Argentinean Real Exchange Rate 1913-2003: Testing Purchasing Power Parity Theory

Marcos J. Dal Bianco[♦]

"Under the skin of any international economist lies a deep-stated belief in some variant of the purchasing power parity theory of the exchange rate." Dornbusch and Krugman, 1976.

"Simplified views based on the purchasing power parity theory have suggested that the equilibrium real exchange rate is a constant that does not vary through time. Speaking rigorously, however, there is no reason why the value of the RER required to attain internal and external equilibrium should be a constant number; it would indeed be an extraordinary coincidence if it was". Edwards, 1989.

1. Introduction

The absolute version of "Purchasing Power Parity Theory" of exchange rates states that, once converted to the same currency, national price levels must be the same. Hence, the Purchasing Power Parity (PPP) exchange rate is the one that equates the purchasing power of one unit of currency in both economies (Sarno and Taylor, 2002). Under this theory, then, the nominal exchange rate is in equilibrium if it is the same as the PPP exchange rate.

The basic building block of PPP is the "Law of One Price" (LOP), which states that in absence of transaction costs competitive markets equate the prices of identical goods in different countries, if they are expressed in the same currency. Thus, if the LOP is verified for a sufficiently large number of goods, the PPP must prevail.[1]

However, absolute PPP has been extensively refuted as a short-run relation.[2] In spite of this, there is a widely extended belief that this proposition remains valid in the long-run, becoming a sort of "anchor for long-run real exchange rates" (Rogoff, 1996). In this view, the nominal exchange rate varies in the short-run because of changes in interest rates, monetary shocks, etc., but in the long-run "economic forces" behind the PPP are the ones that explain its movements.[3] The important place that the PPP occupies in international economics is revealed in that most models of open economies impose the PPP as a long-run equilibrium condition (Obstfeld and Rogoff, 1996).

The aim of this paper is to test the PPP theory in Argentina, using annual data for the 1913-2003 period. We use different estimation techniques in line with what has been done in the wide empirical literature which investigated this subject for other countries.

♦ IAE, Management and Business School. An earlier version of this paper was presented at "Seminarios de Economía y Finanzas" of IAE and at the "Novenas Jornadas de Economía Monetaria e Internacional" of "Universidad Nacional de la Plata". I am grateful to Santiago Acosta, Cecilia Adrogué, Daniel Aromí, Eduardo Fracchia, Leandro Galli, Alejandro Gay, Elina Gigaglia, Juan Manuel Jáuregui, Juan José Llach, Alejo Macaya and Juan Quiroga for constructive suggestions on earlier drafts. All remaining errors are, of course, the sole responsibility of the author. Comments and suggestions are welcomed at mdalbianco@iae.edu.ar.

[1] Even if absolute PPP is not verified, relative PPP can be. Relative PPP states that the growth rate of nominal exchange rate must compensate the difference in the growth rate of national and foreign prices. In this paper we only analyze the absolute PPP.

[2] See Officer (1976), Froot and Rogoff (1995) and Sarno and Taylor (2002) for superb surveys on the PPP literature.

[3] For example, Krugman (1978) states: "Few international economists would deny that purchasing power parity holds in some sufficiently long run…" (p. 397).

It is remarkable that we have found only a few papers testing the PPP for developing countries, especially for Latin American ones. In the case of Argentina, we have found only seven papers that test the PPP, and these works obtained mixed results: McNown and Wallace (1989), Anoruo, et al. (2002), Taylor (2002) and Diamandis (2003) found that the PPP is valid in Argentina; Bahmani-Oskooee (1993) and Carrera, et al. (1999) rejected the PPP as a long-run relation for this country, and McLellan and Chakraborty (1997) have not obtained conclusive results.

The results we found here are in general contrary to the PPP. This has important implications, among other things, for economic policy (Dornbusch, 1987). For example, it is relevant in the debate of how long a country can obtain benefits by maintaining high or low the Real Exchange Rate (RER). These policies will be more effective and longer lasting the smaller the connection is between the nominal exchange rate, prices and salaries. Moreover, the validity of PPP is relevant in practical matters, because the PPP exchange rate is commonly used as a benchmark for the RER.

This paper continues as follows: In section 2 we resume the theory of PPP and in Section 3 the empirical literature that has tested it. In Section 4 we make the econometric study for Argentina. We conclude in Section 5 with some final remarks.

2. Purchasing Power Parity: Conceptual framework

Purchasing Power Parity is one of the oldest theories about the determination of the exchange rate. Rogoff (1996) and Sarno and Taylor (2002) show that the first formulations of the theory have been performed by Spanish scholars of Salamanca University in the XV and XVI centuries, whilst Frenkel (1978) illustrate the development of the doctrine in the writings of John Wheatley and David Ricardo at the beginning of the XIX Century. In its modern version, it was formulated for the first time by Gustav Cassel (1916, 1917 and 1918), who created the expression "Purchasing Power Parity" to refer to the theory he was proposing.[4]

Enunciated like a theorem, the absolute version of PPP states that the prices in one country must be the same as the ones of the other countries if expressed in the same currency (Krueger, 1983). Thus, if PPP is valid, the exchange rate between national and foreign currency must be equal to the ratio of domestic and foreign prices (Frenkel, 1981). The relative version of the doctrine maintains that the changes in the equilibrium exchange rate must be equal to the changes in the ratio of internal to external prices.

The PPP's conceptual base is the LOP which states that identical goods sold in integrated markets, in absence of transaction costs, should have –because of frictionless goods

[4] "At every moment, the real parity between two countries is represented by this quotation between the purchasing power of the money in the one country and the other. I propose to call this parity "*the purchasing power parity*".", Cassel (1918), p. 413.

arbitrage- the same prices in all countries, once converted to a common currency. Thus, LOP implies:

$$P_{i,t} = S_t P_{i,t}^* \qquad (1)$$

Where $P_{i,t}$ is the domestic-currency price of good *i* at time *t*, $P_{,t}^*$ is the foreign currency price of good *i* at *t* and S_t is the exchange rate defined as the domestic price of foreign currency at *t*.

Simply put, the reasons for the rejection of LOP are: (1) national and foreign goods aren't perfect substitutes; (2) tariff and non-tariff trade barriers; (3) transaction costs; (4) absence of competitive markets in any (or all) countries; and (5) non-tradable components of goods varies across countries. Empirical evidence shows that these arguments are relevant, and a number of econometric studies reject LOP for a wide number of tradable goods, except for a few standardized goods strongly exposed to international trade (like gold).[5] In spite of contrary evidence, the LOP is an important conceptual base of most models of open economies in general and PPP theory in particular.

Following Dornbusch (1987), we consider now a domestic price index $P_t = f(P_{1t}, ..., P_{it}, ..., P_{nt})$ and a foreign price index $P^*_t = g(P^*_{1t}, ..., P^*_{it}, ..., P^*_{nt})$. If LOP is valid for all goods and each one of them has the same weight in all baskets, then absolute PPP must be valid, so:

$$S_t = \frac{P_t}{P_t^*} \qquad (2)$$

If LOP is valid for all good *i* at all times *t*, absolute PPP implies that nominal exchange rate must be one at all *t*. It means that "whatever the monetary or real disturbances in the economy because of instantaneous, costless arbitrage the prices of a common market basket of goods in the two countries, measured in a common currency will be the same" (Dornbusch, 1987). This theoretically solid proposition is empirically questionable. On one hand, the same problems that have an effect on LOP affect PPP. On the other hand, PPP as is stated in (2) requires that the basket of goods (f and g functions) be the same and that goods in question be identical. But the national price indexes used to test PPP are usually different, because they typically have dissimilar weights for the same good. Moreover, the goods are usually different. Because of that, it is necessary to assume a high degree of substitution in international trade to assure that monetary disturbances won't have real effects and then the PPP will hold (Dornbusch, 1987). In that case, deviations from PPP generated in monetary changes will be transitory, depending on the flexibility of salaries and wages.

Besides these transitory deviations from PPP, there can exist structural or permanent deviations originated in real disturbances that affect the equilibrium relative prices. For example, the "Balassa-Samuelson effect" (Balassa, 1964; Samuelson, 1964) states that productivity

[5] See Isard (1977), Giovannini (1988), Knetter (1989, 1993) and Rogoff, et al. (2001) for empirical studies of LOP.

differentials between sectors affect relative prices between tradable and non-tradable and cause permanent deviations between national price levels and systematic departures from PPP. Structural deviations can occur because of differences in factor endowment and factor rewards, changes in technology, tastes, commercial policies, growth rate of labour force, etc.

To observe these deviations we express (2) in logs:[6]

$$s_t = p_t - p_t^* \qquad (3)$$

Because the RER, in logs (r_t), is:

$$r_t = s_t - p_t + p_t^* \qquad (4)$$

it can be seen as a measure of deviations from PPP.

3. Purchasing Power Parity: A brief review of empirical literature

Since the 1970's, empirical testing of PPP has grown exponentially, but typically using data from developed countries. Rogoff (1996) affirms that two basic facts emanate from this literature: (a) Real Exchange Rates converge to PPP at the very long-run with extremely low rate of convergence, and (b) short-run deviations from PPP are huge and exceptionally volatile. In this sense, Sarno and Taylor (2002) concluded that PPP can be seen as a valid long-run parity for bilateral exchange rates between industrialized countries.[8]

Empirical studies of PPP have used a variety of econometric techniques that can be divided, arbitrarily, in four groups.

First, we have the works that tested the simplest form of PPP using the hypothesis that PPP holds continuously (at all t), like Frenkel (1978, 1981) and Krugman (1978). So they test:

$$s_t = a + b\ p_t - b^*\ p_t^* + u_t \qquad (5)$$

Were u_t is an error term and *a* is an arbitrary constant. PPP holds as is stipulated in (3), if it is verified the so-called "homogeneity condition", which requires that b=b* and, besides, both coefficients must be equal to unity.

Frenkel (1978) found coefficients *b* closed to unity and statistically significant for a group of hyperinflationary economies of the 1920's. However, this author didn't care about residual's stochastic properties. This is important because it can be verified the existence of residual' serial correlation, with the fact that the nominal exchange rate and the prices are non-stationary process[9], falling in what Granger and Newbold (1974) called "spurious regressions".

[6] Along the text, variables denoted in minuscule are the logarithm of the original variable.
[8] See Alves, et al. (2001), Alba and Park (2003), Calderón and Duncan (2003), Holmes and Wang (2004) and the papers cited for Argentinean case, for studies which test PPP in Latin American countries.
[9] We use stationarity to refer to what strictly speaking is "weak or covariance stationarity". A process is covariance stationary if its mean and variance are finite and constant and if its covariances only depend on the lags involved. In other words, "...a time series is covariance stationarity if its mean and all autocovariances are unaffected by a change in the time origin" (Enders, 1995, p. 69).

Thus, neither the coefficients estimated nor the hypothesis tested are valid (Froot and Rogoff, 1995; Sarno and Taylor, 2002).[10]

A second group of works tested the PPP by verifying if the RER is a stationary process. If this is the case, then RER must return to its constant mean in the long-run, which is interpreted as a convergence to PPP. So there can be short-run deviations from PPP (fluctuations of RER around its long-run equilibrium value) but in the long-run these deviations must be dissipated.[11] On the contrary, if RER is a non-stationary process, its mean will be time-variant and won't converge to the PPP in the long-run (Sarno and Taylor, 2002).

Testing for unit roots has been the most common way to evaluate if the RER was a stationary process. If unit roots are found, then RER is a non-stationary process and no convergence to PPP can be postulated. If the presence of unit roots is rejected, then RER is a stationary process and PPP is verified.[12] Works which followed this line found mixed results. For example, Roll (1979), Darby (1983) and Huizinga (1987) found unit roots in post Bretton-Woods period, while Frenkel (1986) found evidence supporting PPP in the long-run, and says that other works failed because of the low power of its tests.

A third group of works use cointegration methods to test PPP. These methods are designed to model long-run equilibrium relations between same-order integrated variables, but without explaining the mechanism of disequilibria's adjustment. All that is required is a combination of integrated variables which drop an integrated variable of lesser order. If this happens, the variables are "Cointegrated".

Cointegration techniques are ideal to test the PPP theory. On one hand, nominal exchange rates and prices are usually integrated variables of order one (or difference stationary). On the other hand, cointegration relation allows short-run deviations from equilibrium but in the long-run error term must be stationary. In PPP testing, if the nominal exchange rate and the relative prices are cointegrated there are short-run deviations from equilibrium PPP exchange rate but in the long-run these deviations are dissipated (Sarno and Tayor, 2002). On the contrary, if the variables are not cointegrated PPP does not hold. Besides, using cointegration techniques weaker versions of PPP can be tested, because the only requirement is that *any* combination of the nominal exchange rate and the prices to be stationary, while unit

---

[10] An additional problem of these works is that nominal exchange rates and prices are simultaneously determined, so there are no good reasons to put nominal exchange rate in the left side of the equation (Froot and Rogoff, 1995).

[11] Abuaf and Jorion (1990) state that, when the RER follows a first order autoregressive process, we have:

$r_{t+1} = k_0 + k_1 r_t + u_{t+1}$ (i)

where k_0 and k_1 are constants. Logarithm of the long-run equilibrium RER (ř) can be thought as the conditional expectative of process (i). Assuming $|k_1|<1$, we have:

$ř = k_0/(1-k_1)$ (ii)

Short-run PPP is violated every time that r_t is not equal to long-run value ř. Long-run PPP is violated if $|k_1| \geq 1$ and if k_0 and/or k_1 are not time invariant. And, if $|k_1|<1$ *shocks* to the system are "dampened " at $(1-k_1)$ rate per period.

[12] This is, because, as its known, a stochastic process modeled as an ARMA (p, q) is stationary if its difference equation's characteristic roots are less than one (Enders, 1995).

[14] The first strategy has been criticized because it requires to arbitrarily choose one of the integrated variables as dependent and usually the results are sensible to which one is chosen (Froot and Rogoff, 1995). Johansen's technique partially solves this problem because it does not assume *a priori* a causality relation. This once-stage technique consists of using a maximum likelihood estimator to find the coefficients of the equations (6a) or (6b) and simultaneously test the presence of cointegration relations.

root tests require that *only one* lineal combination between this variables have to be stationary, the one in which coefficients are equal to unity (Froot and Rogoff, 1995). Thus, cointegration tests check if:

$$s_t + \mu\, p_t + \mu^*\, p^*_t \qquad (6a)$$

is stationary for *any* constants μ and μ^*, or, if homogeneity condition is satisfied and $\mu = \mu^*$:

$$s_t + \mu\,(p_t - p^*_t) \qquad (6b)$$

the question is if (6b) is stationary for *any* constant μ (that can be different from 1).

Two methods have been used in the PPP literature to test for Cointegration between variables. The first is the two-stage method of Engle and Granger (1987) which studies the stationarity of equilibrium equations' residuals, while the second is the one-stage method of Johansen (1991) based in VAR methodology.[14] Again, the results are mixed: Taylor (1988) and Mark (1990) reject the PPP, while Kugler and Lenz (1993) and works that use longer time series as Kim (1990) and Cheung and Lai (1993) tend to confirm long-run PPP.

Finally, there are the works which use panel data for a group of countries and usually confirm PPP finding evidence of long-run mean-reversion of Real Exchange Rates, as Frankel and Rose (1996) and Wei and Parsley (1995).

4. PPP: Econometric study for Argentina

Here we test the PPP using annual data from Argentina between 1913 and 2003 (91 years). We start in Section 4.1 verifying if Argentinean RER is stationary. Then, in Sections 4.2 and 4.3, we test for Cointegration between nominal exchange rate and relative prices.

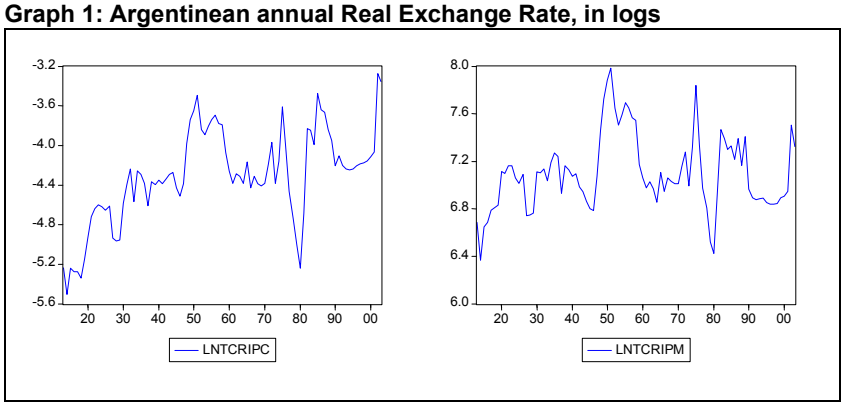
We use annual data because the available monthly series of prices of Argentina starts in 1943 for the consumer price index and in 1957 for the wholesale price index. It means that we have only 60 and 46 years of data available, respectively. It is insufficient because unit root tests have low power, and tend to accept that the evaluated series have unit roots, even when it is not the case (Froot and Rogoff, 1995). Thus, if the rate of mean reversion of RER is low (that is, the characteristic root is less than one but close to it), unit tests employed will easily accept the existence of unit roots. In its literature review, Rogoff (1996) finds that half mean reversion time of deviations from PPP were typically three to five years. If mean-reversion occurs so slowly, the problem of "low power" becomes relevant.[15]

4.1. Is Argentinean Real Exchange Rate stationary?

[15] In a previous version of this work we employed monthly data and found mixed evidence about the validity of PPP in Argentina. But recognizing the problem of low power we decided to present only the results for annual data. The use of annual data is a common way to solve low power problem. For example, Johnson (1990) used 120 years or the RER between Canada and USA and rejected that it was non-stationary, with a half time of mean-reversion of 3 years. Edison (1987) studied the RER between England and USA between 1890 and 1978 and found a higher half time of mean reversion: 7,3 years. Frankel (1986) analyzed the RER between USA and England between 1869-1984 and rejected the unit root hypothesis at 5% of significance, with half-time of mean-reversion of 4,6 years.

We use the annual average of the nominal exchange rate between Argentinean currency and the United States dollar.[16] The question is what price index should be used to test the PPP. Some authors think that PPP refers only to tradable goods and, consequently, suggest to use index prices composed only of this type of goods, typically the wholesale price index (WPI). However, the line traced by Cassel and Keynes stipulates that the PPP theory only makes sense if it comprehends a wider range of goods, including non-tradable goods and suggests to use the consumer price index (CPI).[17] We use both indexes, to verify if there are differences between the results find with of them.[18] We build for each index a RER as it is specified in (4) and present its graphs below.

Graph 1: Argentinean annual Real Exchange Rate, in logs



To check the stationarity of these RERs, we use the following tests: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Dickey-Fuller Test with GLS Detrending (DF-GLS), Kwiatkowski, Phillips, Schmidt y Shin (KPSS) y Elliot, Rothenberg, and Stock Point Optimal test. With the exception of KPSS, all of them have null hypothesis of unit root and the alternative that r_t is stationary. KPSS, conversely, has a null hypothesis of stationarity and alternative of unit root.[19] We use a non-tendency option, as Culver and Papell (1999) suggest, because including the tendency is inconsistent with PPP hypothesis, and we choose lags-length following Schwartz and Hannan-Quinn criteria. We present the test's results in Table 1.

[16] Free nominal exchange rate is from *Fundación de Investigaciones Económicas Latinoamericanas* (FIEL).
[17] "Some people believe that Purchasing Power Parities should be calculated exclusively on price indexes for such commodities as form the subject of trade between the two countries. This is a misinterpretation of the theory... the whole theory of purchasing power parity essentially refers to the internal value of the currencies concerned, and variations in this value can be measured only by general index figures representing as far as possible the whole mass of commodities marketed in the country" (Cassel, 1928, p. 33). In this sense, Keynes (1924) stated: "For if we restrict ourselves to articles entering into international trade and make exact allowance for transport and tariff costs, we should find that the [PPP] theory is always in accordance with the facts, with perhaps a short time-lag (...). In fact, the theory, stated thus, is a truism…", pp. 100-101.
[18] Argentinean CPI and WPI series are from Instituto Nacional de Estadísticas y Censos (Indec) and Gerchunoff and Llach (1998). United States' CPI and WPI data is from US Bureau of Labor Statistics.
[19] See Maddala and Kim (1998), chapters 3 and 4, to know the differences between this tests.

Table 1: Unit root tests for the log of both Real Exchange Rates - 1913-2003

	With CPI			With WPI		
Tests	T statistic (a)	Test critical values:		T statistic (a)	Test critical values:	
ADF for rt	-2.425795	1% level	-3.504727	-3.379793**	1% level	-3.504727
(H0: rt has unit root)		5% level	-2.893956		5% level	-2.893956
		10% level	-2.584126		10% level	-2.584126
Phillips-Perron	-2.552744	1% level	-3.504727	-3.379793**	1% level	-3.504727
(H0: rt has unit root)		5% level	-2.893956		5% level	-2.893956
		10% level	-2.584126		10% level	-2.584126
DF-GLS	-0.986756	1% level	-2.590910	-2.435147**	1% level	-2.590910
(H0: rt has unit root)		5% level	-1.944445		5% level	-1.944445
		10% level	-1.614392		10% level	-1.614392
Elliott-Rothenberg-Stock	8.229386(b)	1% level	1.935600	3.377521*	1% level	1.935600
(H0: rt has unit root)		5% level	3.084800		5% level	3.084800
		10% level	4.123200		10% level	4.123200
	LM statistic (c)			LM statistic (c)		
KPSS	0.739074***	1% level	0.739000	0.349182*	1% level	0.739000
(H0: rt is stationary)		5% level	0.463000		5% level	0.463000
		10% level	0.347000		10% level	0.347000

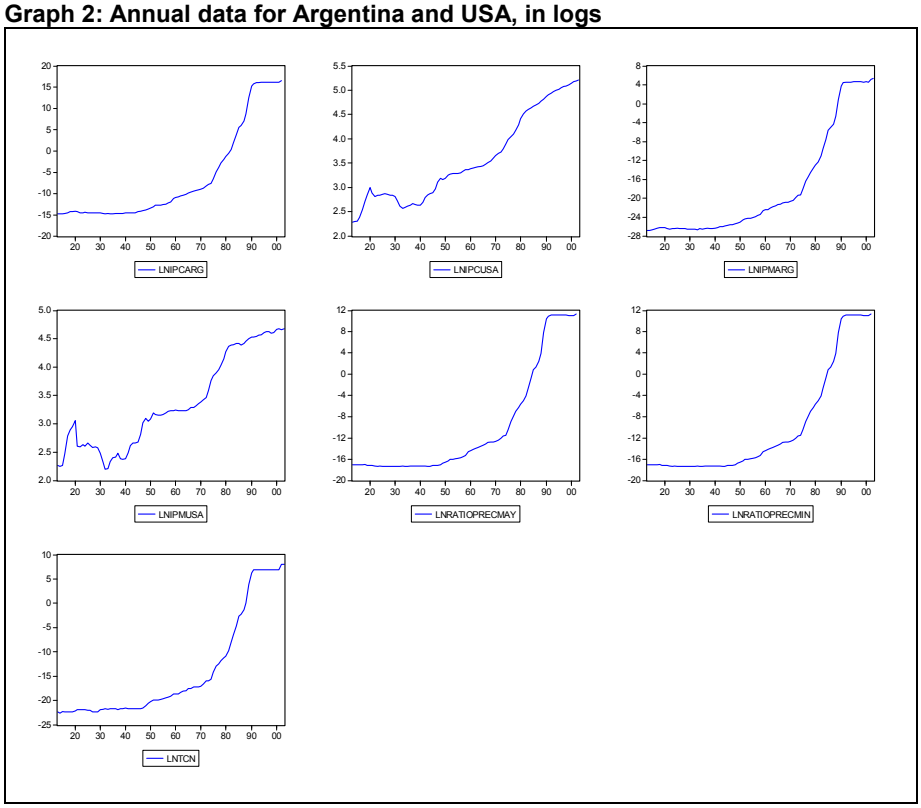
*, ** and *** denotes rejecting null hypothesis at 10%, 5% and 1%, respectively.
a. MacKinnon (1996) one-sided p-values. b. Elliott-Rothenberg-Stock (1996). c. Kwiatkowski-Phillips-Schmidt-Shin (1992)

These results are conclusive against PPP when we use CPI RER, because we cannot reject the presence of unit root[20], but more favorable to the Theory (but less conclusive) when we employ WPIs, because when we reject the presence of unit root in WPI RER in three cases at 5% of significance and in other at 10%, but KPSS rejects RER's stationary at 10%.[21]

4.2. Cointegration Tests for Argentinean Data

To test for Cointegration, the first step is to check if the involved variables are integrated of the same order. We check this here. In graph 2 we present the series we will use.

Graph 2: Annual data for Argentina and USA, in logs



[20] We apply the tests for the equation in first differences (not presented), and reject the presence of unit root at 1% of significance, so we infer that CPI RER has only one unit root. All non-presented results are available by request (mdalbianco@iae.edu.ar).
[21] We cannot reject the presence of unit roots in WPI RER when we use no-tendency/ no-intercept specification.

We checked the presence of unit roots for all the variables, but not present it. In all cases, unit root null hypothesis could not be rejected (or, with KPSS, stationary null hypothesis was rejected) at 10% or less. On his side, the tests applied to the variables in first differences reject the presence of unit root at 1% (or accept, with KPSS, that are stationary). Thus, we conclude that all these variables are integrated of order one.

To test for cointegration between nominal exchange rate and Argentinean and American prices, we can work with the three series separated, in line with equation (6a); or we can build a relative price series (CPI Argentina/CPI USA; WPI Argentina/WPI USA) and check if these variables are cointegrated with the nominal exchange rate, in line with equation (6b). The first case is called "trivariated", the second one "bivariate". We study both cases for CPI and WPI RER.

4.2.1. Cointegration tests with consumer price indexes

4.2.1.2 Bivariate case with CPIs

We start with Engle and Granger (1987) methodology and estimate:

$$s_t = \mu (p_t - p^*_t) + \varepsilon_t \qquad (7)$$

Where ε_t is an error term. If Nominal exchange rate and consumer prices are cointegrated, ε_t must be stationary. If it is non-stationary, then Cointegration between these variables is rejected. Thus, after estimating (7) we check if the estimation's residuals are stationary. [22] We present the results in Tables 2 and 3.

Table 2: Results of regressing $s_t = \mu (p_t - p^*_t) + \varepsilon_t$ with consumer price indexes

Dependent Variable: LNTCN
Method: Least Squares
Sample(adjusted): 1913 2002
Included observations: 90 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRATIOPRECIOS	1.220121	0.022564	54.07374	0.0000

R-squared	0.914841	Mean dependent var	-14.20982
Adjusted R-squared	0.914841	S.D. dependent var	10.41355
S.E. of regression	3.038874	Akaike info criterion	5.071900
Sum squared resid	821.8935	Schwarz criterion	5.099676
Log likelihood	-227.2355	Durbin-Watson stat	0.009241

Table 3: Unit root tests for equation (7) residuals

Tests	t statistic (a)	Test critical value (Engle and Yoo, 1987):[23]	
ADF	0.434830	1% level	4,12
(H0: rt has unit root)		5% level	3,29
		10% level	2,90
Phillips-Perron	1.005524	1% level	4,12
(H0: rt has unit root)		5% level	3,29
		10% level	2,90

*, ** and *** denotes rejection of null hypothesis at 10%, 5% and 1% respectively.

[22] Unit root tests to the residuals were applied without tendency and intercept, as it is suggested by Froot and Rogoff (1995) and Enders (1995). Because of that, we use only ADF and PP tests.
[23] We report Engle and Yoo (1987) critical values, because residuals are generated from a regression equation (Enders, 1995).

These tests indicate that the residuals are non-stationary, so we reject Cointegration between the nominal exchange rate and the prices of Argentina and the United States. Thus, the PPP hypothesis is rejected for these countries in the long-run.

We apply next Johansen's test to bivariate case, and present the results, in its different specifications, in Table 4.

Table 4: Johansen Cointegration test for bivariate case with consumer price indexes

Sample: 1913 2003
Included observations: 83
Series: LNRATIOPRECIOS LNTCN
Lags interval: 1 to 6

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Selected (5% level) Number of Cointegrating Relations by Model (columns)					
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Again, we reject the existence of a Cointegration relation the between nominal exchange rate and the CPIs of Argentina and the USA at 5% of significance. Thus, there is no long-run equilibrium relation between these variables and PPP does not hold.

4.2.1.2 Cointegration Tests for trivariate case and consumer prices

We start applying ordinary least square to:

$$s_t = \mu\, p_t + \mu^*\, p^*_t + \varepsilon_t \qquad (8)$$

Where ε_t is an error term. We present the results of estimating (8) in Table 5 and unit root tests for its residuals in Table 6.

Table 5: Estimation results of $s_t = \mu\, p_t + \mu^*\, p^*_t + \varepsilon_t$

Dependent Variable: LNTCN
Method: Least Squares
Sample(adjusted): 1913 2002

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIPCARG	1.095052	0.005404	202.6361	0.0000
LNIPCUSA	-2.035115	0.018705	-108.8011	0.0000
R-squared	0.996449	Mean dependent var		-14.20982
Adjusted R-squared	0.996409	S.D. dependent var		10.41355
S.E. of regression	0.624036	Akaike info criterion		1.916753
Sum squared resid	34.26900	Schwarz criterion		1.972304
Log likelihood	-84.25388	Durban-Watson stat		0.167603

Table 6: Unit root tests for equation (8) residuals

Tests	t statistic	Test critical values (Engle and Yoo, 1987):	
ADF	-2.584106	1% level	-4,45
(H0: residuals have unit root)		5% level	-3,75
		10% level	-3.36
Phillips-Perron	-2.552744	1% level	-4, 45
(H0: residuals have unit root)		5% level	-3,75
		10% level	-3.36

*, ** and *** denotes rejection of the null hypothesis at 10%, 5% and 1%, respectively.

Based on these tests we cannot reject the unit root null hypothesis at 10%, so we reject that nominal exchange rate and prices are not cointegrated. Thus, we cannot sustain the existence of a long-run equilibrium relation between these variables and PPP does not hold.

Next, we apply Johansen's procedure to the trivariate case and present the results in Table 7.

Table 7: Johansen Cointegration test for trivariate case and consumer price indexes
Sample: 1913 2003
Included observations: 83
Series: LNTCN LNIPCARG LNIPCUSA
Lags interval: 1 to 6

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Selected (5% level) Number of Cointegrating Relations by Model (columns)					
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Using Johansen's procedure we reject again the existence of a Cointegration relation between the nominal exchange rate and the CPIs of Argentina and the United Sates. Thus, all Cointegration studies with consumer prices show that these variables are not cointegrated.

4.2.3 Cointegration tests with wholesale prices

4.2.3.1 Bivariate case with WPI

We replicate here the study of Section 4.2.2.1 but using wholesale price indexes. So, we present the estimation results of equation (7) in Table 8 and unit roots test to its residuals in Table 9.

Table 8: Results of estimation $s_t = \mu (p_t - p^*_t) + \varepsilon_t$ with WPI
Dependent Variable: LNTCN
Method: Least Squares
Sample: 1913 2003
Included observations: 91

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRATIOPRECMAY	0.730388	0.014202	51.42714	0.0000

R-squared	0.909491	Mean dependent var	-13.96544
Adjusted R-squared	0.909491	S.D. dependent var	10.61470
S.E. of regression	3.193403	Akaike info criterion	5.170980
Sum squared resid	917.8042	Schwarz criterion	5.198571
Log likelihood	-234.2796	Durbin-Watson stat	0.007028

Table 9: Unit root tests for equation (7) residuals

Tests	t statistic	Test critical values (Engle and Yoo, 1987):	
ADF	1.930557	1% level	-4,12
(H0: residuals have unit root)		5% level	-3,29
		10% level	-2,90
Phillips-Perron	2.406141	1% level	-4,12
(H0: residuals have unit root)		5% level	-3,29
		10% level	-2,90

*, ** and *** denotes rejection of null hypothesis at 10%, 5% and 1%, respectively.

Results indicate that we cannot reject residual's unit root hypothesis at 10%, so nominal exchange rate and relative wholesale prices are not cointegrated. To verify it, we apply Johansen Test to these variables and show its results in Table 10.

Table 10: Johansen Test for bivariate case with wholesale prices
Sample: 1913 2003
Included observations: 84
Series: LNRATIOPRECMAY LNTCN
Lags interval: 1 to 6

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Selected (5% level) Number of Cointegrating Relations by Model (columns)					
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Again, we cannot verify the existence of a Cointegration relation between the nominal exchange rate and the relative wholesale prices.

4.2.3.1 Cointegration test for trivariate case and wholesale indexes

We start with the two-stage method. We show equation (8) estimation results in Table 11 and unit root tests to its residuals in Table 12.

Table 11: Estimation results of $s_t = \mu\, p_t + \mu^*\, p^*_t + \varepsilon_t$
Dependent Variable: LNTCN
Method: Least Squares
Sample: 1913 2003
Included observations: 91

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIPMARG	0.892347	0.003301	270.3031	0.0000
LNIPMUSA	0.537421	0.020065	26.78440	0.0000
R-squared	0.998047	Mean dependent var		-13.96544
Adjusted R-squared	0.998026	S.D. dependent var		10.61470
S.E. of regression	0.471663	Akaike info criterion		1.356628
Sum squared resid	19.79946	Schwarz criterion		1.411812
Log likelihood	-59.72659	Durbin-Watson stat		0.247515

Table 12: Unit roots tests of equation (8) estimation results

Tests	t statistic	Test Cricital values (Engle and Yoo, 1987):	
ADF	-2.239068	1% level	-4.45
(H0: residuals has unit roots)		5% level	-3.75
		10% level	-3.36
Phillips-Perron	-2.408667	1% level	-4.45
(H0: residuals has unit roots)		5% level	-3.75
		10% level	-3.36

*, ** and *** denotes the rejection of the null hypothesis at 10%, 5% and 1% respectively.

Both tests cannot reject the null of unit roots in the residuals at 10% of significance. Thus, the nominal exchange rate and wholesale prices of Argentina and USA are not cointegrated. To confirm it, we apply Johansen's test to these variables and show the results in Table 13.

Table 13: Johansen's test for trivariate case and wholesale prices

Sample: 1913 2003
Included observations: 84
Series: LNTCN LNIPMARG LNIPMUSA
Lags interval: 1 to 6

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Selected (5% level) Number of Cointegrating Relations by Model (columns)					
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Once more, we cannot affirm that these variables are cointegrated. Thus, all cointegration tests indicate that there isn't a long-run equilibrium relation between the nominal exchange rate and the wholesale prices, which implies that PPP does not hold.

4.3 What have we found for the Argentinean case?

Empirical results obtained in this work using Argentinean data are mostly contrary to PPP theory. In this sense, when we check RER stationary, it appears as clearly non-stationary when we build it with consumer price indexes, and we obtain mixed results when we use wholesale prices. Thus, the assertion of Sarno and Taylor (2002) that is easier to find evidence favoring PPP using wholesale prices than consumer prices is verified. But, when we test for Cointegration between the nominal exchange rate and the consumer/wholesale prices, we cannot sustain the existence of a long-run equilibrium relation between these variables that supports PPP theory. By and large, then, results show that deviations from PPP are not dissipated in the long-run in the Argentina's case. Our results suggest, on the contrary, that nominal exchange rate and relative prices tend to deviate from one another.

What relation exists between our results and those of other studies which test PPP in Argentina? As we said, these works obtain results in favor and against the PPP in Argentina. These different results can come from differences in the data or in the estimation technique employed. We show these similarities and differences between these works in Table 14.

Tabla 14: Empirical studies testing PPP in Argentina

Author/s	Data employed	Estimation method	Major results
McNown and Wallace (1989)	Monthly data; official exchange rate from IFS (e.o.p); 1976:1 and 1986:6 with CPIs and 1976:1 and 1985:3 with WPIs	ADF test for RER, Cointegration test with Engle and Granger method	Evidence favoring PPP with WPI, reject PPP with CPI
Bahmani-Oskooee (1993)	Quarterly data between 1973 and 1988, effective exchange rate, CPI	Cointegration with Engle and Granger methodology	Evidence contrary to PPP
McLellan and Chakraborty (1997)	Monthly data between 1973:7 and 1990:12, official exchange rate and WPI from IFS	DF, ADF and Sims-Bayesian Tests for Real Exchange Rate	Evidence contrary to PPP with DF and ADF tests, in favor with Sims test
Carrera, et al. (1999)	Quarterly data between 1980:1 and 1998:4; nominal exchange rate and CPI from Indec	ADF, PP, variance ratio and Perron test with structural change, for RER	Evidence contrary to PPP
Taylor (2002)	Annual data between 1870 and 1996; official exchange rate, consumer deflator	ADF and GLS tests, and Cointegration with Johansen's test	Evidence favorable to PPP
Anoruo, et al (2002)	Quarterly data between 1961 and 1999; official exchange rate from IFS; CPI	ADF test and *dynamic error-correction model* (DECM)	Reject PPP with ADF test, accept it with DECM
Diamandis (2003)	Monthly data between 1973:11 and 1993:12, official exch. rate and CPI from IFS, black market exch. rate from World Curr. Yearbook.	Johansen (1991) Cointegration test	Evidence in favor of PPP
Our work	Monthly data between 1949:1 and 2003:12, free nominal exchange rate from FIEL; CPI and WPI	ADF, PP, DF-GLS, KPSS and ERS Tests for RER, cointegration with Engle and Granger and Johansen methods	Clear evidence contrary to PPP with CPI, mixed with WPI

4.4. *Caveats*

There are potential problems with our results that weaken the strength of our conclusions. First, we used aggregated price indexes so we are implicitly assuming that the relative prices of the economies (tradables versus non-tradables) remain stable. If this is not the case, we may have incurred in a specification bias (Frenkel, 1981). This is relevant in the Argentinean case because in the period under scrutiny there have been big changes in relative prices.

Besides, long-span price series has additional problems, like the introduction of new goods or measurement errors, that can affect the results.

In addition, we've employed data from different exchange rate regimes. In the period under study, Argentina had successive periods of fixed and floating exchange rates (Gerchunoff and Llach, 1998), while the USA has been under fixed exchange rates twice: under gold-standard between 1900 till –formally- 1933 and under Bretton Woods regime between 1946 and 1971 (McKinnon, 1993). An important difference between fixed and floating exchange rate regimes is that in the first one deviations from the PPP are dissipated by movements in relative prices, while in the second one the main mechanism of adjustment is the nominal exchange rate that is extremely more flexible than prices. So we blended data from monetary regimes with different mechanisms of adjustment which could have affected the results.[24]

An additional problem is the possible existence of structural changes which could have affected the behavior of the RER. Structural changes can make the RER appear as non-stationary when, if controlled by the structural changes, it really is stationary. We have done some preliminary analysis in this sense but more research is needed to confirm that our results are solid in case there were structural changes.

The last *caveat* is the possible existence of non-linearities in the Argentinean RER. The presence of non-linearities in RERs is often attributed to the heterogeneity of the participants in the foreign exchange market (because of different agents' expectations formation, objectives, etc.), to the possible limited arbitrage in the event of small RER shocks because of the existence of transaction costs, and to the effect of trade reforms, changes in fiscal policies, etc. (Sarantis, 1999). The point is that if there were a nonlinear RER dynamic in the Argentinean case our results would not be valid because we have worked with linear tests. Thus, it is essential to check if there are nonlinearities in the Argentinean RER. In this sense, Holmes (2002) tested for nonlinearities in the behavior of the Argentinean RER using quarterly data for the period 1973:2-2001:1 but he didn't find a nonlinear adjustment. However, it is necessary to study this theme in the much longer period of our work.

[24] Rogoff (1996) says: "...an obvious caveat to the above results is that they blend fixed and floating rate data. Real exchange rate tend to be more volatile under floating than under fixed exchange rate, and the econometric implications of mixing data from the two regimes is unclear." (p. 656).

5. Conclusions

Based on our empirical study we conclude that there is evidence against the PPP theory of exchange rates when it is tested for Argentina. This results are solid when we use consumer prices but weaker when we use producer prices.

This evidence contrasts with the "consensus" on the PPP literature about the long-run validity of PPP in developed countries.[25] Two questions emerge: why is the PPP not verified in Argentina? and what are the consequences of this?

In relation to the first question, besides the *caveats* of Section 4.4., there are some *a priori* answers we can hypothesize. On one hand, we found stronger evidence against the PPP using consumer prices. The evidence for developed countries is less conclusive in favor of the PPP when CPIs were used than when WPI were employed. However, a number of works (Kim, 1990; Papell, 1997; Taylor, 2002; and Taylor, Peel and Sarno, 2001) used consumer prices in developed countries and in spite of this they found evidence favoring the PPP. Moreover, when we test for cointegration using producer prices, we strongly reject the PPP.

On the other hand, the "consensus" can be explain by the existence of the "survival bias" mentioned by Froot and Rogoff (1995). Since most studies used data from developed countries, usually because longer series were available, there was a selection bias to "successful" countries and themes like productivity differentials or the other "structural" factors that can generate a definite tendency in the RER are less probably between richer countries. As we studied Argentina in relation with the USA, the PPP adverse results are not so surprising because there are "structural" factors to expect a continuous depreciation of poorest countries RER, as the "Balassa-Samuelson Effect". These structural effects can be responsible for the non-stationarity of the Argentinean RER.[26] Clearly, more research is needed on this subject.

Another factor that can explain our results is the high volatility of the Argentinean exchange rate. This volatility generates huge instability of nominal income and, in the event of imperfect capital markets, it can cause permanent real effects on savings, inversion and labor market (Andersen, 1997). These real effects are translated, sooner or later, to the RER.

In addition, Argentina has historically had high barriers to international trade, making the international arbitrage of goods and services very difficult which, probably, affected the adjustment to the PPP.

Furthermore, it is important to note that a number of studies rejected the PPP even for developed countries. The consensus about its long-run validity is to some extent recent. In the

[25] In this sense, Sarno and Taylor (2002) concludes that: "Our reading of the literature leads us to the main conclusion that Purchasing power parity might be viewed as a valid long-run international parity condition when applied to bilateral exchange rates obtaining among major industrialized countries..." (p. 65).
[26] Cavallo and Domenech (1988), Gay and Pellegrini (2002) and Carrera, et al (1998) are some of the works that have studied Argentinean RER determinants.

1980s, for example, the PPP was rejected as a long-run relation.[27] Econometric advances or the use of new data can, thus, change the actual consensus.

Related to the second question, there are important policy implications of the rejection of the PPP. First, it implies that political economy suggestions derived from models in which PPP is a basic building-block are inappropriate for Argentina or at least have to be taken carefully.

In more general terms, if the PPP were verified deviations from it would be dissipated, sooner or later, because of movements in the nominal exchange rate and/or relative prices. Long-run RER, thus, would be a constant not under policymakers' control. On the contrary, if the PPP is not valid, deviations from this would not dissipate and there will be longer lasting effects on the county's external competitiveness, external balance, product and employment, especially in tradable sector (Dornbusch, 1987). It is important in the debate of how long a country can obtain benefits by deliberately maintaining the RER high, seeking competitive gains, better external balance and foster employment, or low if the objective is to combat inflation. These policies will be more effective and longer lasting the smaller the connection is between the nominal exchange rate, the prices and the salaries.[28]

Finally, the validity of the PPP is relevant in practical matters, like the issue of whether the RER is appreciated (depreciated) or not. If the PPP is valid, then the PPP exchange rate is a benchmark for the exchange rate or, as it is usual in practice, the RER long-run mean. On the contrary, if the RER follows a definite tendency, it is no longer valid to compare the RER against its historical mean to test whether is appreciated or not.

[27] "Within the vast literature on PPP and real exchange rates, professional opinion concerning the validity of PPP between the currencies of the major industrialized countries, in both the short and long run, appears to have shifted several times in the post-war period" (Sarno and Taylor, 2002, p. 95).

[28] "The relationship embodied in the traditional formulations of PPP should be viewed as a short-cut rather than a substitute for a complete model of the determination of prices and exchange rates. (...) Its main usefulness is in providing a guide as to the general trend of exchange rates rather than the day-to-day fluctuations. (...) As for the conduct of macroeconomic policy, the PPP relationship serves as a reminder that the exchange rate and the price level cannot be divorced from each other and therefore, policy targets concerning these two variables should be consistent.", Frenkel (1978), p. 188.

6. References

Abuaf, Niso and Philippe Jorion (1990), "Purchasing Power Parity in the Long Run", Journal of Finance, Vo. 45, No. 1, March, pp. 157-174.

Alba, Joseph D. and Donghyung Park (2003), "Purchasing Power Parity in Developing Countries: Multiperiod Evidence Under the Current Float", World Development, Vol. 31, No. 12, pp. 2049-2060.

Alves, Denisard C. O., Regina Celia Cati and Vera Lucia Fava (2001), "Purchasing Power Parity in Brazil: A Test for Fractional Cointegration", Applied Economics, Vol. 33, pp. 1175-1185.

Andersen, Torben (1997), "Exchange Rate Volatility, Nominal Rigidities, and Persistent Deviations from PPP", Journal of the Japanese and International Economies, Vol. 11, December, pp. 584-609.

Anoruo, Emmanuel, Habtu Braha and Yusuf Ahmad (2002), "Purchasing Power Parity: Evidence from Developing Countries", International Advances in Economic Research, Vol. 8, No. 2, pp. 85-96.

Bahmani-Oskooee, Mohsen (1993), "Purchasing Power Parity Based on Effective Exchange Rate and Cointegration: 25 LDC's Experience with its Absolute Formulation", World Development, Vol. 21, No. 6, pp. 1023-1031.

Balassa, Bela (1964), "The Purchasing Power Parity Doctrine: A Reappraisal", Journal of Political Economy, Vol. 72, No. 6, December, pp. 584-596.

Calderón, César and Roberto Duncan (2003), "Purchasing Power Parity in an Emerging Market Economy: A Long-Span Study for Chile", Estudios de Economía, Vol. 30, No. 1, January, pp. 103-132.

Carrera, Jorge, Mariano Féliz and Demian Panigo (1998), "La Aproximación del TCR de Equilibrio: Una Nueva Aproximación Econométrica", Annals of the XXXIII Annual Meeting of the AAEP.

Carrera, Jorge, Mariano Féliz and Demian Panigo (1999), "Unit Roots and Cycles in the Main Macroeconomic Variables for Argentina", Annals of the XXXIV Annual Meeting of the AAEP.

Cassel, Gustav (1916), "The Present Situation of the Foreign Exchanges", Economic Journal, Vol. 26, No. 101, March, pp. 62-65.

Cassel, Gustav (1917), "The Depreciation of Gold", Economic Journal, Vol. 27, No. 107, September, pp. 346-354.

Cassel, Gustav (1918), "Abnormal Deviations in International Exchanges", Economic Journal, Vol. 28, No. 112, December, pp. 413-415.

Cassel, Gustav (1928), Post-War Monetary Stabilization, Columbia University Press, New York.

Cavallo, Domingo and Roberto Domenech (1988), "Las Políticas Macroeconómicas and el Tipo de Cambio Real. Argentina, 1913-1984", Desarrollo Económico, Vol. 28, No. 111, October-December, pp. 1-27.

Cheung, Yin-Wong and Kon S. Lai (1993), "A Fractional Cointegration Analysis of Purchasing Power Parity", Journal of Business & Economic Statistics, Vol. 11, No. 1, pp. 103-112.

Culver, Sarah E. and David H. Papell (1999), "Long-Rung Purchasing Power Parity with Short-Run Data: Evidence with a Null Hypothesis of Stationarity", Journal of International Money and Finance, Vol. 18, pp. 751-768.

Darby, Michael R. (1983), "Movements in Purchasing Power Parity: The Short and Long Runs", en Michael Darby and James R. Lothian, The International Transmission of Inflation, Chicago University Press, Chicago, pp. 462-77.

Diamandis, Panayiotis F. (2003), "Market Efficiency, Purchasing Power Parity, and the Official and Parallel markets for Foreign Currency in Latin America", International Review of Economics and Finance, Vol. 12, No. 1, pp. 89-110.

Dornbusch, Rudiger (1987), "Purchasing Power Parity", in J. Eatwell, M. Migare and P. Newman (eds.), The New Palgrave Dictionary, Stockton Press, New York.

Dornbusch, Rudiger and Paul A. Krugman (1976), "Flexible Exchange Rates in the Short Run", Brookings Papers on Economic Activity, pp. 537-575.

Edison, Hall J. (1987), "Purchasing Power Parity in the Long Run: A Test on the Dollar/Pound Exchange Rate (1890-1978)", Journal of Money, Credit and Banking, Vol. 19, No. 3, pp. 376-387.

Edwards, Sebastian (1989), Real Exchange Rates, Devaluation, and Adjustment. Exchange Rate Policy in Developing Countries, MIT Press, Cambridge, Massachusetts.

Elliott, Graham, Thomas J. Rothenberg and James H. Stock (1996). "Efficient Tests for an Autoregressive Unit Root," Econometrica 64, 813-836.

Enders, Walter (1995), Applied Econometric Time Series, John Wiley and Sons, EE.UU.

Engel, Charles (1993), "Real Exchange Rates and Relative Prices: An Empirical Investigation", Journal of Monetary Economics, Vol. 32, pp. 35-50.

Engle, Robert F. and Clive Granger (1987), "Co-integration and Error Correction: Representation, Estimation and Testing", Econometrica, Vol. 55, No. 2, March, pp. 251-276.

Engle, Robert F. and Byung Sam Yoo (1987), "Forecasting and Testing in Co-Integrated Systems", Journal of Econometrics, Vol. 35, pp. 143-159.

Frankel, Jeffrey A. (1986), "International Capital Mobility and Crowding-out in the U.S. Economy: Imperfect Integration of Financial Markets or Goods Markets?", in Rik Hafer (Ed.), How Open is the U.S. Economy?, Lexington, pp. 33-67.

Frankel, Jeffrey and Andrew K. Rose (1996), "A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries", Journal of International Economics, Vol. 40, pp. 209-224.

Frenkel, Jacob A. (1978), "Purchasing Power Parity: Doctrinal Perspective and Evidence from the 1920s", Journal of International Economics, Vol. 8, No. 2, pp. 169-191.

Frenkel, Jacob A. (1981), "The Collapse of Purchasing Power Parities During the 1970's", European Economic Review, Vol. 16, pp. 145-165.

Froot, Kenneth A. and Kenneth Rogoff (1995), "Perspectives on PPP and Long-Run Real Exchange Rates", en Gene Grossman and Kenneth Rogoff (Eds.), Handbook of International Economics, Vol. III, Amsterdam, Elsevier Press.

Gay, Alejandro and Santiago Pellegrini (2002), "Tipo de Cambio Real and Crisis Cambiaria en Argentina", Annals of the XXXVII Annual Meeting of the "Asociación Argentina de Economía Política".

Gerchunoff, Pablo and Lucas Llach (1998), El Ciclo de la Ilusión and el Desencanto. Un Siglo de Políticas Económicas Argentinas, Editorial Ariel, Buenos Aires, Argentina.

Giovannini, A. (1988), "Exchange Rate and Prices", Journal of International Economics, Vol. 24, No. 1-2, February, pp. 45-68.

Granger, Clive and P. Newbold (1974), "Spurious Regressions in Econometrics", Journal of Econometrics, Vol. 2, pp. 111-120.

Greene, William H. (2003) Econometric Analysis, fourth edition, Prentice Hall, EE.UU.

Hakkio, Craig (1984), "A Reexamination of Purchasing Power Parity", Journal of International Economics, Vol. 17, pp. 265-277.

Holmes, Mark J. (2002), "Are there Non-Linearities in US:Latin American Real Exchange Behavior", Cuadernos de Economia, Vol. 29, No. 2, December, pp. 177-190.

Holmes, Mark J. and Ping Wang (2004), "Real Exchange Rate Shocks, Asymmetric Adjustment and Long-Run Equilibrium in Less Developed Countries", mimeo, January.

Huizinga, John (1987), "An Empirical Investigation of the Long-run Behavior of Real Exchange Rates", Carnegie-Rochester Conference Series on Public Policy, autumn, pp. 149-215.

Isard, Peter (1977), "How Far can We Push the Law of One Price?", American Economic Review, Vol. 67, No. 5, December, pp. 942-948.

Johnson, David R. (1990), "Co-integration, Error Correction, and Purchasing Power Parity Between Canada and the United States", Canadian Journal of Economics, Vol. 3, No. 4, pp. 839-855.

Johansen, Soren (1991), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", Econometrica, Vol. 59, No. 6., November, pp. 1551-1580.

Keynes, John Maynard (1924), Monetary Reform, Harcourt Brace and Company, New York.

Kim, (1990), "Purchasing Power Parity in the Long Run: A Cointegration Approach", Journal of Money, Credit and Banking, Vol. 22, No. 4, pp. 491-503.

Knetter, Mark (1989), "Price Discrimination by U.S. and German Exporters", American Economic Review, Vol. 79, No. 1, March, pp. 198-210.

Knetter, Mark (1993), "International Comparisons of Price-to-Market Behavior", American Economic Review, Vol. 83, No. 3, January, pp. 473-486.

Krueger, Anne O. (1983), Exchange-rate Determination, Cambridge University Press, United States of Americas.

Krugman, A. (1978), "Purchasing Power Parity and Exchange Rates", Journal of International Economics, Vol. 8, pp. 397-407.

Kugler, Peter and Carlos Lenz (1993), "Multivariate Cointegration Analysis and the Long-Run Validity of PPP", Review of Economics and Statistics, Vol. 75, pp. 180-184.

Kwiatkowski, Denis, Peter C. B. Phillips, Peter Schmidt & Yongcheol Shin (1992). "Testing the Null Hypothesis of Stationary against the Alternative of a Unit Root," Journal of Econometrics, 54, 159-178.

MacKinnon, J. G. (1991). "Critical Values for Cointegration Tests," chapter 13 in R. F. Engle and C. W. J. Granger (eds.), Long-run Economic Relationships: Readings in Cointegration, Oxford University Press.

Maddala, G. S and In-Moo Kim (1998), Unit Roots, Cointegration, and Structural Change, Cambridge University Press, UK.

Mark, Nelson (1990), "Real and Nominal Exchange Rates in the Long Run: An Empirical Investigation", Journal of International Economics, Vol. 28, pp. 115-136.

McKinnon, Ronald (1993), "The Rules of the Game: International Money in Historical Perspectives", Journal of Economic Literature, Vol. 31, No. 1, March, pp. 1-44.

McLellan, Jacquelynne W. and Debasish Chakraborty (1997), "Another Look at Long-Run Purchasing Power Parity using Sims Tests for Unit Roots", Applied Economics Letters, Vol. 4, pp. 473-476.

McNown, Robert and Myles S. Wallace (1989), "National Price Levels, Purchasing Power Parity, and Cointegration: a Test of Four High Inflation Economies", Journal of International Money and Finance, Vol. 8, pp. 533-545.

Obstfeld, Maurice and Kenneth Rogoff (1996), Foundations of International Macroeconomics, MIT Press.

Officer, Lawrence H. (1976), "The Purchasing-Power-Parity Theory of Exchange Rates: A Review Article", IMF Staff Papers, Vol. 23, No. 1, March, pp. 1-60.

Papell, David H. (1997), "Searching for Stationarity: Purchasing Power Parity under the Current Float", Journal of International Economics, Vol. 43, No. 3-4, November, pp. 313-32

Rogoff, Kenneth (1996), "The Purchasing Power Parity Puzzle", Journal of Economic Literature, Vol. 34, June, pp. 647-668.

Rogoff, Kenneth, Michael Kim and Kenneth A. Froot (2001), "The Law of One Price Over 700 Years", IMF Working Paper WP/01/174, November.

Roll, Richard (1979), "Violations of Purchasing Power Parity and their Implications for Efficient International Commodity Markets", in Sarnat Marchasll and Giorgo Szego (eds.), International Finance and Trade, Cambridge, MA, pp. 133-176.

Samuelson, Paul (1964), "Theoretical Notes on Trade Problems", Review of Economics and Statistics, Vol. 46, No. 2, May, pp. 145-154.

Sarantis, Nicholas (1999), "Modelling Non-Linearities in Real Effective Exchange Rates", Journal of International Money and Finance, Vol. 18, No. 1, January, pp. 27-45.

Sarno, Lucio and Mark P. Taylor (2002), "Purchasing Power Parity and the Real Exchange Rate", IMF Staff Papers, Vol. 49, No. 1, pp. 65-105.

Taylor, Alan M. (2002), "A Century of Purchasing Power Parity", Review of Economics and Statistics, Vol. 84, No. 1, pp. 139-150.

Taylor, Mark P. (1988), "An Empirical Examination of Long-run Purchasing Power Parity Using Cointegration Techniques", Applied Economics, Vol. 20, pp. 1369-1381.

Taylor, Mark P., David A. Peel and Lucio Sarno (2001), "Nonlinear Mean-Reversion in Real Exchange Rates: Toward a Solution to the Purchasing Power Parity Puzzles", International Economic Review, Vol. 42, No. 4, November, pp. 1015-1042.

Taylor, Mark P. (2003), "Purchasing Power Parity", Review of International Economics, vol. 11, No. 3, August, pp. 436-452.

Wei, Shang-Jin and David C. Parsley (1995), "Purchasing Power Disparity During the Floating Rate Period: Exchange Rate Volatility, Trade Barriers and Culprits", National Bureau of Economic Research Working Paper No. 5032, February.