The Analysis Between Purchasing Power Parity and Exchange Rates, Inflation and Gross Domestic Product in Developing and Developed Countries Asia and Europe During Covid-19 Pandemic

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ABSTRACT

The study aims to analyze Purchasing Power Parity (PPP) and exchange rates, inflation and Gross Domestic Product (GDP) in developing and developed countries in Asia and Europe during the covid-19 pandemic. The data used secondary data, obtained from the websites of the Central Bank of Indonesia, World Bank, International Monetary Fund (IMF) and Organization for Economic Cooperation and Development (OECD) from 2003 to 2020. This research used method of Vector Error Correction Model (VECM). The results show that the GDP, inflation and exchange rate variables have positive and negative responses to changes in PPP values during the observation period, especially during the Covid-19 pandemic. This condition can occur because the economy in each country experiences fluctuations, especially during the Covid-19 pandemic. This has an impact on the PPP value in these 10 countries, which causes each country to take financial and monetary policies in accordance with the problems they face.

INTRODUCTION

Purchasing power parity (PPP) exchange rate is the exchange rate between two currencies to obtain two relevant national price levels if expressed in a common currency at that rate, so that the purchasing power of one unit of currency will be the same in both economies (Sarno and Taylor, 2002). PPP or purchasing power parity can be used to determine the exchange rate. The dynamics of the nominal exchange rate can be explained by monetary fundamentals in the long term (Khan et al, 2019). When countries carry out free trade, the exchange rate is used as a benchmark in transactions with the reference being the US Dollar exchange rate, because the US Dollar is a stable currency and is recognized by the world. Based on the exchange rate, the economic growth of a country can also be known, because the economic growth of each country is different.

The difference in the exchange rate of a country's currency is in principle determined by the amount of demand and supply of the currency. The exchange rate is one of the important prices in an open economy because it determines the balance between demand and supply that occurs in the market, considering its large influence on the current account and other macroeconomic variables. Any macroeconomic model that wants to capture the dynamics of the nominal exchange rate must have two main characteristics, namely, the nominal exchange rate must be a fundamental function of the steady state of the economy and at the same time there must be an equilibrium in which the nominal exchange rate fluctuates around the term value. length but not as a result of randomness in economic fundamentals (Eugeni, 2020). PPP theory has become a benchmark in international macroeconomics and finance. Prices tend to react more sensitively to exchange rates when countries are more open to international trade (McCarthy, 2000; Benigno and Faia, 2010). PPP conditions and exchange rates in each country are also related to the inflation rate and Gross

Domestic Product (GDP). GDP is a tool to show the average and standard of living of people in a country (Mankiw, 2006). GDP is a strong indicator of a country's economic growth, therefore countries try to maximize GDP when making fiscal plans to achieve high levels of economic growth (Picardo, 2021; Divya & Rama, 2014). Meanwhile, inflation is a situation where there is a general and continuous increase in prices within a certain period (Samuelson and William, 2001).

To determine the relationship between PPP and the exchange rate, a test called the cointegration test is carried out. The cointegration test in PPP is the real exchange rate which shows symmetry and proportionality conditions which cannot be tested easily because of bias in the standard error estimation (Sarno and Taylor, 2000). Cointegration studies generally describe no significant average reversion of exchange rates towards PPP (Taylor, 1988 and Mark, 1990), but support reversion towards PPP (Taylor & McMahon, 1988). Research conducted by Nazlioglu et al (2021) tested PPP in Greece, Italy, Ireland, Portugal and Spain. PPP explains that the exchange rate adjusts to its equilibrium value until there is no difference in purchasing power, the exchange rate between two countries changes according to relative prices and average return or stationary process. Based on these circumstances, the author aims to examine the relationship between PPP and exchange rates, inflation and GDP in developing and developed countries in Asia and Europe during the Covid-19 pandemic. A purchasing power parity (PPP) exchange rate is an exchange rate between two currencies that would equalize the two relevant national price levels if expressed in the common currency at that rate, so that the purchasing power of one unit of one currency would be the same in both economies. PPP, law of one price and price index. Measure of PPP deviation from market prices (Sarno, L. and Mark Taylor, 2002). Taylor (2001) shows that a bias towards the PPP hypothesis can arise in tests of real exchange rate stationarity due to the temporal aggregation of high frequency data in the construction of lower frequency price indices. This shows that bias can affect the accuracy of the unit root test, but if there is bias in the data it can reduce the lag length. Hegwood and Papel (1998) argue that PPP requires a return of the real exchange rate to a constant mean. The unit root test which shows the stationarity of the real exchange rate in the presence of PPP proves that the exchange rate shifts, explaining that the average has changed. PPP theory has become a benchmark in international macroeconomics and finance. Prices tend to react more sensitively to exchange rates when countries are more open to international trade (McCarthy, 2000; Benigno and Faia, 2010).

Holmes (2001) and Sarno (2005) state that PPP is used to predict exchange rates and determine whether a currency is over or undervalued. This is important for developing countries which experience significant differences between domestic and foreign inflation rates (Yildrim, 2017). Purchasing Power Parity (PPP) theory states that price differences in two countries are not permanent if these prices are measured in the same exchange rate, this implies that prices converge towards equilibrium prices based on the Law of One Price (LOP). The existence of trade barriers in the Law of One Price causes PPP to be invalid (Arruda et al, 2018). Gross Domestic Product is the total expenditure on the economy's output of goods and services which is a reflection of economic performance, likewise an economy with a large output of goods and services can properly meet the demand of households, companies and the government (Mankiw, 2007). The Gross Domestic Product produced by each country is different, this is caused by economic shocks, one of which is during the current

pandemic. From a theoretical point of view, the pandemic may have a positive or negative impact on GDP. Productivity and average income will also increase if the pandemic occurs on a massive scale which results in elderly people becoming unproductive. On the other hand, in the short term, the pandemic tends to increase uncertainty and encourage people to save just in case, reducing investment and consumption (Stefanski, 2022). Meanwhile, according to Kozlowski, et al (2020), the level of risk aversion may also increase because economic actors feel afraid or traumatized by another economic shock. The pandemic has also affected developed countries in the European region. For example, during the pandemic, Denmark and Norway's GDP in the economy was classified as stable, in contrast to the UK which failed to coordinate with neighboring countries which resulted in their economic performance being classified as unstable (Fezzi et al, 2021).

Inflation is a situation where there is a general and continuous increase in prices within a certain period. When inflation occurs in the long term, the situation is called an economic crisis (Samuelson & William, 2001). The Covid pandemic has caused quite large inflation volatility in the Euro area and around the world, in several countries measured by the Harmonized Index of Consumer Prices (HICP) (Nickel, et al, 2022). During the Joe Biden administration, the Covid-19 aid plan implemented additional fiscal spending of $1.9 T. Meanwhile, the European Union decided to deactivate fiscal spending until 2022, which allowed countries in the European region to experience an increase in their balance sheet deficit. However, the European Parliament, the European Commission and the European Group have introduced a plan called the Next Generation European Union by spending 1.8 billion euros or $2.2 billion to overcome the unprecedented pandemic crisis (Posta & Mario, 2022). If the fiscal multiplier is greater than 1, which is quite reasonable during a pandemic, then fiscal changes that will reduce public debt also reduce GDP as a result of which the ratio of public debt to GDP increases.

To deal with the economic crisis, many countries have planned strong fiscal stimulus through direct spending and tax cuts. Fiscal expansion measures amounted to 15% of GDP in the United States, about 21% of GDP in Japan, about 14% of GDP in Germany, 5% of GDP in Italy and 3.2% of GDP in Spain (Stirati, 2020). The exchange rate of a currency or exchange rate is the exchange rate of a country's currency against another foreign country (Thobarry, 2009). The nominal exchange rate is the relative price of the currencies of two countries, while the real exchange rate is the nominal exchange rate that has been corrected for the prices of domestic goods compared to the prices of goods abroad (Mankiw, 2007). The current Covid-19 pandemic can disrupt financial markets, including influencing exchange rates and to determine the relevance of exchange rate predictability. In the face of an unprecedented crisis in the form of the Covid-19 pandemic, exchange rate fundamentals may become stronger or weaker considering the dominant pandemic shock. As a result, the exchange rate has been impacted by the pandemic for more than six months, providing a level of resilience to the pandemic, in other words the exchange rate has absorbed the shock of the pandemic (Narayak, 2022). In particular, there is evidence showing that (a) the exchange rate experienced an increase in activity intensity during the Covid-19 period; (b) the exchange rate becomes more resistant to shocks during the Covid-19 period; (c) exchange rate depreciation increases stock returns and (d) the exchange rate becomes inefficient during the Covid-19 pandemic (Ali et al, 2020).

METHODS

The data used is time series data obtained from Bank Indonesia, World Bank, International Monetary Fund (IMF) and Organization for Economic Cooperation and Development (OECD) from 2003 to 2020. The population uses 30 countries, but after carrying out a normality test on Eviews can only be used in 10 countries. This could occur due to economic shocks during the pandemic which resulted in unstable economic conditions. Meanwhile, the data analysis method used is as follows.

1. Augmented Dickey-Fuller (ADF) Stationarity Test

When testing data stationarity using this test, it can be seen from a significance level of 5. In other words, if the t-ADF value is greater than the McKinnon critical value (5%) in absolute terms, it can be concluded that the data used is stationary. In determining the relationship in the unit root test, it is necessary to know whether the times series data is stationary or not, if it is not stationary when the ADF test is carried out at the first difference level, it means that the data follows a random walks. According to Gauss-Markov, it does not have infinite variance. The following is the equation model used:

$$\Delta X_t = \beta_0 + \beta_1 t + \beta_2 X_{t-1} + \sum_{i=1}^{k-1} \beta_i \Delta X_{t-i} + \varepsilon_t$$

This model is interpreted as: H0: $\beta_2 = 0$, Data is not stationary and H1: $\beta_2 < 0$, Satsionary Data

The hypothesis H0 has a unit root, which means the data is not stationary and H1 does not contain a unit root, so it can be called stationary data.

2. Cointegration Test

After testing the unit root test, a cointegration test is carried out. The theory put forward by Engle & Granger (1987) examines the relationship between the long term and integrating the short term. If this test is carried out and results in cointegration, this means that there is a long-term linear relationship between the variables.

3. Lag Test

The next step is to carry out the lag test which is used in the cointegration and VECM tests. Determination of the lag length is carried out using the Akaike Information Criterion (AIC). This is used so that when the Engle-Granger causality test is carried out, it gets the best results, where the number of lags is determined by minimizing the AIC and reduced to the last lag statistically (Awe, 2012). This lag test is important to use in the VAR and VECM approaches because the lag of the endogenous variable in the equation variable will be used as an exogenous variable. Testing the optimal lag length is very useful for eliminating auto correlation problems.

4. VECM Test

The definition of VECM according to Luetkepohl (2011) is a VAR model that explicitly includes a cointegration structure in the variables being estimated. VECM is also a VAR model that has stationary and cointegration conditions. VECM is carried out because the data is not stationary but is cointegrated (stationary at the first difference level). VECM is able to see the long-term relationship of endogenous variables so that they converge into a cointegration relationship, but still allows the existence of short-term dynamics. The following is the general equation of the VECM Test:

$$\Delta PPP_t = \beta_0 ECT + \sum_{i=1}^{p-1} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{p-1} \beta_{2i} \Delta INF_{t-i} + \sum_{i=1}^{p-1} \beta_{3i} \Delta ER_{t-i} + \varepsilon_t$$

Where p is the optimum lag number and ECT is the Error Correction Term. If the coefficient β_0 of ECT is negative and significant at the same time then adjustments can

be found to achieve balance and can suppress causality in the long term. β1iΔGDPt-i is the total GDP of the country's population, β2iΔINFt-i is the amount of inflation of the country's population and β3iΔERt-i is the total exchange rate of the country's population.

5. Impulse Response Function

VECM is a method that will determine the dynamic structure of a model itself. After the VECM test has been carried out, it is necessary to have a method that can clearly characterize the dynamic structure of the VECM. This method is called Impulse Response Function (IRF) which is used to identify a shock to an endogenous variable so that it can determine how an unexpected change in a variable affects other variables. IRF is used to see the contemporary influence of a dependent variable if there is a shock to the independent variable of one standard deviation.

6. Variance Decomposition

After analyzing the behavior of shocks through the impulse response function, the next stage is to predict the contribution of each variable studied to shocks or changes in certain variables by looking at the model through variance decomposition. Based on Boonyanam (2014) variance decomposition shows the fraction of the h-step ahead forecast error in $y_{i,t}$ attributed to its own innovation ($\varepsilon_{i,t}$) and innovation in other variables ($\varepsilon_{j,t}$), which implies the relative importance of each innovation in influencing variable forecasting errors in VECM.

7. Multicollinearity Test

The multicollinearity test is a regression model testing tool to find correlations between independent variables. A good regression model should have no correlation between independent variables. The multicollinearity test can be carried out using a regression test, with the VIF (Variance Inflation Factor) benchmark value and tolerance value. The criteria used are (a) if the VIF value is around 1-10, then it is said that there is no multicollinearity problem and (b) if the tolerance value is more than 0.10 then it is said that there is no multicollinearity problem.

8. Normality test

This test aims to determine whether in the short term and long term the residuals are normally distributed or not using Jarque-Bera, where the results are greater than the specified significance level so the data is normally distributed.

RESULTS AND DISCUSSION

1. Stationarity Test

Table 1. Stationarity Test

Country	Variable	Level			1st Difference			2nd Difference		
		t-statistic	critical value	Prob*.	t-statistic	critical value	Prob*.	t-statistic	critical value	Prob*.
Australia	PPP	0.225	-1.951	0.745	-6.108	-1.951	0.000	-	-	-
	GDP	-1.598	-1.951	0.1023	-4.822	-1.951	0.000	-	-	-
	Inflation	-1.322	-1.952	0.168	-2.407	-1.952	0.017	-	-	-
	Exchange Rate	1.235	-1.950	0.941	-4.500	-1.951	0.000	-	-	-
Brazil	PPP	1.629	-1.951	0.972	-7.979	-1.951	0.000	-	-	-
	GDP	-2.676	-1.951	0.009	-	-	-	-	-	-
	Inflation	-0.794	-1.952	0.363	-5.302	-1.951	0.000	-	-	-
	Exchange Rate	-0.419	-1.951	0.524	-3.732	-1.951	0.005	-	-	-

Country	Variable	Level			1st Difference			2nd Difference		
		t-statistic	critical value	Prob*.	t-statistic	critical value	Prob*.	t-statistic	critical value	Prob*.
Canada	PPP	0.900	-1.953	0.896	-1.140	-1.953	0.224	0.714	-1.955	0.086
	GDP	-2.351	-1.951	0.020	-	-	-	-	-	-
	Inflation	-0.857	-1.953	0.335	-6.189	-1.952	0.000	-	-	-
	Exchange Rate	0.899	-1.951	0.897	-8.373	-1.951	0.000	-	-	-
China	PPP	0.511	-1.952	0.820	-0.894	-1.952	0.320	-6.124	-1.952	0.000
	GDP	-1.420	-1.952	0.142	-2.438	-1.951	0.016	-	-	-
	Inflation	-0.966	-1.953	0.289	-3.091	-1.952	0.003	-	-	-
	Exchange Rate	-0.079	-1.950	0.649	-6.177	-1.951	0.000	-	-	-
Norway	PPP	0.840	-1.951	0.887	-2.81	-1.951	0.006	-	-	-
	GDP	-2.774	-1.951	0.007	-	-	-	-	-	-
	Inflation	-1.532	-1.952	0.115	-7.623	-1.951	0.000	-	-	-
	Exchange Rate	0.500	-1.950	0.818	-3.970	-1.951	0.002	-	-	-
Singapura	PPP	-0.669	-1.952	0.418	-1.633	-1.951	0.095	-8.775	-1.951	0.000
	GDP	-3.198	-1.951	0.002	-	-	-	-	-	-
	Inflasi	-1.416	-1.952	0.142	-1.173	-1.952	0.214	-4.521	-1.953	0.001
	Inflation	-1.294	-1.950	0.176	-5.370	-1.951	0.000	-	-	-
South Africa	Exchange Rate	3.438	-1.951	0.999	-0.101	-1.951	0.640	-6.344	-1.951	0.000
	GDP	-3.198	-1.951	0.002	-	-	-	-	-	-
	Inflation	-0.386	-1.952	0.536	-3.276	-1.952	0.001	-	-	-
	Exchange Rate	1.673	-1.950	0.974	-4.719	-1.951	0.000	-	-	-
Sweden	PPP	-1.137	-1.951	0.227	-3.809	-1.951	0.004	-	-	-
	GDP	-3.847	-1.951	0.003	-	-	-	-	-	-
	Inflation	-0.835	-1.951	0.346	-3.603	-1.951	0.007	-	-	-
	Exchange Rate	0.930	-1.950	0.902	-4.675	-1.951	0.000	-	-	-
Thaiand	PPP	-1.000	-1.952	0.277	-1.309	-1.951	0.171	-8.830	-1.951	0.000
	GDP	-1.251	-1.951	0.189	-2.627	-1.952	0.010	-	-	-
	Inflation	-1.695	-1.952	0.084	-2.029	-1.952	0.042	-	-	-
	Exchange Rate	-1.683	-1.950	0.086	-5.481	-1.951	0.000	-	-	-
UAE	PPP	0.812	-1.952	0.882	-2.869	-1.952	0.005	-	-	-
	GDP	-1.482	-1.951	0.127	-4.097	-1.951	0.002	-	-	-
	Inflation	-1.498	-1.952	0.123	-5.323	-1.952	0.000	-	-	-
	Exchange Rate	-0.079	-1.950	0.649	-6.177	-1.951	0.000	-	-	-

The results of the Augmented Dickey-Fuller (ADF) stationarity test in table 1 above show ten countries consisting of Australia, Brazil, Canada, China, Norway, Singapore, South Africa, Sweden, Thailand and the United Arab Emirates. The results show that the PPP, GDP, inflation and exchange rate variables have a unit root which is indicated by a probability value of more than 5% ($p > 0.05$), or the ADF t-statistic value is smaller than the McKinnon critical value at the 5% level. To obtain stationary results, level, first difference and second difference tests were carried out, where ten

countries showed different results. Countries with first difference level unit root tests consist of Australia, Brazil, Norway, Sweden and the UAE. Meanwhile, countries with second difference level unit root tests consist of Canada, China, Singapore, South Africa and Thailand.

2. Cointegration Test

Table 2. Cointegration Test

Country	Information	F-Statistik	Prob
Australia	GDP does not Granger Cause PPP	3.148	0.033
	PPP does not Granger Cause Kurs	7.279	0.006
Brazil	PPP does not Granger Cause GDP	3.072	0.036
	GDP does not Granger Cause PPP	2.729	0.054
	PPP does not Granger Cause Inflation	2.915	0.043
	Inflaton does not Granger Cause PPP	7.152	0.007
	PPP does not Granger Cause Exchange Rate	4.012	0.013
	Exchange Rate does not Granger Cause PPP	5.387	0.003
Canada	GDP does not Granger Cause Inflation	8.763	0.002
	PPP does not Granger Cause GDP	2.872	0.045
China	PPP does not Granger Cause GDP	5.508	0.002
	GDP does not Granger Cause PPP	5.831	0.002
	PPP does not Granger Cause Inflation	6.982	0.008
Norway	Exchange Rate does not Granger Cause Inflation	5.072	0.004
	Inflation does not Granger Cause Exchange Rate	3.103	0.035
	Exchange Rate does not Granger Cause PPP	4.232	0.010
Singapura	PPP does not Granger Cause Inflation	6.024	0.001
	Inflation doesnot Granger Cause PPP	3.560	0.021
South Africa	GDP does not Granger Cause PPP	4.969	0.004
	Exchange Rate does not Granger Cause Inflation	2.826	0.048
	PPP does not Granger Cause Exchange Rate	3.296	0.028
	Exchange Rate does not Granger Cause PPP	3.175	0.032
Thailand	Inflation does not Granger Cause GDP	4.881	0.005
	PPP does not Granger Cause GDP	7.073	0.007
	PPP does not Granger Cause Inflation	5.216	0.003
	Inflation does not Granger Cause PPP	3.439	0.024
UAE	PPP does not Granger Cause Inflation	5.307	0.003

Variables can be said to be cointegrated if they have a long-term or short-term relationship with a probability value below 5% ($p < 0.05$). The results of the integration test shown in table 2 above show that in Australia, the GDP variable influences PPP by 0.033 and the PPP variable influences the exchange rate by 0.006. Furthermore, in Brazil, the PPP variable affects GDP by 0.036, the GDP variable affects PPP by 0.054, the PPP variable affects inflation by 0.043, the inflation variable affects PPP by 0.007, the PPP variable affects the exchange rate by 0.013 and the exchange rate variable affects PPP by 0.003. For Canada, the GDP variable affects inflation by 0.002 and the PPP variable affects GDP by 0.045. In China, the PPP variable affects GDP by 0.002, the GDP variable affects PPP by 0.002 and the PPP variable affects inflation by 0.008. Then in Norway, the exchange rate variable affects inflation by 0.004, the inflation variable affects the exchange rate by 0.035 and the exchange rate variable affects PPP

by 0.010. In Singapore, the PPP variable affects inflation by 0.001 and the inflation variable affects PPP by 0.021. Next, South Africa, the GDP variable affects PPP by 0.004, the exchange rate variable affects inflation by 0.048, the PPP variable affects the exchange rate by 0.028 and the exchange rate variable affects PPP by 0.032. Then in Thailand, the inflation variable affects GDP by 0.005, the PPP variable affects GDP by 0.007, the PPP variable affects inflation by 0.003 and the inflation variable affects PPP by 0.024. Finally, in the UAE, the PPP variable influences inflation by 0.003.

3. Lag Test

Table 3. Lag Test

Country	Lag	LogL	LR	FPE	AIC	SC	HQ
Australia	0	-436.118	NA	25223883	28.39472	28.57975*	28.45504
	1	-425.888	17.15999	37015147	28.76698	29.69213	29.06856
	2	-392.913	46.80389	13112110	27.67179	29.33706	28.21463
	3	-362.744	35.03434*	6117217	26.75769	29.16309	27.54179
	4	-339.789	20.734	5383885.*	26.30895*	29.45447	27.33431*
Brazil	0	-432.210	NA	19601908	28.14256	28.32759*	28.20287
	1	-414.581	29.57023	17847189	28.03750	28.96265	28.33907
	2	-377.806	52.19754*	4947533.*	26.69714	28.36242	27.23998*
	3	-361.612	18.80523	5686400	26.68466	29.09006	27.46876
	4	-344.578	15.38603	7332952	26.61792*	29.76344	27.64328
Canada	0	-475.855	NA	3.27E+08	30.95837	31.14340*	31.01869
	1	-463.163	21.28927	4.10E+08	31.17181	32.09697	31.47339
	2	-421.853	58.63368	84830271	29.53890	31.20418	30.08174
	3	-399.181	26.32901*	64190353	29.10844	31.51384	29.89254
	4	-373.439	23.25072	47199826*	28.47993*	31.62545	29.50529*
China	0	159.3841	NA	5.21E-10	-10.02480	-9.83975	-9.96446
	1	190.8019	52.70092	1.95E-10	-11.01950	-10.09430	-10.71790
	2	219.8915	41.28847	8.86E-11	-11.86400	-10.19870	-11.32110
	3	251.5776	36.79677*	3.75e-11*	-12.87600	-10.47058*	-12.09188*
	4	269.6704	16.34183	4.52E-11	-13.01099*	-9.86547	-11.98560
Norway	0	-250.402	NA	157.8456	16.41304	16.59807*	16.47335
	1	-233.439	28.45486	150.0149	16.35088	17.27603	16.65245
	2	-204.726	40.75397	69.96116	15.53068	17.19596	16.07352
	3	-180.195	28.48672*	46.95869*	14.98034	17.38574	15.76444*
	4	-163.851	14.76256	63.3138	14.95813*	18.10365	15.98349
Singapura	0	114.6084	NA	9.35E-09	-7.13603	-6.95100	-7.07571
	1	139.2782	41.38159	5.41E-09	-7.69537	-6.77021	-7.39379
	2	172.2937	46.86078	1.91E-09	-8.79315	-7.127869*	-8.25031
	3	195.0276	26.40064*	1.44E-09	-9.22759	-6.82219	-8.44349
	4	216.227	19.14785	1.42e-09*	-9.563034*	-6.41751	-8.537673*
South Africa	0	-9.76461	NA	2.86E-05	8.88E-01	1.07307	0.948355
	1	21.70113	52.78124	1.07E-05	-1.10E-01	0.815403*	0.191827

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Country	Lag	LogL	LR	FPE	AIC	SC	HQ
	2	38.62556	24.02177	1.06E-05	-1.69E-01	1.495885	0.373447
	3	71.49319	38.16887*	4.17e-06*	-1.26E+00	1.147773	-0.473526*
	4	89.17866	15.97397	5.15E-06	-1.366365*	1.779155	-0.34100
Sweden	0	-417.201	NA	7443345	27.17425	27.35928*	27.23456
	1	-395.039	37.17491	5058406	26.77670	27.70186	27.07828
	2	-372.295	32.28120*	3467322.*	26.34163	28.00691	26.88447*
	3	-359.108	15.31461	4837965	26.52308	28.92848	27.30718
	4	-339.992	17.26605	5454866	26.32205*	29.46757	27.34741
Thailand	0	-54.8897	NA	0.000525	3.799337	3.984367*	3.859652
	1	-40.9271	23.42123	0.000606	3.93E+00	4.855931	4.232355
	2	-6.14196	49.37241	0.000191	2.72E+00	4.384111	3.261674
	3	26.07977	37.41878*	7.80E-05	1.67E+00	4.077671	2.456373
	4	49.58135	21.22724	6.63e-05*	1.188300*	4.33382	2.213661*
UAE	0	62.21456	NA	2.75E-07	-3.76E+00	-3.570747*	-3.69546
	1	85.00926	38.23627	1.79E-07	-4.19E+00	-3.26899	-3.89257
	2	111.7074	37.89413	9.52e-08*	-4.88E+00	-3.21907	-4.341510*
	3	120.3081	9.987953	1.79E-07	-4.41E+00	-2.00158	-3.62288
	4	150.4903	27.26135*	9.86E-08	-5.321957*	-2.17644	-4.29660

Table 3 above shows the lag structure for the VECM model. The results obtained show that most of the selection criteria such as the LR test, Akaike Information Criteria (AIC), SC and Hanna-Quinn select the optimum lag 4 at a significance level of 5% and the one with the most asterisks. This was proven in the 10 countries above where the lag order selection criteria test was carried out.

4. 4.4 VECM Test
Table 4 VECM Test

Country	Response	GDP	INFLATION	EXCHANGE RATE
Australia	Short Term	0.234	0.726	-5.725
	Long Term	-3.005	-0.558	5.382
Brazil	Short Term	-2.041	-1.554	0.757
	Long Term	1.115	5.224	-3.053
Canada	Short Term	0.523	-3.451	-1.558
	Long Term	0.952	3.276	3.784
China	Short Term	-0.297	-3.266	2.111
	Long Term	-1.737	-1.427	-3.884
Norway	Short Term	-1.442	1.831	2.99
	Long Term	-2.278	-5.58	-4.084
Singapore	Short Term	-2.506	-2.19	-2.016
	Long Term	3.259	4.14	-0.589
South Africa	Short Term	-0.093	-0.687	-1.83
	Long Term	4.917	4.046	-2.32
Sweden	Short Term	-1.981	0.649	-2.058
	Long Term	4.896	1.815	1.438

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Country	Response	GDP	INFLATION	EXCHANGE RATE
Thailand	Short Term	2.277	-0.917	5.055
	Long Term	-3.902	-2.573	-3.952
UAE	Short Term	0.799	-0.799	2.806
	Long Term	-0.927	-9.095	-1.843

Table 4 above shows the results of the long-term and short-term effects for ten countries. In Australia, the GDP variable has a positive influence on the short term and a negative influence on the long term. This reflects that an increase in the GDP variable by 1% will have an effect on PPP of 0.234 in the short term and -3.005 in the long term. Inflation has a positive influence on PPP in the short term, while it has a negative influence in the long term. This reflects that an increase in inflation of 1% will have an effect on PPP of 0.726 in the short term and -0.558 in the long term. The exchange rate has a negative effect in the short term, while in the long term it has a positive effect. This reflects that an increase in the exchange rate of 1% will have an effect on PPP of -5,725 in the short term and 5,382 in the long term. Likewise for 9 countries based on the table above.

5. IRF Test

Table 5. IRF Test (Response of GDP)

Country	Response of D(GDP):				
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	0.336925	0.000000	0.000000	0.000000
	18	0.164716	0.020443	-0.013841	0.038241
	36	0.152513	0.018311	-0.016362	0.085369
Brazil	1	0.745398	0.000000	0.000000	0.000000
	18	0.383721	-0.174320	0.036508	0.007015
	36	0.397065	-0.171891	0.015993	-0.031799
Canada	1	0.840402	0.000000	0.000000	0.000000
	18	0.399076	0.054169	0.108535	-0.100144
	36	0.397050	0.098122	0.022716	-0.114278
China	1	0.385794	0.000000	0.000000	0.000000
	18	0.940118	1.556499	0.687211	2.155758
	36	3.041760	5.866806	2.592466	7.941380
Norway	1	0.371372	0.000000	0.000000	0.000000
	18	0.162100	0.006102	-0.071408	-0.001614
	36	0.177673	0.033520	-0.074553	0.014778
Singapore	1	1.032641	0.000000	0.000000	0.000000
	18	0.444061	-0.0539	0.043472	0.200558
	36	0.442384	0.278086	-0.01768	0.235922
South Africa	1	1.239312	0.000000	0.000000	0.000000
	18	0.400649	-0.373180	0.075703	0.093590
	36	0.546377	-0.458520	0.129629	0.000828
Sweden	1	1.025784	0.000000	0.000000	0.000000
	18	0.331720	-0.276179	-0.044442	0.245150
	36	0.262318	-0.211799	-0.057727	0.180399
Thailand	1	0.757469	0.000000	0.000000	0.000000

Country	Response of D(GDP):				
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	18	0.308009	-0.351860	-0.061450	0.440268
	36	0.331575	0.076760	0.107463	0.167111
UAE	1	1.421764	0.000000	0.000000	0.000000
	18	1.023204	0.140563	-0.047690	-0.194110
	36	1.088913	0.167236	0.024355	-0.126480

The results of table 5 of the IRF test (GDP response) to the inflation, exchange rate and PPP variables in Australia and Brazil started to experience shocks in the second period, then in the middle of the period they experienced a decline and continued to decline until the end of the period. For China, South Africa, Sweden, Norway and Thailand, shocks began to occur in the second period, then in the middle of the period they experienced an increase and continued to increase until the end of the period. In Singapore, shocks began to occur in the second period, then in the middle of the period until the end of the period there were fluctuations. Meanwhile, the UAE and Canada began to experience shocks in the second period, then tended to be stable until the end of the period.

Table 6. IRF Test (Response of Inflation)

Country	Response of D(INFLATION):				
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	0.022125	0.446033	0.000000	0.000000
	18	-0.304398	0.210271	-0.104517	0.253566
	36	0.107080	0.179735	0.055253	0.020123
Brazil	1	-0.272883	0.224807	0.000000	0.000000
	18	0.001654	-0.022399	0.031865	0.009241
	36	-0.043763	0.012040	0.023850	-0.009341
Canada	1	-0.065421	0.203075	0.000000	0.000000
	18	-0.191784	0.016963	-0.197249	0.010126
	36	0.036133	0.082350	-0.101388	-0.020232
China	1	-0.042686	0.324576	0.000000	0.000000
	18	0.370197	0.390454	0.386748	0.402284
	36	0.879811	1.320748	0.683903	1.680708
Norway	1	0.220977	1,678,011	0.000000	0.000000
	18	-0.133504	0.802163	-0.200009	-0.049164
	36	0.089499	0.321755	-0.236419	-0.010618
Singapore	1	0.233957	0.419049	0.000000	0.000000
	18	0.057221	0.281973	-0.02649	0.115755
	36	-0.017236	0.188115	-0.08130	-0.01970
South Africa	1	-0.203200	0.195883	0.000000	0.000000
	18	-0.176640	0.037066	0.005550	-0.04930
	36	-0.106805	0.149059	-0.009130	-0.02495
Sweden	1	0.018806	0.140809	0.000000	0.000000
	18	0.045632	0.112267	-0.002761	-0.050115
	36	0.022179	0.119575	0.005127	-0.048753
Thailand	1	0.440962	0.312322	0.000000	0.000000

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| Country | Response of D(INFLATION): | | | | |
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	18	0.218189	0.124746	-0.015610	0.044786
	36	0.117078	0.114653	0.022177	0.008077
UAE	1	0.621862	2.261558	0.000000	0.000000
	18	-0.454735	-0.017640	-0.544150	-0.366970
	36	-1.001548	0.286840	0.007474	0.125563

The results of table 6 of the IRF test (inflation response) on the GDP, exchange rate and PPP variables in Australia, Brazil, Singapore and Thailand started to experience shocks in the first period, then in the middle of the period they experienced a decline and continued to decline until the end of the period. For China, shocks began to occur in the first period, then in the middle of the period it increased and continued to increase until the end of the period. In Canada, Norway, South Africa, Sweden and the UAE, shocks began to occur in the first period, then in the middle of the period until the end of the period there were fluctuations.

Table 7. IRF Test (Response of Exchange Rate)

| Country | Response of D(EXCHANGE RATE): | | | | |
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	303.6469	364.4130	628.2220	0.000000
	18	-353.5100	67.83982	89.83176	0.781041
	36	-527.6892	73.44270	-32.53752	28.35953
Brazil	1	-130.0952	-11.35090	648.9173	0.000000
	18	27.94410	1.020979	107.8269	-193.9470
	36	70.83891	-62.94432	127.4042	-160.8138
Canada	1	-551.5897	-407.9479	3403.007	0.000000
	18	-805.0404	-550.3663	690.2792	302.3740
	36	-414.6386	-323.1603	792.5975	-542.6513
China	1	0.001636	-0.000195	0.002660	0.000000
	18	0.002284	0.004940	0.002182	0.006528
	36	0.008843	0.018295	0.008330	0.024440
Norway	1	-50.45745	11.54227	148.7342	0.000000
	18	-36.21599	-44.25505	28.07709	-30.21820
	36	-51.47545	-42.54217	2.667281	-54.31258
Singapore	1	0.009523	-0.000604	0.015549	0.000000
	18	0.004660	0.011799	0.003309	0.005235
	36	0.004390	0.010761	0.003069	0.003974
South Africa	1	-0.218939	0.165672	0.373083	0.000000
	18	-0.099122	-0.043957	0.128364	-0.063989
	36	-0.131701	0.096768	0.098886	-0.032178
Sweden	1	-155.9354	109.0317	196.0308	0.000000
	18	-69.29961	51.64512	50.45556	-36.80698
	36	-103.2392	49.38670	37.24437	-55.25284
Thailand	1	0.102893	0.104085	0.485399	0.000000
	18	0.030296	-0.178924	0.065281	0.032136

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Country		Response of D(EXCHANGE RATE):			
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	36	0.093733	-0.092468	0.073549	0.015929
UAE	1	0.000825	-0.002443	0.001119	0.00E+00
	18	0.000426	-0.001961	0.000317	0.000484
	36	0.000739	-0.001581	0.000315	0.000370

The results of table 7 of the IRF test (exchange rate response) on the GDP, inflation and PPP variables in Thailand and the UAE started to experience shocks in the first period, then in the middle of the period they experienced a decline and continued to decline until the end of the period. For Australia, Brazil and China, shocks began to occur in the first period, then in the middle of the period they increased and continued to increase until the end of the period. In Canada, Norway, Singapore, South Africa and Sweden, shocks began to occur in the first period, then in the middle of the period until the end of the period they experienced fluctuations.

Table 8. IRF Test (Response of PPP)

Country		Response of D(PPP):			
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	-0.681927	1.075090	-2.302069	4.818832
	18	1.371641	1.247530	-0.528144	1.183397
	36	1.238122	1.427903	-0.679969	4.178868
Brazil	1	-4.872959	2.464131	-0.587482	4.798522
	18	-3.479496	1.622114	0.650661	7.423119
	36	-3.833024	2.180027	0.442772	6.896748
Canada	1	-1.119984	-0.753548	-1.940556	4.413327
	18	0.599094	-1.187967	-0.687647	2.958306
	36	-0.196525	-0.799140	-0.185717	0.965711
China	1	-0.006749	0.009685	0.002263	0.006322
	18	0.010007	0.018738	0.012907	0.022571
	36	0.027862	0.058717	0.028541	0.076135
Norway	1	0.029920	-0.040632	0.012514	0.035327
	18	0.023519	-0.022773	0.009756	0.025120
	36	0.018543	-0.016139	0.013955	0.023942
Singapore	1	0.001901	0.002413	-5.11E-05	0.001036
	18	0.001409	0.002443	-0.000475	0.001336
	36	0.001174	0.002481	-0.00092	0.000618
South Africa	1	-0.004352	0.010014	-0.000505	0.003801
	18	-0.010596	-0.005909	4.99E-03	5.69E-05
	36	-0.010087	-0.002974	0.001047	-0.001599
Sweden	1	18.14835	-24.49080	1.840775	33.51987
	18	5.700061	-17.43930	2.881504	22.79396
	36	4.150829	-15.02072	3.656011	21.81082
Thailand	1	0.033968	0.012309	-0.003791	0.011896
	18	0.008482	0.003281	-0.001405	0.010246
	36	0.006151	-0.000513	0.000304	0.009523
UAE	1	0.012475	0.028742	0.002177	0.012613

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Country	Response of D(PPP):				
	Period	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	18	0.007652	0.023184	-0.001394	0.000252
	36	0.007111	0.018809	0.002692	0.003119

The results of table 8 of the IRF test (exchange rate response) on the GDP, inflation and PPP variables in Canada, Norway, South Africa, Thailand and the UAE began to experience shocks in the first period, then in the middle of the period they experienced a decline and continued to decline until the end of the period. For China, shocks began to occur in the first period, then in the middle of the period it increased and continued to increase until the end of the period. In Australia, Brazil and Sweden, shocks began to occur in the first period, then in the middle of the period until the end of the period they experienced fluctuations. Meanwhile, Singapore started experiencing shocks in the first period, then until the end of the period it tended to be stable.

Before the Australian dollar floated in 1983, the exchange rate policy had undergone several changes from pegging the Australian dollar to the Pound Sterling, pegging it to the US dollar in 1971 and then pegging it to the Trade Weighted Index (TWI) in 1974. Implications of a fixed exchange rate on the economy Australia means that the inflation rate pegged to the exchange rate has a direct influence on the local economy. However, in a floating exchange rate regime, inflation is directly influenced by changes in the exchange rate. This suggests that different exchange rate regimes will have different effects on changes in the price level and possibly PPP (Loh, 2008). Meanwhile, Brazil and South Africa, which are part of BRICS (Brazil, Russia, India, China and South Africa), implement monetary policies to maintain the value of their national currencies by developing foreign trade strategies based on PPP and by deciding the optimal level of currency. foreign money (Guris & Tirasoglu, 2017). PPP validity refers to the fact that the real exchange rate is permanent in the long run by having an average reversion.

The Engle-Granger cointegration method allows divergence from equilibrium. Under absolute PPP, the exchange rate is equal to the ratio of domestic prices to foreign prices of a given aggregate basket of commodities, but this implies that the real exchange rate is constant. The relative stability of the estimated PPP exchange rate is caused by three main factors, namely (a) as a result of existing monetary policy in Canada, (b) most goods and services are not traded therefore their prices are not directly influenced by the exchange rate and (c) the extent to which the company passes exchange rate movements into the domestic prices of traded goods, often not very large because it is expensive to adjust prices in response to short-term exchange rate fluctuations (Zyoud, 2015).

During the current pandemic, the Chinese Central Bank will maintain a flexible and appropriate monetary policy to maintain stability as the pandemic continues and the domestic economic recovery is uneven. This is done by maintaining sufficient liquidity and increasing support for technological innovation, small companies and the manufacturing sector. The Central Bank of Singapore maintains its forecast of GDP growing 3-5%. The Singapore monetary authority said it would remain alert to developments in the external environment and their impact on the Singapore economy. Apart from that, another monetary policy carried out by Singapore is to maintain its currency in line with the currencies of other major trading partners, thereby ensuring that price stability in the medium term will be maintained.

The Swedish government also predicts that they will experience a GDP contraction of 4.6%, and inflation will be within touching distance of the 2% target caused by massive fiscal and monetary stimulus. When many European countries were forced to reimpose regional quarantines or social distancing regulations due to the pandemic, the Swedish government's attention shifted to finding ways to revive the economy by increasing employment opportunities that could improve the welfare of the population. The Central Bank of Thailand will continue to support the economy as it has left the main interest rate at a record low of 0.05%. The Thai monetary authority predicts that GDP will continue to rise in the tourism sector because the pandemic has begun to recover.

6. Variance Decomposition Test

The variance decomposition test is used to show the proportion of a variable itself or other variables. In other words, this test is carried out to find out how big the variance is before and after a shock from another variable in order to see the relative influence of the variable on other variables.

Table 9. Variance Decomposition Test (GDP)

Country	Variance Decomposition of D(GDP):				
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	0.336925	100.0000	0.000000	0.000000	0.000000
	18	0.875480	79.98453	2.260228	1.413161	16.34209
	36	1.142004	79.70090	2.053372	1.290461	16.95527
Brazil	1	0.745398	100.0000	0.000000	0.000000	0.000000
	18	2.395507	67.96305	21.11636	5.998372	4.922217
	36	3.007666	73.83085	18.99824	3.875482	3.295423
Canada	1	0.840402	100.0000	0.000000	0.000000	0.000000
	18	2.424151	84.54338	2.291278	6.917034	6.248306
	36	3.142499	85.99779	2.564216	5.921703	5.516293
China	1	1.421764	100.0000	0.000000	0.000000	0.000000
	18	5.060654	96.28536	1.743045	0.419923	1.551669
	36	6.985544	96.58646	1.638761	0.240064	1.534719
Norway	1	0.371372	100.0000	0.000000	0.000000	0.000000
	18	1.107414	72.77914	10.73011	10.86412	5.626630
	36	1.426100	76.89221	7.446577	10.87314	4.788078
Singapore	1	1.032641	100.0000	0.000000	0.000000	0.000000
	18	3.190538	49.35432	34.01333	7.189169	9.443184
	36	3.854827	54.69689	28.26342	5.295447	11.74425
South Africa	1	1.239312	100.0000	0.000000	0.000000	0.000000
	18	3.67422	72.5019	20.26548	6.176723	1.055901
	36	4.77594	72.50851	22.20147	4.370985	0.919037
Sweden	1	1.025784	100.0000	0.000000	0.000000	0.000000
	18	2.144705	61.13462	19.98354	6.638277	12.24357
	36	2.522852	55.39987	24.15295	5.966015	14.48116
Thailand	1	0.757469	100.0000	0.000000	0.000000	0.000000
	18	3.032681	58.18179	18.39577	6.116171	17.30627

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Country	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
				Variance Decomposition of D(GDP):		
	36	3.496926	59.08246	16.75787	6.224846	17.93483
UAE	1	1.421764	100.0000	0.000000	0.000000	0.000000
	18	5.060654	96.28536	1.743045	0.419923	1.551669
	36	6.985544	96.58646	1.638761	0.240064	1.534719

From the results of the variance decomposition test in table 9 above, it can be seen that the GDP variance in the 10 countries was influenced by GDP itself in the first period by 100%. Meanwhile, in the middle of the period, inflation was influenced by other variables with the lowest value being 2.2% in Australia and the highest value being 34% in Singapore. Furthermore, it is influenced by the exchange rate variable with the lowest value of 0.24% in China, and the largest value of 10.87% in Norway. Finally, it is influenced by the PPP variable with the lowest value of 0.91% in South Africa and the highest value of 16% in Australia.

Table 10. Variance Decomposition Test (Inflation)

Country	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
				Variance Decomposition of D(INFLATION):		
Australia	1	0.446581	0.245445	99.75456	0.000000	0.000000
	18	1.613714	3.525062	35.92883	5.134445	23.68611
	36	1.944447	33.20518	37.35437	5.154565	24.28588
Brazil	1	0.353558	59.57042	40.42958	0.000000	0.000000
	18	0.694754	41.83080	34.37529	12.34193	11.45198
	36	0.732008	44.23308	32.07054	12.98926	10.70711
Canada	1	0.213353	9.402415	90.59759	0.000000	0.000000
	18	1.669201	62.75858	4.602864	24.05694	8.581617
	36	1.919950	53.91659	5.185567	30.90976	9.988083
China	1	2.345498	7.029399	92.9706	0.000000	0.000000
	18	7.803746	48.28658	42.88021	2.907777	5.925437
	36	8.670812	51.90996	39.56345	2.908885	5.617708
Norway	1	1.692499	1.704661	98.29534	0.000000	0.000000
	18	3.829047	9.114761	72.76904	11.11222	7.003980
	36	4.376373	9.575700	70.42636	13.83420	6.163732
Singapore	1	0.479935	23.76334	76.23666	0.000000	0.000000
	18	1.492536	7.320444	71.71033	11.05237	9.916859
	36	1.742032	6.017000	74.42316	10.75106	8.808782
South Africa	1	0.282241	51.83284	48.16716	0.000000	0.000000
	18	0.917118	44.06805	44.33803	8.421168	3.172751
	36	1.189600	43.81331	47.51217	5.520295	3.154223
Sweden	1	0.142059	1.752510	98.24749	0.000000	0.000000
	18	0.703098	9.099620	71.86815	1.591709	17.44052
	36	0.944260	6.468969	74.68371	0.980316	17.86700
Thailand	1	0.540364	66.59341	33.40659	0.000000	0.000000
	18	1.375202	56.62009	35.89603	2.50222	4.981656

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Country	Variance Decomposition of D(INFLATION):				
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	36	1.619174	54.13836	39.46673	2.339278	4.055634
UAE	1	2.345498	7.029399	92.97060	0.000000	0.000000
	18	7.803746	48.28658	42.88021	2.907777	5.925437
	36	8.670812	51.90996	39.56345	2.908885	5.617708

From the results of the variance decomposition test in table 10 above, it can be seen that the inflation variance was influenced by inflation itself in the first period with a range of values below 50% for the countries Brazil, South Africa and Thailand. For the range of inflation values above 50%, these are Australia, Canada, China, Norway, Singapore, Sweden and the UAE. Meanwhile, in the middle of the period, it is influenced by other variables, namely GDP, exchange rate and PPP, with the lowest value of GDP being 0.24% in Australia and the highest value being 62% in Canada. Furthermore, it is influenced by the exchange rate variable with the lowest value being 0.98% in Sweden, and the highest value being 30% in Canada. Finally, it is influenced by the PPP variable with the lowest value of 3% in South Africa and the highest value of 24% in Australia.

Table 11. Variance Decomposition Test (EXCHANGE RATE)

Country	Variance Decomposition of D(EXCHANGE RATE):				
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	787.1856	14.87933	21.43055	63.69011	0.000000
	18	3073.462	58.86113	6.265454	8.493352	26.38007
	36	3764.486	69.58032	5.186821	6.048866	19.18399
Brazil	1	671.4929	3.753530	2.857445	93.38903	0.000000
	18	1525.017	24.04990	13.07333	31.17585	31.70092
	36	1803.114	19.84115	11.27394	31.18364	37.70126
Canada	1	3471.473	2.524670	1.380962	96.09437	0.000000
	18	6852.728	18.02441	7.174437	62.36043	12.44073
	36	8147.181	19.89561	8.429665	60.12042	11.55431
China	1	0.002811	8.60698	75.54460	15.848420	0.000000
	18	0.008422	19.38069	68.33015	5.942690	6.346463
	36	0.011292	15.97540	72.99914	5.076929	5.948532
Norway	1	157.4834	10.26552	0.537171	89.19731	0.000000
	18	516.7568	27.10780	28.31813	11.78639	32.78768
	36	633.8827	27.41520	27.45151	8.070974	37.06232
Singapore	1	0.018243	27.24582	0.109574	72.64460	0.000000
	18	0.059753	14.30915	60.09281	15.16238	10.43566
	36	0.079869	13.21892	64.85910	11.31883	10.60315
South Africa	1	0.463220	22.33940	12.79163	64.86898	0.000000
	18	0.982853	34.97318	24.05245	37.77396	3.20041
	36	1.181304	39.01698	21.68614	35.57139	3.725482
Sweden	1	273.1883	32.58108	15.92874	51.49018	0.000000
	18	787.9160	56.94741	12.56899	9.892451	20.59115

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Country	Variance Decomposition of D(EXCHANGE RATE):				
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	36	1025.926	59.05531	11.94597	7.748960	21.24976
Thailand	1	0.506984	4.11890	4.214869	91.66623	0.000000
	18	1.193314	30.55004	35.17959	27.81163	6.458748
	36	1.403007	32.22503	38.22735	24.35064	5.196980
UAE	1	0.002811	8.60698	75.54460	15.84842	0.000000
	18	0.008422	19.38069	68.33015	5.94269	6.346463
	36	0.011292	15.9754	72.99914	5.076929	5.948532

From the results of the variance decomposition test in table 11 above, it can be seen that the exchange rate variance was influenced by the exchange rate itself in the first period with a range of values below 50% for China and the UAE. For the range of inflation values above 50%, the countries are Australia, Brazil, Canada, Norway, Singapore, South Africa, Sweden and Thailand. Meanwhile, in the middle of the period, it is influenced by other variables, namely GDP, inflation and PPP, with the lowest value of GDP being 14% in Singapore and the highest value being 69% in Australia. Furthermore, it is influenced by the inflation variable with the lowest value of 0.19% in Singapore, and the highest value of 72% in the UAE. Finally, it is influenced by the PPP variable with the lowest value of 3.2% in South Africa and the highest value of 37% in Norway.

Table 12. Variance Decomposition Test (PPP)

Country	Variance Decomposition of D(PPP):				
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
Australia	1	5.490128	1.542802	3.834638	17.58215	77.04041
	18	23.40056	39.91812	11.41525	3.739006	44.92762
	36	29.66666	34.58356	10.62679	3.638925	51.15072
Brazil	1	7.293053	44.64438	11.41586	0.648889	43.29087
	18	36.18630	24.18074	9.169915	0.637905	66.01144
	36	50.04988	22.75284	8.246862	0.467371	68.53293
Canada	1	5.006537	5.004367	2.265410	15.02372	77.70650
	18	15.27538	24.58331	6.427962	25.81911	43.16961
	36	18.96443	23.28268	7.491424	26.59729	42.62861
China	1	0.033846	13.58567	72.11354	0.413551	13.88725
	18	0.112380	41.96450	52.39118	1.280151	4.364175
	36	0.143878	39.76916	56.14769	1.100668	2.982483
Norway	1	0.062855	22.65899	41.78806	3.963587	31.58936
	18	0.182922	25.63601	18.96421	14.32548	41.07430
	36	0.234770	24.44706	18.38752	15.08363	42.08180
Singapore	1	0.003242	34.37145	55.39940	0.024871	10.20428
	18	0.013624	17.10164	65.41503	7.410395	10.07294
	36	0.018254	17.16134	66.24385	7.449064	9.145745
South Africa	1	0.011573	14.13976	74.88373	0.190319	10.78619
	18	0.051882	56.49021	26.79789	13.55884	3.153058

Country	Variance Decomposition of D(PPP):					
	Period	S.E.	D(GDP)	D(INFLATION)	D(EXCHANGE RATE)	D(PPP)
	36	0.067253	64.84226	22.44103	10.13863	2.57809
Sweden	1	45.34459	16.01855	29.17124	0.164798	54.64540
	18	127.5423	10.06729	27.75098	2.566443	59.61528
	36	165.9909	7.083510	28.10492	2.509018	62.30255
Thailand	1	0.038226	78.9633	10.36929	0.983396	9.68401
	18	0.089653	49.7192	16.33556	4.992429	28.95281
	36	0.102464	47.10595	13.41810	4.009223	35.46673
UAE	1	0.033846	13.58567	72.11354	0.413551	13.88725
	18	0.112380	41.96450	52.39118	1.280151	4.364175
	36	0.143878	39.76916	56.14769	1.100668	2.982483

From the results of the variance decomposition test in table 12 above, it can be seen that the PPP variance was influenced by PPP itself in the first period with values ranging below 50% for the countries Brazil, China, Norway, Singapore, South Africa, Thailand and the UAE. For the PPP value range above 50% are Australia, Canada and Sweden. Meanwhile, in the middle of the period it is influenced by other variables, namely GDP, inflation and the exchange rate with the lowest value for GDP being 10% in Sweden and the highest value being 56% in South Africa. Furthermore, it is influenced by the inflation variable with the lowest value being 6% in Canada, and the highest value being 65% in Singapore. Lastly, it is influenced by the exchange rate variable with the lowest value being 0.63% in Brazil and the highest value being 25% in Canada.

PPP shows the exchange rate that should change when prices reach cateris paribus. This is not realistic because there are international trade barriers such as transportation costs which cause domestic and foreign prices to differ when expressed in a common currency. Goods that are considered highly traded may also contain significant non-traded components and thus influence relative prices. The Australian Central Bank decided to reduce one of its monetary stimuli after inflation figures started to approach the target. One of its main monetary stimuli is known as yield curve control or YCC. Through the YCC scheme, the central bank bought up billions of dollars in government bonds with a short tenor of three years which mature in April 2024. This step was taken to encourage yields to remain low at around 0.1%. PPP requires that deviations of the actual real exchange rate from the long-term and constant real exchange rate be temporary, which implies that the real exchange rate must be a stationary time series. The method often used to test PPP empirically is the use of the unit root test. If the real exchange rate is stationary the shock will have a temporal effect. If the real exchange rate contains a unit root then the shock will have a permanent effect, meaning that PPP is invalid (Cuestas & Regis, 2013).

PPP validity refers to the fact that the real exchange rate is permanent in the long run by having an average reversion. Brazil is experiencing inflationary pressure at its highest level in the last 20 years and currency depreciation as a result of Brazil taking monetary policy by aggressively raising interest rates. Apart from being influenced by inflation, pressure is on the Brazilian Central Bank to take monetary policy by accelerating interest rate increases due to turmoil in financial markets amidst increasing concerns about Brazil's fiscal discipline. This fiscal pressure occurred after

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the Brazilian president asked to expand social assistance programs for the poor, which is believed to have strong implications for his plans to re-nominate in next year's elections. In contrast to Brazil, South Africa is likely to hold its benchmark interest rate after several African Central Bank benchmark interest rates fell to record lows in 2020, largely having reached the limit of monetary policy easing and a pause in interest rate increases, occurring at a time when the exchange rate was not too severe.

The real exchange rate will adjust in the long run to equalize the relative demand and supply of domestic and foreign goods to ensure that demand for domestic goods equals supply. Any factor that will affect the relative demand for or supply of domestic and foreign goods will affect the equilibrium real exchange rate. Due to international trade conflicts, Canada implemented monetary policy by deciding to maintain its benchmark interest rate. This was done because the Canadian economy was developing rapidly. PPP applies to Asian countries, including China, which experience long-term flexible and convergent exchange rates (Murad & Hossain, 2018). If there is a relative change in the exchange rate and a relative change in the price level ratio, then the monetary authority can carry out its own self-regulating policies to harmonize the economy and also be able to control exchange rate fluctuations.

During the pandemic, the Central Bank of Norway took a policy of increasing its benchmark interest rate by 1.25%. This was done because Norway believes its economic growth is more stable. The Central Bank of Singapore is tightening its monetary policy, which will tighten inflation. The policy tightening occurred because data showed that Singapore's economy was declining. The Singapore dollar experienced a brief increase after the Singapore monetary authority refocused the midpoint of the exchange rate, known as the nominal effective exchange rate, at the prevailing level. The United Arab Emirates estimates that economic growth will recover compared to before. The policies implemented include the use of capital stimulus programs and liquidity measures to help the economy through the global health crisis which has fallen by around 50% from its peak. The UAE monetary authority has prepared a stimulus fund of 50 billion Real or US$ 13.32 billion to restore the economy.

CONCLUSION

The VECM test results show that the GDP, inflation and exchange rate variables have positive and negative responses to changes in PPP values during the observation period, especially during the Covid-19 pandemic. This condition can occur because the economy in each country experiences fluctuations, especially during the Covid-19 pandemic. This has an impact on the PPP value in these 10 countries, which causes each country to take financial and monetary policies in accordance with the problems they face.

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