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RE-EXAMINING THE RELATIVE PRICE-EXCHANGE RATE NEXUS

***Abstract.** Exchange rate is one of the key macroeconomic indicators in emerging markets. This study investigates the validity of purchasing power parity (PPP) hypothesis in Indonesia and Philippines over the period 2005(1)-2021(12). Unit roots tests reveal that the exchange rate in both countries reverts to its mean. From the autoregressive distributed lag model, we find that there is a strongly long-run PPP relationship but no significant short-run PPP relationship. Partitioning the source of exchange rate misalignment, we obtain that in Indonesia the effect of the relative price on the exchange rate appreciation is greater than that on exchange rate depreciation. Interestingly, in the Philippines where the relative PPP holds both in currency depreciation and appreciation, the effect of the central bank's intervention is statistically insignificant. However, The CUSUM and CUSUMQ stability tests of the estimated results confirm that the PPP hypothesis in Indonesia and Philippines is robust for the long-run.*

***Keywords:** Relative price, Foreign exchange reserves, Exchange rate.*

JEL Classification: E52, E58, F31, C50, G15

1. Introduction

Within the globalization era, there has been a growing effect of the external shocks on the domestic macroeconomic performances. The interrelationship or even interdependence of domestic economy on the world economy is inevitable. The higher foreign price levels, for example, will induce the domestic price level, and therefore, the foreign inflation rates will also influence the domestic inflation rates. Eventually, they also will affect the domestic currency.

The link among foreign prices, domestic prices, and exchange rates in theoretical perspectives is well-known as purchasing power parity (PPP). The

absolute PPP postulates that the national price levels should tend to be equal when converted into a common currency, implying that the nominal exchange rate between two currencies should be equal to the ratio of a basket of goods/services price levels between the two countries (Taylor, 2004). Hence, the PPP exchange rates being relatively stable over time, resulting in the PPP hypothesis having no effect on international trade of a country (Rogoff, 1996).

Even though the notion of PPP does not always empirically hold, on the one hand, several studies found that the presence of absolute PPP for some countries (Taylor, 2001). Contrary, many scholars obtained the relative PPP holds for some other countries (Shiller, 2013). Even if the relative PPP holds whenever the absolute PPP presents, the reverse relationship does not exist (Taylor and Taylor, 2004). Due to there is no unique consensus on how the relative prices affect the exchange rates, therefore, the chance to re-investigate the nexus is still open.

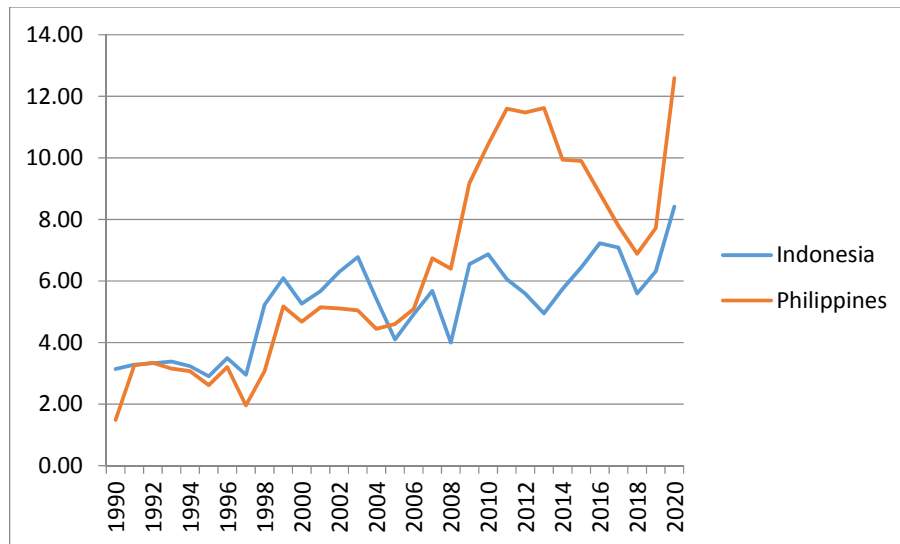
Indonesia and the Philippines are good laboratories for this case. The two emerging countries in Asia heavily suffered from the monetary crisis. Both two countries experienced high inflation rates, minus economic growth, and deep currency depreciation in relation to Asian financial crisis in 1997/98 that pushed the monetary authority to carry out the economic rescue and stabilization programs. However, in the global financial crisis 2007/08, the domestic currency of both two countries seemed to be more stable compared with the 1998 monetary crisis. By adopting the inflation targeting framework in early 2000s, the massive capital inflow during that period.

Moreover, the stable currency in both countries is supported by large foreign reserves. The international reserves held by the central bank of Indonesia and Philippines steadily increases since 1998 (see Figure 1). Our question in mind is whether the foreign reserve is effective enough to maintain the fundamental value of the exchange rate. The more basic question is whether the effect of central bank market intervention is permanent or temporary in nature. As small open countries, their individual economies have a little impact on the level of international economic performance. Adopting a floating exchange rate system induces both countries' currencies are considered as being susceptible to similar determinants such as inflation differentials against the US.

The answer of those questions brings back the discussion on the foreign reserves used by the central bank to intervene in the foreign exchange market which further determines the exchange rate. Exchange rates deviate from PPP due to distortions in home and foreign prices as a result of some factors (Qayyum *et al.*, 2004). One of them is speculative activities and official intervention. In our view, market interventions can distort exchange rates if the PPP has already achieved. By contrast, market interventions can bring exchange rates in the short-run back to the PPP. In other words, monetary policy is ineffective if the real exchange rate has been stable. Therefore, we assume that the main goal of foreign exchange market intervention is to combat misalignments from the fundamental values. In the most

basic form, the fundamental values of bilateral exchange rate refers to the relative prices in the two countries.

This study contributes to the empirical literature on the exchange rate determination. Unlike other studies (Murad and Hossain, 2018; Sidiq and Herawati, 2016; and Nababan, 2016), this study specifies a threshold from where the source of misalignments emerges and, hence, allows the central bank to effectively improve the exchange rate misalignment. The PPP-based exchange rate deviations stimulate the exchange rate volatility when the foreign currency is undervalued (Grossman and Orlow, 2022). This paper is structured as follows. In section 2, we outline a brief review of empirical literature on the relationship between relative price and exchange rate. Section 3 provides the methodology and data used in the estimation. Section 4 describes the estimates and discussion of findings. Some concluding remarks are drawn in Section 5.



Source: IMF

Figure 1. Foreign Reserves in Months of Import

2. Literature Review

The PPP was first stated in an exhaustive manner by the Swedish economist, Gustav Cassel, in 1918. He used it as the foundation for recommending a new set of official exchange rates at the end of World War I that would enable for the resumption of normal trade relations. Since that, the PPP has been an important subject in international economics (Cabello *et al.*, 2005). The root of the PPP is based on the law of one price, which argues that in the absence of transaction costs

and official trade barriers, identical goods will have the same price in different markets when they are stated in the same currency.

The absolute PPP postulates that the bilateral exchange rate should be proportional to the ratio of aggregate price levels between the two countries such that a unit of currency of one country will be equal to the purchasing power in the counterpart country (Taylor, 2004). Although the absolute PPP does not hold for a number of reasons, it remains fruitful as a theory of the determination of the level of the exchange rate.

The other variant of PPP is the relative PPP. This model is concerned with the rate of change in the exchange rate in a manner that variations in bilateral exchange rate move in an inverse direction with the inflation differential between the two countries. Although the relative PPP refers to nominal exchange rate in two pair countries, it can be extended for multiple countries. Therefore, the relative PPP also depicts the global competitiveness of a country's goods/services.

Therefore, it is not surprising that most empirical studies of PPP focus on changes in the real exchange rate, rather than on its level. Prior research has been conducted to examine the validity of the PPP theory in many countries over the years. During the 1980's, the PPP theory was validated in both developed and developing countries (see for example: Froot and Rogoff, 1995). In 1990's and early 2000's, the empirical studies produced a mixed result in line with the development of verification techniques. In this paper, we prefer to survey the recent empirical studies of PPP only in the emerging markets, which are comparable to Indonesia and the Philippines. There are several studies conducted to examine the hypothesis in emerging economies in the single country setting by using time series data.

Testing the PPP hypothesis in Sri Lanka, Wickremasinghe (2004) uses exchange rates for six foreign currencies for the period 1986-2000. Using unit roots test and error correction model, non-stationarity of the exchange rates is observed and, thereby, violating the necessary conditions for the PPP to hold. Therefore, the study concludes that the PPP hypothesis is not valid for Sri Lanka. In contrast, Liew and Tang (2009) discover an empirical support of PPP theory for Cambodia. Cointegration is found among Cambodian Riel-US Dollar, Cambodia consumer price index (CPI), and world CPI over the period May 2001-February 2009.

Cointegration test was also used by Zayed and Zahan (2017) to test the relation between exchange rate and prices in Bangladesh. Their results suggest that a long-run relationship exists between exchange rate and inflation. Yildirim (2017) analyzes the PPP validity in Turkey with respect to its four main trading partners, Russia, the European Union, the US, and China. Raising non-linearity issues in the unit roots tests, this study reveals that non-linear unit roots tests are stronger evidence in support of the PPP hypothesis relative to the conventional unit roots test on the condition that non-linearities in the exchange rate are correctly specified.

In the same spirit, Yilanci *et al.* (2017) examines the validity of the PPP hypothesis for 14 African countries during the period 1980-2015 using monthly time series data. The unit roots tests on the real exchange rates for these 14 countries fail to prove the mean-reverting tendencies. However, the cointegration test detects a long-term stable relationship between the relative price level and the nominal exchange rate for 8 countries.

Furthermore, by using different methods i.e time-varying cointegration model, Yoon *et al.* (2018) examine the PPP in China and UK from the periods of 1986:M1–2016:M12. That model was used due to a structural change and economic shock during observation periods. Therefore, time in-variant cointegration model is not appropriate. The result shows that the validity of PPP in China varies over periods. In the UK, however, the PPP does not hold for all periods. More recently, Nakorji *et al.* (2021) examine the Nigerian Naira exchange rate misalignment. Referring to US Dollar, UK Pounds, and Chinese Yuan, they confirm that the absolute PPP supports the relative PPP. Furthermore, all exchange rate pairs are overvalued in most of the period of their study.

Murad and Hossain (2018) support the relative PPP hypothesis in Southeast Asian countries, including Philippines and Indonesia. Purely in the case of Indonesia, Sidiq and Herawati (2016) show that Rupiah against the US Dollar is undervalued during the free floating exchange rate regime and, the PPP theory of Rupiah against the US Dollar is not valid in the period of their study. Nababan (2016) presents that based on the Big Mac index during 1998-2015, Rupiah tends to be undervalued against the US Dollar.

The survey of literature above briefly presents some interesting hypotheses about the potential linkage between relative price and exchange rate movements. First, studies using long span time series data tend to support the presence of long-run PPP. Second, in general, they assume that the relative prices affect the exchange rate symmetrically. Hence, the empirical results in the case of developing countries, primarily in Indonesia and Philippines, cannot be generally accepted yet. As argued by Boršič and Bekő (2018), the ambiguity of the results depends on the choice of the referred currency, the time period of observation, and on the selection of the methodology.

3. Research Method

To re-examine the relative price and exchange rate relationships, a function in which nominal exchange rate (ER) presumably depends on the domestic price-to-foreign price ratio (Pd/Pf) and foreign reserves (FR). The above idea is formally stated as:

$$ER = f \left(\frac{Pd}{Pf}, FR \right) \quad (1)$$

Taking the log-linear on Equation (1) results in:

$$er_t = a + b_1 \left(\frac{pd}{pf} \right)_t + b_2 fr_t + \epsilon_t \quad (2)$$

where the lower-case represents the logarithmic form.

Equation (2) is the representation of absolute PPP. The standard international monetary economic model postulates that the domestic price-to-foreign price ratio will proportionally increase the exchange rate ($b_1 = 1$). The foreign reserves could be an indicator of the degree of market intervention (Daude *et al.*, 2016). In addition, Suardi and Chang (2012) claim that variation in international currency reserves are good proxies for central banks interventions. The central bank could purchase foreign currency in the foreign exchange market, thus increasing international reserves holding, to allow foreign currency appreciates, or equivalently home currency depreciates, ($b_2 < 0$).

Based on the absolute PPP, Equation (2) is then transformed into the ARDL (auto-regressive distributed lag) model to take into account the relative PPP. The use of the ARDL model is supported in that it makes it possible to easily appraise exchange rate both in the short-term and the long-term. The short-run relationships could be identified from the first-difference variable, whereas the long-run relationships could be evaluated from the variable in level. Another benefit of the ARDL estimation model is consistent and efficient in the presence of endogenous explanatory variables. In addition, the traditional unit roots tests are very sensitive to draw a conclusive result.

To address the issues, Pesaran and Shin (1999) put forward that the ARDL models produce consistent estimates of the coefficients, regardless of whether the underlying explanatory variable series data are integrated of degree one ($I(1)$) or integrated of degree zero ($I(0)$). Therefore, the ARDL specification guarantees robustness of the results. Taking the unrestricted form, the ARDL(1,1) model is as follows:

$$\Delta er_t = \alpha + \beta_1 \Delta \left(\frac{pd}{pf}\right)_t + \beta_2 \Delta fr_t + \varphi_1 \left(\frac{pd}{pf}\right)_{t-1} + \varphi_2 fr_{t-1} + \varphi_3 er_{t-1} + \epsilon_t \quad (3)$$

where Δ is the difference operator.

Equation (3) implicitly assumes that the relative price linearly and symmetrically affects the exchange rate. To accommodate the non-linearity and asymmetric behaviors, the exchange rate deviation to the relative price is classified into four quadrants: (i) $\Delta er < 0$; $\Delta (pd/pf) < 0$, (ii) $\Delta er < 0$; $\Delta (pd/pf) > 0$, (iii) $\Delta er > 0$; $\Delta (pd/pf) < 0$, and (iv) $\Delta er > 0$; $\Delta (pd/pf) > 0$, respectively. The four classifications are then converted into dummy (d) variables as follows:

$$d_1 = \begin{cases} 1 - if \Delta \left(\frac{pd}{pf}\right)_t < 0 ; \Delta er_t < 0 \\ 0 - if \Delta \left(\frac{pd}{pf}\right)_t \geq 0 ; \Delta er_t \geq 0 \end{cases} \quad (4a)$$

$$d_2 = \begin{cases} 1 - if \Delta \left(\frac{pd}{pf}\right)_t < 0 ; \Delta er_t > 0 \\ 0 - if \Delta \left(\frac{pd}{pf}\right)_t \geq 0 ; \Delta er_t \leq 0 \end{cases} \quad (4b)$$

$$d_3 = \begin{cases} 1 - if \Delta \left(\frac{pd}{pf}\right)_t > 0 ; \Delta er_t < 0 \\ 0 - if \Delta \left(\frac{pd}{pf}\right)_t \leq 0 ; \Delta er_t \geq 0 \end{cases} \quad (4c)$$

$$d_4 = \begin{cases} 1 - if \Delta \left(\frac{pd}{pf}\right)_t > 0 ; \Delta er_t > 0 \\ 0 - if \Delta \left(\frac{pd}{pf}\right)_t \leq 0 ; \Delta er_t \leq 0 \end{cases} \quad (4d)$$

Substituting Equations (4) to (3), we have:

$$\Delta er_t = a + \sum_{i=1}^4 \beta_i [d_i \Delta \left(\frac{pd}{pf}\right)_t] + \beta_5 \Delta fr_t + \varphi_1 \left(\frac{pd}{pf}\right)_{t-1} + \varphi_2 fr_{t-1} + \varphi_3 er_{t-1} + \varepsilon_t \quad (5)$$

The symmetric impact of relative price on the exchange rate can be examined whether $\beta_1 = \beta_2 = \beta_3 = \beta_4$. Hence, Equation (5) could address the asymmetric and non-linearity issues which often emerge in the financial markets (Law, 2019). Equation (5) is also compatible with the non-linear unit roots tests.

Concerning with the cointegration relationship in the long-run, the Wald test is carried out to test the null hypothesis, $H_0: \varphi_1 = \varphi_2 = \varphi_3 = 0$, against the alternative hypothesis, $H_a: \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq 0$. If the value of Wald test is greater than the upper-bound, the null hypothesis of no cointegration relationship is denied. Hence, relative price, foreign reserves, and exchange rate are said to be cointegrated. Nevertheless, no conclusive inference can be drawn if the value of Wald test lies in the critical interval bounds, except the order of integration of the variables is known. If the value of Wald test is less than the lower-bound, the null hypothesis of no cointegration cannot be denied.

Equations (3) and (5) will be applied to Indonesia and the Philippines. Since we are concerned with the degree of responsiveness of market intervention, we need a long span and reliable time series data on domestic price, foreign price, foreign reserves, and exchange rate. The domestic price levels refer to the CPI (2012=100). The foreign price level is represented by the US CPI (2012=100). The use of CPI in the exchange rate determination model has been criticized. The CPI, instead of producer price index (PPI), takes into account non-tradable goods/services, whereas exchange rate neglects them. Nevertheless, the CPI remains appropriate to compare the purchasing power across countries. Moreover, the CPI instead of PPI is commonly employed to represent the general price levels.

The exchange rate is defined as the price of the US Dollar in terms of domestic currency (Indonesian Rupiah and Philippines Peso, respectively). The discussion of exchange rates movement ideally explores the daily data. Unfortunately, the data of daily central bank intervention in foreign exchange market is not for public consumption. Hence, we employ the change in foreign reserves data on a monthly basis with caution to evaluate the behavior of the central bank's market intervention. The foreign reserve basket comprises various foreign currencies, securities, monetary golds, reserves position in the IMF, and special drawing rights, which are under control of the central bank in both

countries. Stated in billion US Dollar, they are readily available for any balance of payments financing.

The sample periods extend from 2005(M1) to 2021(M12) due to merely the data availability. The total observation is 204 sample points. The observation period covers the inflation targeting regime adoption in both countries. Most of the monthly data came from the central bank of Indonesia and Philippines (Bangko Sentral ng Pilipinas). Other data were taken from the IMF.

4. Results and Discussion

Table 1 shows the descriptive statistics of all interest variables used in this study. The mean of relative change of Rupiah is positive 0.2% a month, meanwhile Peso has a negative mean, -0.5%. In addition, the mean of relative price in Indonesia is 0.27%, higher than that in Philippines that is only 0.12%. Combining the above figures preliminary presents that the movements of Rupiah (compared to Peso) is closely related to the fluctuations in relative price.

The distance between maximum and minimum values for all variables in both countries are relatively large, ranging from minus to plus, primarily exchange rate and foreign reserves. The range value of foreign reserves is 0.26 for Indonesia and 0.16 for the Philippines. The high dispersion of foreign reserves is confirmed by their standard deviation. The coefficient of variation is 5.11 for Indonesia and 2.2 for Philippines respectively. Since the change in foreign reserves represents the central bank intervention, we infer that Indonesia is more frequent to intervene than the Philippines.

Table 1. Descriptive Statistics

	Indonesia			Philippines		
	Δ (er)	Δ (pd/pf)	Δ (fr)	Δ (er)	Δ (pd/pf)	Δ (fr)
Mean	0.0021	0.0027	0.0068	-0.0005	0.0012	0.0099
Median	0.0009	0.0018	0.0096	-0.0007	0.0010	0.0056
Maximum	0.1591	0.0818	0.1394	0.0395	0.0162	0.1122
Minimum	-0.1041	-0.0106	-0.1214	-0.0387	-0.0104	-0.0472
Std. Dev.	0.0283	0.0081	0.0347	0.0130	0.0038	0.0217
Skewness	0.9966	5.0395	-0.0184	0.1951	0.3174	1.0102
Kurtosis	10.6883	47.4861	5.0969	3.5390	4.2804	5.9944

The harmony between the distribution of exchange rate, relative price, and foreign reserves series data in both countries raises a logical question of how closely they are related. Figure 2 delivers the behavior of exchange rates and relative price in both countries. It seems there is a strong co-movement between currency and relative price in each country. It is also notable that the fluctuations of currency and relative price in the Philippines is more dynamic than those in Indonesia.

Based on those figures, we hypothesise that the dynamics of the exchange rate is closely associated with the fluctuation of foreign reserves. In other words, the exchange rate appreciation or depreciation in each country is moderately related to the change in foreign reserves. The impact of relative price and foreign reserves behaviors on the exchange rate movements will be re-examined more precisely using econometric models as specified in the previous section.

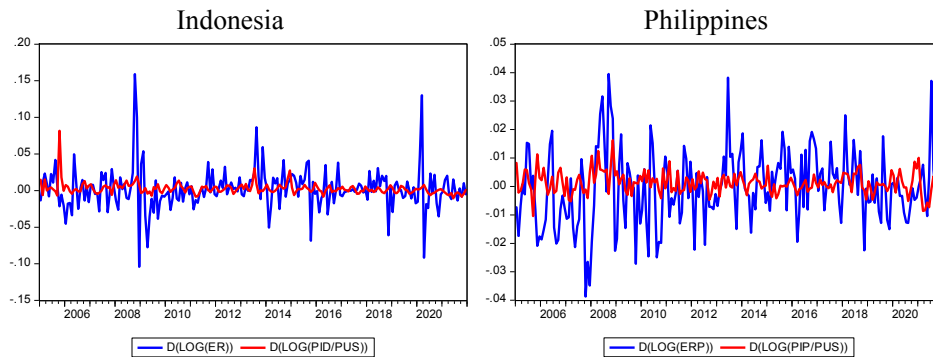


Figure 2. Relative Price and Exchange Rate

In accordance with the time series econometric methods, we first examine the properties of the underlying data. The existence of unit roots is evaluated by using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. The ADF unit roots test could be misleading toward false unit roots in level primarily when the data series are trend-stationary with a structural break. The structural break arose around 2007/08 when the global financial crisis erupted. This holds for both Indonesia and the Philippines. Meanwhile, the foreign reserves and the relative price experienced a structural break around 2014 in relation to the end of the commodity boom era. Hence, the PP test is employed complementary to the ADF test. The PP test is better to verify the validity of series data in the presence of unknown multiple structural breaks.

The test is undertaken 4 times for the level and the first-difference data respectively. The results of ADF and PP tests are shown in Table 2. Both tests present that relative price series data for Indonesia have unit roots in level. In the case of the Philippines, foreign reserves series data is stationary in level ($I(0)$). Other variables are non-stationary in their level. Therefore, the ADF and PP tests are conducted again to the transformed series of each variable to ensure the possibility of stationary in first-differences. The results of the test establish that those series are stationary in first-difference. In other words, in the first-difference forms, they become stationary ($I(1)$). Since there is no series data performing $I(2)$, the ARDL model is suitable for the underlying data.

Stationarity is required to achieve cointegration. Cointegration is a fundamental concept to investigate the long-term behavior of the data. To convince

the existence of cointegration, we examine the possibility of cointegration by conducting the bound test. As depicted in Table 4, the Wald test (F and χ^2 statistic) is calculated for each model to test the null hypothesis that all of lagged variables equals to zero against the alternative hypothesis, that all of lagged variables does not equal to zero. The result of the F-test values falls outside the upper-bound in the lower (0.05) probability value. It seems that the null hypothesis of no cointegration can be denied, implying the existence of cointegrating relation. The interactions among the three variables with the different order of integration tend to evolve towards the long-run equilibrium relationship. In other words, the relative price, foreign reserves, and exchange rates are said to be cointegrated.

Table 2. Unit Roots Test

	Level		First-difference		Conclusion
	ADF	PP	ADF	PP	
Indonesia					
er	-0.9213	-0.9140	-11.5276*	-13.5101*	<i>I(1)</i>
pd/pf	-3.2531**	-3.7100*	-	-	<i>I(0)</i>
fr	-1.6346	-1.6378	-11.9027*	-11.9581*	<i>I(1)</i>
Philippines					
er	-2.1995	-2.1069	-9.5295*	-9.4587*	<i>I(1)</i>
pd/pf	-2.1379	-2.4036	-10.3207*	-10.2745*	<i>I(1)</i>
fr	-4.0005*	-3.8227*	-	-	<i>I(0)</i>

Note: *, **, and *** indicate significant at 1, 5, and 10 percent respectively

The ordinary least squares estimation results are reported in Table 3. Estimation of Equation (3) is considered as a base-line (Model (1)) and Model (2) based on Equation (5) is the extended one. As presented in Table 3, most of the estimated coefficients in the equation model are statistically significant, verified by t-statistics value exceeding the relevant t-table at 5 percent or even 1 percent significance levels. Statistical indicators, such as F-test, standard error of regression, and DW-test are sufficiently reliable. The coefficient of determination is relatively low, suggesting there are many different shocks influencing the exchange rate in emerging markets.

The result of Model (1) shows that the change in domestic price-to-foreign price ratio is the only insignificant one. It seems that in the short-run the ratio of domestic price-to-foreign prices does not affect the exchange rate behavior in both countries. However, in the long-run the corresponding variable influences the exchange rate movement, indicated by the significance of the lagged variable. The impacts are almost the same, -0.13 and -0.16. Based on those figures, we conclude that the law of one price in the short-run does not hold. The change in exchange rate is not proportionally related to the change in the relative price and, therefore, the exchange rate misalignment occurs in both countries.

Furthermore, partitioning the relative price changes component with respect to 4 quadrants specification provides a better result. For the case of Indonesia, the change in relative price is more sensitive to the currency appreciation rather than the currency depreciation. In relation to the currency appreciation, the two corresponding coefficients (2.1 and -4.2, respectively) are significant and statistically equal to unity. More specifically, the theory of PPP holds when the relative price changes either increase or decrease, implying that the presence of PPP is asymmetric in the short-run.

Table 3. Estimation Results of Exchange Rate Fluctuation

	Indonesia		Philippines	
	(1)	(2)	(1)	(2)
C	1.2050*	1.0083*	0.3855**	0.3076***
Δ (pd/pf)	0.1394	-	0.2329	-
$d_1 \times \Delta$ (pd/pf)	-	1.5275	-	2.4377*
$d_2 \times \Delta$ (pd/pf)	-	-0.3494	-	-1.5665*
$d_3 \times \Delta$ (pd/pf)	-	2.0980*	-	2.0300*
$d_4 \times \Delta$ (pd/pf)	-	-4.1869*	-	-1.3143*
Δ (fr)	-0.3661*	-0.2885*	-0.2523*	-0.1630*
(pd/pf)(-1)	0.1642*	0.1360**	0.1251***	0.1017***
fr(-1)	-0.0355**	-0.0298***	-0.0174***	-0.0139
er(-1)	-0.0861*	-0.0724*	-0.0500**	-0.0398**
R ²	0.2084	0.3584	0.2085	0.4885
Adj R ²	0.1884	0.3321	0.1885	0.4676
SEE	0.0255	0.0231	0.0117	0.0095
SSR	0.1289	0.1044	0.0271	0.0175
F	10.4228	13.6166	10.4323	23.2825
DW	1.9918	2.1574	1.5216	1.7428
Bound Test				
F-stat	3.6729	2.8148	2.2424	2.2485
χ^2 -stat	11.0187	8.4444	6.7271	6.7454
Conclusion	Cointegrated		Cointegrated	
PPP Test				
t-stat	-	-1.1632	-	0.7314
F-stat	-	1.3531	-	0.5349
χ^2 -stat	-	1.3531	-	0.5349
Conclusion	PPP holds		PPP holds	
Symmetric Test				
F-stat	-	11.5116	-	27.1156
χ^2 -stat	-	46.0466	-	108.4625
Conclusion	Asymmetric		Asymmetric	

Note: *, **, and *** indicate significant at 1, 5, and 10 percent respectively

For the case of the Philippines, the changes in relative price have a significant effect on the home currency both when it depreciates and appreciates. All the four partitions coefficients are statistically significant. However, the effect on the exchange rate is weaker when the relative price movement is not in the same direction with the change in exchange rate (-1.6 and -1.3, respectively). Overall, despite the PPP being asymmetric, the short-run PPP exists in the Philippines, indicated by the Wald test (t, F, and χ^2 statistics) of the four coefficient summation statistically equals to unity.

Interestingly, in the Philippines where the relative PPP holds both in currency depreciation and appreciation, the effect of the central bank's intervention is statistically insignificant to manage the long-run exchange rate movement. In contrast, for Indonesia where the presence of relative PPP is greater when currency appreciates compared to depreciates, the central bank's intervention plays an important role to correct exchange rate misalignments from the PPP. This finding supports the conventional wisdom that monetary policy has no impact on the real exchange rate in the long-run.

The asymmetric behavior of the PPP is probably related to the degree of exchange rate pass-through (ERPT). In the low degree of ERPT, import prices slowly adjust to exchange rates and delays the monetary policy response. In the inflation targeting regime, monetary authorities are able to forecast inflation in the presence of a low degree of ERPT. In the high degree of ERPT, the exchange rate fluctuations change the current account balance which in turn influences aggregate demand. Accordingly, the high degree of ERPT is often an argument for an economy to 'fear' floating exchange rate and is thus a given rationale for the more frequent market intervention (Calvo and Reinhart, 2002). Therefore, by adopting inflation targeting, emerging economies have dual inflation-exchange rate goals.

The coefficient of lagged dependent variables is statistically significant for both countries. The associated coefficient represents the partial adjustment. Only 0.07 percent (for Indonesia) and 0.04 (for Philippines) percent of any exchange rate disequilibrium is gradually corrected to the desired level in a month. Given the relatively low adjustment mechanism, the exchange rate tends to be more persistent to respond to any fluctuations in the short-term, suggesting that the habit slowly changes over time.

Our models above employ the ordinary least squares estimators, which are susceptible to the existence of sample observations that lie outside the tolerable interval limits. The susceptibility of ordinary least squares regression methods to these abnormal observations can produce bias parameter estimates that do not properly describe the underlying statistical relationship. Hence, it is necessary to check for the stability of the exchange rate determination function.

The stability of the exchange rate determination model is important for an effective monetary policy. The effective monetary policy requires that the estimated model does not change over time. Broadly speaking, we will test the robustness of the estimated models as an integral part of an empirical study. As a

robustness technique, we conduct the cumulative sum (CUSUM) and cumulative sum squares of residuals (CUSUMSQ) tests for the parameter constancy of the model. The two tests will be applied only on model (2), since it offers a better result.

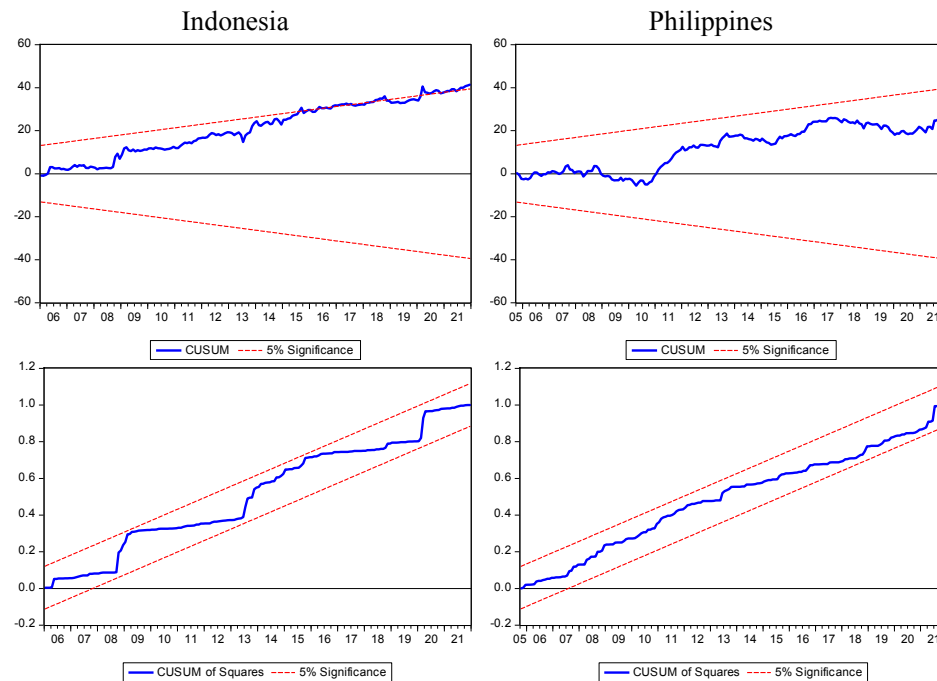


Figure 3. CUSUM and CUSUMSQ Test

The plots of the CUSUM in the left-column of Figure 3 occupy within the 95 percent confidence bands, which verify the constancy of estimated parameters in the two models. Similarly, the plots of the CUSUMSQ in the right-column of Figure 3 fall within the 95 percent confidence bands, which exhibit stability of the parameters. Thus, the parameter estimates can be used not only by the central bank but also by the foreign exchange market players as a predictor to forecast the exchange rate movements in the future.

Another robustness measure involves a dummy variable to capture the global financial crisis (2007/08), the commodity boom era (2000-2014), and the ‘mini-crisis’ (2015) in the model as additional control variables. The results indicate that those exogenous shocks do not alter the magnitude and significance of our estimators, postulating all models are encompassed to the others. The model remains to be fit to portray the exchange rate movements. In principle, they support the presence of a significant effect of relative price on the exchange rate performance.

5. Conclusion

Exchange rate is one of the key macroeconomic indicators in emerging markets. The exchange rate stability, both in its level and its growth, is crucial for small-open developing countries to promote exports and to attract investments which are the main source of economic growth. Hence, many strategies are devoted by the central bank, monetary authority, and/or government to control the exchange rate fluctuation from its fundamentals. Purchasing power parity is the most important aspect used as reference. It postulates that the national price levels should tend to be the same when expressed in a common currency,

The goal of this paper is to appraise the effect of domestic price and foreign price on the exchange rate movements. Taking the case of Indonesia and Philippines over the period 2005(1)-2021(12), we find that the exchange rate in the long-run reverts to the mean. In addition, the application of the autoregressive distributed lag model reveals that there is a strongly robust long-run PPP relationship but no significant short-run PPP relationship in both countries. We also obtain that in the case of Indonesia the effect of the relative price on the exchange rate appreciation is greater than that on exchange rate depreciation.

Interestingly, in the Philippines where the relative PPP holds both in currency depreciation and appreciation, the effect of the central bank's intervention is statistically insignificant to manage the long-run exchange rate movement. Furthermore, unlike the previous literature, this paper confirms the stability of the estimated results by CUSUM and CUSUMQ tests. Overall, the results suggest that the PPP hypothesis in Indonesia and Philippines strongly holds for the long-run while not for the short-run. It implies that the central bank's intervention in the foreign exchange market will not be effective.

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