# AN EMPIRICAL TEST OF PURCHASING POWER PARITY OF THE ALGERIAN EXCHANGE RATE: EVIDENCE FROM PANEL DYNAMIC

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**Abstract**

The goal of this study is to examine the validity of the long-run purchasing power parity (PPP) for a sample of nine principle trade partners of Algeria namely Canada, China, Japan, Switzerland, Sweden, Turkey, the United Kingdom, the United States and the euro zone countries. Using panel error correction model (PECM) upon monthly data for the period 2003 M1 – 2015M5, results suggested that the bilateral exchange rate movements is a suitable to support the purchasing power parity (PPP) hypothesis. However, suggesting that there is long run relationship between exchange rates and relative prices in foreign courtiers by using panel cointegraion of Pedroni (1999, 2004), that can be interpreted by the validity of purchasing power parity for nine principle trade partners of Algeria.

**Keywords:** Algeria, panel cointegration, Purchasing Power Parity (PPP), panel error correction model (PECM)

## Introduction

As far as the Algerian exchange rate is concerned, since 1996 the central bank adopted a managed floating exchange rate after a long experience with the former regime (1974-1995) that was built upon a strong concentration of the US dollar that played an important role due to its 98% in hydrocarbon export receipts, while imports are made in Euros, which account for about 50 percent of total imports (Kamel et al, 2014).

Of course, the Euro and the US dollar are still the major currencies attractive in the actual International monetary systems and the Algerian economy in particularly. But, the Algerian exchange rate is still vulnerable to other currencies that we shall investigate, in this paper, the PPP concept of these major currencies against the Algerian dinar

Purchasing power parity (PPP) is a technique used to allow equal between relative prices in two countries which relied on its own monies. It is known that from the early idea of classical doctrine (Ricardo 1811, wheatley 1819). G Cassel, (1916, 1918, 1922) illustrated in his original theory of purchasing power parity the deviation between two exchange rates in long run. Largely literature reviews on PPP have highlighted its different stages: least square method, unit-root test, cointegration studies, ARIMA, ARDL, panel and nonlinear tests. In addition, the validity of the PPP were used the official exchange rate and relative price has been rejected in most emerging and less countries, numerous of them choose to employ the black market exchange rate. Moreover, the use of black market rate data in testing Algeria's PPP is unexplored and has not been published yet in the literature reviews.

This a strong concentration of the US dollar and Euro against the Algerian Dinar exchange rate in international trade transactions remains the main issue to be dealt with in this paper and it also adds to the empirical literature of the Algerian PPP law.

The rest of the paper is organized as follows. Thereafter, in section 2, we present review literature. Section 3 highlighted on overview of the Algerian case. Section 4 and 5 shows methodology and results of PPP concept. Finally, section 6 contains the main conclusion of the use of wholesale prices.

**Literature Review**

The early empirical has drudged for many decades to examine the purchasing power parity (PPP) exchange rates[106] evidence by statically estimation and finding elasticity coefficients on domestic and foreign prices such least square method see more: Gilbert and Kravis (1954) Frankel (1976), (1981), Kravis and Lipsey (1978), Adler and Lehmann (1983), Cumby and Obstfeld (1984).

Frankel, 1978 cover absolute and relative PPP doctrine during the flexible exchange rates period February 1920 tell May 1925. His result found causality relationship of exchange rate on price in the granger sense.

Most classical econometric estimations as least square method (GLS) based on non-stationary time series produce spurious regression and statistics may simply indicate only correlated trends rather than a true relationship (Granger and Newbold, 1974). Augmented Dickey-Fuller (1979, 1981) and Philips and Perron, (1988) tests can help avoid false results through stationary test of times series.

[106] Most early empirical studies test the PPP concept of the major currencies (US dollar, German mark, French Franc, UK pound, Japanese yen)

On this based, several empirical studies introduce dynamics in the estimated equation of PPP. Abuaf and Jorian (1990), Meese and Rogoff (1988) drown unit-root test after found non stationary of time series. They results does not support PPP in long-run of the major currencies.

Taylor (1988) used a cointegration of Johansen technique (1988) to arrive at the conclusion that there is a no relationship between prices and exchange rate. See also MacDonald and Taylor, (1993, 1994).... whilst, on the contrary, Baillie and selover (1987) Mark (1990), Patel (1990) used Engel-granger cointegrtion technique to confirm purchasing power parity evidence. They pointed in their results unfavourable evidence to PPP theory during the after 1971-period estimated as flouting period after the Nixon shock

Cheung and lai (1993) examined long-run purchasing power parity using a fractional cointegration analysis for the period 1914 -1989. They results supported PPP as a long-run phenomenon. Johnson (1990) detected a strong and long-run U.S.-Canada data PPP concept.

Philip A. Shively (2001) confirmed the evidence of purchasing power parity in small-sample from annual data spanning 1973 through 1997 Nominal exchange rates for Canada, France, Italy, Japan, Switzerland and the United Kingdom are relative to the U.S. dollar. Rogoff (1996) found PPP theory did not hold between developed and developing countries what we called The Purchasing Power Parity Puzzle**.** Haug and Besher (2007) found mixed results for non–linear and also a linear cointegration in the PPP model using monthly data from the post-Bretton Woods era for G-10 countries. Ozdemir, (2008) find support for PPP either in the long run

Hyrina and Serletis (2010) cited different econometric method used an early and later study to verify PPP concept, where early empirical methods failed to detect PPP existence compared to current studies.

Hussein Al-Zyoud (2015) examined the long run movement between Canadian dollar and US dollar exchange rates upon monthly data for the period 1995 M01 to 2008 M08 using the Engle-Granger cointegration test. He doesn't provide the validity of purchasing power parity between Canadian dollar and US dollar exchange rates.

A third group of studies have used a panel model. Pedroni (2001) indicate mixed evidence of PPP based on panel unit root tests. He illustrated the existence of weak PPP and he rejected of strong PPP concept.

More recently, Robertson et al (2014) used panel cointegration technique of monthly data from 1982:1 to 2010:2 to investigate the Purchasing Power Parity (PPP) between the US and Mexico. They results argue in favor the existence of weak-form and strong-form PPP between Mexico and the US.

He et al (2014) applied Panel SURKSS test with a Fourier function to detect the validity of long-run purchasing power parity (PPP) in fifteen Latin American countries over the period of December 1994 to February 2010

**Overview of the Algerian case**

As far as the Algerian exchange rate is concerned, the central bank adopted, since 1996, a managed floating exchange rate after a long experience with the former regime (1974-1995)[107] that was built upon a strong concentration of the US dollar that played an important role due to its 98% in hydrocarbon export receipts. Between 2004 and 2014 this sector accounted 35% to 45% of GDP and 46% to 70% of government revenue, while trade openness exhibits a high figure of 60% in the same period, (see Table 1)**.** US dollar is not the only dominate currency used in the Algerian trade; the euro is Algeria's largest trading currency. The Algerian imports from The European Union are made in Euros, which account more than 50 percent of total imports, while Total trade between the EU and Algeria amounted to €52.76 billion in 2014, see Table 02.

Table (1): GDP & government revenues dependency on oil

| | 2004 | 2005 | 2006 | 2008 | 2009 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| GDP (billions of dollars) | 85 | 103 | 117 | 171 | 137 | 199 | 204 | 210 | 227 |
| Share of oil in GDP(%) | 35,5 | 45 | 45,4 | 45,4 | 31,6 | 39 | 31,7 | 34 | 36 |
| Government expenditure (billions of dollars) | 44,4 | 46,1 | 50,8 | 73,9 | 67,4 | 81 | 91,4 | 100 | 111 |
| Trade Openness (%) | 58,1 | 64,8 | 64,9 | 69,4 | 60,2 | 71 | 53,9 | 64 | 64,8 |

**Source:*** IMF Country Report of Algeria from 2004-2012.
**Statistics Algeria, The ministry of Finance:
http://www.mf.gov.dz/rubriques/15/Activités.html

Table 02: Trade in goods 2012-2014, € billions

| Year | EU* imports | EU* exports | Balance |
|---|---|---|---|
| 2012 | 33 | 21 | -11 |
| 2013 | 32 | 22 | -10 |
| 2014 | 30 | 24 | -6 |

Source: Indicator Source IMF (World Economic Outlook)

- EU concerns the European Union of 28 members for all indicated years

Despite the launch of pertinent economic reforms and the implementation of structural Adjustment Program during the 1990s, which

[107] Algerian exchange rate was based upon a basket of 14 currencies.

was adopt by the Algerian government in cooperation with the International Monetary Fund (FMI) and the World Bank (WB).The intervention of the Bank of Algeria resulted by devaluation nominal and real exchange rate at an average rate of about 54 and 33 percent in1994 respectively. The US Dollar increased to nine Algerian Dinar in 1990 from 35 in 1994 and 47 dollar again the Dinar year a later.

In addition, the nominal exchange rate index was characterized by increasing in levels to 2 and 8 percent for nominal and real exchange rate respectively during 1997-1999.

Between January 2003 and January 2013, the Algerian exchange rate has varied continuously; from January 2003 to September 2008, the U.S dollar depreciated monthly against the Algerian Dinar by about 19%, followed by a depreciation of 6% during the financial crisis. Between January 2010 and January 2013, the Algerian dinar depreciated against the U.S. dollar by 4.2%.

In this context, Price stability as the actually challenge of the bank of Algeria is not yet a bed variable for the Algerian economy. The first half of the 1970's is characterized by the continuing stability of the Algerian inflation rate oscillating between 3 to 6%. However from 1975 to 1988, inflation registered high trend with an average annual rate of 9.96%. This peak can be explained by many reasons, mainly the adaptation of new Algerian exchange rate regime that has become based upon a basket of 14 currencies[108] instead of the strict begs. The second reason behind the high inflation rate during 1975-1988 is within the core inflation in itself, as measured by the dominance of food products that contributed up to 50% to the total increase in imports due to the expansion of trade openness.

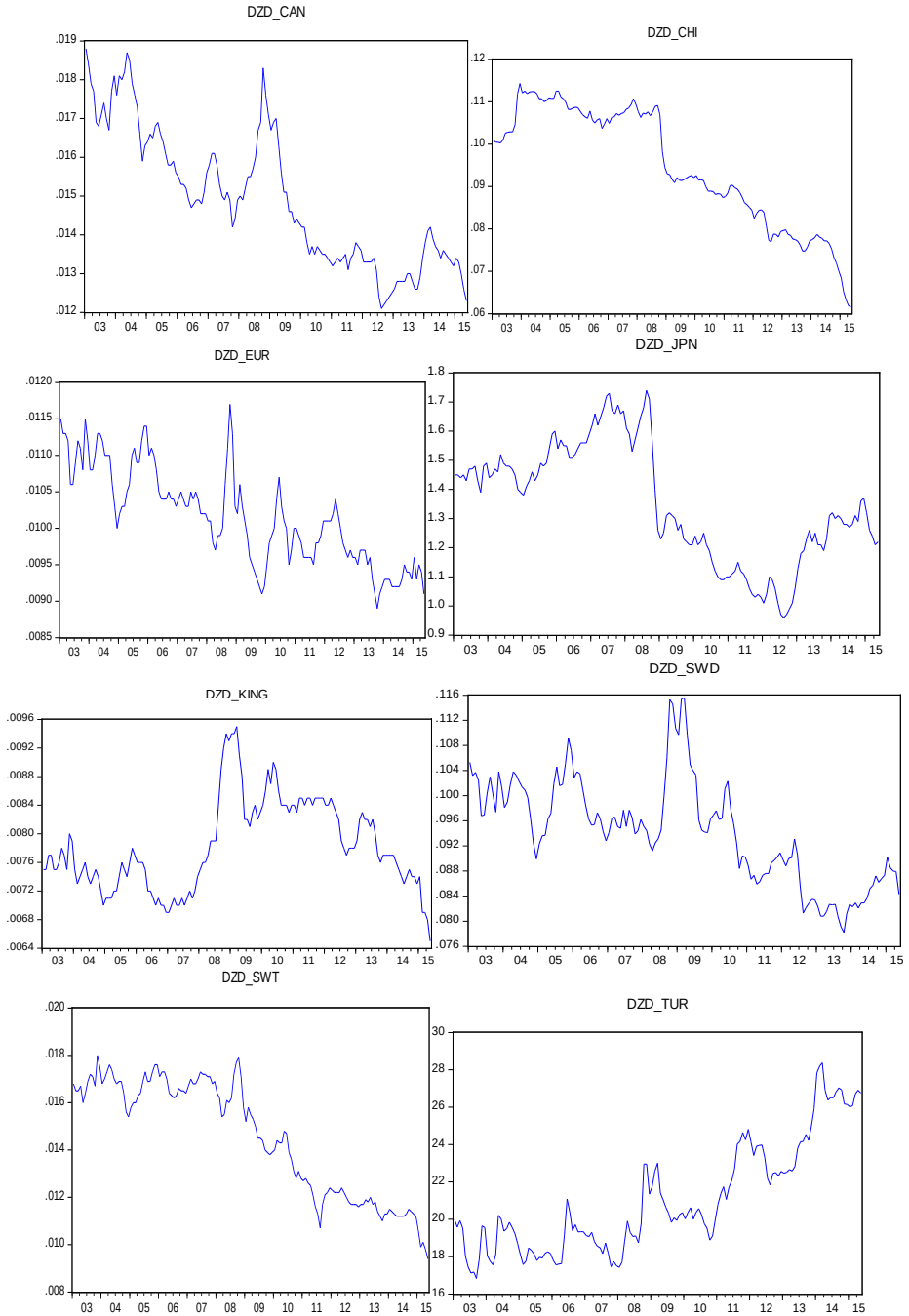
As the Algerian inflation rate has been growing steadily since the 1990s, price stability became actually the main challenge of the bank of Algeria as it has a great impact on the Algerian economy and the consumer purchasing power. In fact, the average increase of the CPI turned around 18.55% in the 90's, whilst in the 20's it witnessed its lowest average at 3.2%. From the beginning of the second decade of the new millennium, inflation rates increased to ranges between 6 to 8.5% to such an extent that it has become necessary for policy makers to grasp inflation trends with their uncertainties. **Methodolgie**

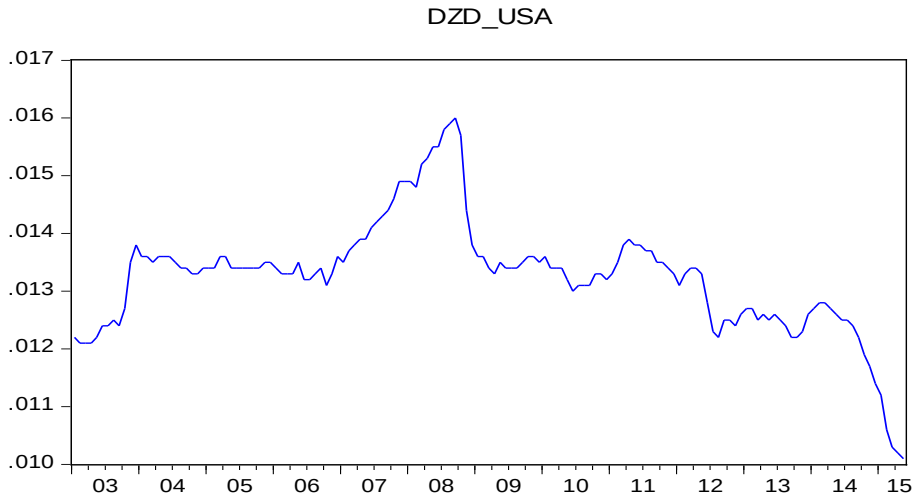
A. **Data source**

In our analysis, we make use two macroeconomic variables representing the relation between the exchange rate and consumer price indices for a sample of nine principle trade partners of Algeria namely

[108] Australia, Belgium,Canada, China, France, Germany, Italy, Japan, the Netherlands, Spain, Switzerland, Sweden, Turkey, the United Kingdom, and the United States.

Canada, China, Japan, Switzerland, Sweden, Turkey, the United Kingdom, the United States and the euro zone countries. These bilateral relationships are represents respectively DZD–CAD, DZD–CNY, DZD–YEN, DZD–CHF, DZD–SEK, DZD–TRL, DZD–GBP, DZD–US Dollar and DZD–EURO.






Let P, P* and P** represent the domestic price and the foreign prices ((based on 2010 = 100). The sample of each time series comprises 149 monthly observations for the period 2003 M1 – 2015M5, while transformed into natural logarithms. These variables are collected from different issues of the IMF's International Financial Statistics and the DataStream.

**B. Definition of Model**

In this paper, we use Panel cointegration tests to test PPP hypothesis for cross-section data by using Pedroni (1999, 2004). The relationships detection between the exchange rate and consumer price indices allow us to confirm PPP evidence in this case. As a result of this, we get the following equation:

Loge= a + b Log P, + c Log/P* + $\varepsilon_{it}$ ……(1)

Where:

Log : logarithm

P :CPI in Algeria (Domestic price index)

P* :CPI in USA (Foreign price index)

. e :exchange rate

$\varepsilon_{it}$ : error term

**Results and desscussion**

**A: Stationarity tests**

Before presenting the results from the empirical panel cointegration, we will apply the stationary test of the time series data. In this context, we have chosen the cross-sectionally augmented panel unit root test of Levin, Lin and Chu (2002), , Im, Pesaran and Shin (2003), Fisher-type tests using ADF and and Hadri (2000)..All results drawn from stationary tests represented in tables (3) allow a rejection of the null hypothesis in first difference that signify no stationary of all series, but enable an acceptation at

a level, that signify integration of the variables at order 1 and can be interpreted as pre-evidence against the PPP.

Table 3: ADF and PP Unit Root Tests

| | Levin, Lin & Chu t | | Im, Pesaran and Shin W-stat | | ADF - Fisher Chi-square | | Hadri | |
|---|---|---|---|---|---|---|---|---|
| | Level | First order difference | Level | First order difference | Level | First order difference | Level | First order difference |
| Exchange rate | 3.66410<br>0.9999 | -9.39421<br>0.0000** | 2.27170<br>0.9884 | -12.2169<br>0.0000** | 7.99159<br>0.9788 | 189.688<br>0.0000** | 19.6385<br>0.0000 | -0.02438<br>0.5097** |
| Forgien prices | -2.07056<br>0.0192 | -6.06144<br>0.0000** | 1.60979<br>0.9463 | -15.4587<br>0.0000** | 7.56402<br>0.9844 | 261.467<br>0.0000** | 25.8394<br>0.0000 | -0.49700<br>0.6904** |
| Domestic Prices | 4.40268<br>0.9999 | -6.45872<br>0.0000** | 8.13349<br>0.9888 | -17.1972<br>0.0000** | 0.08826<br>0.9799 | 302.519<br>0.0000** | 25.7641<br>0.0000 | 0.41820<br>0.3379** |

*, ** indicates rejection of the null hypothesis of no-cointegration at 1% and 5%, levels of significance

**B: Analysis of co-integration tests**

In order to explain that nominal exchange rates and consumer price indices are integrated in first difference, Pedroni (1999 and 2004) develop statistic test to capture the relationships among variables in long run. However, we indicate that 7 out of 7 statistics (within-dimension (4) and between-dimension (3)) reject null by hypothesis of cointegration at the 5 percent level. In addition, the exist a long run cointegration in panel indicate that there is a long and short run relationship between the exchange rates and relative prices in Algeria and nine countries partners at the 0.05 level, (see Tables 4), implies that purchasing power parity in Algeria does holds true.

Table 4: The Pedroni Panel Cointegration Test

| | Statistic | Prob |
|---|---|---|
| (within-dimension) | | |
| Panel v-stat | 5.784724 | 0.0000 |
| Panel rho-stat | -3.632365 | 0.0001 |
| Panel pp-stat | -2.714988 | 0.0033 |
| Panel ADF-stat | -4.145040 | 0.0000 |
| Group mean cointegration tests (between-dimension) | | |
| Group rho-stat | -3.031367 | 0.0012 |
| Group pp-stat | -2.602828 | 0.0046 |
| Group ADF-stat | -4.764081 | 0.0000 |

*Note:* All statistics are from Pedroni's procedure (1999) where the adjusted values can be compared to the N (0,1) distribution. The Pedroni (2004) statistics are one-sided tests with a critical value of -1.64 ($k < -1.64$ implies rejection of the null), except the *v*-statistic that has a critical value of 1.64 ($k > 1.64$ suggests rejection of the null).

The validity of the long-run purchasing power parity behaviour between Algeria and an important trading partners employed the following techniques of error correction model to capture the adjustment speed of exchange rate deviations from the PPP.

The empirical results presented in tables (7) show through some elasticity that one per cent change in foreign price index leads to depreciate 1.72% of exchange rate against the other currencies. So, one percent increase in domestic price index to 0.8 of the official exchange rate in the long-run. The short- run estimated elasticity of same variables has a mixed impact on the exchange rate in Algeria. In addition to that, one percent increase in consumer price indices for the Algeria and foreign countries respectively leads to 0.08 and -0.52 percent Moreover, the ECM coefficients shows that the exchange rate is adjusted about 30 % deviations from the purchasing power by bilateral exchange rate movements every month, therefore, the term of error correction appear statistically significant but positive and incorrectly signed. See table 05.

Table 05: Short and Long- run coefficients

| Long- run coefficients | |
|---|---|
| | Ln BEX |
| EC (-1) | 0. 35* |
| local CPI | 0.80 |
| Foreign CPI | -1.72 |
| Short- run coefficients | |
| DZD(-1) | 0.14 |
| local CPI(-1) | -0.52 |
| Foreign CPI(-1) | 0.08 |
| Δ Ln CPI in USA (-2) | -2.412304 |
| C | -3.72 |

## Conclusion

In this paper, we investigated the Purchasing Power Parity (PPP) in Algeria using monthly data for the period 2003 M1 – 2015M5 through an empirical at various stages: unit-root test, panel cointegration, panel error correction model (PECM). However, the estimation of the coinetgraion establishes a long run relationship between the Algerian exchange rate and the major currencies namely Canadian dollar,, US dollar, Euro, UK pound, Japanese yen, Turkish lira, Chinese yuan, Swedish krona and Swiss franc. All econometric stages confirms the evidence of PPP holding.

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