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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 countries by using panel cointegration of Pedroni (1999, 2004), that can be interpreted by the validity of purchasing power parity for nine principle trade partners of Algeria.

Key Words: (Algeria, panel cointegration, Purchasing Power Parity (PPP), panel error correction model (PECM))

I. Introduction:

Since 1996, the Bank of Algeria (Central Bank) adopted the floating exchange rate regime after a long period from 1997 to 1996 characterized by a strong dominance of the reference to US dollars due to the particularity of Algerian economy, an economy based on exports of oil - 98percent of export revenues paid in US dollars and imports, rising continuously, paid in euro ((Kamel et al, 2014). There is evidence that this reflects instead the US dollar and the euro in the international currency market. With a relatively large share of American productions and the euro area in world production, these two currencies is an important element as to their attractiveness, particularly for the Algerian economy. The exchange rate of the Algerian Dinar by being very vulnerable nature to other foreign currencies, given the specificity of the Algerian economy (mono exporting countries), it would be interesting to see his behavior through the PPP concept. This study will be devoted largely to see how performs and behaves Algerian Dinar currency face some major trading partners of Algeria.

Remember that the purchasing power parity (PPP) is a technique used to enable equality between relative prices in two countries that relied on its own funds. It is known that the idea at the beginning of the classical doctrine (Ricardo 1811 Wheatley 1819). G Cassel (1916, 1918, 1922) shown in its original power parity theory of the gap between two long-term exchange rate. At first it is developed in the classical doctrine (Ricardo 1811 Wheatley 1819). G Cassel (1916, 1918, 1922) and shown in its original power parity theory of the gap between two long-term exchange rate. All reviews of the literature on PPP highlighted its various stages: least squares method, unit root tests, cointegration studies, ARIMA, ARDL, panel and nonlinear tests.

In addition, for the validity of PPP various theories have used the official exchange rate and the relative price. Nevertheless, in the majority of less

developed countries, the validity stumbles before a somewhat complex economic reality characterized by a relatively large informal sector. These countries tend to use the exchange rate on the black market. Note, in the case of Algeria, the use of black market rate data to test PPP Algeria is unexplored and has not yet been published in the literature reviews.

Furthermore, the high concentration of US dollar and euro against the exchange rate Algerian Dinar in international commercial transactions remains the main problem to be addressed in this work.

In the first section, it comes to clearly define the economic literature revolving around the PPP. In the next section we present an overview on the status of the exchange rate in Algeria followed a methodology and concept of PPP results. Finally, we conclude our article by a method using the wholesale price as a reference to a calculation of the PPP.

II. Literature Review

The first empirical study made several decades to examine the purchasing power ratio (PPP) and the obvious fact of exchange rate. According to statistical data and test of evaluation, it was this study made the discovery of modulus of elasticity on domestic prices inside and foreign, it is the least square method (Gilbert and Kravis (on 1954) Frankel (on 1976), (on 1981), Kravis and Lipsey (on 1978), Adler and Lehmann (on 1983), Cumby and Obstfeld (on 1984).

Frankel, (1978) covers the absolute and relative doctrine PPP during the period going from February, 1920 till May, 1925. The result at which arrived demonstrate clearly a relation of causality enter the exchange rate on the price farmer's sense.

Most of the econometric evaluations classic as the least squared method (GLS) based on the series of non-still time produce the false regression. The statistics can simply indicate trends correlated rather than real relation (the Farmer and Newbold, on 1974). The test of Dickey-Fuller (on 1979, 1981), of Philips and Flight of steps, (1988) can help to avoid false results by the still series of tests of time.

It is on these studies that it is based by the other empirical studies presenting a dynamics in the equation estimated by PPP. Flood the test of root of unity later found that the series of time is not still. They do not support the idea of the PPP in long-term for the major currencies.

Taylor (1988) used one cointegration of the technique of Johansen (1988) to arrive at the conclusion that there is no relation between prices and exchange rate. On this subject, it is necessary interessant also to see the works of MacDonald and Taylor, (on 1993, 1994). Whereas, on the contrary, Baillie and to selover (1987), Mark (1990), Patel (1990) used the technique of cointegrtn. They confirmed the obvious fact unfavorable to the theory PPP there later in 1971-period estimated as flouting period after the Nixon shock.

Cheung and lai (1993) examined the long-term purchasing power ratio by the use of an analysis of fractional cointegration during the period 1914-1989. Their results demonstrate that the PPP behaves as a long-term 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) noticed that the theory PPP did not take into account between developing countries

and developed countries, what we called the Riddle of Purchasing power ratio. Haug and Basher (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

III. Overview of the Algerian case

As much as the Algerian exchange rate is concerned, the Bank of Algeria (central bank) adopted, since 1996, a floating exchange rate managed after a long experience with the former regime (1974-1995). This regime was

built on a strong concentration of dollar US which played an important role because of the exports of Algeria constituted at the level of 98 percent by hydrocarbons and paid by this currency. Between 2004 and 2014 the sector of hydrocarbons accounted 35percent to 45percent of GDP and 46percent to 70percent of government revenue, while trade openness exhibits a high figure of 60percent 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 (EU) 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 billions 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 US dollars)	85	103	117	171	137	199	204	210	227
Share of oil in GDP (percent)	35,5	45	45,4	45,4	31,6	39	31,7	34	36
Government expenditure (billions of US dollars)	44,4	46,1	50,8	73,9	67,4	81	91,4	100	111
Trade Openness (percent)	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/Activit es.html>

Table 02: Trade in goods 2012-2014, billions of Euro (€)

Years	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 the economic reforms and the implementation by the Algerian government of Program of structural Adjustment during the 1990s under the aegis of the International Monetary Fund (IMF) and the World Bank (WB), the intervention of the Bank of Algeria did not prevent the devaluation of the nominal and real exchange rate with regard to the US dollar. The nominal and real exchange rate of the Algerian Dinar with regard to the US dollar was situated respectively on average about 54 percent and 33 percent in 1994. The dollar US was exchanged at nine Algerian Dinars in 1990, 35 in 1994 and 47 dollars in 1995.

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 percent, followed by a depreciation of 6 percent during the financial crisis. Between January 2010 and January 2013, the Algerian Dinar depreciated against the U.S. dollar by 4.2 percent.

In this context, Price stability as the actually challenge of the bank of Algeria. He seems what is more his monetary policy is centered on this objective. For reminder, the first half of the 1970's is characterized by the continuing stability of the Algerian inflation rate oscillating between 3 percent to 6 percent. However, from 1975 to 1988, the inflation registered high trend with an average annual rate of 9.96 percent. We can explain this summit by several many reasons, the most main are the adaptation again regime of Algerian exchange rate which became more based on a basket of 14 currencies instead of the strict asks. The second reason behind the high inflation rate registered during 1975-1988 is situated in the main inflation in itself. The consumer price index is essentially dominated by foodstuffs increasing by 50 percent during this period. These products being for the importing main part and the increase of their prices on the international market echoes automatically on those practised in Algeria.

As the Algerian inflation rate strongly increased since the 1990s, the price stability became the main challenge of the bank of Algeria, held account when the impact on the purchasing power of the population became more visible. One relatively strong inflation penalizes the consumption and make difficult the relaunching of the investment, two important aggregates for an economic growth.

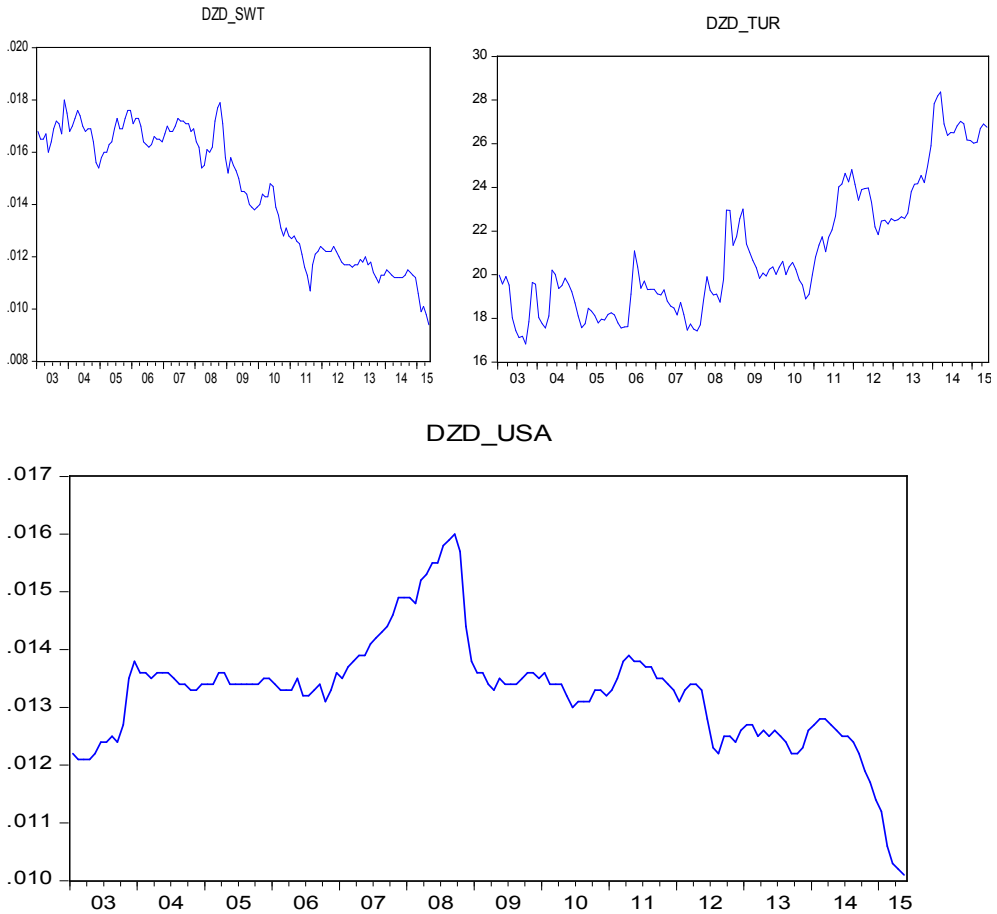
Methodologie

A. Data source

In our analysis, we use two macroeconomic variables representing the relation between the exchange rate and the consumer price index for a sample of nine main business partners of Algeria to know Canada, China, Japan, Switzerland, Sweden, Turkey, the United Kingdom, the United States and the countries of Eurozones. These bilateral relations are represent

respectively as follows: 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 index allow us to confirm PPP evidence in this case. As a result of this, we get the following equation:

$$\text{Log}e = a + b \text{Log} P + c \text{Log} P^* + \varepsilon_{it} \dots\dots(1)$$

Where:

Log : logarithm

P :CPI in Algeria (Domestic price index)

P* :CPI in USA (Foreign price index)

e :exchange rate

ε_{it} : error term

IV. Results and dessionion

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 Hadri (2000). All the results pulled by still tests represented in the table (3) allow a rejection of the no hypothesis in the first difference which is significant none still of all the series. But these results allow a meaning of a level, which informs the integration of variables of order 1 and can be interpreted as the obvious fact 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	Level	First order	Level	First order	Level	First order

		difference		difference		difference		difference
	3.66410	-9.39421	2.27170	-12.2169	7.99159	189.688	19.6385	-0.02438
Exchange rate	0.9999	0.0000**	0.9884	0.0000**	0.9788	0.0000**	0.0000	0.5097**
Forgien prices	-2.07056	-6.06144	1.60979	-15.4587	7.56402	261.467	25.8394	-0.49700
	0.0192	0.0000**	0.9463	0.0000**	0.9844	0.0000**	0.0000	0.6904**
Domestic Prices	4.40268	-6.45872	8.13349	-17.1972	0.08826	302.519	25.7641	0.41820
	0.9999	0.0000**	0.9888	0.0000**	0.9799	0.0000**	0.0000	0.3379**

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

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 1.72percent 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 percent 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 cointegration 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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