Validity test of purchasing power parity doctrine: An Indonesian case study

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Abstract

The goal of this study is to analyze the doctrine purchasing power parity (PPP) in Indonesia with the case study of the rupiah exchange rate to U.S. dollar. The autoregressive is used to estimate the relationship between the change of exchange rate and the difference Indonesia–USA inflation rate. The data used in this study are quarterly data obtained from the International Financial Statistics (IFS) and Bank Indonesia (BI) with the period 1997Q4-2013Q4. The exchange rate that used in this study is using the rate on rupiah to U S dollar. The price data used consumer price index in Indonesia and the United States with a base year of 2000. The results of this study show, that rupiah to the U.S. dollar is undervalued during the free floating exchange rate system and, the PPP doctrine to the case of the rupiah to the U.S. dollar is not valid in the period of this study.

Abstrak

Tujuan dari penelitian ini untuk menganalisis dokrin paritas daya beli (PPP) dengan studi kasus nilai tukar rupiah terhadap dolar Amerika Serikat. Dalam penelitian ini menggunakan alat analisis autoregresif untuk mengestimasi hubungan antara perubahan nilai tukar rupiah dengan perbedaan tingkat inflasi Indenesia-Amerika Serikat. Data yang digunakan adalah data kuartalan dari Internatioanal Financial Statistics (IFS) dan Bank Indonesia dengan peride waktu 1997Q4-2013Q4. Hasil dari penelitian ini menunjukkan pertama bahwa nilai tukar rupiah terhadap dolar Amerika Serikat dinilai terlalu rendah (*undervaled*) pada sistem nilai tukar mengambang bebas. Kedua, Dokrin PPP tidak berlaku selama periode penelitian.

Introduction

The theory of Purchasing Power Parity (PPP) states that the exchange rate of a country to other countries will be equal to the ratio of domestic price with the price of other countries. This hypothesis implicitly assumes that markets for good are perfectly competitive, no transportation costs and no barriers on trade between countries (Krugman & Maurice, 1997). This theory has been a big debate among scholars, whether or not PPP theory applies both for short term and long term.

Empirical data shows that the value of rupiah exchange rate to U.S. dollar deviates from purchasing power parity on free-floating system in Indonesia. Figure 1 shows that the rupiah exchange rate to the U.S. dollar from the year 1997 to 2013 on average higher than the difference in the change of Indonesia - US inflation rate. The average change in rupiah exchange rate to U.S. dollar is 3.8 percent, while the average change the difference Indonesia-US inflation rate is 1.6 percent. This condition indicate that the exchange rate is not the parity rate. Exchange rate parity occurs when the change of the exchange rate rates is equal to the difference Indonesia-US inflation rate. If the change in the exchange rate is higher than the difference in the rate of inflation is considered undervalued. Conversely, if the rate change is lower than the difference in the rate of inflation that means overvalued rupiah. Due to changes in the average value of the rupiah to the U.S. dollar is greater than the average difference in Indonesia-US inflation rate indicates that the exchange rate for the period study was undervalued compared with the exchange rate parity. Thus, it can be indicated that during this period rupiah exchange rate tends to deviate from its parity.
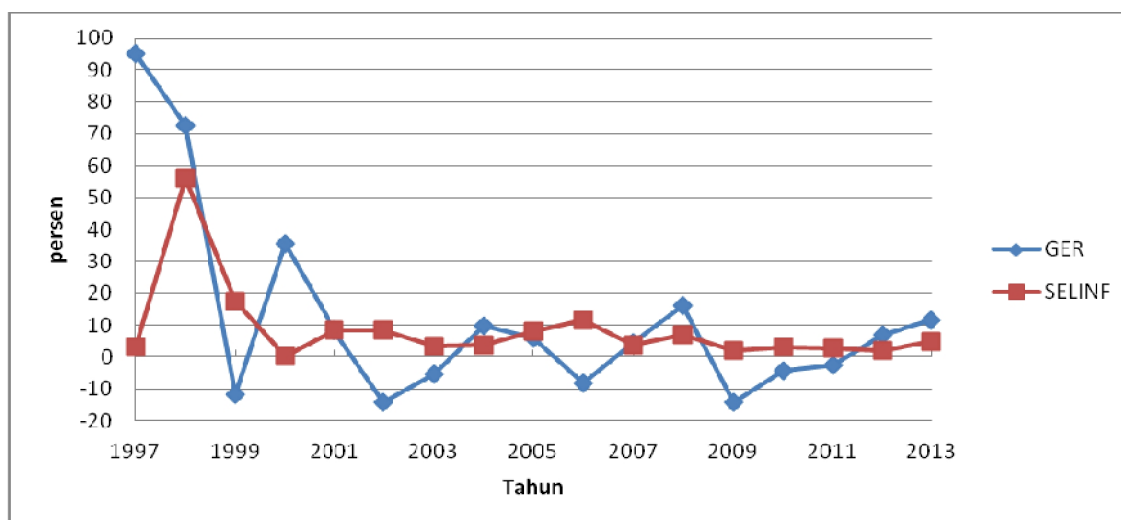
Note:
GER: The Cange of relative exchange rate (Rp/US$)
SELINF: The difference of Inflation rate Indonesia-USA
Sources: International Financial Statistics, 2014

Figure 1. The Change of Rupiah Exchange Rate and the Difference between Indonesian -USA Inflation Rate: 1997.1-2013.4

Specifically, the purpose of this study is to examine whether or not the doctrine of Purchasing Power Parity (PPP) applies in the cases of Indonesia during the free-floating system. The systematically discussion in this study is a literature review discusses the theoretical basis as well as studies that have been done. The description of the data used. The f economic and econometric models are used. Data analysis and discussion of the results and the last section is the conclusions and policy implications.

The Law of one price explains the relationship between exchange rates and commodity prices. This law states that price of one commodity will have a relatively the same price, although it is sold in different places. The difference in the price of commodities will create opportunities for arbitrage. Arbitrage will occured by buying a commodity at a cheaper place and sell it at a more expensive place. The existence of arbitrage will ultimately raise the price of the commodity at a cheaper and lower price somewhere more expensive. In the end, the prices at various places will be relatively the same. The underlying assumption of this theory is that the goods market is perfectly competitive, no transportation costs and no barriers on trade between countries (Krugman & Maurice, 1997).

The development of the theory of exchange rate determination begins with the concept of the law of one price. This law states that the price of a country's currency exchange rate is the ratio of the domestic price level to the price level of other countries. The implications of these laws is that identical goods will be sold at the same price in different countries. This theory was put forward by Gustav Cassel, a Swedish economist, who introduced the theory of purchasing power parity (PPP) in 1918. Purchasing power parity theory states that a country's currency exchange rate is the ratio of the domestic price level to the price level of other countries. PPP theory links the foreign exchange rate at commodity prices in local currency in the international market, namely that the foreign exchange rate will tend to decrease in the same proportion as the rate of price increase. PPP theory is divided into two versions of absolute and relative versions. Absolute PPP explains that the nominal exchange rate is determined by the relative prices of a number of the same items in the foreign country. Absolute PPP is theory mathematically formulated as follows:

$$S_t = P_t / P_t^*$$

where,
S_t = nominal exchange rate
P_t = domestic price
P_t^* = foreign price

Absolute version of the PPP theory is often associated with the law of one price, despite the fact that there is a difference between them. The law of one price is applied to only for one type of goods while the PPP theory is applied to the overall price levels by using a basket of goods and services. In its relative version, the PPP theory states that the foreign exchange rate is a percentage ratio of absolute price changes in the foreign country (Salvatore, 2004). Mathematically relative version of the PPP theory is formulated as follows:

$$\%\Delta S_t = \%\Delta P_t \, / \, \%\Delta P_t{}^*$$

where,
$\%\Delta S_t$ = percentage change in the nominal exchange rate
$\%\Delta P_t$ = percentage change in domestic prices
$\% \Delta P_t {}^*$ = percentage changes in the foreign price

From equation relative version of PPP theory suggests that changes in foreign exchange rates are expressed in percentage of the price level, it shows how the relationship between the rates of inflation in the two countries by foreign exchange rates respectively. Thus, it can be argued that if the domestic inflation rate is less than the inflation rate of the foreign country, the domestic currency will appreciate. Conversely, if the rate of domestic inflation over the inflation rate of the foreign country, the domestic currency will depreciate

There are some drawbacks to the PPP theory in determining the equilibrium exchange rate in the form of assumptions that are not realistic, such as no transportation costs and no trade barriers. Some scholars believe that the exchange rate can deviate from purchasing power parity is caused by four factors. First, the existence of international trade barrier, for example if the restriction of imports is greater than export restrictions, the domestic exchange rate will be greater than the provisions in the theory of purchasing power parity. Second, the presence of speculation in the foreign exchange market will cause the value of domestic exchange will be greater than the provisions in the theory of purchasing power parity. Third, the anticipation of the community towards the domestic inflation rate greater than the rate of inflation in the foreign exchange of the domestic lead will be under the provisions of the theory of purchasing power parity. Forth, long-run capital flows can cause the exchange rate deviates from purchasing power parity theory, such as the presence of long-run net capital inflow will cause the domestic exchange rate will deviate of the theory of purchasing power parity (Officer, 1976).

In an empirical study of the use of the PPP theory there are some criticisms. First In determining the price index variable, whether to use the consumer price index (CPI), producer price index (PPI) or the GDP deflator, each of which has a scope of goods that are not the same in each country. Pattinasarany (1997) examine whether PPP applies in Indonesia. The data used are monthly data from the period 1978:11 to 1996:7 with a managed floating exchange rate system. Two models are proposed, namely the model with the consumer price index and a model with whole price index and co-integration testing procedures performed by Johansen. The results showed that the model with the consumer price index PPP doctrine does not apply to long-term, while for models with whole price index PPP doctrine applies in the long run.

The third criticism, with respect to the issue of price level for traded goods and non- traded goods. Some scholars argue that the price level should be used regarding the overall goods and services in question; traded and non- traded goods. Because it does not agree when Cassel used is the price level of goods traded. By using the basic theory of purchasing power parity, exchange rate in developing countries would be considered undervalued.

The results of the study from Ballasa (1964) supports why the exchange rate in developing countries was undervalued compared to developed countries. He states, that the ratio price of non - trades goods have positive relationship to the per capita income. The reason is the technology in non- traded goods relatively similar between countries, such as barbers, tool and do almost the same in several countries. However, the wages are not the same, the opportunity costs are depended on each country. In developed countries, the opportunity cost is much higher so that the wage (the price of non- traded goods) is also higher. With the above functional relationship, then the purchasing power parity index calculations involving two countries (developed and developing countries) will always result in that low-income countries (developing countries) have a relatively low price as well, so indigo its currency undervalued as well.

The fourth criticism, is the question whether the PPP theory applies to short-run or long-run. Short-run equilibrium exchange rate is defined as the exchange rate of the domestic currency with foreign currency that occurred at some point. While the long-run equilibrium exchange rate is a fixed exchange rate that results in the balance of payments. This criticism is important because PPP is one of the international macroeconomic concepts. This concept plays an important role in the monetary approach to the exchange rate (Menezes & Resende, 1995). PPP hypothesis is that the exchange rate of the other country will be equal to the ratio of domestic prices in the country compared to prices in other countries. This hypothesis is in fact implicitly start from the assumption that the price of goods can move freely. This assumption becomes a major debate between the keynesian and the moneterist in international economy, which also raises further ideological controversy between the two groups (Caves, Frankel, & Jones, 1993).

Some empirical studies have been done in some countries, but there has been no agreement on this matter. Most of the studies were conducted to support the hypothesis that PPP is valid for long-term (Pippenger 1993; Ramirez & Khan, 1999). While some other studies point to the contrary that the PPP hypothesis does not apply to long-run (Edison, 1987; Menezes & Resende, 1995). Most of the studies that show that PPP is not valid in the long-term equilibrium, generally argues the existence of transaction costs, imperfect information and contracts in consumer behavior, thus making the PPP docrine does not apply.

Research Method

Model specification

There are several models to test the of purchasing power parity, Frenkel (1976) and Madura (2003) uses regression between changes in foreign exchange rate to inflation change. Other researcher, Patinassarany (1998) used co-integration approach to the case in Indonesia. While Krugman & Maurice (1997) test the purchasing power parity by using autoregressive models of the real exchange rate. In this study, for testing the purchasing power parity enactment will use the regression between the change of exchange rate with the inflation change and the real exchange rate autoregressive.

In purchasing power parity doctrine test involves examining the relationship changes in the exchange rate (LER) with the difference in the price level (SELINF) and autoregressive real exchange rate (RS (-1)) as shown in equation 1 and 2.

$$LER = \alpha_0 + \alpha_1 SELINF \tag{1}$$
$$RLER = \beta_0 + \beta_1 RLER(-1) \tag{2}$$

The equations model (1) and (2) are estimated by ordinary least square (OLS). Then from the results of the coefficient will be tested by the Wald test. The data used in this study are quarterly data obtained from the International Financial Statistics (IFS) with the period 1997Q4-2013Q4. The data of exchange rate using the exchange rate of the rupiah to the U.S. dollar and the data price is used the consumer price index in Indonesia and the United States with a base year of 2000 year.

Data behavior

The most important thing to analyze the time series data is by looking at the concept of stationary. Stationary means that expectations and variances of a time series are constant. The degree of integration is the major interest because this number shows how often a time series y_t has to be differentiated in be stationary. If a time series is integrated at level, I(0), it is stationary. But if the time series is integrated at first difference, $I(1)$, the data is non-stationary.

To test a time series on stationary the augmented Dickey Fuller test (ADF) including a trend and a constant is used:

$$\Delta Y_t = a_0 + a_1 T + \gamma Y_{t-1} + \beta_i \sum_{i=1}^{k} \Delta Y_{t-1} + e_t \tag{3}$$

Δy_t is the change of y during time t, a_0 is a constant, a_1T describes a trend in the time series, γ is a parameter to test stationary, β_i is a coefficient and e_t is an error term. The parameter k which represents the number of lags should be chosen in a way to avoid any autocorrelation in the residuals. The procedure to determine whether the data are stationary is comparing the statistical and critical values of the ADF statistic distribution Mackinon. If the absolute value of the ADF statistic is greater than the critical value, then the

observed data suggests otherwise stationary and if the absolute value of the ADF statistic is less than the critical value then the data is not stationary.

As stationary test, co-integration test is also a test of stationary, but in a different level with the previous stationery test. The integration test is a test of stationary in the level of long-term model. To be able to perform co-integration test must first believed that the variables associated with this approach has the same degree of integration or not. In connection with that, the unit root test and test the degree of integration needs to be done first. In this study use the Johansen Co-integration Test. Basic decision-making is to look at Log Likelihood Ratio (LR) statistic is compared with the LR table. If LR statistically greater than the LR table at alpha 1%, 5% or 10% then Ho is rejected, which means the co-integration properties found in the model.

Results and Discussion

In this study, the root of the unit root is test by using DF test (Dickey-Fuller) and the ADF test (Augmented Dickey Fuller). The procedure to determine whether the data is stationary or not is by comparing the value of the critical value of the ADF statistic distribution Mackinon. If the absolute value of the ADF statistic is greater than the critical value, then the observed data is stationary and if the absolute value of the ADF statistic is less than the critical value then the data is not stationary.

Table 1. Unit Root Test at Level

No	Variabel	ADF	
		t-statistik	Prob.
1	LER	-8.551293***	0.0000
2	SELINF	-5.080128***	0.0001
3	RLER	-6.312565***	0.0000
4	RLER(-1)	-6.312565***	0.0000

Notes:　***) Stationary at critical value 1%
　　　　**) Stationary at critical value 5%
　　　　*) Stationary at critical value 10%

The results of stationary in Table 1 shows that, the exchange rate variable (LER), relatif inflation (SELINF), the real exchange rate (RLER) and lag of the real exchange rate (RLER (-1)) reached stationary with ADF at level of 1 % critical value. Due to the level of all the variables are stationary level then proceed with the co-integration test. In conducting the co-integration test, a step that must be done is to find a data residuals (et) on the regression model used in the analysis. Co-integration test is done by using the model of change in exchange rate equation (equation 1) and the real exchange rate changes autoregressive equation (equation 2), After the data residual known, these data need to be tested for unit roots. If the residual in the equation stationary I (0), then it is said that the variables co-integration which means it has a long-term relationship

Table 2, shows the statistical values and probability values of residual co-integration test on each model. The results of the unit root tests on level I (0) show all models are significant at 1 % critical value which means there is no indication that the residual variable for each model level data does not contain a unit root, in other words the residual variable already stationary at level I (0). It can be concluded that there is co-integration between all variables included in all models above. This has the meaning that in the long run will be a balance or stability between variables.

Table 2. Co-integration Test

No	Model	ADF	
		t-Statistics	Probability
1	LER = f (SELINF)	-6.877677	0.0000
2	RLER = f (RLER (-1))	-5.633591	0.0000

Notes : ***) Stationary at critical value 1%
　　　　**) Stationary at critical value 5%
　　　　*) Stationary at critical value 10%

By using the Wald test results (Table 3), to equation (1) indicated that the null hypothesis that the proportion of changes in foreign inflation rate is equal to one is rejected. This means that the proportion of rate changes with the inflation rate difference between Indonesia and the United States is not equal to one. This condition indicates that the purchasing power parity (PPP) does not apply in the observation period of this study. Similarly, the Wald test (Table 3), to equation (2) indicates that the null hypothesis that the real exchange rate changes have no effect on prior periods was also rejected. This means that the real exchange rate is not independent to the changes in the real exchange rate in the prior period. The implication is that in the long run the real exchange rate will deviate from the real exchange rate initially. It can be concluded that the length of the PPP doctrine is not valid in this study.

Table 3. Wald Test

Variable (Dep. Var. : LER)	Coefficient	Variable (Dep. Var. : RLER)	Coefficient
Constanta	9.111368 (709.4607)	Constanta	1.062827 (3.091057)
SELINF	0.012927 (4.047054)	RLER(-1)	0.882015 (23.42384)
Ho: $\alpha 1 = 1$ *Chi-Square* = 398912.6 Ha: $\alpha 1 = 0$ *Probability* = 0,000		Ho: $\alpha 1 = 1$ *Chi-Square* = 9.554635 Ha: $\alpha 1 = 0$ *Probability* = 0,002	

Note: Values in the parethes are t-statistic

These results reinforce the study conducted by Pattinasarany (1997) for the case of Indonesia that there is no co-integration between the change in the exchange rate with the inflation rate in the consumer price index price level, other studies support the no co-integration in the long run is Hoque (1995), Edison (1997), Menezes & Resende (1995), Al-Zyoud (2015). And vice versa study Pippenger (1993) and Ramirez & Khan (1999) that the PPP hypothesis applies to long-term. Implicit termination of the PPP doctrine indicative barriers (protection) in international trade. This level of protection will result in the traded goods turn out to be non -traded goods. Whereas the fundamental assumptions in the PPP doctrine is all goods are goods trade. Second, the PPP termination doctrine also demonstrates the integration of the Indonesian capital market to foreign capital markets especially the U.S. capital markets.
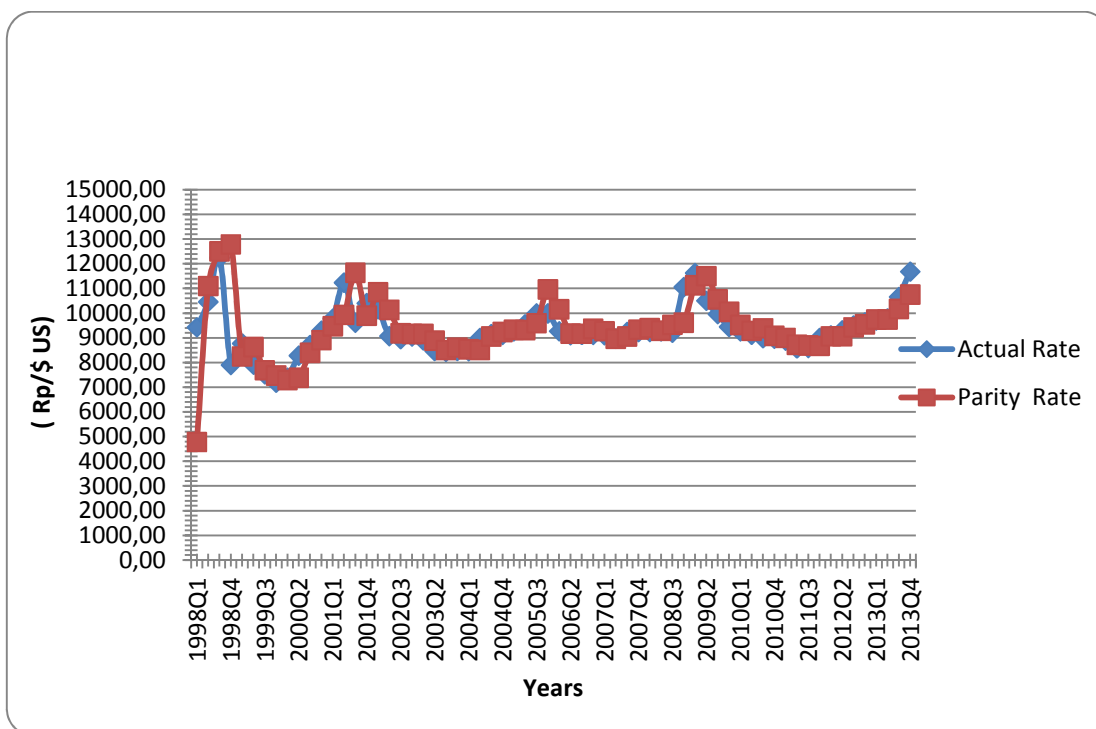
Sources: International Financial Statistics, 2014

Figure 2. Actual and Parity Exchange Rate (Rp/$ US)

Since free-floating exchange rate system in August 1997, rupiah with respect to the US dollar tends to fluctuate. Rupiah exchange rate is influenced by factors of demand and supply on the US dollar. These factors include the export-import activity and the movement of investments from abroad. Another factor that greatly affects the movement of the exchange rate is inflation as explained by the theory of purchasing power parity (PPP). According to this theory, the current and future inflation will affect the behaviour of the exchange rate of a country's currency. Countries with a higher inflation rate would depreciate its exchange rate.

Figure 2 shows that the actual rupiah exchange rate and parity rate based on the formula PPP moves in the same direction. The average value of the actual exchange rate Rp / $ US is underestimated or undervalued by 2.28%. If Indonesia inflation rate is higher than inflation in the USA, the rupiah exchange rate will depreciate. It can be concluded that if inflation in Indonesia remains higher than inflation in the US, the rupiah exchange rate will continue to depreciate. Based on the theory of PPP, the rupiah exchange rate will stable if inflation in Indonesia equal to inflation in the USA. The rupiah exchange rate will appreciate, if inflation in Indonesia lowers than inflation in the US. Therefore, Bank Indonesia should be concern to manage the inflation in Indonesia.

Based on the theory of PPP, the first key factor of controlling the exchange rate is the rate of inflation. However, the characteristic of inflation in Indonesia is mainly due to the price of goods controlled by the government such as the price of energy and seasonal factors (the crops failure or due to the fasting month and Eid). By examining the characteristics of inflation in Indonesia, the efforts to control inflation cannot rely on Bank Indonesia, but also depend on the government and private sectors to maintain the supply of goods and services for the community.

Conclusion

The first conclusion from this study, that during free floating exchange rate system, rupiah exchange rate to U.S. dollar is undervalued to the exchange rate parity (PPP). Second, PPP doctrine to the case of the rupiah to the U.S. dollar is not valid in the period of this study. From the results of this study indicate that under conditions of free market, there are still protections of international trade in both the goods market and the capital market. Therefore, the policy implications that the government should reduce the level of protection in the international goods market and the capital market in order to accelerate the integration Indonesian with foreign market.

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