REAL EXCHANGE RATE BEHAVIOUR: A REPLICATION AND ROBUSTNESS CHECK

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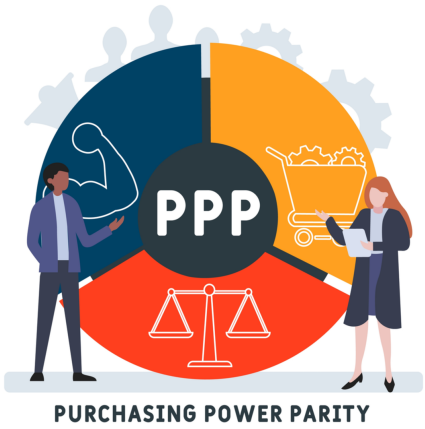

Econometrics 871: Time Series Project

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1. Introduction

How do we compare living standards and economic productivity between countries? This is one of the questions that macroeconomics attempts to answer, and a number of tools have been developed within the field to this end. One of these tools is the Purchasing Power Parity (PPP) theory, which uses a basket of goods to compare the currencies of different countries. This theory has been widely tested using data, and the results have been divisive and somewhat puzzling (El-Gamal & Ryu (2006)). In this essay, I replicate[1] the paper "Real Exchange Rate Behaviour: Evidence from Black Markets" by Luintel (2000), which tests the PPP hypothesis. Luintel (2000) finds that the behaviour of the real exchange rate is mean-reverting in the long-run, which suggests that the PPP theory is empirically supported. I include some other tests in addition to those presented in the paper as a robustness check on these results.

This essay[2] is organised as follows. Section 2 contextualises Luintel's paper and discusses the robustness checks. Section 3 discusses the data and reports the results of the Wald-Wolfowitz tests. Section 4 deals with the unit root tests and section 5 reports the results of the variance ratio test. The code for this replication can be found on Github here.

2. Context and Evaluation

Luintel (2000) investigates whether the PPP hypothesis holds empirically. To test this theory, Luintel (2000) uses monthly black market real exchange rates (in terms of the US dollar) from eight developing Asian countries: India, Sri Lanka, Myanmar, Malaysia, Pakistan, Philippines, Taiwan and Thailand. Using data from developing countries (rather than from developed countries) was a novel approach for its time. The black market rates are used as a proxy for the float rates of developing countries.

Practically, the paper has two main aims: the first is to determine whether there are segmented trends in the data, and the second is to test whether the panel data is stationary. At the time that this paper was written (early 2000s), the puzzle of PPP was that tests for unit roots failed to reject the null hypothesis. The null hypothesis in these cases was the presence of unit roots; these tests implied non-stationarity and discredited PPP, despite the support from economic theory(El-Gamal & Ryu (2006)).

Luintel (2000) makes use of (more) powerful unit root tests for heterogeneous panels, and finds that real exchange rates are mean-reverting. This was novel for the time as most time-series studies rejected PPP and concluded that the real exchange rate followed a random walk. This suggested that any

[1] More accurately, try my best to replicate
[2] This essay was written in R using the package by Katzke (2017)

shocks to the real exchange rate were persistent and there was no mean-reversion either in the short or long term (Rogoff (1996)). Luintel (2000) finds that the black market real exchange rates do not behave in an excessively volatile manner, which conflicted with the findings of the literature at that time. Additionally, the findings of the study implied that such empirical investigations may not necessarily suffer from survivorship bias.

A critical part of Luintel's paper is testing for unit roots in the panel data; specifically, the paper makes use of the Im-Pesaran-Shin (IPS) T-bar test. In addition to replicating this test, I implement several other unit root tests as a robustness check and find that the results are mixed. Luintel (2000: 170) defends the choice of the IPS tests well, citing that they allow for the dynamics and error variances across groups and these tests may have better small sample properties. I run the IPS tests using Luintel (2000)'s specified lags, and the AIC method. I then implement the panel stationarity tests proposed by Levin, Lin & James Chu (2002), Maddala & Wu (1999), Hadri (2002), as well as a bootstrapped panel unit root test from Palm, Smeekes & Urbain (2011)..

3. Data

The data used for the analysis is a series on black market nominal exchange rates and consumer price indices (CPI) for 8 developing Asian countries, namely: India, Sri Lanka, Myanmar, Malaysia, Pakistan, Philippines, Taiwan and Thailand. I take a subset of these countries by excluding Taiwan[3] from the analysis. Luintel (2000) sources data from various issues of *Pick's Currency Year Book* and *World Currency Year Book*. The data used for Luintel's paper is accessible through the Journal of Applied Econometrics archive, which is where I attained my data. The sample period runs for 31 periods from January 1958 to June 1989. This sample period is split into two parts: Bretton Woods and after Bretton Woods (also referred to as pre-float period and the float period).

The nominal exchange rates are units currencies per unit of US dollar. There were two mistakes in the nominal exchange rate datasets: for Myanmar November 1974, there was a value of 1.45, which I replaced with 16.5 (based on interpolation). And for the Philippines in September 1975, there was a value of 0.7 with which I replaced with 7.7 (based on interpolation).[4] Luintel sources the CPI figures from various issues of International Financial Statistics (which are included in Luintel's dataset available in the JAE data archives).

To calculate the real exchange rates, I follow the lead of Luintel (2000: 165) and apply the following formula to the nominal exchange rates:

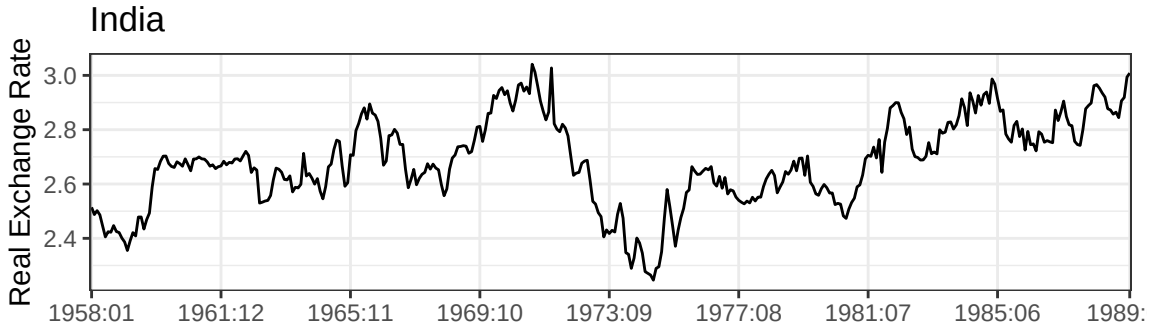
[3] I excluded Taiwan because there is some data missing from the set and I don't know how to manage an unbalanced panel. However, it is also interesting to test if the results of the paper hold when taking a subset of the data.

[4] I discovered these mistakes when there was a dramatic difference in my plots of the real exchange rates and Luintel's plots.

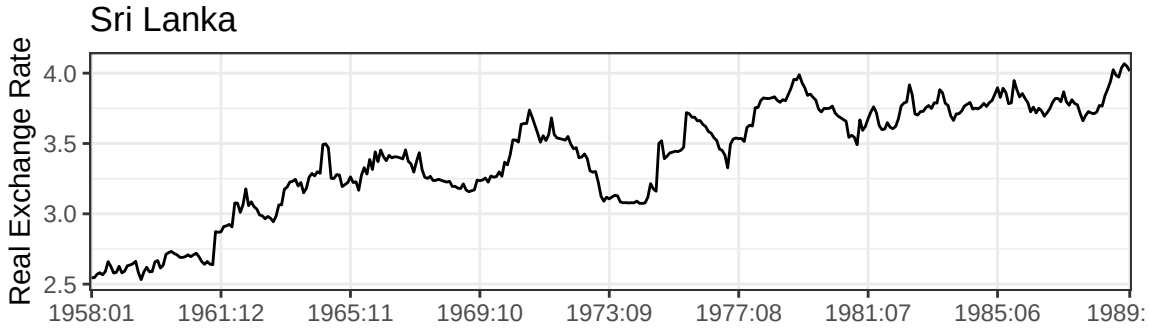
$$rex = log(NominalExchangeRate) - log(CPI) + log(UnitedStatesCPI)$$

I plot the real exchange rate series below in 3.1. The plots below match those of Luintel (2000: 166) and preliminarily indicate that the real exchange rates are trending. Additionally, the graphs show that the black market exchange rates are somewhat volatile. As expected, we see that after the first oil shock of 1973 the currencies appreciated and then slowly reverted. The plots suggest that the trends are segmented. Luintel (2000: 169) tests this hypothesis using formal tests, and I follow suit - the results of the Wald-Wolfowitz Tests are reported below after the plots, in table 3.1.

Real Exchange Rates Plot



Source: Own Calculations



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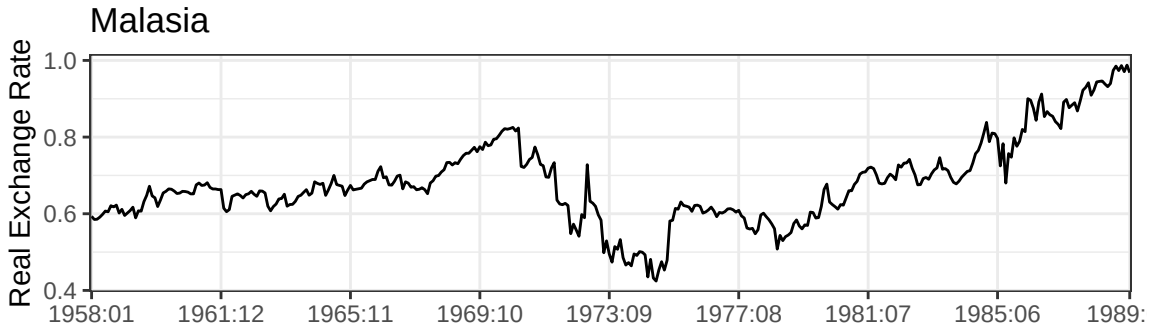

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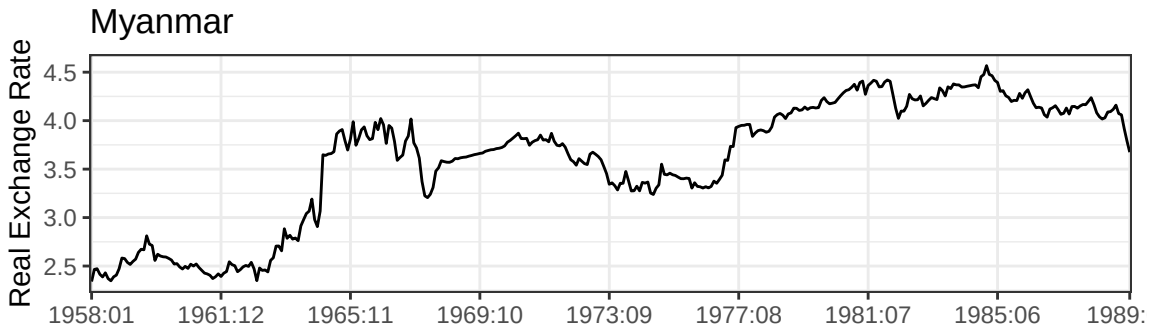

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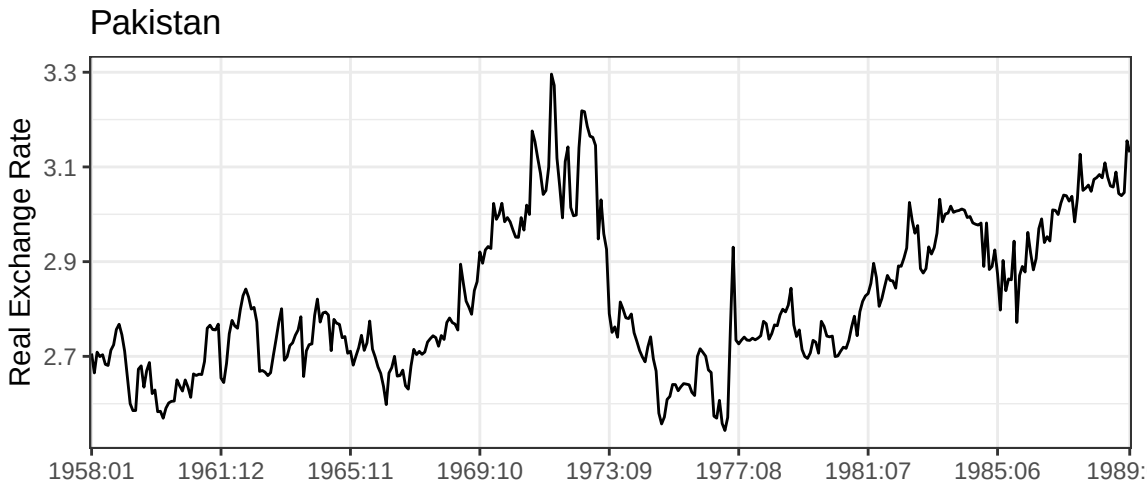

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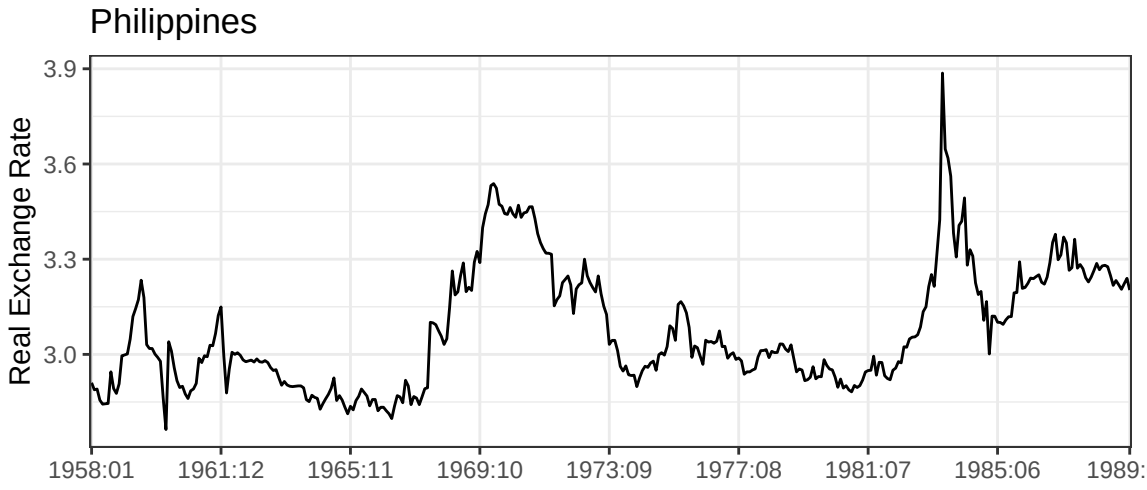

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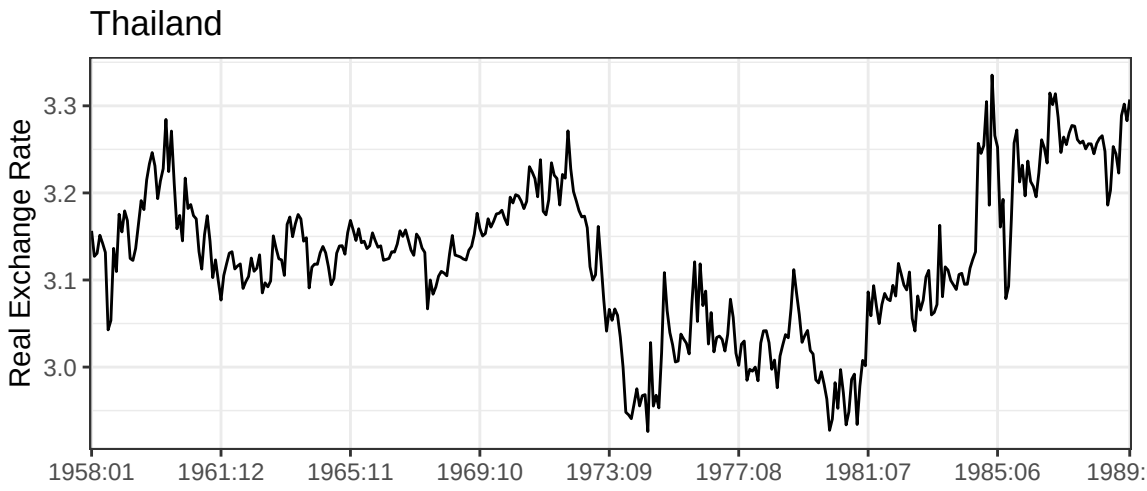

Source: Own Calculations

Figure 3.1: Plot of Real Exchange Rates over Time

3.1. Wald-Wolfowitz Tests

The Wald-Wolfowitz test is a nonparametric test that discriminates between the underlying distributions of the Bretton Woods and post Bretton Woods real exchange rates. Essentially, it tests whether two random samples are from populations with the same distribution (this is the null hypothesis), or whether the two samples descend from populations with different distributions (the alternative hypothesis).[5]

The critical values for this test at 1% and 5% are 2.58 and 1.96 respectively. 3.1 shows that the tests reject the null hypothesis at a 1% significance level for all the countries. These results imply that the Bretton Woods real exchange rates descend from a population that follows a distribution that may differ in skewness, kurtosis and dispersion from that of the post Bretton Woods. This suggests that it is important to include the Bretton Woods period in our analysis of real exchange rates. Luintel (2000: 169) reports smaller test statistics, but rejects the null comfortably for all of the countries.

Table 3.1: Wald-Wolfowitz tests

Test/Country	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
Wald-Wolfowitz	-16.07	-18.54	-17.10	-18.23	-16.27	-17.10	-15.96

4. Unit Root Tests

We can define relative PPP as:

$$\Delta s_t = \Delta p_t - \Delta p_t^*$$

This relationship shows that the percentage change in the nominal exchange rate should be equal to the difference in inflation between the domestic and foreign country. The real exchange rate (q_t) is given by:

$$q_t = s_t - p_t + p_t^*$$

From 4 we can see that the real exchange rate should be zero or a constant if PPP holds continuously. To test whether PPP holds, we can test whether the real exchange rate is stationary. Luintel (2000) argues that the power of unit-root tests is significantly higher when using a panel data set as opposed to a univariate time series. The first panel unit-root test that Luintel (2000) runs is the Augmented Dickey-Fuller test, which fails to reject the null hypothesis (there exists a unit root, and therefore the process is nonstationary) for all the countries. The only exception is for Pakistan in the post Bretton Woods period. My replicated tests show similar results in 4.1, with most countries failing to reject

[5] Luintel (2000: 169) gives the mathematical details of the test.

the null (with the exceptions occurring at a 5% level for four countries post Bretton Woods[6]). Both Luintel (2000) and my tests include a time trend, but the non-stationary results hold when excluding this trend.

However, the Dickey-Fuller tests are known for their low power. Low statistical power means we have a higher probability of committing a type 2 error: failing to reject the null hypothesis when the alternative hypothesis is true. In our context, this means we may be incorrectly concluding that real exchange rates are nonstationary. Thus, we need to consider other tests when testing for stationarity, which are discussed below.

Table 4.1: Augmented Dickey-Fuller Tests

Countries	Full Sample	Bretton Woods (1958:1-1973:3)	Post-Bretton Woods (1973:4-1989:6)
India (Rupee)	-2.70	-2.07	-3.66
Sri Lanka (Rupee)	-3.22	-2.11	-2.44
Malaysia (Ringgit)	-1.47	-2.12	-3.77
Myanmar (Kyat)	-1.53	-1.71	-0.16
Pakistan (Rupee)	-3.35	-2.63	-5.91
Phillipines (Peso)	-3.09	-2.07	-3.20
Thailand (Baht)	-2.44	-3.36	-3.93

As noted by Breitung & Pesaran (2005: 18), when using country data for macroeconomic applications, there are often contemporaneous correlations within the time series, which is a relevant concern for testing the PPP hypothesis. There may be unobserved common factors or spatial spillover effects, which need to be accounted for in the unit root test. Modelling cross section dependence in panel data sets is still an emerging field, but Pasaran, Im & Shin (1997) suggest that the appropriate test statistic is the T-bar test based on cross-sectional demeaned regressions. This is the approach that I take below (Im-Pesaran-Shin T-bar test). I use the same lags as Luintel (2000) for the first IPS T-bar test. For the full sample: Malaysia(l) and Thailand(1), for the Bretton Woods period: Thailand(1), and for the post Bretton Woods period: Malaysia(l) and Thailand(1). The IPS test is run on the cross-sectionally demeaned data.

The results (4.2) of the first IPS tests show that the null hypothesis is rejected at a 1% level of significance for the full sample. This supports a stationary real exchange rate and therefore is evidence towards the PPP. Luintel (2000: 173) finds similar results. However, for the Bretton Woods and Post Bretton Woods, my test fails to reject the null hypothesis, whereas Luintel (2000) rejects the null at 1%. This difference could be due to a difference in how the data was demeaned or because I am testing a subset of currencies.

[6]India, Malaysia, Pakistan and Thailand

Table 4.2: IPS Panel Unit Root Tests (Tbar)

Period	Test	T-statistic	P value	Trend	Lags
Full Sample	IPS	-3.00	0.00	No	Luintel
	IPS	-2.14	0.02	Yes	Luintel
Bretton Woods	IPS	-0.76	0.22	No	Luintel
	IPS	-0.76	0.22	Yes	Luintel
Post Bretton Woods	IPS	-0.71	0.24	No	Luintel
	IPS	-0.71	0.24	Yes	Luintel

Next, I rerun the IPS test and use Akaike's information criterion (AIC) to select the lags as a robustness check on the first IPS test. The results (4.3) show that the null hypothesis is rejected at 1% for the full sample and for the post Bretton Woods period. This implies there is no unit root present, and real exchange rates are mean-reverting in the long run. This supports the findings of Luintel (2000). However, the test again fails to reject the null for the Bretton Woods period, which is contrary to Luintel (2000)'s results.

Table 4.3: IPS Panel Unit Root Tests (Tbar)

Period	Test	T-statistic	P value	Trend	Lags
Full Sample	IPS	-2.55	0.01	No	AIC
	IPS	23.41	0.05	Yes	AIC
Bretton Woods	IPS	-0.33	0.37	No	AIC
	IPS	11.87	0.62	Yes	AIC
Post Bretton Woods	IPS	-3.36	0.00	No	AIC
	IPS	23.99	0.05	Yes	AIC

As a further robustness check on the results of Luintel (2000), I test the panel for unit roots using the tests proposed by Levin, Lin & James Chu (2002) (LL), Maddala & Wu (1999) (MadWu), Hadri (2002) (Hadri). I used the package by Millo (2017) to run these tests. For the Levin, Lin & James Chu (2002) and Maddala & Wu (1999) tests I again used AIC for the lag selection. The Hadri (2002) test directly tests for stationarity and has as the null hypothesis that all the panels are (trend) stationary.

The results presented in 4.4 show that all Levin, Lin & James Chu (2002) tests fail to reject the null hypothesis (i.e. there are unit roots present). The only Maddala & Wu (1999) test that rejects the null hypothesis is the one for post Bretton Woods when a trend is included. Otherwise this test suggests that the real exchange rate is nonstationary. All Hadri (2002) tests reject the null hypothesis at a 1%

level of significance. A rejection of the null here is an indication of nonstationarity. These results can be interpereted in two ways. They can suggest that real exchange rates are nonstationary, the PPP doesn't hold empirically and Luintel (2000)'s results are not robust. Or these results support Luintel (2000)'s claim that the IPS test is the correct test to use because other unit root tests are too weak to correctly identify stationary processes.

Table 4.4: Various Panel Unit Root Tests

Period	Test	T-statistic	P value	Trend	Lags
Full Sample	LL	-0.51	0.31	No	AIC
	LL	1.01	0.84	Yes	AIC
	MadWu	17.47	0.23	No	AIC
	MadWu	13.90	0.46	Yes	AIC
	Hadri	233.20	0.00	No	NA
	Hadri	171.05	0.00	Yes	NA
Bretton Woods	LL	-0.32	0.37	No	AIC
	LL	1.44	0.92	Yes	AIC
	MadWu	16.80	0.27	No	AIC
	MadWu	8.94	0.84	Yes	AIC
	Hadri	165.47	0.00	No	NA
	Hadri	100.18	0.00	Yes	NA
Post Bretton Woods	LL	0.47	0.68	No	AIC
	LL	-0.94	0.17	Yes	AIC
	MadWu	10.51	0.72	No	AIC
	MadWu	51.41	0.00	Yes	AIC
	Hadri	224.04	0.00	No	NA
	Hadri	108.94	0.00	Yes	NA

As a final check on the stationarity of real exchange rates, I employ a panel bootstrap group-mean union test as proposed by Palm, Smeekes & Urbain (2011). The test has a null hypothesis that all series have a unit root. If the null is rejected then some proportion of the series is stationary. I also ran the test on the cross-section demeaned data (in addition to the non-demeaned data) for the full sample. The results are shown in 4.5. The test fails to reject the null for both series, which suggests the panel is non-stationary. This undermines the results of Luintel (2000). However, the number of runs for the test was 1000[7], which is quite low for bootstrapping and the test may be giving inaccurate results.

[7]My laptop struggled with runs higher than this unfortunately.

Table 4.5: Bootstrapped panel unit root tests

Test	Test Statistic	P value
Panel	-0.82	0.28
Panel Demeaned	-0.86	0.19

5. Variance Ratio Test

Luintel (2000: 174) makes use of the variance ratio test to examine the persistence in real exchange rates. The variance ratio V^k is defined as:

$$V^k = \frac{Var(y_t - y_{t-k})}{k \times Var(y_t - y_{t-1})}$$

where k is the lag length, $Var(y_t - y_{t-k})$ and $Var(y_t - y_{t-1})$ are the variances of kth difference and the first difference of a time series y_t. Luintel (2000: 174) goes into detail of the intuition and the interpretation of this test. I replicate this test, and table (5.1) shows results for the full sample for up to 20 months. The results of the variance ratio test for the Bretton Woods period and post Bretton Woods period (for up to 20 months[8]) can be found in the Appendix (6). I find the same variance ratios as Luintel (2000) for all the countries. My standard errors (se) were slightly larger because the formula I used for the variance was different[9] but the qualitative results remain similar. For all the countries except Myanmar, the variance ratios are all significantly different from zero for k ranging from 1 - 70, and the cut-off lag length is 70 for all the countries. According to Luintel (2000), this suggests that the real exchange rates (for the countries other than Myanmar) are stationary. The two sub-periods show similar results (6).

Table 5.1: Variance Ratio Test for Full Sample Up to month 20

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
2	1.00	0.95	0.79	1.04	0.91	0.91	0.74
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
3	1.02	0.86	0.79	1.05	0.81	0.86	0.68

Continued on next page

[8]The results for 190 months are available upon request; it has been omitted to save space

[9]I tried to replicate the variance formula as it is in the paper but it kept breaking the code of the function I built, unfortunately

Table 5.1: Variance Ratio Test for Full Sample Up to month 20

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
4	1.01	0.87	0.75	1.00	0.71	0.82	0.58
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5	0.95	0.89	0.73	0.98	0.65	0.80	0.52
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
6	0.91	0.90	0.73	0.95	0.61	0.77	0.48
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
7	0.86	0.91	0.69	0.93	0.58	0.76	0.44
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
8	0.83	0.90	0.69	0.92	0.56	0.77	0.42
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
9	0.81	0.89	0.66	0.90	0.53	0.81	0.40
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
10	0.81	0.88	0.63	0.89	0.50	0.79	0.39
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
11	0.81	0.88	0.61	0.91	0.49	0.79	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
12	0.83	0.88	0.57	0.95	0.46	0.78	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
13	0.86	0.87	0.57	0.96	0.47	0.79	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
14	0.88	0.87	0.57	0.98	0.48	0.79	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
15	0.90	0.88	0.57	1.00	0.48	0.80	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
16	0.92	0.88	0.57	1.02	0.49	0.79	0.37
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
17	0.92	0.89	0.58	1.03	0.49	0.78	0.36
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
18	0.92	0.88	0.59	1.04	0.49	0.77	0.36
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
19	0.91	0.88	0.60	1.05	0.50	0.76	0.36
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10
20	0.90	0.87	0.62	1.08	0.52	0.75	0.36
se	0.10	0.10	0.10	0.10	0.10	0.10	0.10

6. Conclusion

Luintel (2000) performs a number of tests to show that real exchange rates are stationary and thus PPP holds empirically. My replication of the IPS test and variance ratio test support the results of the paper. However, the robustness checks of using other panel unit root tests show that real exchange rates are nonstationary. This undermines the results and conclusions reached by Luintel (2000). An interesting study would be to extend the panel (in terms of the time dimension and include more countries) and apply unit root testing to ascertain whether real exchange rates are stationary.

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Appendix

Table 6.1: Variance Ratio Test for Bretton Woods period up to month 20

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
2	1.06	0.88	0.80	1.03	1.01	1.02	0.79
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
3	1.03	0.80	0.73	1.01	0.92	0.90	0.72
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4	0.99	0.77	0.66	0.95	0.76	0.84	0.61
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
5	0.92	0.79	0.59	0.93	0.61	0.81	0.50
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6	0.88	0.80	0.56	0.91	0.55	0.79	0.47
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
7	0.84	0.80	0.53	0.90	0.50	0.79	0.39
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
8	0.82	0.80	0.55	0.89	0.49	0.81	0.36
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
9	0.80	0.80	0.55	0.88	0.44	0.83	0.36
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
10	0.80	0.78	0.56	0.87	0.39	0.82	0.36
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
11	0.79	0.78	0.56	0.90	0.36	0.81	0.37
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
12	0.80	0.78	0.53	0.96	0.34	0.82	0.35
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
13	0.83	0.76	0.53	0.98	0.35	0.84	0.35
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
14	0.86	0.74	0.55	1.00	0.36	0.85	0.34
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
15	0.90	0.74	0.56	1.04	0.35	0.87	0.32
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
16	0.88	0.72	0.56	1.07	0.34	0.87	0.31
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
17	0.89	0.71	0.56	1.09	0.33	0.87	0.30
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
18	0.89	0.71	0.56	1.10	0.34	0.88	0.31

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Table 6.1: Variance Ratio Test for Bretton Woods period up to month 20

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19	0.87	0.70	0.57	1.11	0.35	0.88	0.31
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20	0.84	0.69	0.58	1.15	0.36	0.89	0.32
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Table 6.2: Variance Ratio Test for post Bretton Woods period up to 20 months

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
2	0.95	1.01	0.78	1.05	0.78	0.85	0.71
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
3	0.99	0.91	0.80	1.14	0.68	0.84	0.66
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
4	0.98	0.93	0.75	1.14	0.61	0.82	0.58
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
5	0.93	0.94	0.76	1.12	0.60	0.81	0.53
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
6	0.88	0.94	0.73	1.06	0.54	0.78	0.49
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
7	0.82	0.94	0.69	1.02	0.50	0.76	0.45
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
8	0.77	0.92	0.68	1.00	0.45	0.76	0.44
se	0.14	0.14	0.14	0.14	0.14	0.14	0.14
9	0.75	0.89	0.62	0.98	0.40	0.81	0.40
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
10	0.75	0.86	0.60	0.98	0.39	0.79	0.38
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
11	0.75	0.85	0.55	0.98	0.38	0.79	0.34
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
12	0.76	0.84	0.51	0.99	0.37	0.78	0.33
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
13	0.76	0.82	0.47	1.00	0.39	0.78	0.32
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
14	0.75	0.83	0.45	0.99	0.40	0.77	0.32

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Table 6.2: Variance Ratio Test for post Bretton Woods period up to 20 months

Months	India	SriLanka	Malaysia	Myanmar	Pakistan	Philippines	Thailand
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
15	0.73	0.83	0.43	0.98	0.39	0.77	0.31
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
16	0.72	0.83	0.42	0.99	0.39	0.75	0.31
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
17	0.72	0.83	0.42	0.98	0.38	0.74	0.30
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
18	0.71	0.81	0.42	0.98	0.38	0.72	0.28
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19	0.68	0.80	0.42	0.99	0.38	0.70	0.27
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20	0.64	0.78	0.41	0.99	0.39	0.68	0.25
se	0.15	0.15	0.15	0.15	0.15	0.15	0.15