The Law of One Price and the Purchase Power Parity theory: a review

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Content:

1. Introduction

Purchasing Power Parity (PPP) is a theory according to which the price of a same basket of goods in different countries expressed in a common currency should be equalized, at least in the long run and in the absence of transportation costs and other frictions. This theory is used to make predictions on what the value of the nominal exchange rate should be in the future (equal to the ratio of price levels), thus allowing to estimate by how much a currency is currently under- or over-valued, and to make a prediction on the currency' future appreciation or depreciation. Another implication of the PPP theory is the following: if converted in a foreign currency at the nominal exchange rate calculated according to the PPP, a unit of the domestic currency should have the same purchasing power in the foreign country. The nominal exchange rates implied by PPP then can be used to convert the real GDP of different countries in a common currency (for example, the U.S. dollar), making the standard of living of these countries comparable. The objective of this thesis is to present a review of the studies that empirically test whether this theory matches the reality.

There are two main factors in the exchange rate: inflation and the balance of payments. We will explain very briefly how inflation affects the exchange rate, while we will not focus on the balance of payments, although this is a factor that would helps us explain the fluctuations in the real exchange rate. Regarding inflation, we can say that the PPP assumes that all countries are equally competitive; goods and services have the same cost; the real exchange rate is always equal to 1 (later we will explain the PPP concept in more detail). Just to make an example:

Variation in JPY / EUR = Inflation Japan - Inflation Germany

That is, currencies tend to depreciate in case of high inflation rates and appreciate in low inflation environments.

This theory does not work in the short term, but it has been shown that it may in the long term, so that it can be useful to explain the effect of inflation on exchange rates, as we will see in more detail below.

The topic of Purchase Power Parity is so wide and interesting because there are many variables that can affect PPP. Therefore, we will firstly introduce the concept of the Single Price Law (LOP) and then Purchase Power Parity (PPP) in order to understand

this phenomenon, followed by a study that has to do with the prices of the Big Mac, which is basically related to these concepts.

After that, we will focus on in two early studies, such as that of Isard (1977) and Richardson (1978) who studied the existing relationship of deviations from the single price law with movements in the exchange rate. Linked to this we will see a study based on US prices.

In the central part of this work, several studies are discussed to see whether PPP holds in the short and/or the long term (even a century), or if this is not the case, as many other studies found. All in all, we will investigate this issue in the short term, the medium term and the (very) long term.

Finally, we will analyze the Balassa-Samuelson hypothesis, which is a modification of the PPP and introduces the concept of partial productivity of purchasing power parity. This hypothesis is centered on two main points:

1. The fact that the consumer price levels in the poorest countries are lower than in the richest countries (Penn effect).

2. Productivity varies more in tradable goods sectors than in other sectors. (Productivity or productivity growth rates).

2. Law of One Price and Purchasing Power Parity

The law of one price (LOP) is the theory according to which the same good should be sold in different places at the same price if prices are expressed in the same currency, if there were no tariffs, transportation costs, or nontariff barriers. Taking the example given in Feenstra and Taylor (2012) book, we have two countries, the United States and Holland, trading diamonds. A given diamond costs 5.000€ in the Holland market and the exchange rate is 1,20$/€. If the LOP holds, the same diamond should be sold in New York for 6.000$ (= 5.000€ x 1,20$/€). In an equilibrium situation, there must not be arbitrage opportunities, so if this does not hold there would be an arbitrage situation, where you can buy this diamond in the cheaper market and sell it in the more expensive market. (Feenstra and Taylor, 2012).

Now that we know what LOP is, we are able to explain Purchase Power Parity (PPP). PPP is the law of one Price but taking a group of goods instead of a single good. The idea of PPP is that being P_{USA} the price of a basket of goods in United States and P_{EUR} the price of this basket in Europe: if the law of one price holds for every single good in the basket, it will hold for the basket too. Therefore, LOP is a microeconomic idea and PPP is a macroeconomic idea.

To go deeper into PPP, it is necessary to calculate the relative price, represented by $q_{USA/EUR}$, of the basket of goods in each location.

$q_{USA/EUR} = (E_{\$/€}P_{EUR}) / P_{USA}$

$q_{USA/EUR}$: relative price of the basket in Europe versus United States (called Real Exchange Rate).

$(E_{\$/€}P_{EUR})$: price of the European basket expressed in dollars

P_{USA}: price of the American basket expressed in dollars

There are three different results about the relative price (q). The basket can be cheaper in the United States, cheaper in Europe or it can have the same price, then $E_{\$/€}P_{EUR} = P_{USA}$, this is $q_{USA/EUR} = 1$. When q=1 we can say that PPP holds.

We can distinguish two different version of the PPP concept: absolute PPP and relative PPP.

- Absolute PPP can be reformulated in terms of the real exchange rate: “PPP establishes that real exchange rate is equal to the unit”. (Feenstra and Taylor, pg 67). We can reorder the condition of no arbitrage, $E_{\$/€}P_{EUR} = P_{USA}$ to deduct the nominal exchange rate if absolute PPP holds.

  $E_{\$/€} = P_{USA}/P_{EUR}$

  This equation would help us to predict what the value of the nominal exchange rate should be in the long run.

- Relative PPP is derived from absolute PPP, but focuses on the rate of change of the exchange rate and prices. If the last equation holds for absolute PPP, then relative PPP must hold too:

  $\Delta E_{\$/€,t}/E_{\$/€,t} = \pi_{USA,t} - \pi_{EUR,t}$

  where $\Delta E_{\$/€,t}/E_{\$/€,t}$ is the depreciation rate of the nominal exchange rate, and

  $\pi_{USA,t} - \pi_{EUR,t}$ is the inflation differential.

Once we got the basic idea about main concepts, we are going to briefly talk about one implementation of the PPP theory, the Big Mac Index calculated by The Economist newspaper.

3. LOP evidences and some studies about it

Since 1986, based on the Law of One Price theory, The Economist newspaper compares the prices of McDonald's Big Mac hamburger (a uniform good) across selected countries to infer whether a currency is under- or over-valued with respect to the U.S. Dollar. Taking a look to Big Mac prices and converting all prices to Dollars using the current exchange rate, as we can see below in a graph made by *Statista*, what we do is to see if prices are equal in different countries, and if according to these prices the LOP holds.

Observing the graph below, we can say that the euro is undervalued against the dollar at the beginning of 2019. Why can we say this? Because the price in dollars of the Big Mac in Europe is lower than the price of the Big Mac in the United States, this is, the European currency must appreciate with respect to the dollar to adjust to the real exchange rate, measured by the purchasing power of a Big Mac.

As we can see only Sweden, Switzerland and Norway have a more expensive Big Mac than the United States. Most currencies are undervalued against the dollar and the Big Mac is cheaper in the rest of countries in the list.

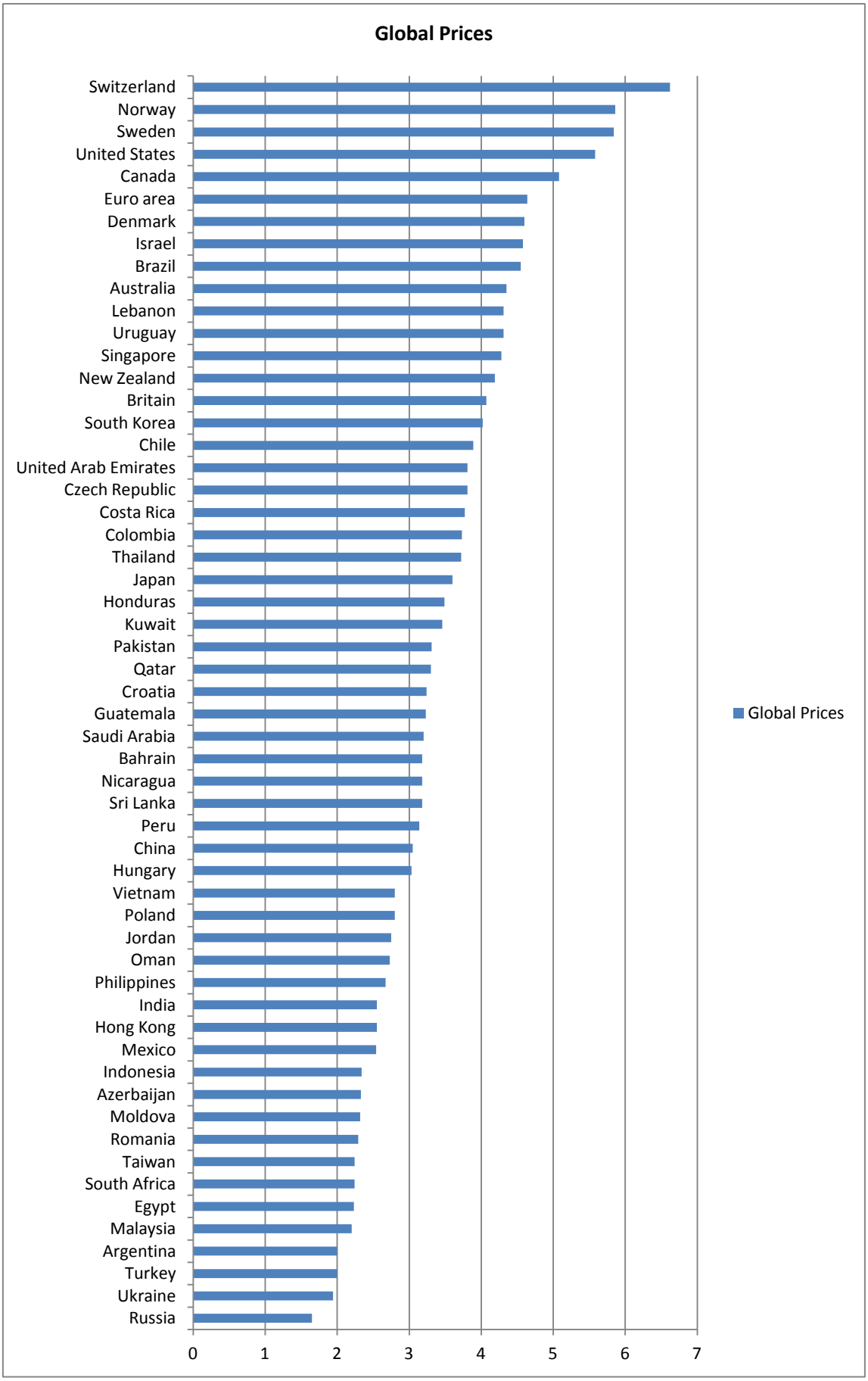

Global Prices
Switzerland
Norway
Sweden
United States
Canada
Euro area
Denmark
Israel
Brazil
Australia
Lebanon
Uruguay
Singapore
New Zealand
Britain
South Korea
Chile
United Arab Emirates
Czech Republic
Costa Rica
Colombia
Thailand
Japan
Honduras
Kuwait
Pakistan
Qatar
Croatia
Guatemala
Saudi Arabia
Bahrain
Nicaragua
Sri Lanka
Peru
China
Hungary
Vietnam
Poland
Jordan
Oman
Philippines
India
Hong Kong
Mexico
Indonesia
Azerbaijan
Moldova
Romania
Taiwan
South Africa
Egypt
Malaysia
Argentina
Turkey
Ukraine
Russia
0
1
2
3
4
5
6
7
Global Prices

Figure 1. Global prices for a Big Mac in January 2019, by country (in U.S dollars)

Source: (Statista, January, 2019)[https://www.statista.com/statistics/274326/big-mac-index-global-prices-for-a-big-mac/ Accessed on April, 2019]

I. Isard and Richardson studies

Next we are going to have a look at the work by Isard (1977) and Richardson (1978) that are two of the first studies that have empirically tested the Purchasing Power Parity theory.

It is true that the law of one price deviations are highly correlated with the exchange rate movements, and this can be proved thanks especially to the studies made by Isard and Richardson, where they show the volatility of prices in the law of one price.

Isard (1977)

Isard (1977) proposed a model with a few goods produced in several homogeneous countries. Isard assumed absence of transport costs and trade clampdown, with a perfect commodity arbitrage to make sure that each good should have the same price expressed in the same currency. Given these assumptions Isard (1977)'s theory predicted that the law of one price was true.

However, Isard (1977) shows that this theory is violated empirically, as evidenced by the fact that exchange rate changes persistently modify the relative dollar equivalent prices.

Figure 2 displays the nominal exchange rate, the price of paper products, and of apparel between 1968 and 1975, “stressing that there is strong evidence that relative dollar prices of apparel and paper products have not fluctuated about constant levels during the period of eight years, but rather have been influenced strongly by exchange rate movements” (Isard, 1977, p. 943).

Table 1 collects data from 8 three-month period. This table compares movements in the exchange rate and relative prices. For most, the author found a parallelism

between changes in the exchange rate and the change in the relative price indexes. This does not happen for all goods, we can remark metalworking machinery, electrical industrial equipment, home electronic equipment, and glass products.

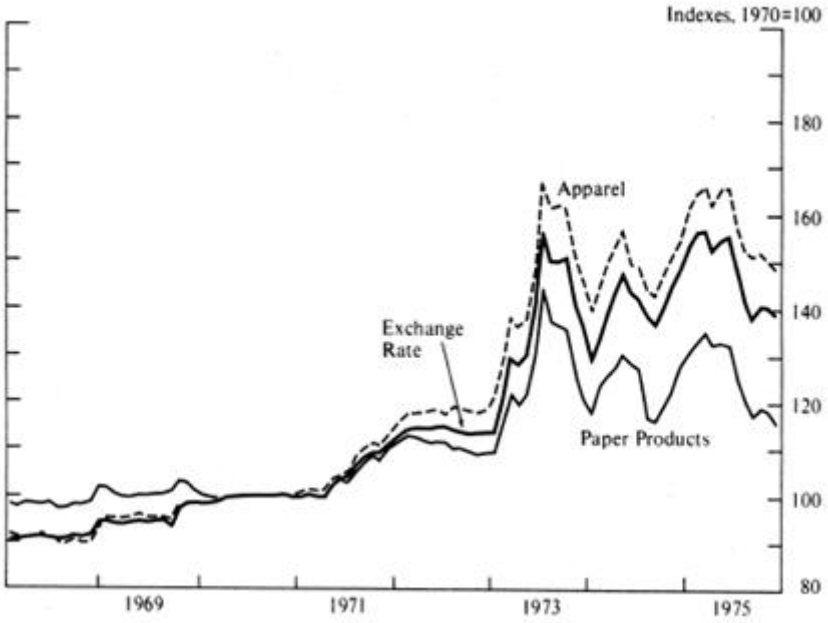


Figure 2. Nominal exchange rate, price of paper products and apparel between 1968 and 1975

Source: The American Economic Review, Vol. 67, No. 5 (Dec., 1977), p.944

	Jan.–Mar. 1968 to June–Aug. 1969	June–Aug. 1969 to Feb.–Apr. 1971	Feb.–Apr. 1971 to July–Sept. 1972	July–Sept. 1972 to Aug.–Oct. 1973	Aug.–Oct. 1973 to Aug.–Oct. 1974	Aug.–Oct. 1974 to Feb.–Apr. 1975	Feb.–Apr. 1975 to Oct.–Dec. 1975	Jan.–Mar. 1968 to Oct.–Dec. 1975
Exchange rate (dollars/mark)	4.07	5.85	14.14	31.33	−7.70	12.11	−9.90	53.94
German dollar price/ *U.S.* price								
Apparel	4.57	6.15	16.73	36.26	−10.52	13.61	−8.47	64.29
Industrial chemicals	6.17	3.36	9.91	43.92	−15.01	−13.47	−16.04	7.18
Agricultural chemicals	8.39	−4.51	9.02	37.36	14.37	−10.26	−27.05	16.06
Plastic materials	10.73	10.90	14.93	28.96	−20.23	−10.13	−13.11	13.37
Paper products	2.08	0.86	9.35	23.57	−14.12	13.92	−12.00	19.78
Metalworking machinery	10.68	20.66	14.23	33.52	−14.98	11.08	−12.04	69.18
Electrical industrial equipment	5.36	7.85	15.04	34.08	−5.06	8.88	−11.85	59.71
Home electronic equipment	10.99	8.07	10.87	38.32	−5.68	12.69	−9.22	77.51
Glass products	−0.47	−3.66	19.54	38.97	−11.61	4.44	−13.26	27.55

Table 1. Percentage changes in exchange rates and relative dollar price indexes between selected periods

Source: The American Economic Review, Vol. 67, No. 5 (Dec., 1977), p.944

We found two conclusions from this study:

- Movements in exchange rate entails short run changes in relative dollar price indexes for industries categories mentioned in the study.
- An important part of the relative price change in the short term persists for at least several years.

Once we talked about Isard (1977) study we are moving to Richardson (1978)'s one.

Richardson (1978)

Richardson (1978) found three conclusions after doing a regression study of disaggregated commodity arbitrage between the US and Canada:

1. The majority of basic goods can be described as nontradeable goods.
2. Goods arbitrage is imperfect.
3. Canadian prices invariably respond to the exchange rate and to the US prices.

Commodity arbitrage helps to understand the international transmission of inflation, the isolation of variable exchange rate (the value of one currency for the purpose of

conversion to another), the consequences on the exchange rate of different monetary growth rates, and purchasing power parity trends.

The expression that makes Canadian and U.S. prices of similar goods be equal given any commodity arbitrage is this:

$P_c = \beta_0 E^{\beta 1} P_{US}^{\beta 2} T^{\beta 3} R^{\beta 4}$

Where: P_c is the Canadian dollar price of the good, E is the Canadian dollar price of a US dollar, P_{us} is the US dollar price of the good, T is a measure of transfer costs (transport, insurance, tariffs, etc.), R is residual reasons why prices might differ, and β_0, β_1, β_2, β_3, β_4 are parameters .

Perfect commodity arbitrage and perfect substitutability of the Canadian and US goods would suggest that:

$\beta_0 = \beta_1 = \beta_2 = \beta_3 = 1$

$\beta_4 = 0$

and the previous equation would be a statement of the 'law of once price'. However, with perfect nontradeability, where we have absence of commodity arbitrage, would suggest that $\beta_1 = \beta_2 = \beta_3 = 0$

The empirical findings on disaggregated commodity arbitrage between the United States and Canada are summarized in the center of table 2. On the right, we have the database described, consisting in monthly observations on Canadian and U.S price indexes over the period 1965 through 1974.

The results of this study are the following:

1. Table 2 is a three-way classification of goods: we can reject with a 95% confidence the presence of commodity arbitrage for 13 out of the 22 groups. And we can affirm this in a more conclusive way for the last 7 groups.

2. A failure in the law of one price is observed. There is no empirical evidence about the existence of perfect commodity arbitrage with 95% confidence for all the groups in table 2.

3. The fact that we can only reject the hypothesis that $\beta_1 = \beta_2$ in only three out of 22 cases shows that exchange rates affect Canadian prices in the same way and to the same degree as US prices do.

Commodity group	Est. β_1[a]	Est. β_2[a]	Calc. t for $\beta_1=\beta_2$[b]	Calc. F[c]	D–W[d]	Canadian SIC code	U.S. SIC code	U.S. WPI code[e]	Observation period
Commodity arbitrage apparently present[f]									
Slaughtering and meat-packing products	0.43 (0.49)	0.52 (0.07)	−0.18	26.04	2.11	1010	2011+2031	02-21	65.1–73.12
Animal feeds	0.31 (0.50)	0.16 (0.04)	0.30	7.34	1.34	1230	2042	02-9	67.1–73.12
Distilled spirits	0.17 (0.14)	−0.62 (0.18)	3.27	6.09	2.25	1430	2085	02-61-02	67.1–73.12
Biscuits, crackers, and cookies	0.38 (0.27)	0.39 (0.12)	−0.03	6.34	2.05	1280	2052	–	67.1–74.6
Bakery products	0.43 (0.25)	0.18 (0.07)	0.41	5.03	2.23	1290	2051	02-11-01	65.1–73.12
Leather tanning products	0.06 (0.46)	0.78 (0.14)	−1.25	12.25	2.20	1720	3111	–	67.1–73.12
Pulp and paper	0.74 (0.16)	0.33 (0.05)	2.46	27.97	2.16	2710	2611	09-11	65.1–73.12
Agricultural implements and tractors	0.44 (0.15)	0.02 (0.04)	2.79	4.70	1.97	3110	3552	11-11	65.1–73.12
Fertilizers	0.19 (0.37)	0.32 (0.10)	−0.36	5.01	1.86	3720	2871	–	67.1–74.6
Commodity arbitrage possibly present[f]									
Poultry products	1.16 (1.07)	0.09 (0.08)	0.97	1.76	2.92	1030	2015	–	65.1–74.6
Fruits and vegetables	0.18 (0.17)	0.09 (0.09)	0.44	1.03	2.71	1120	2033+2034 +2035+2037	02-4	65.1–73.12
Wines and brandy	−0.28 (0.25)	−0.21 (0.12)	−0.27	1.94	1.97	1470	2084	–	65.1–74.6
Wooden commercial furniture	−0.06 (0.19)	0.37 (0.19)	−1.55	1.91	2.31	2640 001	2521	12-21	67.1–73.12
Gypsum products	0.01 (0.22)	0.11 (0.06)	−0.43	1.94	1.56	3450	3275	–	65.1–74.6
Ready mixed concrete	0.04 (0.19)	−0.31 (0.17)	1.60	1.95	1.94	3480	3273	–	65.1–74.6
No significant evidence of commodity arbitrage[f]									
Chewing gum	0.13 (0.19)	−0.04 (0.05)	0.92	0.64	1.86	1310 001	2073	–	65.1–74.6
Nonalcoholic beverages	−0.10 (0.21)	−0.08 (0.19)	−0.06	0.19	2.25	1410	2086	02-62	67.1–73.12
Brewing products	0.03 (0.36)	0.23 (0.39)	−0.37	0.18	1.36	1450	2082	–	65.1–74.6
Cigarettes	0.04 (0.32)	0.01 (0.10)	0.12	0.01	2.15	1530 010	2111	–	65.1–74.6
Malleable pig iron	−0.23 (0.50)	0.19 (0.21)	−0.79	0.55	2.21	2910 016	3312	–	65.1–74.6
Cement	−0.16 (0.18)	0.00 (0.06)	−0.89	0.42	1.99	3410	3241	13-22-01-31	67.1–73.12
Petroleum refining products	0.21 (0.24)	−0.13 (0.12)	1.17	0.79	1.84	3651	2911	–	67.1–72.12

Table 2. Commodity arbitrage

"[a]Standard errors in parentheses. Estimated intercepts (β'_0) insignificantly different from zero with 95 percent confidence in 21 out of 22 cases. [b]Calculated t on the hypothesis $\beta_1 = \beta_2$. High values of t suggest rejection of the hypothesis. Critical values of t for most of the commodity groups arc 0.68 (50 percent significance), 1.66 (10 percent significance), 1.99 (5 percent

significance), and 2.64 (1 percent significance), all for a two-tail test. [c]Calculated F on the hypothesis $\beta_1 = \beta_2 = 0$. High values of F suggest rejection of the hypothesis. Critical values of F for most of the commodity groups are 3.10 (5 percent significance) and 4.85 (1 percent significance). [d] -Durbin Watson statistic."

Source: Journal of International Economics, 1978, pp. 341-351

4. United States prices and the relation with PPP

The behavior of the real exchange rate with city price data has been studied for years. For example, in 1966, Engel and Roger pioneered their study, where they sought to compare the relative variability of price in the US and Canada. To do this, they used disaggregated consumer price indices for the city. Chen and Devereux extend the previous work made by Engel and Roger (1996) in order to consider the long run behavior of absolute price levels. We can define absolute price levels as what a consumer basket costs at a certain point. Analyze the study carried out by Chen and Devereux (2003), aimed to understand how the absolute price levels behave for some cities in the US is our first objective. The second objective is to understand why we cannot reject the non-stationarity of the real exchange rate for the real exchange rates of cities. We have to remark that this work has been performed by different economists: firstly Engel and Roger (1996) started the project, then Chen and Devereux (2003) improved that previous work, etc. Over the years, better techniques for conducting and improving the study were achieved.

Revisiting the work made by Chen and Devereux (2003), we have CPI indices for 19 cities from 1918. The cities are: New York, Philadelphia, Boston, Pittsburgh, Chicago, Detroit, St Louis, Cleveland, Minneapolis, Cincinnati, Kansas city, Washington DC, Baltimore, Houston, Atlanta, San Francisco, Los Angeles, Seattle and Portland. Each city CPI has the same base year, 1982-1980 = 100. So with the same base year we can compare the data.

Next we will see the dispersion of the price city level. We can find an increase of this level or a diminution. If this value increases we can affirm that the dispersion has augmented and vice versa. If the value has fallen we can say that there has been an improvement in market integration.

Figure 3 shows the dispersion of the average price level since 1918. As we can see, there has been a decrease over time.

Improvements in transportation and communications may be the reason we reached these results. We can say that the convergence of the price level is important. We can also point to the construction of the interstate highway system as an important factor for this.

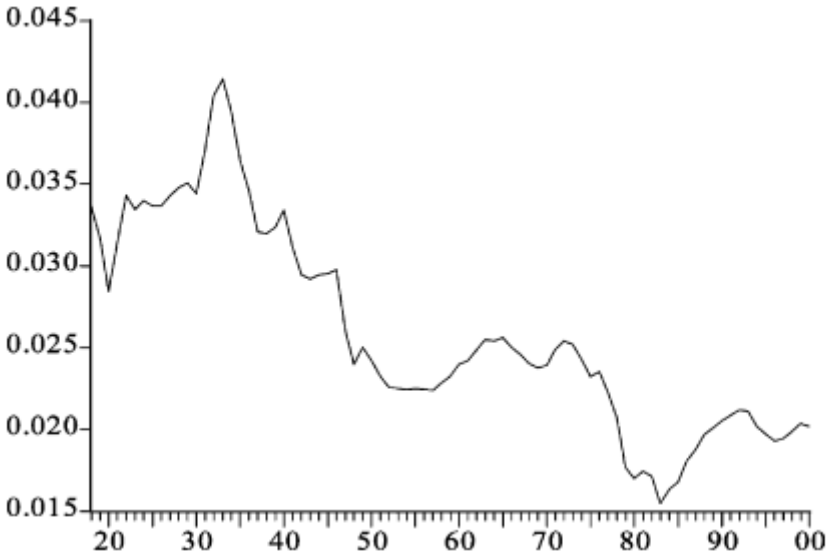


Figure 3. The dispersion of city price levels: 1918 – 2000

Source: L.L. Chen, J. Devereux / Journal of International Money and Finance 22, 2003, pp. 213–222

Studying the dispersion between tradeables and nontradeables goods we find two sub-indices of the CPI for a period between 1918 and 2000. These two sub-indices are rent and food. We can take food as the proxy for the tradeable goods and rent as the proxy for nontradeable goods. Figure 3 above shows us the dispersion price levels of food since 1918.

Analyzing the previous figure we can conclude that for all the time series the coefficient of variation for food prices is lower than for the overall price level. What could be the reasons for this? This could be mainly for two reasons; first, food prices have a larger traded component, and second, food price levels tend to converge over time. We see a decline since the 1920s, where the coefficient of variation stands at 0,023, to a level of 0,010 in 2000.

In figure 4 we find the dispersion of rents. We can see that the dispersion follows a downward path until 1950. However, after 1950 it follows a path of rise, in fact, in 2000 it returns to the level had in 1920. Note that in the 2000 the coefficient of variation of

rent is double that of the general price level and is four times higher than the food price level. After 1950 rents had a higher increase in the West and the North East of the US.

There are several reasons that can explain this difference in growth according to areas of the United States. One of the reasons may be the weather, this possible reason was dictated by Roback in 1982. Another possible reason for this may be the fiscal differences according to territories, as pointed out by Gyourko and Tracy in 1991. And finally, Rauch in 1993 pointed out that there is evidence that such differences in rent could be reflected in agglomerations in these territories.

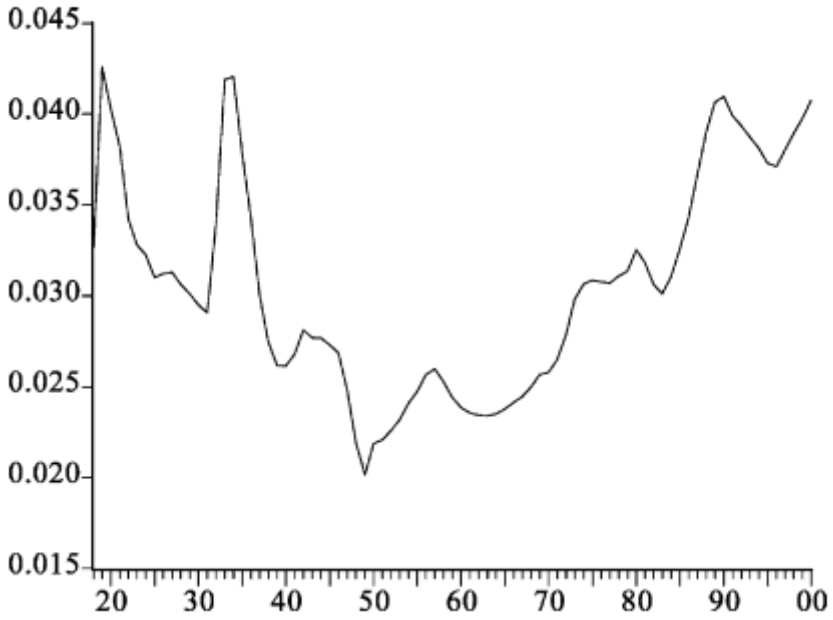
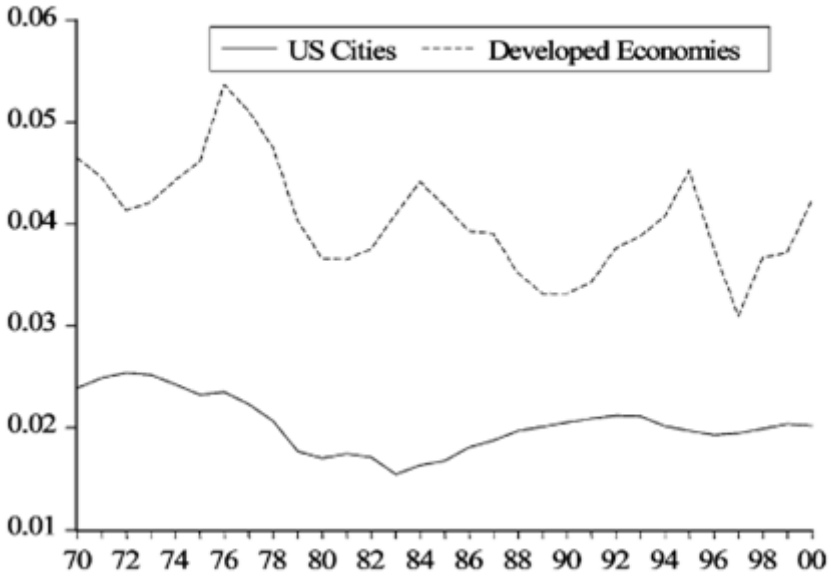


Figure 4. The dispersion of city rent levels: 1918 – 2000

Source: L.L. Chen, J. Devereux / Journal of International Money and Finance 22 (2003) 213–222

One question we can ask ourselves is, how can we compare the dispersion of the price level of cities in the United States with the dispersion of the price level internationally? In order to answer this question we will use Figure 5, which compares the dispersion of the absolute price level of the 19 cities of the United States with the international price data offered by the OECD.



The data is from 1970 to 2000.

Figure 5. Comparing the dispersion of US city price levels with the dispersion of price levels for developed OECD economies

Source: L.L. Chen, J. Devereux / Journal of International Money and Finance 22, 2003, pp. 213–222

Having in mind the explanation that Engel and Rogers made in 1996, where they say that markets are more integrated within countries, it is not surprising that the dispersion of the price level is lower across cities of the United States than internationally.

As it has been proven in other studies, the convergence of the city's price level will produce a non-stationarity of the bilateral real exchange rate, and non-stationarity in these circumstances cannot reject the PPP.

5. Convergence to PPP

Dornbush (1976) helps us in this part, talking about why PPP is not a short run movement. This is because of the stickiness in nominal prices, as we will go through below.

Long-run Convergence to PPP

The failure PPP in the short-run can be due to stickiness in nominal prices, as Dornbush (1976) said in his overshooting model on nominal and real exchange rate volatility. Convergence to PPP cannot be achieved in a few years, because it is a very slow movement.

Figure 6 presents movements in the relative (log) CPI levels of the United States and Germany (together) with the (log) DM/dollar exchange rate. The variance of relative price indices is lower than the variance of floating nominal exchange rates. This means that relative prices are more sticky than nominal exchange rates. This stuck on prices compared on nominal exchange rates impedes that PPP is reached in the short term.

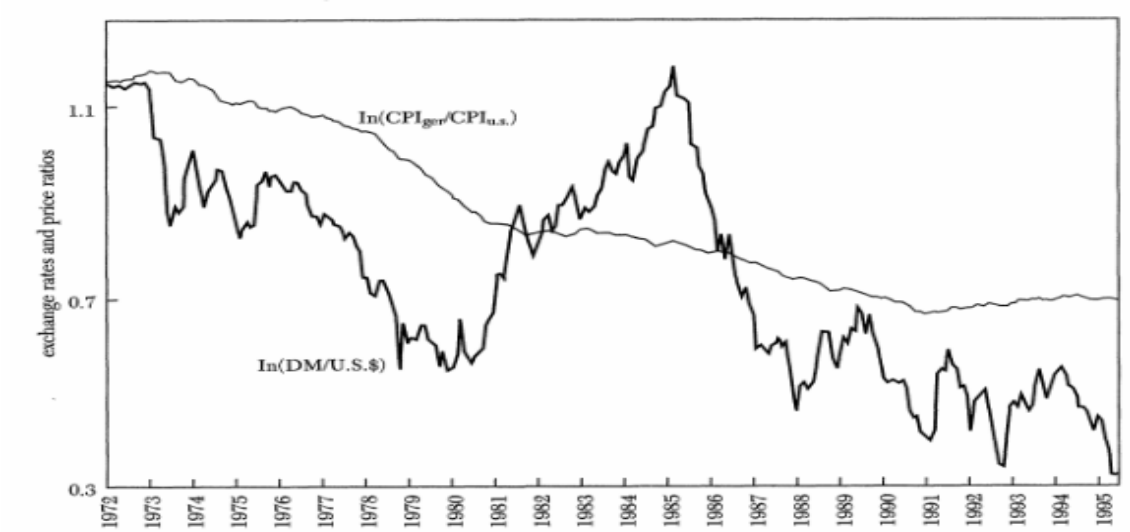


Figure 6. DM/U.S.$ exchange rate and ratio of German to U.S. CPIs, Jan. 1972-May 1995

Source: *Journal of Economic Literature*, Vol. 34, No. 2. (Jun., 1996), p. 651

Researchers, after doing this study they found it difficult to reject that real exchange rate in major countries under floating exchange rate regimes follow a random walk.

This means that the movements or changes in the variable do not follow a trend. They found it difficult to prove that there was any convergence toward PPP in the long run.

Figure 7 includes several data for a high number of countries between 1970 and 1998. The vertical axis represents the differentials of the accumulated inflation rate of the countries with respect to the United States in percentage, while on the horizontal axis we can find their accumulated depreciation rates against the US dollar in percentage as well. The two graphs on the left represent CPI inflation, consumer price indices. While the two on the right represent the inflation of the PPI, producer price indices. Above we see them with annual rates and below with average rates. The range is 29 years, spanning from 1970 to 1998.

This analysis shows that PPP does not hold in the short run because of deviations.
What is the reason that the relative PPP does not hold in the short term?
This is due to differences in annual inflation. When there are small differences, the correlation between relative inflation and depreciation is low and PPP does not hold in the short term. The author, Rogoff (1996), averages data over 29 years in the bottom graph trying to observe if relative PPP holds in the long run or not. Observing the bottom part of figure 7 we can say that relative PPP holds in the long run. We can explain the fact that relative PPP holds in the long run because of the linearity of the points observed in the bottom figures. The fact that points are on the line plotted tell us that convergence is true. We have to remark that we can affirm this if we take the Relative Consumer/Producer Price Inflation instead of Annual Consumer/Producer Price Inflation.

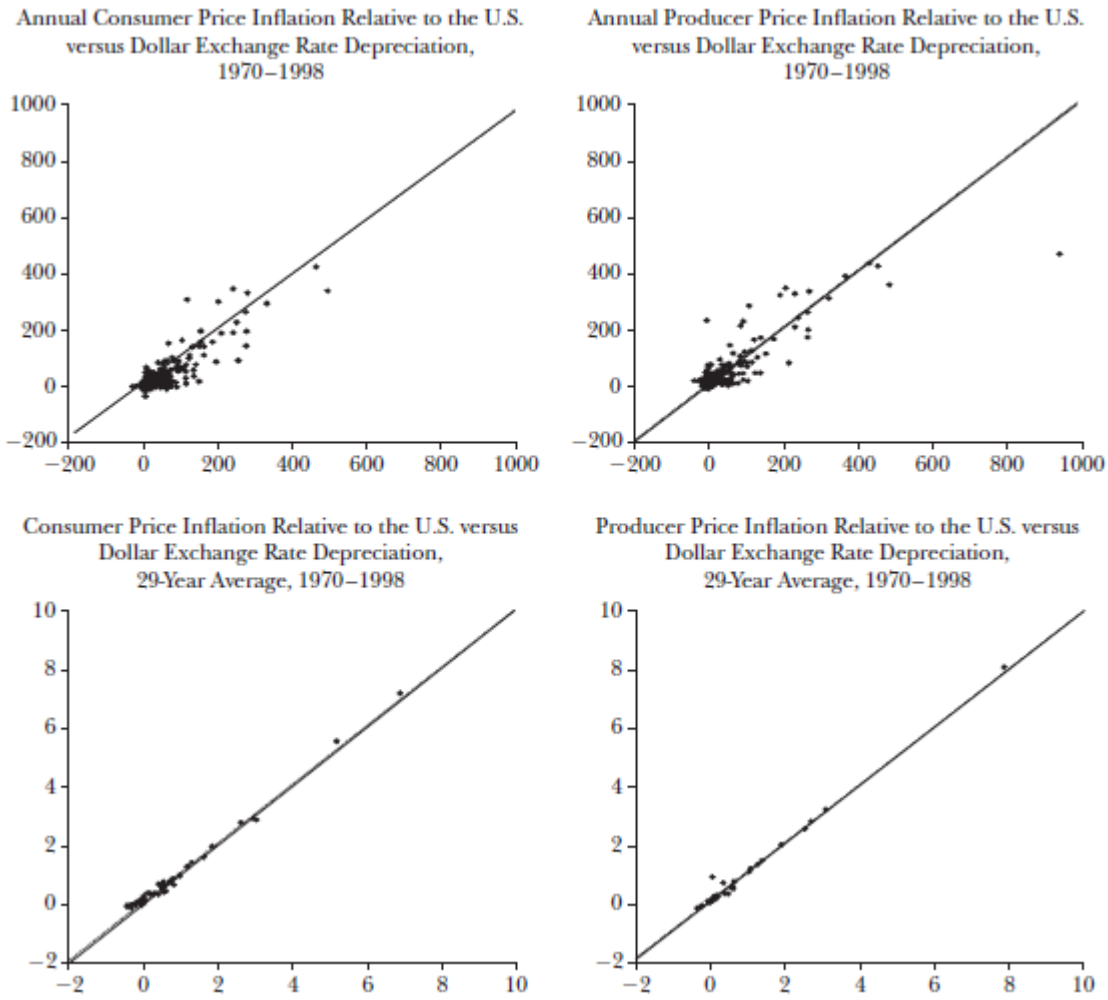


Figure 7. PPP at Various Time Horizons

Source: Journal of Economic Perspectives Volume 18, Number 4, 2004, p. 140

Once proved that PPP does not hold in the short run, one of the reasons for this is represented by sticky prices (Dornbusch, 1976). Roll (1979) and Adler and Lehmann (1983) studied the hypothesis which says that the real exchange rate mean reverts. They do not confirm that and concluded it rather follows a random walk, because of the efficiency of international markets.

Under this view, Roll (1979) said that “the change in the real exchange rate should have an expected value of zero if markets are efficient”. This study failed due to the real cost of financing goods arbitrage (Taylor and Sarno, 2004).

6. PPP studies

I. Revisiting purchasing power parity in G6 countries

In this section we elaborate on a work made by Jingfei Wu (School of economics, Shangai University), Mohsen Bahmani-Oskooee (department of economics, University of Wisconsin-Milwaukee) and Tsangyao Chang (department of Finance, Feng Chia University, Taiwan) in 2016. (Jingfei Wu & Mohsen Bahmani-Oskooee & Tsangyao Chang, 2018. "Revisiting purchasing power parity in G6 countries: an application of smooth time-varying cointegration approach,").

In this study G6 countries' (i.e., Canada, France, German, Italy, Japan, and the UK) purchasing power parity is tested over the 1971-2013 period. Authors found that exchange rates are in equilibrium between two countries when purchasing power matches. Based on this study, authors concluded that only in two of G6 countries (i.e, France and Germany) PPP matched in the long-run. So they found that deviations in the short run are prolonged for some of these G6 countries and there are no forces able to redirect exchange rate to its PPP values in the long run. So we can say that if PPP does not match at first, there are no mechanisms able to match PPP between two countries.

Another conclusion that authors found with this work is that not in every country of the Euro zone the euro adjusts to local prices. While in France and Germany euro adjusted to relative prices in the long run, in Italy this does not happen and could be due to rigidities in the Italian economy, compared to the French or the German ones.

Although we saw in the last study that in a period of 42 years there are no forces able to redirect exchange rate to its PPP values, we can look at an extended period, say a century. Will it be any way in which PPP converges? By converging we refer to the relative price of a basket in two different countries (q) being equal to 1.

II. **PPP over a century**

Before starting this section I would like to mark that the figures and tables I am going to work with can be found in the paper made by Yevheniya Hyrina and Apostolos Serletis in 2010.

As we already know, the theory of purchasing power parity is based on the law of one price. PPP implies (in its relative form) that changes in the exchange rate will be proportional to relative inflation, or equivalently, that relative goods prices are not affected by exchange rates.

After many different tests done to see if PPP holds, Mark (1990), Flynn and Boucher (1993), Serletis and Zimonopoulos (1997), Wu and Chen (1999), and Duekeer and Serletis (2000) conclude that PPP does not hold in the floating exchange rate systems.

However, not every researcher reaches the same conclusion, so there is a mix of verdicts regarding the validity of the theory of PPP.

The data set used comes from Taylor (2002) and consists of price indices and annual nominal exchange rates for 23 OECD countries. The 23 OECD countries are: the USA, the UK, Switzerland, Sweden, Spain, Portugal, Norway, New Zealand, The Netherlands, Mexico, Japan, Italy, Greece, Germany, France, Finland, Denmark, Chile, Canada, Brazil, Belgium, Australia and Argentina.

Taking as a reference the study carried out in 2010 by Yevheniya and Apostolis, where they calculated the real exchange rate, E, for the 23 OECD countries in relation to each of the four base countries; the United States, the United Kingdom, Japan and Germany, we find 88 real exchange rate series.

In the sample we can find several international monetary regimes, such as the gold standard, the Bretton Woods era and the modern floating system. This is because the time series runs from the late 19th century to the late 20th century.

To complete the missing data, a linear interpolation procedure was carried out in the analyzed study. In the figures that go from 1 to 23 (from the original paper mentioned before) we can find the series of the real exchange rate of each country compared to the four base countries. And in the tables that go from 1 to 4 (from the original paper) we find the exact sample period for each country.

Remember that by verifying if the real exchange rate is constant or stationary we can test the PPP theory. If this is stationary, we can say that there is evidence in favor of the PPA.

Yevheniya and Apostolis (2010) began the analysis by using standard unit root tests, the ADF test, the augmented weighted symmetric (WS) test and the Phillips and Perron (PP) test.

We can define the unit root test as checking whether a time series variable is not stationary. We normally define the null hypothesis as the presence of non-stationarity. We also find the ADF, Augmented Dickey – Fuller test, which is also based on the search for stationarity, like the unit root test but for a larger and more complex set of time series models. The Philips and Perron (PP) test is a variation of the ADF test, it is known that in a finite sample the PP test is less efficient that the ADF test. WS tests are stronger in the absence of structural breaks in a time series, stronger compared to ADF tests.

The p-values for the PP, WS and ADF tests are shown in columns 2-4 of tables 1-4. The null of a unit root are rejected at conventional significance levels. The null hypothesis, this is presence of non-stationarity, cannot be rejected in 73 out of 88 real exchange rate series. The unit root null is rejected in the case of the USA, Sweden, Spain, Norway, Italy, Belgium, France and Australia (with the UK as the base country), and in the case of the UK, Sweden, Norway, Italy, Canada, Belgium and Australia (with the USA as the base country). In columns 8-10 of Tables 1-4 is the test that they did of a second unit root. The series appear to be stationary in logarithmic first differences.

To ensure the robustness of the results there are reported the results based on the DF-GLS test in columns five of tables 1-4.

With a significance level of 5 percent, the null hypothesis cannot be rejected for more than 11 countries. The null hypothesis is rejected for Sweden, Italy, Brazil and Belgium (with the USA as the base country), Sweden, Norway, New Zealand, Italy and France (with the UK as the base country), for Switzerland (with Japan as the base country) and for Portugal (with Germany as the base country).

Lastly, in columns six and seven of Tables 1-4 we find the KPSS test statistics, where the null hypothesis of trend and level stationarity is tested. There seems to be evidence against PPP in tests of level stationarity for most countries with Germany as the base country (stationarity is rejected for 18 series), for all countries with Japan as the base

country, for most countries with the UK as the base country (stationarity is rejected for 14 series), and for most countries with USA as the base country (stationarity is rejected for 15 series). However, when the null hypothesis of trend stationarity is tested the opposite happens. Particularly this is rejected for only 41 out of 88 real exchange rate series.

We have seen that using different test procedures we find contradictory results, which indicates that a unit root is likely to exist, as pointed out by Yevheniya and Apostolos (2010). That there is a unit root means that there may be problems in statistical inference. This unit root would be found in the real exchange rate series in Table 5 for each real exchange rate.

Finally, due to the results they are against the PPP theory.

To sum up, we have reviewed the test of the theory of PPP for a sample of 23 OECD countries. In this test is used long, low-frequency data over a century. Real exchange rates were calculated for each of the 23 countries against each of four countries – the USA, the UK, Japan and Germany.

Experts used standard unit root tests (the ADF, WS, and Phillips-Perron tests) and found that the majority of the real exchange rate series are non-stationarity (with 73 out of the 88 real exchange rates series having a unit root). After all the tests, the evidence they got is against the theory of PPP.

We have seen, with the help of a hundred years time series test, that purchasing power parity hypothesis does not hold even in the long-run.

III. **Purchasing Power Parity in developing countries**

Reading Bahmani-Oskooee (1995), we observe that PPP is more likely to be met in countries with a high level of inflation. In order to check the validity of the evidence Mark J. Holmes (2001) studied the relation between PPP and high inflation countries. In this section I am going to describe the empirical methodology that Holmes used, the results he found and a brief conclusion about it.

Methodology

Thirty developing countries are involved in the study. Holmes used growth rate in real exchange rates, where P^i_t is the price level in country i, where i = 1,2,… n. P^*_t is the base country price level, and e^i_t is the country i' nominal spot price of foreign (base country) currency. By 'base country' we mean the country against which we compare other countries.

"Supposing absolute PPP, we should have $e^i_t = p^i_t / p^*_t$ which means that prices of a basket of goods expressed in the same currency are the same. If PPP holds then deviations from absolute PPP should be stationary, which means that real exchange rate, defined as $e^i_t p^*_t / p^i_t$, should not contain a unit root. Furthermore, deviations from PPP may occur on account of transport costs, tariffs, and differential speeds of adjustment in the goods and foreign exchange markets". (Holmes, 2001)

PPP can be transformed into relative terms, due to relative PPP can be used to compare country i and the base country in terms of inflation differential $\dot{e}^i_t = \dot{p}^i_t - \dot{p}^*_t$.

If we define $U^i_t = \dot{e}^i_t – (\dot{p}^i_t - \dot{p}^*_t)$ we find that U^i_t is the growth of the real exchange rate of country i. The stationarity of U^i_t may indicate that the deviations from the relative PPP are self-correcting. Then, the relative PPP can be confirmed if the U^i_t's of the sample of developing countries present stationarity.

The data and results

The thirty developing countries included in the sample are: Argentina, Barbados, Brazil, Chile, Columbia, Costa Rica, Ecuador, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Israel, Jamaica, Kenya, Mauritius, Mexico, Morocco, Netherlands Antilles, Nigeria, Pakistan, Philippines, Singapore, South Africa, Sri Lanka, Suriname, Thailand, Uruguay, and Venezuela.

All price and exchange rate data are taken from the *International Financial Statistics* database. Inflation rates are based on the consumer price index, and exchange rates are end-of-period spot rates with respect to the U.S. dollar.

This test is conducted for three different "subsets" of the sample. The first one is "all countries" where the thirty countries are tested together. The second is given by high or low inflation countries that experienced an average annual inflation rate in excess of 30 percent over the sample period 1973Q2 – 1997Q3, then the countries included here are Argentina, Brazil, Chile, Ecuador, Ghana, Israel, Mexico, Suriname and Uruguay, while the low inflation countries group comprises the rest of countries mentioned. The third group is classified by regions, here we find five groups: Africa-Ghana, Kenya, Mauritius, Morocco, Nigeria, and South Africa; Asia-India, Indonesia, Israel, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand; Central America-Costa Rica, El Salvador, Guatemala, Honduras, and Mexico; South America-Argentina, Brazil, Chile, Columbia, Ecuador, Suriname, Uruguay, and Venezuela; and Other-Barbados, Jamaica, and Netherlands Antilles.

	Eigenvalue	Cumulative R^2	Sample Size (n)
All countries	5.609*	0.189	30
High-inflation countries	1.882*	0.209	9
Low-inflation countries	5.039*	0.240	21
Africa	2.624	0.437	6
Asia	2.533*	0.317	8
Central America	1.726*	0.345	5
South America	1.716	0.214	8
Other	1.847*	0.616	3

Notes: 1. Estimation is for the period 1973Q2–1997Q3. Growth in real exchange rates, or deviations from relative PPP, are with respect to the United States. The full sample of countries comprises Argentina, Barbados, Brazil, Chile, Columbia, Costa Rica, Ecuador, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Israel, Jamaica, Kenya, Mauritius, Mexico, Morocco, Netherlands Antilles, Nigeria, Pakistan, Philippines, Singapore, South Africa, Sri Lanka, Suriname, Thailand, Uruguay, and Venezuela.

2. * indicates stationarity at the 5 per cent significance level or better of the first largest principal component (LPC) as reported in Table II.

Table 3. Principal components based on growth in real exchange rate

Source: Holmes, 2001, p. 194

In Table 3 we can find the results of the principal components for the complete sample of countries, together with inflationary and regional groups. The explanatory power of the first LPC (largest principal component) can be measured by its eigenvalue or the cumulative R^2 (measured as the eigenvalue divided by the number of countries in that particular group).

Holmes (2001) uses the Augmented Dickey-Fuller (ADF) test to test for stationarity. Thanks to table 4 we can see how the first LPC is confirmed as stationary in almost all cases, which leads us to think that the relative PPP is maintained throughout the sample. The first LPC is confirmed as stationary in all country groups at the 5% significance level. In the group of high and low inflation countries we find it stationary at a significance level of 1%, as in Central America and the group 'others'. In Africa we find it as stationary at a level of 10% and in South America there is no evidence to confirm it as stationary.

	ADF Statistic	Lag
All countries	–3.139**	5
High-inflation countries	–3.774***	8
Low-inflation countries	–3.603***	5
Africa	–2.582*	8
Asia	–3.249**	4
Central America	–4.006***	8
South America	–2.230	4
Other	–3.156***	8

Notes: 1. The lag lengths are chosen to ensure white noise residuals. Following the application of the Schwarz Information Criteria, all regressions exclude a time trend. Further tests based on Dickey and Fuller (1981, Tables I–IV) revealed the time trend to be insignificant.

2. ***, **, and * indicate rejection of the null of nonstationarity at the 1 per cent, 5 per cent, and 10 per cent significance levels with critical values taken from Fuller (1976).

Table 4. ADF Unit root tests on the first LPC

Source: Holmes, 2001, p. 194

Table 5 "reports the factor loadings applying to the first LPC for all countries, high inflation countries, low inflation countries and the regional groups. These factor loadings are the squared coefficients of correlation between the U^i_t's and the first LPC. Perfect synchronization of deviations from relative PPP would require factor loadings of unity attached to the first LPC across all countries". (Holmes, 2001)

	LPC[a]	LPC[b]	LPC[c]	LPC[d]	LPC[e]	LPC[f]	LPC[g]	LPC[h]
Argentina	0.102	0.050					0.278***	
Barbados	0.485***		0.567***					0.400***
Brazil	0.128	0.240**					0.248**	
Chile	−0.312***	−0.031					−0.008	
Columbia	0.396***		0.380***				0.768***	
Costa Rica	−0.650***		−0.690***			−0.035		
Ecuador	0.065	−0.130					0.505***	
El Salvador	−0.180		−0.128			0.262***		
Ghana	0.406***	0.698***		0.358***				
Guatemala	0.000		0.024			0.968***		
Honduras	−0.037		−0.006			−0.040		
India	0.447***		0.474***		0.937***			
Indonesia	0.657***		0.679***		0.003			
Israel	0.483***	0.788***			−0.004			
Jamaica	0.447***		0.375***					0.114
Kenya	0.475***		0.492***	0.619***				
Mauritius	0.772***		0.756***	0.846***				
Mexico	−0.079	−0.701***				0.093		
Morocco	0.604***		0.573***	0.830***				
Netherlands Antilles	0.514***		0.582***					0.886***
Nigeria	−0.010		0.020	−0.321***				
Pakistan	0.734***		0.759***		0.206**			
Philippines	0.522***		0.502***		0.212**			
Singapore	0.291***		0.294***		−0.003			
South Africa	0.559***		0.532***	0.778***				
Sri Lanka	−0.002		0.034		−0.055			
Suriname	−0.241***	−0.385***					−0.633***	
Thailand	0.707***		0.731***		0.178			
Uruguay	0.351***	−0.239**					0.356***	
Venezuela	0.237**		0.195**				0.453***	

Notes: 1. Factor loadings are for the first LPC reported in Tables I and II. LPC[a] is the first LPC for the full sample of countries, LPC[b] applies to the high-inflation countries, LPC[c] applies to the low-inflation countries, LPC[d] applies to the group of African countries, LPC[e] applies to the Asian countries, LPC[f] applies to Central American countries, LPC[g] applies so South American countries, and LPC[h] applies to Other countries.

2. *** and ** indicate significance of the factor loadings at the 1 per cent and 5 per cent levels based on Pearson correlation coefficients [see Child (1970)].

Table 5. Factor loadings attached to the first LPC

Source: The Developing Economies, 2001, p. 196

The remarkable thing here occurs with the high inflation countries (LPC^b), as we can see there are different signs between them. As we can observe, deviations from relative PPP are different between countries. If we compare Brazil, Ghana and Israel, we can see that there have been different experiences compared to Mexico, Suriname and Uruguay. We can contrast this fact with the low inflation countries (LPCc) whose values, except for Costa Rica, are all positive.

The study is made up of a sample of thirty developing countries. The relative PPP is tested by the stationarity of the largest principal component (LPC) based on the deviations of the relative PPP of the United States. The data used are quarterly and range from 1973 to 1997. With the results we can say that the PPP is generally confirmed and that we have no scientific evidence that the PPP is only limited to developing countries with high levels of inflation.

7. Modifications to PPP

As we already noted, nominal exchange rate movements lead to real exchange rate movements due to short-term nominal price rigidities. Over the long term, however, deviations from purchasing power parity must be accounted for by real factors. This is what we are looking in this section. There are 3 modifications to long-run PPP that could explain why purchasing power parity might not hold always in the long-term.

We have:

I. The Balassa-Samuelson hypothesis.

II. Cumulated current account deficits and long-run real exchange rate depreciation.

III. Government spending and the real exchange rate.

I. The Balassa-Samuelson Hypothesis

If we use current exchange rates to compare GDP per capita between different countries, biases are usually generated in the study. This is generated by the temporary fluctuations that exchange rates normally suffer. If the domestic currency is devalued, domestic prices and income will tend to be very low. The same thing happens inversely, if the local currency is overvalued, prices and domestic income will be very high. The annual movements of per capita income mainly show exchange rate instabilities and not growth in real wages or productivity.

However, there is another systematic error apart from the one discussed above. Using real exchange rates tends to overestimate or underestimate countries' GDP depending on whether their income is high or low. We tend to overestimate the GDP of a high-income country and vice versa. In other words, the income difference between rich and poor countries is usually exaggerated.

This happens because services and goods in high-income countries are more expensive than those in low-income countries (generally). In other words, if the only currency was the euro we could say that the purchasing power of one euro is lower in developed countries. Something striking here is: why prices in developing countries are systematically lower than in already developed countries when international trade is free and the law of one price is maintained?

The Balassa-Samuelson effect helps us with this. The model assumes that the economy is formed by two sectors:

- The tradable sector, which as industrialization advances has higher productivity growth.
- The non-tradable sector whose productivity growth rate is zero, that is, it is stagnant.

If the factor market is integrated within a rapidly industrializing country, the cost of employing that factor has to be the same in all industries. Therefore, all producers should pay the same to their workers, but since the productivity growth rate is higher in the manufacturing sector than in the agricultural and service sectors, the price of manufactured products can be reduced much faster than the price of the other two sectors. We can resume this with one phrase: productivity growth translates into lower prices.

Due to the internal productivity growth gap between manufacturing and farming/services being greater in more developed countries, nontradeable prices in those countries are lower than in developed countries.

This gap can be explained by the Balassa-Samuelson effect, explained below.

An example to generate a Balassa-Samuelson effect would be the next one: two countries with two goods, one tradable and the other non-tradable. A factor of production such as labor. Suppose that productivity in the non-tradable sector is equal to one in both countries.

$$MPL_{nt,1} = MPL_{nt,2} = 1$$

Where "nt" denotes the nontradeable sector and 1 and 2 indexes the two countries.

Assuming competition in the labor market in each country, the wage is equal to the value of the marginal product, or the price of the sector multiplied by MPL.

$$w_1 = p_{nt,1} * MPL_{nt,1} = p_t * MPL_{t,1}$$
$$w_2 = p_{nt,2} * MPL_{nt,2} = p_t * MPL_{t,2}$$

Where the sub-index "t" denotes the tradable goods sector. Note that the prices of tradable goods in the different countries are equal and therefore there is no specific sub-index for each country.

If we assume that country 2 is richer due to its higher productivity we have:

$$MPL_{t,1} < MPL_{t,2}$$

which implies that

$$p_{nt,1} < p_{nt,2}\,.$$

Given that with the same world price for tradable goods the price of non-tradable goods will be lower in the country with lower productivity, we find that this country will have a lower price level in general.

We can find some proof about this below, with the help of Rogoff (1996), extracted from the Penn World Tables.

Another theory proposed by Kravis and Robert Lipsey (1983) predicts that “rich countries will have higher exchange rate adjusted price levels than poor countries”. This is because of the capital-labor ratios. Rich countries have a higher capital-labor ratio due to the capital mobility. This ratio will permit rich countries to get higher wage rates.

In Table 6 Rogoff lists the real income and price levels for the selected countries.

Each point in Figure 8 is the real GDP and the real price level of an individual country compared to the United States in 1990. We can deduce that there is a relationship between income and prices in a country thanks to the figure. Balassa-Samuelson

predicted that countries with a fast growth will tend to an appreciation in the real exchange rate, and vice versa for countries with a slow grow.

Country	Per Capita GDP Relative to the United States	Price Level Relative to the United States
United States	100	100
Canada	95.9	103.9
Germany	84.0	132.3
Japan	82.5	133.9
France	77.3	126.5
United Kingdom	71.3	110.5
Italy	69.8	125.6
Spain	54.0	108.2
Taiwan	47.1	74.9
Venezuala	30.2	37.5
Mexico	29.3	43.7
Brazil	21.3	68.6
Poland	21.0	36.8
Turkey	20.4	43.9
Thailand	19.3	34.4
Argentina	19.0	79.8
Columbia	17.3	34.0
South Africa	17.2	76.0
Algeria	13.0	74.7
China	12.5	11.9
Peru	11.2	70.0
Morocco	11.1	41.9
Indonesia	10.3	27.0
Philippines	9.6	34.3
Egypt	9.4	33.5
Pakistan	7.4	22.4
Bangladesh	6.5	15.4
India	5.8	26.7
Sudan	5.2	30.1
Kenya	5.0	33.6
Nigeria	3.9	36.7

Source: Penn World Tables, Mark 5.6; see Summers and Heston (1991) for a description of the data.

Table 6. ICP measures of absolute PPP versus per capita GDP

Source: Penn World Tables, Mark 5.6**;** see Summers and Heston, 1991

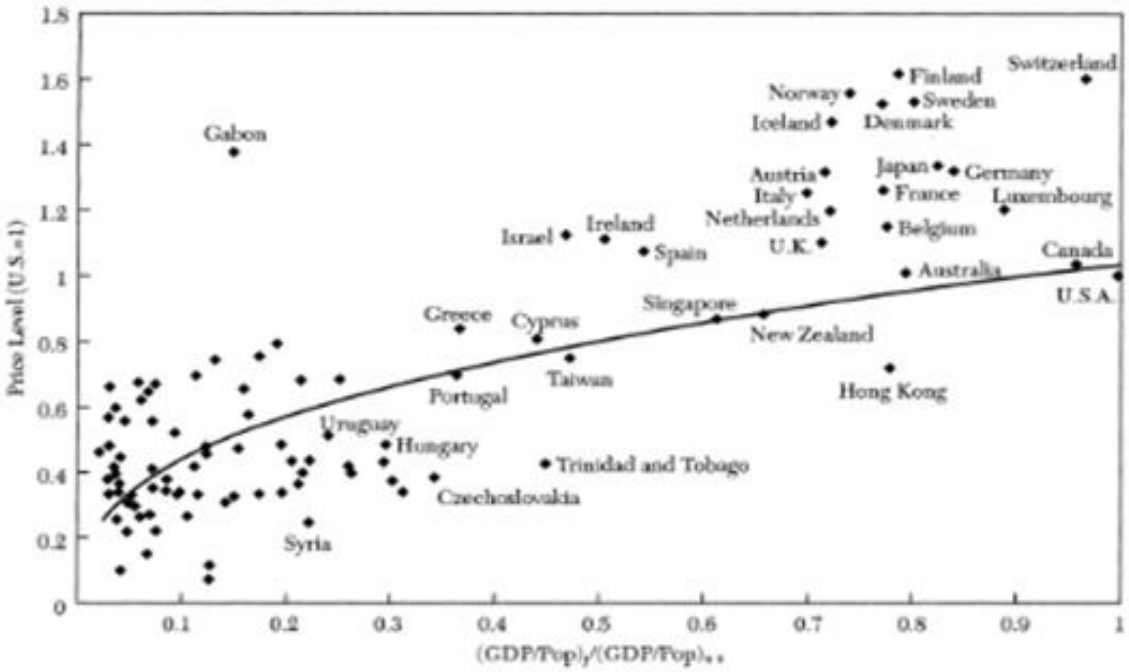


Figure 8. Price level versus GDP per capita

Source: The Penn World Table, Aug. 1994

II. Cumulated current account deficits and long-run real exchange rate depreciation

There is another popular theory of the real exchange rate that maintains that sustained current account deficits are linked to long-term depreciation of the real exchange rate. If we are based on the study carried out by Obstfeld and Rogoff carried out in 1995, we could say that in a horizon of five to ten years there could be a relationship between these two endogenous variables. This work, mentioned above, verifies that the correlation between the variations in the trade-weighted real exchange rate and the variations in the positions of net external assets is large and significant enough in the countries that make up the OECD during the years 1981 and 1990. Thanks to simulations of the IMF multi-country model, Tamim Bayoumi et al. (1994) find a correlation between the real exchange rate and the current account, this correlation is affected depending on whether a fiscal or monetary policy occurs. For example, a temporary drop in productivity can worsen a country's current account at the same time that it could cause an improvement in a country's terms of trade.

III. Government spending and the real exchange rate

The third tool that we can use to modify purchasing power parity is the level of public spending. So, an increase in public spending implies an increase in the real exchange rate. This effect must be transitory if capital and labor are not perfectly mobile between sectors, since in a small country demand shocks can affect the real exchange rate. If these factors are completely mobile, productivity and other long-term supply factors limit the real exchange rate. Alberto Alesina and Roberto Perotti (1995) observed, however, that fiscal policy is able to have long-run real effects in a model where distortionary taxes are used to finance government spending programs.

Overall, the three modifications to PPP previously cited, are useful in some circumstances but are not nearly robust or universal enough to fully supplant purchasing power parity as a theory of the long-run real exchange rate.

8. Conclusion

We are going to conclude this work summarizing all we have been talking about. I will give my own idea about it and I will suggest a practical application.

Before starting with that I would like to summarize some ideas we got with the thesis.

- Purchasing power parity was used in its beginnings to determine the exchange rate between currencies, now, after years of progress, it is used to measure the standard of living between countries.
- Thanks to purchasing power parity, we know that the real exchange rate is not affected in the long term by monetary policy. Countries with disparate inflation rates should expect their bilateral exchange rate to adjust to compensate for these differences in the long run.

First of all we have analyzed the studies by Isard (1977) and Richardson (1978), finding that:

1. Movements in exchange rate entails short run changes in relative dollar price indexes.
2. An important part of the relative price change in the short term persists for several years.
3. Following on Richardson we conclude that the law of one price fails because there is no empirical evidence on the existence of perfect commodity arbitrage with 95 percent confidence.
4. Exchange rate affects Canadian prices in the same way and to the same degree as United States prices do.

Following this part, we analyzed the United States city price data in order to see which ideas it could bring us about the purchase power parity. We concluded that PPP was fulfilled for the overall price level than for food, which means that the United States city price data support PPP.

After all of this, our purpose was to verify whether the convergence of PPP is a long term or short term effect and we proved that it was not a short-term movement due to

sticky prices. Thus we focused on the long term. We revisited purchasing power parity in G6 countries, and we found that only in two out of 6 countries PPP held in the long-run. We can add here that deviations in the short run were prolonged for some of these G6 countries and there were no forces able to redirect exchange rate to its PPP values in the long run. Another relevant conclusion is that the euro does not adjust to local prices in every country of the Euro-zone. This only happened in France and Germany, which make us think that the reason is based on the stronger economies of France and Germany with respect to the other countries.

We could not prove that PPP holds in the long-run, so we drawn on a study of the PPP over a century, trying to prove if the convergence could be possible in a longer period of time like a century. The evidence we collected is against this version of theory of PPP too.

Based on my reading of the research on PPP, I can affirm that the real world is made up of many complexities and, unlike in a research study, we cannot keep these complexities constant or eliminate them to study this phenomenon.

As we have verified throughout this thesis the purchasing power parity is not going to be fulfilled for most countries of the world. PPP is hardly found both for single countries and groups of countries, in different time horizons, though many statistical and econometrics methods have been employed. In the real world, with transactions costs, the purchasing power parity has no place.

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