro area, we find that the GDP size, euro area membership, and the ratio of government debt to GDP have an effect significant on the validity of the PPP hypothesis.

Papell & Prodan, (2020) examining Long-run purchasing power parity redux. Results The main point of this paper is that the 90 percent confidence interval for (1) the coefficient long-term correlation above zero and (2) long-term linear regression coefficient contains one and, therefore, long-run PPP cannot be rejected for 9 of 16 countries. For six countries, adding a third criterion that the confidence interval for long-term linear regression coefficients have relatively narrow bands giving strong evidence of long-run PPP. The evidence of long-run PPP is much stronger for developing countries. countries with high inflation/high depreciation than for countries with low inflation/high depreciation. low/low depreciation.

Doğanlar et al., (2021) researched Testing the validity of purchasing power parity in alternative markets: Evidence from the fourier quantile unit root test. This study analyzes long term validity purchasing power parity (PPP) in three types of market economies market developed, emerging, and frontier markets using unit root tests quantile fourier. The results of the Fourier quantile unit root test provide more evidence than any other test about validity of PPP, which shows that PPP is valid in 8 developed countries, 11 developing countries developing, and 7 frontier market economy countries.

Lothian, (2016) research Purchasing power parity and the behavior of prices and nominal exchange rates across exchange-rate regimes. The results of the study stated that the behavior of the price level in different countries differs in the way that PPP is shown when monetary arrangements are different and very similar when the monetary arrangements themselves are similar. The inflation rate adjusted for changes in exchange rates is generally very correlated and have a one-to-one relationship with each other within and across the three periods and the various monetary regimes in force.

METHOD

This study applies an econometric approach using the Granger Causality test and Vector Error Correction Model (VECM) analysis methods. The Granger Causality test is used to identify causal relationships between variables. Vector Error Correction Model (VECM) is used to analyze the relationship between long-term equilibrium and short-term adjustment. The type of data used is secondary data with an observation period of 1990-

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2023. Secondary data was obtained from the World Bank with the scope of the Republic of Indonesia.

The following function can explain the behavior between Inflation GDP deflator, Interest Rate, Inflation consumer prices, and Broad money growth towards Exchange Rate can be written as follows:

EXC= (IGDP, IR, ICP, BMG)…….....…….(1)

Research Variable Specifications

a) Dependent Variable:
   Exchange Rate is defined as the conversion value of domestic currency against US Dollar officially set by monetary authority or formed through foreign exchange market mechanism. In this study, the exchange rate is calculated as the annual average of monthly values (in local currency units per USD).
b) Independent Variables:
   Inflation (GDP Deflator): Measures the change in aggregate prices in the economy through the annual growth of the implicit GDP deflator, which is the ratio of nominal GDP to real GDP. This indicator reflects structural inflationary pressures in the economy.

Real Interest Rate: Calculated as the nominal interest rate adjusted for inflation (using the GDP deflator). It should be noted that variations in loan product terms across jurisdictions may affect the comparability of cross-country data.

Consumer Price Inflation: Expressed by the annual percentage change in the Consumer Price Index (CPI), which measures the average cost of a fixed basket of consumer goods and services over a given period.

Broad Money: Includes all liquid instruments in the economy including: (1) paper money outside the banking system, (2) non-government demand deposits, (3) term deposits and savings in domestic and foreign currencies, and (4) quasi-money instruments such as certificates of deposit and commercial papers.

Research Process Model

This research was conducted through several stages of testing. First, testing the degree of integration and stationarity of each variable. Second, use the cointegration test to examine the long-term relationship between variables. Third, see the Lag Length criteria and VAR stability test before starting the long-term and short-term analysis. Fourth, use the Granger Causality Test to see the long-term cointegration and directional causality variables, then use the Vector Error Correction Model (VECM) to compare the short-term causality between variables. Finally, conduct the Variance Decomposition and IRF tests.

Based on Gujarati (2003) there are several methods to test the stationarity of time series data, namely the Exploratory Method, visual analysis through data plotting, examination of the autocorrelation function using a correlogram. Formal Statistical Method, unit root test to determine data stationarity, Augmented Dickey-Fuller Test (ADF) as the main testing method. Analysis Procedure, namely if the data is not stationary at the level, then it is necessary to conduct a degree of integration test to determine the required differencing order, data transformation to achieve stationarity.

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Stationarity test allows identification of the nature of the data to be used in the study, whether stationary or non-stationary. Cointegration refers to a long-term equilibrium relationship between variables, where two or more non-stationary time series have interrelated stochastic trends. This concept is based on the similarity of stochastic components, which describe random fluctuations from the mean value of a dynamic process. Empirically, this relationship can be modeled through the following equation:

$EXC_t = \alpha_0 + \alpha_1 IGDP + \alpha_2 IR + \alpha_3 ICP + \alpha_4 BMG$ ………………………………………. (2)

In analyzing the long-term influence of independent variables on dependent variables, equation (2) can be changed into another equation form, namely:

$D(Log(EXC))t = \alpha_0 + \alpha_1 DIGDP_t + \alpha_2 DIR_t + \alpha_3 DICP_t + \alpha_4 DBMG_t + \alpha_5 ECT_{t-1}$ ....(3)

Where $ECT = IGDP_{t-1} + IR_{t-1} + ICP_{t-1} + BMG_{t-1}$ ……………………………………….. (4)

Granger causality VECM can be applied when the variables are integrated with the same integration order. To determine the direction of causality between variables, VECM is presented with the following equation:

$D(Log(EXC))t = \delta_{10} + \sum_{i=1}^{q} \delta_{11} D(Log(EXC))_{t-i} + \sum_{i=1}^{r} \delta_{12} DIGDP_{t-i} + \sum_{i=1}^{s} \delta_{13} DIR_{t-i} + \sum_{i=1}^{t} \delta_{14} DICP_{t-i} + \sum_{i=1}^{u} \delta_{15} DBMG_{t-} + \mu_1 ECTt_{-i} + \varepsilon_{1t}$ ……………………………………… (5)

$DIGDP\,t = \delta_{20} + \sum_{i=1}^{q} \delta 21\, DIGDP_{t-i} + \sum_{i=1}^{r} \delta_{22} D(Log(EXC))_{t-i} + \sum_{i=1}^{s} \delta_{23} DIR_{t-i} + \sum_{i=1}^{t} \delta_{24} DICP_{t-i} + \sum_{i=1}^{u} \delta_{25} BMG_{t-} + \mu_2 ECTt_{-i} + \varepsilon_{2t}$ ……………………………………… (6)

$DIR\,t = \delta_{30} + \sum_{i=1}^{q} \delta 31\, DIR_{t-i} + \sum_{i=1}^{r} \delta_{32} D(Log(EXC))_{t-i} + \sum_{i=1}^{s} \delta_{33} DIGDP_{t-i} + \sum_{i=1}^{t} \delta_{34} DICP_{t-i} + \sum_{i=1}^{u} \delta_{35} DBMG_{t-} + \mu_3 ECTt_{-i} + \varepsilon_{3t}$ ……………………………………… (7)

$DICP\,t = \delta_{40} + \sum_{i=1}^{q} \delta 41\, DICP_{t-i} + \sum_{i=1}^{r} \delta_{42} D(Log(EXC))_{t-i} + \sum_{i=1}^{s} \delta_{43} DIGDP_{t-i} + \sum_{i=1}^{t} \delta_{44} DIR_{t-i} + \sum_{i=1}^{u} \delta_{45} DBMG_{t-} + \mu_4 ECTt_{-i} + \varepsilon_{4t}$ ……………………………………… (8)

$DBMG\,t = \delta_{50} + \sum_{i=1}^{q} \delta 51\, DBMG_{t-i} + \sum_{i=1}^{r} \delta_{52} D(Log(EXC))_{t-i} + \sum_{i=1}^{s} \delta_{53} IGDP_{t-i} + \sum_{i=1}^{t} \delta_{54} DICP_{t-i} + \sum_{i=1}^{u} \delta_{55} DIR_{t-} + \mu_5 ECTt_{-i} + \varepsilon_{5t}$ ……………………………………… (9)

The impulse response test allows the examination of the dynamic structure between variables in a model system through stochastic innovation analysis. This approach includes two main components: the Impulse Response Function (IRF) and the Cholesky Decomposition. The IRF measures the response of an endogenous variable to shocks from other variables in the system, thereby revealing the dynamic adjustment patterns between variables (Parot et al., 2019). Meanwhile, the Cholesky Decomposition – often referred to as the Forecast Error Variance Decomposition (FEVD) – quantifies the relative contribution of each stochastic innovation in explaining the variance of the endogenous variable, while identifying dynamic causal relationships in the VAR model. Furthermore, the FEVD is able to measure the significance of the influence of random shocks of a variable on other endogenous variables in the system Sulistiana, Hidayati, & Sumar, (2017) in (Setiawan, Novianti, and Najib 2021).

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

RESULTS AND DISCUSSION

Stationary Test

Stationarity analysis of all research variables including the official exchange rate, inflation based on the GDP deflator, real interest rate, consumer price inflation, and broad money growth produces statistical outputs presented in the following table.

Table 1. Root Unit

Variable	Level	1st Difference
EXC	0.7143	0.0000
IGDP	0.0535	0.0000
IR	0.0000	0.0000
ICP	0.7618	0.0000
BMG	0.0012	0.0000

Source: the results of data processing using Eviews 13

The ADF test reveals that the interest rate (IR) and broad money growth (BMG) variables have achieved stationarity at the level with a statistical significance of 0.05. Furthermore, all research variables show stationary properties at the first difference with a 95% confidence level, indicating that the first differentiation transformation has successfully eliminated non-stationary components in the time series data.

Lag Length Criteria Test

Determining the optimum lag is an important procedure to identify the time interval required for a variable to respond to changes in other variables in the research system. In this study, the optimal lag length was determined based on the Akaike Information Criterion (AIC) criteria through computational analysis using EViews 10 software. The estimation results showed that the identified optimum lag was 2, which reflects the shortest response period that meets the statistical efficiency criteria of the model.

Table 2. Selection Order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-355.1092	NA	8464.000	23.23285	23.46414	23.30824
1	-297.3493	93.16111	1048.012	21.11931	22.50704*	21.57167
2	-263.5799	43.57345*	682.2899*	20.55354*	23.09771	21.38288*

Source: the results of data processing using Eviews 13

Stability Test

Stability testing in the VECM model aims to verify the validity of the results of the Impulse Response Function (IRF) and Variance Decomposition (VDC) analysis. The test results show that the model meets the system stability criteria, indicated by the modulus values of all characteristic roots that are below one (modulus <1). This condition indicates

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

that the system of equations built is dynamically stable, so that the IRF and VDC estimation results can be statistically accounted for.

Table 3. VAR Stability Test

Root	Modulus
-0.224997 - 0.773266i	0.805335
-0.224997 + 0.773266i	0.805335
0.483970 - 0.539872i	0.725044
0.483970 + 0.539872i	0.725044
-0.716398	0.716398
-0.406356 - 0.425561i	0.588411
-0.406356 + 0.425561i	0.588411
0.255436 - 0.324468i	0.412949
0.255436 + 0.324468i	0.412949
0.401306	0.401306

No root lies outside the unit circle.
VAR satisfies the stability condition.
Source: the results of data processing using Eviews 13

Cointegration Test

The VECM estimation procedure is continued with cointegration testing to identify the long-run equilibrium relationship between variables. The test results indicate the existence of a significant cointegration relationship at the 95% confidence level ($\alpha = 0.05$), as evidenced by the trace statistic value exceeding its critical value. This finding confirms the existence of a stable long-run relationship among all variables in the system, with complete results presented in Table 4. Validation of this cointegration relationship is an important basis for the formation of an adequate error correction model.

Table 4. Johanson Co-Integration Test
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.949786	202.2605	69.81889	0.0000
At most 1 *	0.909255	112.5166	47.85613	0.0000
At most 2 *	0.491455	40.52564	29.79707	0.0020
At most 3 *	0.354267	20.23960	15.49471	0.0089
At most 4 *	0.211233	7.118514	3.841465	0.0076

Trace test indicates 5 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

Unrestricted Cointegration Rank Test (Max-eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.949786	89.74393	33.87687	0.0000
At most 1 *	0.909255	71.99097	27.58434	0.0000
At most 2	0.491455	20.28604	21.13162	0.0653
At most 3	0.354267	13.12109	14.26460	0.0752
At most 4 *	0.211233	7.118514	3.841465	0.0076

Max-eigenvalue test indicates 2 cointegrating equation(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: the results of data processing using Eviews 13

Granger Causality Test

Table 5. Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
BMG does not Granger Cause EXC	32	0.07038	0.9322
EXC does not Granger Cause BMG		7.61501	0.0024
ICP does not Granger Cause EXC	32	3.17232	0.0579
EXC does not Granger Cause ICP		4.05219	0.0289
IGDP does not Granger Cause EXC	32	0.74220	0.4855
EXC does not Granger Cause IGDP		2.58541	0.0939
IR does not Granger Cause EXC	32	0.51188	0.6051
EXC does not Granger Cause IR		0.74849	0.4826
ICP does not Granger Cause BMG	32	7.40625	0.0027
BMG does not Granger Cause ICP		3.19381	0.0569
IGDP does not Granger Cause BMG	32	5.38791	0.0107
BMG does not Granger Cause IGDP		2.31740	0.1178
IR does not Granger Cause BMG	32	3.97786	0.0306
BMG does not Granger Cause IR		0.12561	0.8825
IGDP does not Granger Cause ICP	32	1.13916	0.3350
ICP does not Granger Cause IGDP		1.14781	0.3323
IR does not Granger Cause ICP	32	0.69789	0.5064

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

ICP does not Granger Cause IR		2.14335	0.1368
IR does not Granger Cause IGDP	32	1.30588	0.2875
IGDP does not Granger Cause IR		0.72280	0.4945

Source: the results of data processing using Eviews 13

The results of the Engle-Granger causality test indicate that there is no two-way relationship between variables, because all p-values or probabilities do not reach statistical significance ($\alpha < 0.05$) simultaneously in both directions.

Long Term and Short Term Effects The

VECM estimation results for the long-run equation are shown in Table 6 and the short-run equation in Table 7 the factors that influence the exchange rate in the long-run and short-run are shown in the following table.

Table 6. Long Run Results

Dependent Variabel : EXC		
Variabel	Coefficient	T-Statistics
D(BMG(-1))	0.141199	25.5406
D(ICP(-1))	0.126966	8.00845
D(IGDP(-1))	-0.075062	-4.82378
D(IR(-1))	0.091086	8.67631

Source: the results of data processing using Eviews 13

Table 7. Short Run Results

Dependent Variabel : EXC		
Variabel	Coefficient	T-Statistics
COINTEQ1	0.093898	0.66731
D(LOG(EXC(-1)))	0.256086	0.29962
D(LOG(EXC(-2)))	-0.961685	[-1.59389
D(BMG(-1))	-0.029771	[-1.64135
D(BMG(-2))	0.004598	0.58236
D(ICP(-1))	-0.048391	[-2.38939
D(ICP(-2))	-0.009969	[-0.62148
D(IGDP(-1))	0.070926	1.85307
D(IGDP(-2))	0.009835	0.41912
D(IR(-1))	0.053466	1.57608
D(IR(-2))	0.003536	0.11533
C	0.125717	1.84065
R-Squared : 0.453583		
F-statistics : 1.433816		

Source: the results of data processing using Eviews 13

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

VECM analysis reveals that the Broad Money Growth (BMG) variable has a significant influence in the long-term framework, but does not show a significant impact in the short-term period. This finding is in line with researchFatmawati & Sugiharti, (2021)which highlights the crucial role of the money supply in influencing the movement of the rupiah exchange rate. The transmission mechanism occurs through the elasticity of currency supply, where an increase in demand for the rupiah that exceeds its supply will drive exchange rate depreciation. The high rupiah supply condition actually causes exchange rate appreciation. Furthermore, excessive monetary expansion can trigger inflationary pressure through rising prices of goods, which in turn will weaken the rupiah exchange rate. This phenomenon reflects the causal relationship between domestic liquidity, price stability, and exchange rates in an open economic framework.

The results of empirical testing reveal that the Inflation, Consumer Prices (ICP) variable has a significant influence in both the short and long term, a finding that is consistent with research.Gugun et al., (2025)Key factors influencing the dynamics of the Consumer Price Index (CPI) include the inflation rate playing a central role in determining the movement of the CPI, where the increase in the prices of basic commodities and services in general will drive an increase in the CPI figure. The transmission mechanism occurs through the import channel - the depreciation of the USD/IDR exchange rate increases the cost of importing raw materials, which then has an impact on increasing domestic output prices and inflationary pressures. Paradoxically, inflation at a moderate level can function as a stimulus for economic growth by encouraging production and consumption activities. However, when inflation exceeds a certain threshold, the negative impacts begin to dominate in the form of a decrease in people's purchasing power, distortion of household consumption patterns, instability of essential commodity prices. These findings underline the importance of controlling inflation within a balanced monetary policy framework, while strengthening empirical evidence on the sensitivity of the CPI to fluctuations in exchange rates and global commodity prices.

The test results on the Inflation variable measured through the GDP deflator show a significant negative effect in the long term, although no significant impact was found in the short term. This finding is in line with research conducted byTamonsang & Arochman, (2020)which states that the application of the Purchasing Power Parity (PPP) method can describe the response to changes in the rupiah exchange rate against the US dollar by considering the inflation rate in each country. A high inflation rate indicates a condition where the price of domestic products has increased so that it is relatively more expensive compared to imported goods. This in turn encourages increased public demand for imported products as a result of the price difference.

The results of the analysis of the Real Interest Rate (IR) variable show a significant influence in the long term, which is indicated by a t-statistic value exceeding 1.9, although no significant influence was found in the short term. This finding is consistent with researchFatmawati & Sugiharti, (2021)which states that the interest rate has a positive and significant effect on the rupiah exchange rate against the US dollar. More specifically, the increase in interest rates set by Bank Indonesia (BI) will encourage an increase in the supply

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

of the rupiah, thus having an impact on strengthening the rupiah exchange rate. This is in accordance with economic theory which states that an increase in interest rates can attract foreign capital flows, thereby increasing demand for the domestic currency.

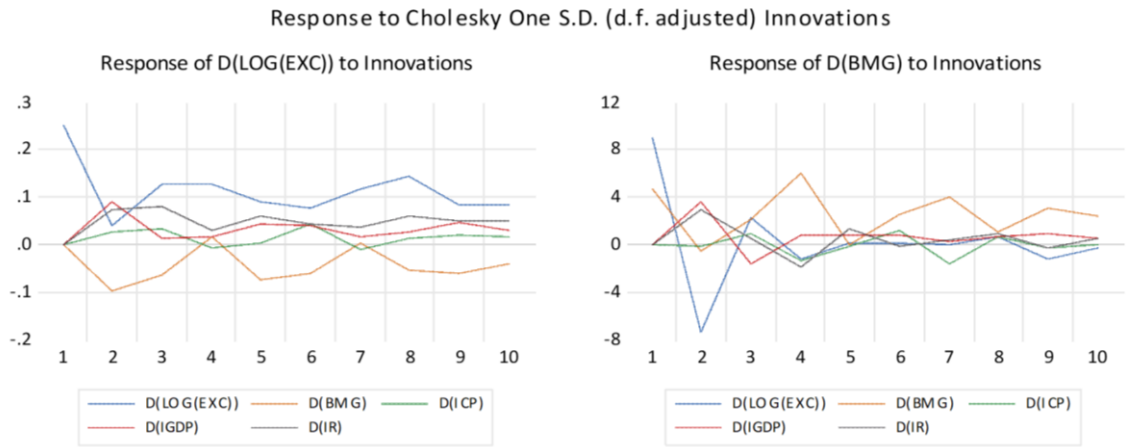
Impulse Response Function (IRF) Test

The IRF test is used to analyze the predictive impact of a variable on other variables in a certain period of time, by measuring the dynamic response caused by a shock to a variable on the system. Through this test, it can be observed how long the effect of a shock lasts before finally returning to equilibrium conditions Ajija et al., (2011:168) in(Chaidir & Arini, 2019).

Impulse Response describes the reaction of a variable to a shock from another variable over several time periods. If the Impulse Response visualization results show a convergence pattern a movement that gradually approaches the initial equilibrium point this indicates that the impact of the shock is temporary. In other words, the impact of the shock will weaken over time and ultimately have no permanent effect on the observed variable.

Analysis of exchange rate responses to economic shocks shows varying patterns. When a variable causes a negative trend, it indicates depreciation pressure on the exchange rate. Conversely, a positive trend indicates an appreciation tendency. In more detail, the results of the Impulse Response Function (IRF) reveal that the BMG variable generally shows a fluctuating pattern with a tendency to weaken the exchange rate, except in the first, fourth, and seventh periods. The ICP variable has a negative impact (exchange rate weakening) especially in the fourth and seventh periods. The IGDP and IR variables consistently show a positive influence (exchange rate strengthening) throughout the entire observation period.

These findings illustrate the complex dynamics of exchange rate responses to various economic factors, with different temporal patterns for each variable.



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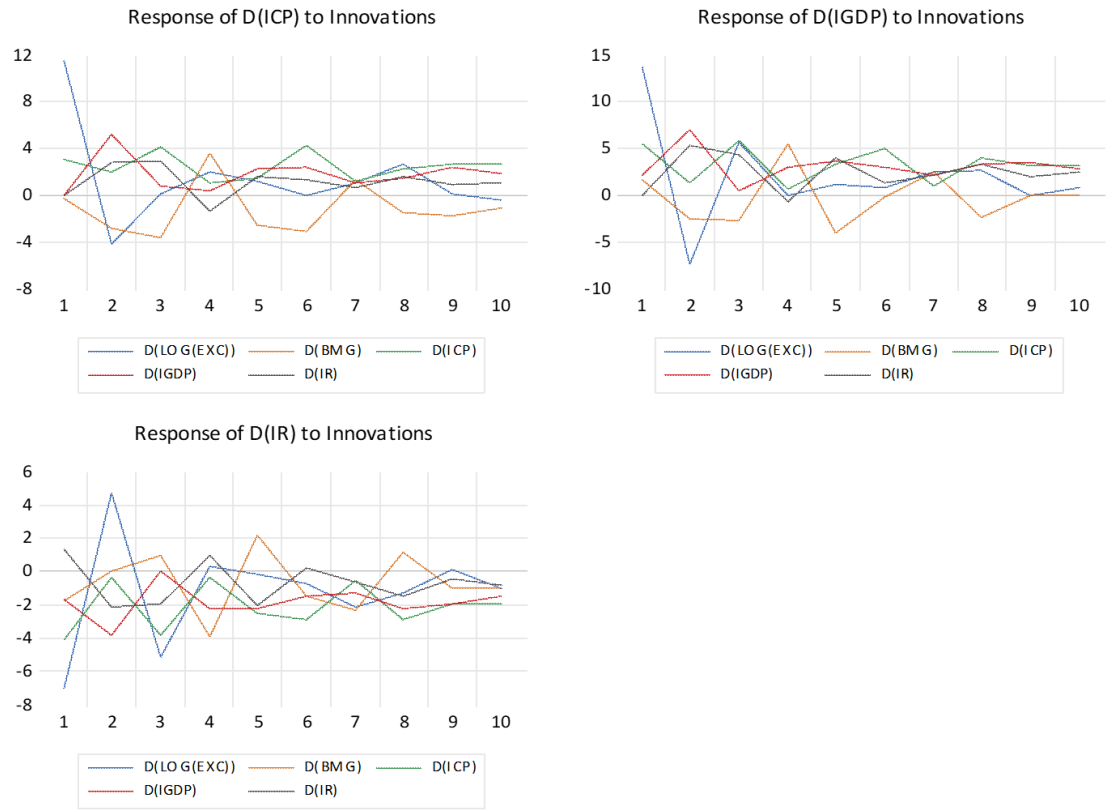

Figure 2. IRF Graph
Source: the results of data processing using Eviews 13

Forecast Error Variance Decomposition (FEVD) Or Variance Decomposition (VD) Test

Forecast Error Variance Decomposition (FEVD) or Variance Decomposition (VD) analysis serves to quantify the relative contribution of a shock variable to the variance of predictions of other variables in the future time period. Specifically, the results of the application of the FEVD/VD test on the exchange rate variable show the following pattern:

Table 8. Variance Decomposition (VD)

Variance Decomposition of D(LOG(EXC)):

Period	S.E.	D(LOG(EXC))	D(BMG)	D(ICP)	D(IGDP)	D(IR)
1	0.250437	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.296553	73.13840	10.91089	0.738567	9.177705	6.034438
3	0.340800	69.47976	11.86747	1.425745	7.070374	10.15665
4	0.365927	72.29006	10.53604	1.272699	6.370228	9.530972
5	0.391048	68.53526	12.84876	1.126414	6.828190	10.66138
6	0.409728	65.99235	13.98295	2.111996	7.153933	10.75878
7	0.427748	67.85115	12.83163	1.983978	6.684550	10.64869

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

8	0.459661	68.68081	12.48093	1.787950	6.164025	10.88629
9	0.476630	67.00672	13.16893	1.835212	6.693098	11.29603
10	0.489460	66.44272	13.18064	1.875687	6.741514	11.75943

Source: the results of data processing using Eviews 13

a) The response of the EXC variable to shocks to itself shows a dynamic pattern that varies based on the time horizon. In the short term, all fluctuations in EXC (100%) are entirely due to internal shocks to the variable. However, as the movement to the medium term, the contribution of EXC shocks to its own variance decreases significantly to 66.4%. This finding indicates that in the longer term, external factors begin to play an increasingly important role in explaining the variation in EXC values.
b) The impact of BMG shocks on the EXC variable reveals an interesting temporal development. In the short-term time horizon, the BMG variable does not contribute at all (0%) to EXC fluctuations. However, in the medium-term perspective, the influence of BMG experiences a progressive increase to reach a contribution of 13.18% to EXC variations. This pattern shows that the effect of BMG is gradual and only becomes significant in a longer period.
c) The impact of ICP shocks on EXC variables shows a typical development pattern. In the early phase (short term), the ICP variable has no effect at all (0%) on EXC dynamics. However, in the medium-term perspective, the contribution of ICP has increased gradually, although with a relatively small magnitude, reaching 1.87% of EXC variations. This finding indicates that the influence of ICP is delayed, the intensity of its impact is relatively limited compared to other variables, there is a transmission mechanism that takes time to manifest.
d) IGDP shocks to the EXC variable show a significant temporal development pattern. In the early phase (short term), the IGDP variable does not contribute (0%) to exchange rate fluctuations (EXC). However, in the medium-term time horizon, the influence of IGDP shows a progressive increase to reach 6.74% of EXC variations. This pattern indicates that the impact of IGDP is cumulative and only becomes significant in a longer period. There is an indirect transmission mechanism that links economic growth to the exchange rate.
e) The IR shocks to EXC reveal an interesting temporal pattern. In the short term, the IR variable shows no effect (0%) on the movement of EXC. However, as time goes by towards the medium term, the contribution of IR increases significantly to 11.75% of the variation of EXC. This finding indicates several important things. First, there is a time lag before interest rates have a real impact on the exchange rate. Second, the transmission mechanism of monetary policy through interest rates takes time to affect the foreign exchange market. Third, the large contribution of IR which reaches almost 12% indicates the important role of monetary policy in exchange rate stability in the medium term.

Based on the analysis that has been done, it can be concluded that there is a pattern of progressive increase in the influence of macroeconomic variables shocks on the exchange

DOI: https://doi.org/10.54443/sibatik.v4i7.2799

rate (EXC) throughout the observation period. Specifically, the cumulative impact of BMG, ICP, IGDP, and IR shocks on EXC shows a tendency to strengthen, starting from the early period to the late period. This finding indicates that the effects of economic shocks are cumulative on the exchange rate. The policy transmission mechanism takes time to achieve full impact. Macroeconomic factors show an increasingly significant influence over time.

CLOSING

Conclusion

This study evaluates the validity of the purchasing power parity (PPP) theory in the context of the Indonesian economy through an analysis of the influence of macroeconomic variables on the exchange rate. The results of the analysis reveal that in the long term, the variables Inflation GDP deflator, Real interest rate, Inflation consumer prices, and Broad money growth significantly affect the exchange rate, while in the short term only Inflation consumer prices show a significant influence.

This finding is not entirely consistent with the postulate of the PPP theory which states that exchange rate fluctuations will affect the price of tradable goods and subsequently impact the variability of inflation. This discrepancy is mainly due to the special characteristics of the Indonesian economy where the Rupiah exchange rate against the US dollar is not only determined by economic factors, but also influenced by non-economic factors such as market sentiment and political stability. In addition, this study confirms that the PPP theory can only be applied effectively for long-term analysis, while in the short term there are other factors that are more dominant in influencing exchange rate movements.

Suggestions

This study recognizes the limitations in modeling the rupiah exchange rate prediction against the US dollar which only relies on the Purchasing Power Parity (PPP) theory approach. For further research development, it is recommended to integrate a more comprehensive theoretical approach by considering various exchange rate determinants, such as:

a) Economic growth indicators (GDP level, productivity)
b) Government intervention and monetary policy
c) Financial market expectations and sentiment
d) Structural macroeconomic factors
e) Non-economic variables that are exogenous

By expanding the theoretical framework and research variables, the exchange rate prediction model is expected to provide more accurate and comprehensive results in analyzing rupiah exchange rate fluctuations.

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