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Testing Black Market vs. Official PPP: A Pooled Mean Group Estimation Approach

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Abstract: Testing purchasing power parity (PPP) using black market exchange rate data has gained popularity in recent times. It is claimed that black market exchange rate data more often support the PPP than the official exchange rate data. In this study, to assess both the long run stability of exchange rate and the short run dynamics, we employ Pooled Mean Group (PMG) Estimation developed by Pesaran et al. (1999) on eight groups of countries based on different criteria. Using the famous Reinhart and Rogoff (2002) dataset on black market exchange rate in the framework of Bahmani-Oskooee and Goswami (2005), the results are in sharp contrast with the most recent studies. We find very weak and insufficient support for the PPP using both the black market and the official exchange rate data. The assumption of long run homogeneity is also invalidated for some groups. Therefore, the results of PPP testing are not conclusive even though we switch from the official rate to the black market rate for a global data set. The finding holds even though we swap static panel for dynamic heterogeneous panel in the light of PMG estimation.

Keywords: Purchasing Power Parity (PPP), Pooled Mean Group (PMG) Estimator, Panel Data, Black Market Exchange Rate

JEL Classification Number: C23, F3

1. Introduction

Purchasing power parity (PPP) is one of the most pronounced terms in the field of international macroeconomics and finance. PPP, though first coined by renowned Swedish economist Gustav Cassel (1918) as an economic jargon in the early twentieth century, has an archaic history dating back to fifteenth and sixteenth century in Spain. The pundits at the University of Salamanca, through their writings, first led the way to the development of the

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concept of PPP (Officer, 1982). Though it had infinitesimal importance in the domain of economics until the twentieth century, the concept has gained vast popularity among the scholars in the field of international economics now a days. This admiration is manifested as an overflow of growing theoretical and empirical literatures in this field. Empirically, economists across the world test PPP either by trying to find the long run linkage between nominal exchange rates and relative prices or by investigating the stationarity of real exchange rates (Bahmani-Oskooee et al., 2007). However, analyzing the PPP using official exchange rates for countries, which have significant black market or parallel market exchange rates, will produce bias and incorrect inferences[1]. After Culbertson's (1975) instrumental paper that laid down the theory of black market exchange rate, a number of works make an attempt to test the validity of PPP using black market exchange rates; among them Phillips (1988), Edwards (1989), Bahmani-Oskooee (1993), Baghestani (1997), Luintel (2000), Hassanain (2005), Bahmani-Oskooee et al. (2007), Bahmani-Oskooee and Tankui (2008) and many others conclude that black market exchange rates support PPP more often than the official exchange rates. In other words, market forces are better represented by the black market exchange rate.

If we examine the literature carefully we can observe that the findings of the studies which use black market exchange rates need to go through a rigorous examination in the framework of dynamic heterogeneous panel estimation technique which makes a sound balance between homogeneity on the one hand after retaining the individual heterogeneity in a dynamic set-up on the other. The added advantage of this approach is that we can work with the global dataset with different groups based on some classification even if the data are non-stationary in nature. The purpose of this paper is to investigate the validity of the PPP primarily by using both the official and the black market exchange rates under heterogeneous dynamic panel data method. The main distinguishing feature of this paper is to particularly explore the black market and the official PPP in the framework of country-specific heterogeneity in the short run and homogeneity in the long run.

The layout of the paper is as follows: section 2 outlines the econometric methodology for modeling the PPP theory, the variables under the study and the sources of data, section 3 presents the empirical results and the findings, and section 4 concludes the study.

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[1] Bahmani-Oskooee et al. (2007) state that parallel market exchange rates, which is determined by market forces, can serve as an excellent proxy for floating exchange rates because official exchange rates are either fixed or subject to government or other interventions, specially for developing, transitional and less developed countries (Bahmani Oskooee and G. Goswami, 2005).

2. Model, Variables and Data

It is imperative to understand the econometric methodology proposed in this paper. In this study we want to explore the long run equilibrium of exchange rate along with cross section heterogeneity, which may arise due to country specific factors since country specific factors play a vital role when time series is longer. In this regard, Pesaran et al. (1999) state that two procedures are widely used for "large N, large T" panels. These are Mean Group (MG) estimator and Pooled Mean Group (PMG) estimator[2].

Pooled Mean Group estimator involves the estimation of the ARDL models and their error corrections-representation for the estimation of the long-run relationships. Applying this PMG estimation framework to the specification of PPP that does not require any a priori restriction as suggested by Bahmani-Oskooee and Goswami (2005), we construct the panel version of the model in an Autoregressive Distributed Lag [ARDL (p, q, q... q)] FE framework is represented as follows:

$$\ln EX_{it}^{BM} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} \ln EX_{i,t-j}^{BM} + \sum_{j=0}^{q} \delta_{1ij} \ln P_{i,t-j} + \sum_{j=0}^{q} \delta_{2ij} \ln P_{i,t-j}^{US} + \varepsilon_{it} \qquad (1)$$

$$\ln EX_{it}^{OM} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} \ln EX_{i,t-j}^{OM} + \sum_{j=0}^{q} \delta_{1ij} \ln P_{i,t-j} + \sum_{j=0}^{q} \delta_{2ij} \ln P_{i,t-j}^{US} + \varepsilon_{it} \qquad (2)$$

where equation (1) for black market rate, and (2) for official exchange rate, $\ln EX_{it}^{BM}$ and $\ln EX_{it}^{OM}$ represent the natural logarithm of black market and official nominal exchange rates respectively, $\ln P_{it}$ represents the natural logarithm of each country's consumer price index (CPI)[3], and $\ln P_{it}^{US}$ represents the natural logarithm of US consumer price index (CPI). We expect that $\delta_1>0$, which states that increase in domestic prices leads to an increase in the nominal exchange rate, whereas the coefficient $\delta_2<0$ means that increase in foreign prices leads to a decrease in nominal exchange rate *ceteris paribus*. The re-parameterization of the above two equations can be formulated as suggested by Pesaran et al. (1999):

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[2] Under MG estimator, separate equations for each N are run and the averaging of parameters does produce consistent estimates. On the other hand, PMG estimator fuses the characteristics of MG estimator and typical pooled estimators in such a way that it allows heterogeneity in the short run coefficients, speed of adjustment, and error variances across groups, but proposes homogeneity in the long run coefficients for each N.

[3] We use the Producer Price Index (PPI) data for Brazil and Ireland in place of CPI for few periods due to the unavailability of CPI data for those two countries.

$$\Delta \ln EX_{it}^{BM} = \alpha_i + \phi_i \ln EX_{i,t-1}^{BM} + \beta_{1i}' \ln P_{it} + \beta_{2i}' \ln P_{it}^{US} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta \ln EX_{i,t-j}^{BM}$$
$$+ \sum_{j=0}^{q-1} \delta_{1ij}^{*\prime} \Delta \ln P_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2ij}^{*\prime} \Delta \ln P_{i,t-j}^{US} + \varepsilon_{it} \qquad (3)$$

$$\Delta \ln EX_{it}^{OM} = \alpha_i + \phi_i \ln EX_{i,t-1}^{OM} + \beta_{1i}' \ln P_{it} + \beta_{2i}' \ln P_{it}^{US} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta \ln EX_{i,t-j}^{OM}$$
$$+ \sum_{j=0}^{q-1} \delta_{1ij}^{*\prime} \Delta \ln P_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2ij}^{*\prime} \Delta \ln P_{i,t-j}^{US} + \varepsilon_{it} \qquad (4)$$

where equation (3) is for black market rate, and (4) for official exchange rate. We use the GAUSS program produced by Pesaran et al. (1999) after having necessary transformations or adjustments based on the requirement of our study.[4] The lag length has been selected based on the Akaike Information Criteria (AIC). We set the maximum lag length to be three as outlined by Pesaran et al. (1999).

We classify all the countries related to our study into eight groups: first of all we group the countries for which we have dataset from 1957; later on seven groups[5] are formed based on World Bank classification of countries, which is based on income, debt burden, and region. These seven groups are: high income countries, low income countries, upper middle income countries, lower middle income countries, highly indebted poor countries (HIPC), OECD and European Monetary Union (EMU). The original source of data for monthly price indices is International Financial Statistics 2005 CD-ROM of the IMF. The monthly black market exchange rates and official bilateral exchange rates, however, come from Reinhart and Rogoff (2002) dataset. No black market rate data are available beyond December, 1998.

3. Empirical Results

We present only the tables of the PPP testing with the black market exchange rate data for the first group of thirty three countries into this study. This group consists of countries from different continent, income groups, cultures, and other economic patterns. For this group, the speed of adjustment parameter (ϕ_i) becomes smaller in absolute value in most

[4] a) For the iteration procedure of the long run parameters of the maximum likelihood estimation under this study, initial estimates have been taken from Mean Group estimation.
b) To download the original GAUSS program produced by Pesaran et al., visit http://www.econ.cam.ac.uk/people/emeritus/mhp1/wp.htm#1999

[5] Due to the unavailability of data, the time series lengths of different country groups are not equal.

of the cases as we switch from the ARDL estimation to the PMG estimation using both the black market (Table 1) and the official exchange rates[6]. The lower value of ϕ_i represents slower speed of adjustment of any deviation from the equilibrium state due to any shock in the process. This is the indication of the impact of country specific factors on the adjustment process. Furthermore, the negative signs of the error correction coefficient (ϕ_i) represent the existence of cointegration among the variables under the PMG framework, yet a non-significant one. Another interesting thing to note is the positive signs for some of the coefficients of adjustment parameter under ARDL framework. Therefore, it is a straightforward improvement in the speed of adjustment parameter under PMG framework, except the positive sign for Japan. However, the significance of the speed of adjustment parameter falls down for most of the cases under PMG framework, which is not desirable. As for the short run coefficients of lnP and lnP^{US}, there is an improvement in the signs of the coefficients under PMG model using the black market exchange rate (Table 1) than the official exchange rate. After investigating the long run coefficients of lnP and lnP^{US} of the ARDL procedure (Table 2), it is very clear that both the variables are giving mixed results about the correct signs and significances of the estimates. This is almost same whether we are using the black market or the official exchange rates.

It is now necessary and sensible to figure out if there is any gain from PMG model over ARDL, FE, or MG approach. It is seen from the Table 3 that all of the three panel estimations provide theoretically consistent signs of all the coefficients using black market rate. On the other hand, only the FE panel estimation provides theoretically consistent signs of all the coefficients under the official exchange rate. In case of FE, it is surprisingly visible that the coefficients are highly significant, whereas one of the two coefficients is highly significant under PMG method using both the black market and the official rate. The estimated joint Hausman test statistics are 9.25 and 4.93 with associated p-values 0.01 and 0.08 respectively for black market and official exchange rates. Hence, the null hypothesis of homogeneity of slopes in the long run is not accepted under black market rate, whereas the same hypothesis cannot be rejected under the official rate at 5% level. However, the individual Hausman test statistic suggests that the data do not reject the restriction of common long run coefficients, thereby validating the use of PMG estimator, which would appear to be an acceptable and informative procedure. In a word, the findings are not conclusive and the test results for other groups are also not robust to model specification, area or types of countries[7].

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[6] To save space the result for official market exchange rate is not being presented.

[7] The necessary tables for various groups of countries, which are not presented in this paper, are available upon request.

Table 1: Short-run Coefficients of the Pooled Mean Group vs. Group-specific ARDL Estimates based on the AIC (Dependent variable: lnEX^{BM})

Group	Pooled Mean Group			ARDL		
	ECC (ϕ_i)	lnP_t	lnP^{US}_t	ECC(ϕ_i)	lnP_t	lnP^{US}_t
Argentina	-0.001 (0.15)	0.001 (0.15)	-0.0001 (0.13)	0.020 (1.21)	-0.027 (1.63)	0.156 (3.90)
Austria	-0.001 (0.35)	0.001 (0.35)	-0.000 (0.24)	-0.017 (1.76)	-0.044 (1.99)	0.029 (1.49)
Belgium	-0.002 (0.75)	0.002 (0.74)	-0.0001 (0.30)	-0.015 (1.83)	0.003 (0.20)	-0.005 (0.42)
Bolivia	-0.026 (2.17)	0.022 (2.15)	-0.001 (0.32)	0.0009 (0.04)	-0.008 (0.35)	0.074 (2.47)
Canada	-0.002 (1.23)	0.001 (1.23)	-0.0001 (0.31)	-0.016 (1.71)	-0.034 (1.68)	0.040 (1.85)
Chile	-0.004 (0.73)	0.003 (0.73)	-0.0002 (0.30)	0.011 (1.19)	-0.008 (0.89)	-0.031 (1.11)
Colombia	-0.025 (2.69)	0.021 (2.65)	-0.001 (0.32)	-0.018 (1.37)	0.010 (0.62)	0.021 (0.69)
Costa Rica	-0.016 (1.85)	0.014 (1.83)	-0.0007 (0.32)	-0.023 (2.00)	0.007 (0.59)	0.029 (1.70)
Ecuador	-0.023 (2.89)	0.020 (2.86)	-0.001 (0.32)	-0.006 (0.57)	0.0002 (0.01)	0.028 (2.25)
Egypt	-0.005 (0.96)	0.004 (0.96)	-0.0002 (0.31)	-0.032 (2.90)	0.017 (1.26)	-0.007 (0.36)
Finland	-0.002 (0.81)	0.002 (0.81)	-0.0001 (0.30)	-0.037 (3.10)	0.006 (0.34)	0.001 (0.03)
France	-0.0003 (0.13)	0.0003 (0.13)	-0.000 (0.12)	-0.017 (1.72)	-0.021 (0.88)	0.028 (0.96)
Greece	-0.009 (2.39)	0.008 (2.36)	-0.0004 (0.32)	-0.054 (4.05)	0.017 (1.79)	0.037 (2.86)
India	-0.011 (2.00)	0.010 (1.98)	-0.001 (0.31)	-0.035 (2.83)	0.041 (2.04)	-0.031 (1.39)
Israel	-0.054 (3.44)	0.047 (3.39)	-0.002 (0.33)	-0.069 (3.52)	0.065 (3.31)	-0.037 (1.31)
Italy	-0.002 (0.90)	0.002 (0.90)	-0.0001 (0.30)	-0.031 (2.83)	-0.011 (0.52)	0.040 (1.14)
Japan	0.0002 (0.15)	-0.0002 (0.15)	0.000 (0.13)	-0.021 (2.31)	0.001 (0.07)	-0.017 (1.31)
Malaysia	-0.005 (1.94)	0.004 (1.92)	-0.0002 (0.31)	-0.005 (0.63)	0.037 (1.49)	-0.024 (1.32)
Mexico	-0.139 (4.22)	0.121 (4.21)	-0.006 (0.33)	-0.146 (4.33)	0.091 (2.83)	0.170 (1.98)
Netherlands	-0.001 (0.35)	0.001 (0.35)	-0.000 (0.24)	-0.026 (1.80)	-0.025 (1.13)	0.012 (0.54)
Norway	-0.002 (1.36)	0.002 (1.36)	-0.0001 (0.32)	-0.035 (3.28)	-0.048 (2.39)	0.062 (2.45)
Pakistan	-0.012 (2.11)	0.010 (2.08)	-0.001 (0.31)	-0.029 (2.10)	0.039 (1.93)	-0.033 (1.30)
Paraguay	-0.014 (2.59)	0.013 (2.56)	-0.001 (0.32)	-0.009 (1.14)	-0.007 (0.80)	0.039 (2.86)
Peru	-0.039 (2.52)	0.034 (2.48)	-0.002 (0.32)	-0.033 (2.02)	-0.027 (1.82)	0.031 (1.96)
Philippines	-0.011 (1.44)	0.009 (1.43)	-0.0004 (0.31)	-0.025 (2.24)	-0.003 (0.33)	0.040 (2.23)
Portugal	-0.004 (1.34)	0.004 (1.34)	-0.0002 (0.32)	-0.009 (0.77)	-0.032 (1.55)	0.094 (2.26)
South Africa	-0.030 (3.47)	0.026 (3.38)	-0.001 (0.32)	-0.072 (3.04)	0.039 (1.44)	0.013 (0.38)
Spain	-0.002 (1.00)	0.002 (1.00)	-0.0001 (0.31)	-0.021 (2.34)	-0.019 (1.16)	0.048 (1.60)
Sri Lanka	-0.006 (1.03)	0.005 (1.03)	-0.0002 (0.31)	-0.026 (2.53)	-0.003 (0.41)	0.033 (2.30)
Sweden	-0.003 (1.40)	0.002 (1.39)	-0.0001 (0.31)	-0.028 (2.94)	-0.054 (2.40)	0.079 (2.65)
Switzerland	-0.001 (0.39)	0.001 (0.39)	-0.000 (0.25)	-0.031 (2.71)	-0.048 (2.01)	0.013 (0.70)
UK	-0.001 (0.54)	0.001 (0.54)	-0.0001 (0.28)	-0.051 (3.39)	0.038 (1.14)	-0.040 (0.81)
Uruguay	-0.025 (2.04)	0.022 (2.04)	-0.001 (0.33)	-0.022 (1.56)	0.015 (1.07)	0.032 (1.00)

Note: ECC= Error Correction Coefficient. Figures in the parentheses represent the absolute values of the *t*-ratios.

Table 2: Group-specific ARDL Estimates of the Long-Run Coefficients based on Specification using the AIC (Dependent Variable: lnEX^{BM})

Group	$\ln P_t$	$\ln P^{US}_t$	Group	$\ln P_t$	$\ln P^{US}_t$
Argentina	1.343 (4.32)	-7.692 (1.36)	Malaysia	6.755 (0.62)	-4.327 (0.63)
Austria	-2.619 (1.28)	1.719 (1.00)	Mexico	0.624 (4.76)	1.161 (1.87)
Belgium	0.201 (0.20)	-0.312 (0.43)	Netherlands	-0.956 (0.89)	0.442 (0.47)
Bolivia	8.775 (0.04)	-80.686 (0.04)	Norway	-1.384 (1.95)	1.780 (1.98)
Canada	-2.178 (1.18)	2.567 (1.28)	Pakistan	1.350 (2.51)	-1.138 (1.39)
Chile	0.739 (2.17)	2.909 (0.87)	Paraguay	-0.829 (0.49)	4.392 (0.93)
Colombia	0.576 (1.01)	1.154 (0.51)	Peru	0.817 (14.81)	0.933 (1.20)
Costa Rica	0.302 (0.77)	1.273 (1.17)	Philippines	-0.136 (0.30)	1.578 (1.85)
Ecuador	0.025 (0.01)	4.675 (0.49)	Portugal	-3.446 (0.55)	10.067 (0.63)
Egypt	0.519 (1.69)	-0.230 (0.38)	South Africa	0.535 (2.23)	0.182 (0.35)
Finland	0.161 (0.34)	0.021 (0.03)	Spain	-0.919 (0.95)	2.328 (1.26)
France	-1.238 (0.67)	1.661 (0.72)	Sri Lanka	-0.097 (0.39)	1.262 (3.21)
Greece	0.314 (2.57)	0.684 (2.36)	Sweden	-1.957 (1.91)	2.847 (2.11)
India	1.170 (3.71)	-0.882 (1.85)	Switzerland	-1.575 (1.68)	0.430 (0.63)
Israel	0.931 (20.91)	-0.526 (1.59)	UK	0.747 (1.20)	-0.782 (0.83)
Italy	-0.350 (0.47)	1.260 (0.96)	Uruguay	0.679 (2.81)	1.493 (0.72)
Japan	0.029 (0.07)	-0.781 (1.97)			

Note: Figures in the parentheses represent the absolute values of the t-ratios.

Table 3: Alternative Panel Estimates using Black Market Exchange Rate

Coefficient	Fixed Effect Estimator (FE)	Mean Group Estimator (MG)	Pooled Mean Group Estimator (PMG)	Hausman Test (h-test)	Joint Hausman Test	p-value
ϕ_i		-0.028 (5.62)	-0.014 (3.21)			
$\ln P_t$	0.988 (988.57)	0.270 (0.68)	0.871 (52.25)	2.30		0.13
$\ln P^{US}_t$	-0.961 (188.84)	-1.531 (0.61)	-0.041 (0.34)	0.35		0.55
					9.25	0.01

Note: Figures in the parentheses represent the absolute values of the t-ratios.

4. Conclusion

Until recently, most of the studies on PPP theory using black market or official exchange rate data are purely based on modern cointegration techniques or unit root testing with non-linear adjustments. In this study, PPP theory has been discussed with the help of heterogeneous dynamic panel data, more specifically with Pooled Mean Group (PMG) estimation procedure introduced by Pesaran et al. (1999). We intend to explore the empirical evidences suggesting that black market exchange rate supports PPP theory more often than the official exchange rate.

Among the eight groups of countries studied in this paper, it is found that there exists cointegrating relationship among the variables for most of the countries under the classification of high income, EMU, HIPC, OECD, and the first group of thirty three countries. For the rest of the groups, cointegrating relationship has been found for some of the countries. Moreover, these cointegrating relationships are not significant, which cast a shadow on the existence of long run PPP. There is also a rising concern over the test procedure for some groups of countries regarding homogeneity issue. It is revealed that PMG estimation procedure performs well using black market data for high income and upper middle income countries. For low income, lower middle income, upper middle income and EMU, official exchange rate has performed well with PMG estimation. Finally, PMG procedure cannot be used even though black market data perform well for the three groups: group of thirty three countries, EMU and OECD. The reason is that long run homogeneity is absent in those groups. Moreover, long run coefficients are found to be non-significant for several groups that are clear indications of the weak support for the PPP. Besides, the significance and signs of the coefficients are not robust to changes in the lag selection procedures for most of the groups, which also demonstrate a very insubstantial support for the PPP with either black market or official data. Similar results have been found by Adler and Lehmann (1983), Manzur (1990), Huang and Yang (1996), Ahking (1997), and Bahmani-Oskooee and Goswami (2005). They all have failed to detect the long run stationarity of PPP using different types of tests. All these results are very much consistent with Rogoff's (1996) findings, which state that various types of frictions exist in reality to keep international market away from the possibility of price convergence. Nevertheless, it should be noted carefully that the results may also be tainted by the selection of time periods and countries chosen within the group.

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