

FEAR OF FLOATING AND EXCHANGE RATE PASS THROUGH TO INFLATION IN ALGERIA

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ABSTRACT

The purpose of this paper is twofold: (i) identify a "fear of floating" theory in Algeria using indicators defined in empirical studies of Calvo and Reinhart (2002) and Hausmann et al (2000) and (ii) examine empirically one of its explanations; a strength pass-through of devaluation on domestic prices. For results, US/DZ exchange rates and foreign reserves variability probabilities, on monthly data over 1990-2015 period, classify Algeria among fear of floating countries. The VAR model based on Mc Carty (2007), over quarterly data of 2000-2016 period, shows that a three stage of inflation; import, producer and consumer prices react at US/DZ and do not at EU/DZ exchange rate.

KEYWORDS:

Exchange rate regime, inflation, pass-through, monetary policy, VAR model.

JEL CLASSIFICATION: E31, F31, F33

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RÉSUMÉ

Ce papier a un double objectif : (i) identifier la théorie de la "peur du flottement" pour l'Algérie, en utilisant les indicateurs définis dans les travaux empiriques de Calvo et Reinhart (2002) et Hausmann et al (2000) et (ii) évaluer l'une des explications de cette théorie ; la forte transmission de la dévaluation à l'inflation. Pour résultats, les probabilités de variations du taux de change US/DZ et des réserves de change, sur données mensuelles de la période 1990-2015, permet de classer l'Algérie parmi les pays à peur du flottement. L'application du modèle VAR et en se basant sur Mc Carty (2007), sur données trimestrielles de la période 2000-2016, montre que les trois niveaux d'inflation; indice des prix à l'importation, à la production et à la consommation répondent au taux de change US/DZ et non à celui de EU/DZ.

MOTS CLÉS:

Régime de change, inflation, transmission, politique monétaire, modèle VAR.

JEL CLASSIFICATION: E31, F31, F33

ملخص:

تتضمن هذه المقالة على هدفين؛ يتمثل الأول في السعي إلى تحديد نظرية "الخوف من التعويم" بالنسبة للجزائر، وذلك باستخدام المؤشرات المحددة في العمل التجريبي لكالفو ورينهارت Calvo et Reinhart (2002) و هوسمان وآخرون Hausman et al. (2000) و (2000)؛ أما الهدف الثاني فيتمثل في تقييم أحد تفسيرات هذه النظرية؛ أي انتقال قوي لتخفيض قيمة التضخم. ونتيجة لذلك، فإن احتمالات تقلبات سعر صرف الدولار الأمريكي مقابل الدينار الجزائري واحتياطيات النقد الأجنبي، استناداً إلى البيانات الشهرية للفترة 1990-2015، تجعل من الممكن تصنيف الجزائر بين الدول التي تخشى التعويم.

ويوضح تطبيق نموذج VAR واستناداً إلى Mc Carty (2007)، و على البيانات الفصلية للفترة الممتدة بين 2000-2016، لمستويات التضخم الثلاثة. وتستند مؤشرات الاستيراد والإنتاج والاستهلاك إلى سعر صرف الدولار الأمريكي / مقابل الدينار وليس على سعر الصرف الأورو الأوروبي/الدينار الجزائري.

كلمات مفتاحية

نظام سعر الصرف، التضخم، النقل، السياسة النقدية، نموذج VAR.

تصنيف جال: E31, F31, F33

INTRODUCTION

Inflation targeting implementation is problematic for emerging and development economies (EDE) due to importance of exchange rate objective there. On the one hand and in the literature, flexible exchange rate is a condition to inflation targeting because it permit a monetary policy independence and facilitate its implementation. In the case of direct reaction to the exchange rate, it may have adverse affects on both real output and inflation (Taylor, 2001). On the other hand and in practice, some EDE uses a mixed targeting in their monetary policy: exchange rate and inflation. The exchange rate objective is explained in these countries by "fear of floating" in lack of central bank's credibility context and high exchange rate pass through (ERPT) to domestic prices (Calvo and Reinhart, 2002). The 1990s exchange crisis, all generations considered, have put in evidence the stylized facts of central bank behavior in exchange rate fields; exchange rate stabilization enable the central banks of these EDE to have more credibility to achieve an inflation target. Thus, fear of floating is justified by fear of inflation (Goldfajn and Olivares 2001).

In Algeria, inflation targeting is explicitly defined as the ultimate goal of monetary policy in conjunction with the stabilization of the Real Effective Exchange Rate (Money and Credit Act of 2010). Officially, Bank of Algeria adopted the managed float regime (fixed exchange with large band fluctuations) since 1996 and the exchange rate is one of the explanatory variables of its inflation forecasting model (published reports of the bank). However the behavior of exchange rates suggests a fear of floating and this is due to the fluctuation of exchange rates rather upward (devaluation) than downward and thus its falls on inflation. This is explained by the mono-export nature of the Algerian economy and its dependence on imports of production goods and consumer goods.

This work consists to determine if Algeria is among fear of floating countries and whether the strong ERPT to inflation is a plausible justification. After a review of the literature (section 1), the study of fear of floating is carried out using empirical research of Calvo and

Reinhart (2002) and Hausmann et al (2000) (section 2). Analysis of macroeconomic indicators supports our results (section 3). In the study of exchange rate impact to inflation, during the period 2000Q1-2016Q4, we evaluate the pass-through of euro and US dollar exchange rates to three stage of inflation (section 4).

1- REVIEW OF EMPIRICAL LITERATURE

Empirical research on fear of floating theory has focused on questioning the results of Fisher (2001) in his *de jure* classification of exchange rate regimes. Levy-Yeyati and Sturzenegger (2000) gave a new *de facto* classification, based on the nominal exchange rate (monthly average change), its volatility and international reserves volatility. They consider a fixed regime as the case of high reserve volatility associated with lower exchange rate volatility and conversely for a flexible regime. For results, more than 26% on average of formal fixed (float) regime country behave in a *de facto* floating (fixed) regime; "Words are not deeds" as expression of the authors. Further study of Calvo and Reinhart (2002) explains the fear of floating by the weak credibility of central banks. By comparing probabilities of small exchange rates, foreign exchange reserves and interest rates fluctuations to those refer to floating countries, they noted that floating and managed float countries have probabilities close to those of fixed regime countries. The calculated exchange rate flexibility index for each country, based on lack of credibility, strong ERPT to prices and adoption of inflation targeting, are lower than those of the benchmark countries. The Hausmann and al (2000) study, based on international reserve stock, relative volatility of exchange rates to reserves and interest rates showed that formal floating countries have a reserve / M2 ratio six times higher than that of the G3 countries. The relative volatility of depreciation ratios are significantly lower and have shown a strong link between a country's floating model and its ability into external debt in local currency (the foreign currency stock is weak in the case of floating) and a less obvious relationship between the importance of the exchange rate and the pass through. Goldfajn and Olivares (2001) have highlighted the stylized

facts in the behavior of developing countries; these last are willing to accept large fluctuations in reserves and interest rates for small ones in exchange rates. Authors explained the fear of floating by the fear of inflation due to adverse effects of depreciation induced by a high degree of pass-through.

Concerning the link between pass through and inflation, Taylor (2000) was one of the first to explicitly formulate the decline of pass through hypothesis by the switch to low inflation. Choudhri and Hakura (2001) confirm this hypothesis For 71 emerging countries over the period 1979-2000, based on an open economy model. Empirical analysis of Campa et al (2005) tested short and long term transmission of exchange rate movements to import prices, across euro area countries and product categories, for monthly data over 1989-2004 period. As results, the transmission in the short run is high, although incomplete; in the long run, it is higher and close to one. Mc Carthy (2007) examine the pass-through of exchange rate and import price fluctuations to producer and consumer inflation for industrialized economies. He uses a VAR model to track pass-through from exchange rate fluctuations to each stage of the distribution chain in a simple integrated framework. As result, exchange rate shocks have modest effects on domestic inflation in most of the countries, while import price shocks appear to have a larger effect. Pass-through is larger in countries with a higher import share of domestic demand and in countries with more persistent and less volatile GDP. Variance decompositions suggest that the role of exchange rate and import price shocks on domestic is relatively modest.

Few works are devoted to inflation and the exchange rate in Algeria. In their "natural" algorithm based on dual or parallel exchange rate, covering 153 countries, Reinhart and Rogoff (2002) uses, for Algeria, monthly data of official and parallel rates over 1946-2001 and 1955-1998 periods respectively. As findings, Algerian exchange rate regime looks like a managed float on the euro in terms of the natural classification, but in practice the currency has been

relatively more aligned with the dollar¹. Zouache and Ilmane (2009)² showed a weak independence from the Bank of Algeria: *de jure* independence but not *de facto*. Cobham (2012) focuses on Middle East and North Africa countries and classifies them into three sub-groups according to the development of the monetary architecture³. Using the results of the two studies mentioned above, the paper classifies Algeria in the intermediate category closely near the basic architecture in which the financial system is little or not developed and the role of central bank is elementary. According to the author fixing the exchange rate in these countries is not inappropriate. Si Mohamed et al (2015a) evaluates ERPT on producer and consumer price indexes (PPI and CPI), using a VAR Model, upon quarterly data, over 2002-2011 period. He uses theoretical model of Mc Carty (2007). As findings, there is an important pass-through on CPI with complete effect of Euro against the Algerian Dinar (DZ) in long run compared to the ERPT of US dollar and no one on PPI. The variance decomposition estimate increasing magnitude contribution of euro's exchange rate shocks to explain CPI (28% after 30 periods). Si Mohamed et al (2015b) evaluates the determinants of inflation using annual data over 1980-2012 period and showed that in the short term only the external factors namely the import prices, hydrocarbon prices, the Nominal Effective Exchange Rate (NEER) are influential. Empirical research of Ben Naceur (2013) on determinants of inflation uses quarterly data of CPI, NEER, broad money (without hydrocarbon company deposit), world oil price, import prices, real non-oil GDP and treasury bills yield, over the period 2003-11. Among the results,

¹ The paper underline that the older classifications of exchange rate failed in the none taking account of the fact of the exchange rates either single or multiple or parallel. For that, in the vast majority of multiple exchange rate or dual systems, the dual or parallel rate is a far better barometer of monetary policy than is the official rate and it is often the most economically meaningful rate.

² Cited in Cobham (2012).

³ defined by a number of indicators such as the independence of the central bank, its expertise, monetary policy instruments and link between interest rates and external relations.

the Vector Error Correction Model shows that the NEER pass-through is significant but low.

2- FEAR OF FLOATING IN ALGERIA

Algeria has maintained a fixed exchange rate regime since independence and adopted a managed float with the objective of stabilizing the Real Effective Exchange Rate from 1996. Tables 1 and 2 provide some guidance on the nature of the monthly exchange rate movements of Algerian Dinar (DZ) against the US dollar, foreign reserves and interest rates over the period 1990-2015. The first table is based on the indicators defined in the Hausmann et al. (2000) and the second one evaluates the probabilities of variations within an interval such as Calvo and Reinhart (2002). The breakdown of the sub-periods is justified by the major achieved changes and policies; before and during implementation of the Structural Adjustment Program (SAP) period, after major devaluations period (after 1995) and finally period of financial ease resulting from the structural increase in hydrocarbon export earnings.

Table 1: **Absolute and relative change of selected indicators in Algeria, 1990-2015 (monthly data)**

| Period | Average fluctuation and standard deviation (σ) | | | | Exchange rate volatility / volatility of: | |
|-----------|---|-------------------|-------------------------|--------------------|---|-------------------------|
| | Exchange rate | Exchange reserves | 3 months interest rate* | Rediscount rate | Exchange Reserves | 3 months interest rate* |
| 1990-2015 | 0.009 (0.038) | 0.022 (0.124) | 0.025 (0.360) | -0.0007 (0.049) | 0.31 | 0.106 |
| 1990-1995 | 0.030 (0.07) | 0.035 (0.247) | -- | 0.013 (0.091) | 0.28 | -- |
| 1996-2000 | 0.004 (0.011) | 0.028 (0.071) | -0.016 (0.055) | -0.13 (0.039) | 0.15 | 0.2 |
| 2001-2015 | 0.002 (0.018) | 0.014 (0.024) | 0.032 (0.385) | -0.002 (0.017) | 0.7 | 0.046 |

Source: based on International Financial Statistics data and Bank of Algeria statistical bulletins. (*) start date: december 1998.

Theoretically stability (volatility) in foreign exchange reserves should correspond to exchange rate flexibility (stability). However in Algeria, both indicators seem to be moving in the same direction; they show a volatility over the 1990-1995 period on average and standard deviation and a stability from 1996 (Table 1).

Table 2: Volatility of selected indicators in Algeria, 1990-2015 (monthly data)

| Period | Probability that change is within +/-2.5 percent band: | | Probability that change is within +/-4 percent band: | | |
|-----------|--|-------------------|--|-----------------|----------------------|
| | Exchange Rate | Exchange Reserves | 3 months interest rate * | Rediscount Rate | Deposit auction rate |
| 1990-2015 | 85.53 | 46.25 | 67.21 | 94.85 | -- |
| 1990-1995 | 69.01 | 19.72 | -- | 91.54 | -- |
| 1996-2000 | 95 | 18.90 | 91.67 | 88.33 | -- |
| 2001-2015 | 88.89 | 65.56 | 63.52 | 93.75 | 95.12 |

Source: based on International Financial Statistics data and Bank of Algeria statistical bulletins.

() start date: december 1998.*

Exchange rate volatility over the first sub-period is the result of successive devaluations made after the oil counter-shock of 1986 in response to reserve stock breakdown: 0.8 months of imports in 1990 and 2.08 months in 1995 (Nashashibi et al., 1998, p.79). Internal economic and external finance difficulties showed the unsustainable of the current exchange regime obliging thus Algeria to devalue its currency and break with fixed exchange rates. Restocking exchange reserves (respectively 4.5 and 9 months of imports in 1996 and 1997) as a result of hydrocarbon price rises led to a stabilization of exchange rates over 1996-2000 period. Continued consolidation of the external finance position from 2000 to 2013 has resulted in greater both reserves and exchange rates stability; reserve values are respectively to 18 and close to 37 months of imports in 2001 and 2006. This Stability is broken from the third quarter of 2014; the drop in hydrocarbon prices and their non-recovery led to a fall in foreign exchange reserves and led to the series of devaluations over the period 2015-2017.

However, throughout the study period, volatility of exchange rates is lower than that of foreign reserves: relatively, the ratio remains less than unity (column 5 of table 1). This is consistent with the results of Hausmann et al (2000) on *de jure* floating countries but *de facto* fixed. This finding supports the idea that foreign exchange reserves are used to defund exchange rate and that Algerian economy depend on external relations; exports and imports and its exchange rate is not defined by internal inputs.

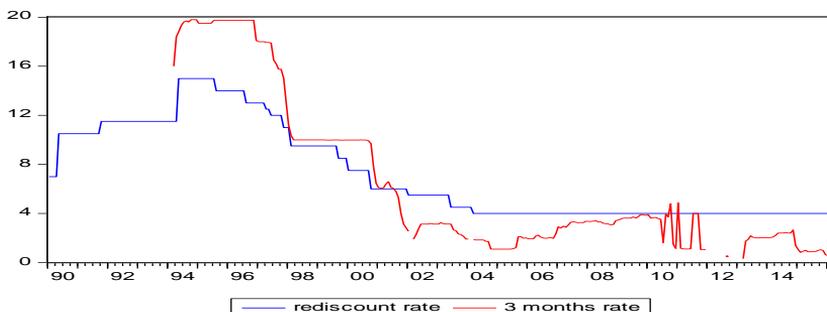
Analyze detailed in table 2 reveals three situations: two exceptional and concern the first and third sub-periods of 1990-1995 and 2001-2015; and one that can be characterized as stationary or according to theory. The exception is the situation of stability (volatility) in both exchange rates and foreign reserves which explanation has been given above (comment of table 1). This is the case in a crisis context where volatility as well as devaluation are inevitable (sub- period 1) and high stability of macroeconomic and financial situation where exchange rate stabilization is not costly (sub-period 3). The medium sub-period displays a negative relationship between the two indicator fluctuations; volatility of exchange reserves corresponds to exchange rate stability according to theory. This sub-period well reflects authorities behavior in exchange rates stabilization in rarefaction of foreign reserves sources context and commitment to repay the external debt. Apparently, this situation recurs in 2014 as a result of the shock caused by hydrocarbon price relapse; at the fall in foreign reserve stock are associated a series of devaluations from 2012 onwards.

Considering the entire period, table 2 shows a high probability of small changes in exchange rates associated with a low probability of stability of reserves which is consistent with Calvo and Reinhart's (2002) results on fear of floating countries.

Regarding the role of interest rates in exchange rate stabilization, the results are not conclusive (the same results of empirical studies in

this matter). volatility of exchange rate is lower than that of interest rates (table 1) but this does not allow us to comment on the role played by this latest in stabilization of the former; interest rates are also subject to small fluctuations and they have also experienced some liberalization. After a ceiling of 15% in 1994, rediscount rates declined continuously (chart 1). From 2001, structural excess liquidity situation of the commercial banks makes inoperative the action of central bank via rediscount rate; this rate has been zero since April 2004. Likewise, deposit auction rate (introduced since 2002) remains largely within the 4% range (Table 2). In sum, interest rates play a minor role in monetary policy.

Chart 1: **Rediscount and interbank rates in Algeria, 1990:01-2016:01 (monthly changes)**



3- Macroeconomic indicator analysis

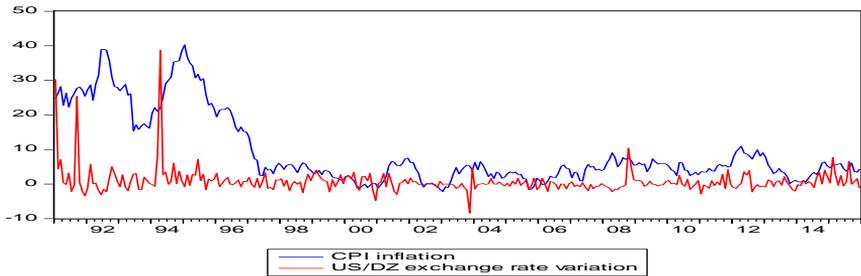
Other indicators reinforce fear of floating theory: Algerian economic characteristics and poor experience of devaluation in the 1990s.

Algerian economy depends broadly from hydrocarbon exports which constitute about 95% of total exports over the whole period of study. Foreign exchange market is characterized by concomitance of an official and a parallel market. The first one is essentially interbank, without forward compartment and where central bank remains the main supplier of foreign currency. Authorities have introduced exchange controls by limiting the Dinar convertibility and obligation to repatriate currencies related to exports, among others. Also, they

control capital flows through a number of administrative measures in external trade and foreign investment fields. Liberalization of foreign trade in 1994 is incomplete and benefits most to final consumer imports.

Poor experience with the Dinar devaluations seems to explain the behavior of authorities in maintaining exchange rate objective. One apparent reason of fear of floating is the inflationary result of depreciation. The first oil shock in 1986 puts Algerian economy in difficulty. Large dinar depreciation (60%) resulting from exchange rate adjustment associated with partial liberalization of domestic prices and interest rates has led to an inflationary surge; CPI rose from an average of 10.3% over the 1986-1990 period to 22.8 in 1991 (Nashashibi et al,1998, p.7). After 1998, inflation rates remained below 5% except in 2009 (5.7%) and 2012 (8.9%). The rise in 2009 is explained by the 2007 financial crisis consequences as Algeria is major importer of countries directly affected by the crisis. This exposure to external shock is an additional argument to want to protect from external fluctuations. Inflation increase in 2012 is a result of wages raise⁴. Increase in the exchange rate (devaluation) and the resumption of inflation are renewed at the end of 2014: the rate of inflation reaches at 6.8% and 7% in 2016 and first quarter of 2017 respectively.

Chart 2: US/DZ exchange rates and CPI inflation in Algeria, 1991:01- 2015:12 (% change)



⁴ Raising in the guaranteed minimum wage and public sector wages with a retroactive recall until 2008.

4- TRANSMISSION OF CHANGES IN THE EXCHANGE RATE TO INFLATION

4.1- Empirical model

We analyze the ERPT into inflation using a VAR model based on Mc Carthy (2007). This model examine the pass-through of exchange rate and import price fluctuations to domestic producer (PPI) and consumer (CPI) inflation, using a model of pricing along a distribution chain. Inflation at each stage—import, producer, and consumer—in period t is assumed to be comprised of (i) expected inflation at that stage based on the available information at the end of period $t-1$; (ii) and (iii) the effects of period t domestic “supply” and “demand” shocks on inflation at that stage; (iiii) the effect of exchange rate shocks on inflation at a particular stage; next are shocks at the previous stages of the chain and finally, stage’s shock.

The mathematic formulation of three inflation stage are as follow:

$$\pi_t^m = E_{t-1}(\pi_t^m) + \alpha_1 \mathcal{E}_t^s + \alpha_2 \mathcal{E}_t^d + \alpha_3 \mathcal{E}_t^e + \mathcal{E}_t^m \quad (1)$$

$$\pi_t^w = E_{t-1}(\pi_t^w) + \beta_1 \mathcal{E}_t^s + \beta_2 \mathcal{E}_t^d + \beta_3 \mathcal{E}_t^e + \beta_4 \mathcal{E}_t^m + \mathcal{E}_t^w \quad (2)$$

$$\pi_t^c = E_{t-1}(\pi_t^c) + \gamma_1 \mathcal{E}_t^s + \gamma_2 \mathcal{E}_t^d + \gamma_3 \mathcal{E}_t^e + \gamma_4 \mathcal{E}_t^m + \gamma_5 \mathcal{E}_t^w + \mathcal{E}_t^c \quad (3)$$

Where π_t^m, π_t^w and π_t^c are import price, PPI, and CPI inflation respectively; $\mathcal{E}_t^s, \mathcal{E}_t^d$ and \mathcal{E}_t^e are the supply, demand, and exchange rate shocks respectively; $\mathcal{E}_t^m, \mathcal{E}_t^w$ and \mathcal{E}_t^c are the import price, PPI, and CPI inflation shocks; and $E_{t-1}(\cdot)$ is the expectation of a variable based on the information available at the end of period $t-1$. The shocks are assumed to be not auto-correlated as well as uncorrelated with one another within a period.

We assume that supply shocks are identified from the dynamics of oil price inflation denominated in US dollars (equation 4). This assumptions can be justified by the relationship between oil prices and both public and private investments increases^{5,6}. Demand shocks

⁵ Quarterly data on public expenditure and/or investment are unavailable.

are identified from the dynamics of the output gap after taking into account the contemporaneous effect of the supply shock (equation 5). Exchange rate shocks are identified from the dynamics of exchange rate depreciation (Δe_t) after taking into account the contemporaneous effects of the two previous shocks (equation 6).

$$\pi_t^{oil} = E_{t-1}(\pi_t^{oil}) + \varepsilon_t^s \quad (4)$$

$$gap_t = E_{t-1}(gap_t) + a_1 \varepsilon_t^s + \varepsilon_t^d \quad (5)$$

$$\Delta e_t = E_{t-1}(\Delta e_t) + b_1 \varepsilon_t^s + b_2 \varepsilon_t^d + \varepsilon_t^e \quad (6)$$

The interactions between monetary policy (MP)/ money demand (MD) and other variables are identified:

$$r_t = E_{t-1}(r_t) + c_1 \varepsilon_t^s + c_2 \varepsilon_t^d + c_3 \varepsilon_t^e + c_4 \varepsilon_t^m + c_5 \varepsilon_t^w + c_6 \varepsilon_t^c + \varepsilon_t^{MP} \quad (7)$$

$$\Delta m_t = E_{t-1}(\Delta m_t) + d_1 \varepsilon_t^s + d_2 \varepsilon_t^d + d_3 \varepsilon_t^e + d_4 \varepsilon_t^m + d_5 \varepsilon_t^w + d_6 \varepsilon_t^c + d_7 \varepsilon_t^{MP} + \varepsilon_t^{MD} \quad (8)$$

Finally, it is assumed that the conditional expectations ($E_{t-1}(\bullet)$) of variables in all equations is replaced by previous values (\bullet_{t-1}).

4.2- Data and econometric methodology

In order to assess pass-through and importance of exchange rate shocks to the variability of inflation, we use a vector autoregressive (VAR) estimate, with quarterly data covering the 2002:1 to 2016:4 period. The model tests the relationship between the dependent variables, import, producer and consumer inflation (IPI, PPI and CPI) and a set of exogenous variables; oil inflation (OIL), real growth output (GDP), exchange rates of Algerian Dinar; US/DZ and EURO/DZ fluctuations (USE and EUE). This model is augmented by broad money growth ratio (M2). Interbank interest rate is not included in the model due to its steady values over the period. The data sources are Bank of Algeria statistical report for broad money and oil prices; National

⁶ It should be noted that the relationship is positive for oil-exporting countries such as Algeria unlike non exporter's and developed countries.

Statistical Office for GDP and the three price indexes; and International financial statistics of IMF for exchanges rates.

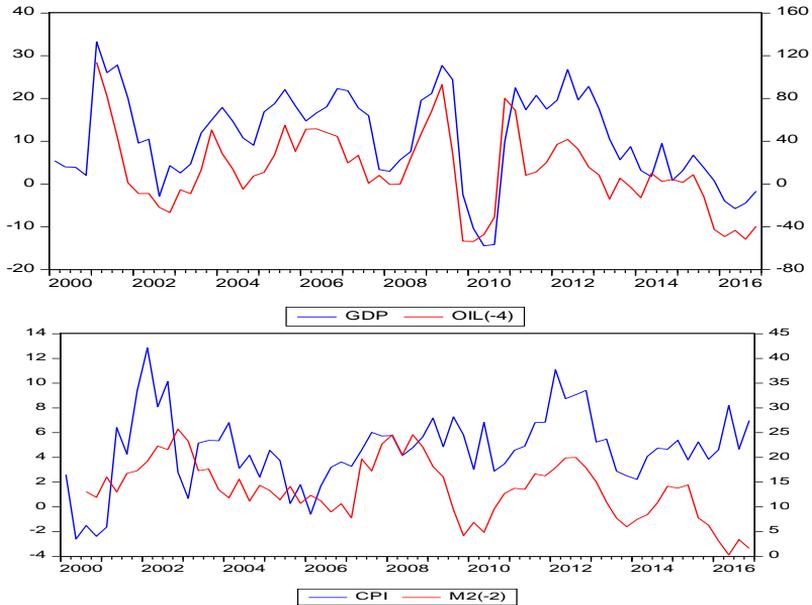
The effect of exchange rate depreciation and import price inflation are estimated by the impulse responses functions over a two-year (8-quarter) horizon. They correspond to the response to a one percent shock in the exchange rate or import price. Variance decompositions are used to measure the percentage of the forecast variance in domestic price indices that can be attributed to these factors. The error bands are estimated using the Monte Carlo method employed by E-views 9.

Impulse response analysis is a useful tool to explore the dynamic structure of the system. Matrix of impact multipliers is identified using restrictions: the structural shocks are orthogonal and the matrix is assumed to be lower triangular. This imposes a recursive form on the contemporaneous correlations in the system ; the first variable responds only to its own shock, the second variable responds to the first variable plus to a shock to the second variable, and so on. Finally, the last variable reacts without delay to all shocks. Thus, the ordering of the variables has important implications for the identification of the shocks. In this paper, the ordering was chosen on the basis of the speed of variable respond. The oil price inflation is assumed to be most exogenous, followed respectively by GDP growth, exchange rates, import inflation, producer inflation, money growth and consumer inflation.

By putting CPI in the last position, we assume that the monetary authorities (using money growth) respond to all the other variables contemporaneously except inflation. In other words, it is money growth that generate CPI inflation. These assumptions are guided by Algerian economic and monetary characteristics : economic growth rate, which is largely driven by public expenditure, is closely linked to hydrocarbon export earnings which are estimated at 94.5% of total exports. In turn, these export receipts are at the root of increase in external assets (of central and secondary banks) which dominate the broad money counterparts. As a result, monetary growth has escaped the bank of Algeria and the latter can only slow it down to avoid its

implications for consumer inflation. Following chart, that display respectively GDP with delayed oil from (t-4) period and consumer inflation with delayed money growth are additional argument.

Chart 3: Evolution of GDP with oil (left side) and CPI with money (right side), in percentage of growth.



Source: Based on Bank of Algeria statistical report and National Statistical Office.

4.3- Results

The number of lags in the VAR is set at five (a constant is the only other variable included in the regressions). Impulse responses to the exchange rate shocks are estimated over a two-year (8-quarter) horizon and variance decompositions are used to measure the percentage of the forecast variance in prices.

Impulse responses

Figure 1 displays accumulated effects of depreciation on import inflation. In short and medium-term (one- and two- to eight-quarter horizon), the responses are so high albeit statistically not significant. Response to EURO/DZ exchange rate increases gradually to 3.4% during one year and quarter and the response to US/DZ exchange rate has the wrong sign. These results are then contradictory and not conclusive. This may be explained by two important factors; the implemented exchange controls and its consequence; the development of a parallel market of currencies (underlined in sub-section 4.1). Exchange rates in black market are identified as real currency value because it is the result of supply and demand currencies. Finally, these factors reduce the impact of the depreciation.

Figure 1: import inflation response to cholesky one S.D. of depreciation

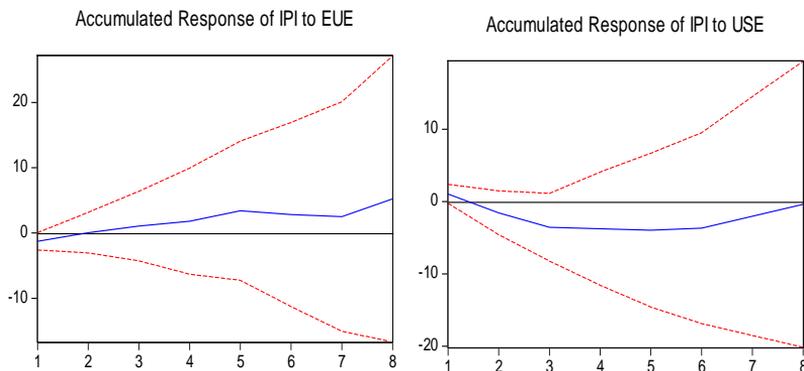
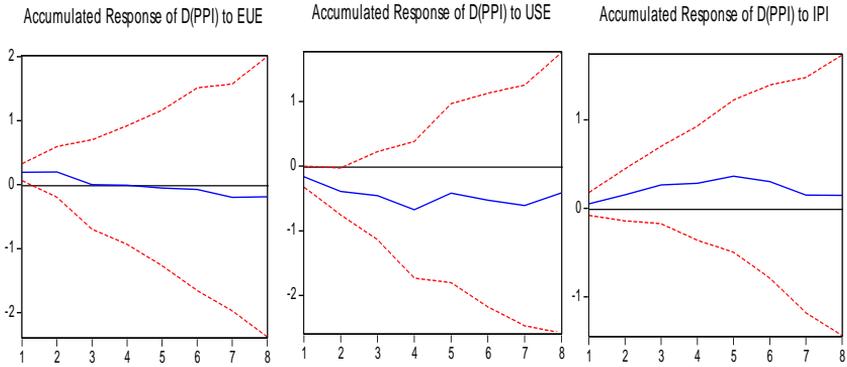


Figure 2 displays estimated pass-through of exchange rate and import inflation to producer inflation. A notable feature is that US/DZ depreciation triggers significant, immediate and persistent decrease in inflation in the first quarter but on the wrong sign. The responses to EURO/DZ exchange rate increase and import inflation are not significantly different from zero. In addition to comments cited above, the non response of producer inflation to import one may be explained by the characteristics of the both representative indexes: the first one expresses import prices of final goods mainly while the

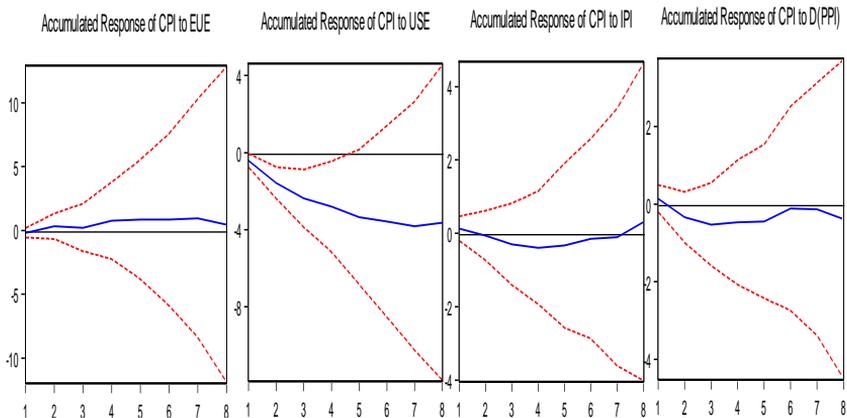
second reflect the prices of public production; the only index that is less incorrectly estimated by the National Statistical Office.

Figure 2: Producer inflation response to Cholesky one S.D. of depreciation and Import inflation



Finally, figure 3 shows the consumer inflation response to different chocks. The results are not surprisingly not different from others. The only significant response is that of US/DZ exchange rate but in the wrong sign.

Figure 3: Consumer inflation response to Cholesky one S.D. of depreciation, Import and Producer inflation



Variance decomposition

Variance decompositions (table 4) enable us to determine the importance of the different shocks for each stage inflation at various horizons.

For import prices, innovations in US/DZ exchange rate are low in explaining import price variance in the beginning, increases sharply near to 20% by a year and declines slightly to 16% at the two-year horizon. EURO/DZ exchange rate explain near to 6% of import price forecast variance initially. This percentage increases gradually as the forecast horizon expands (14% in 8 period). A direct effect of import inflation on itself is high initially (77%) but declines near to 30% in the 8th quarter. Thus, the contribution of exchange rates are not negligible and import inflation expresses some inertia.

Table 3: **Variance decomposition of Import, Producer and Consumer inflation**

| Quarter | 1 | 2 | 4 | 6 | 8 |
|----------------------------------|----------|----------|----------|----------|----------|
| Variance decomposition of IPI | | | | | |
| EUE | 5.851683 | 7.714804 | 7.937093 | 10.02359 | 14.39896 |
| USE | 3.976264 | 17.95748 | 18.96931 | 15.28825 | 16.36267 |
| IPI | 77.38200 | 56.74521 | 45.70954 | 37.86855 | 29.65192 |
| Variance decomposition of d(PPI) | | | | | |
| EUE | 8.224545 | 4.534629 | 7.474237 | 6.375792 | 6.703625 |
| USE | 6.010658 | 9.671651 | 12.95392 | 17.08941 | 18.27260 |
| IPI | 0.555924 | 1.565614 | 2.546745 | 2.921135 | 4.235454 |
| D(PPI) | 59.27016 | 33.09069 | 28.43343 | 24.99734 | 22.22358 |
| Variance decomposition of CPI | | | | | |
| EUE | 2.125896 | 6.326602 | 9.313092 | 8.308902 | 10.28605 |
| USE | 10.95577 | 34.02216 | 36.86321 | 37.26279 | 34.38144 |
| IPI | 1.105926 | 1.237834 | 1.854739 | 2.149614 | 4.119643 |
| D(PPI) | 1.274789 | 5.609241 | 4.532837 | 5.505649 | 5.700583 |
| CPI | 73.10148 | 27.11506 | 22.86757 | 21.04370 | 19.56515 |

For producer prices, innovations in EURO/DZ exchange rates are low and relatively stable around 7% for all horizons while US/DZ exchange rate has a gradual and high percentage (18% in last quarter). The contribution of import inflation is negligible but contribution of

producer inflation on itself is high (upper than 50% initially) and persistent although its decrease.

Finally, US/DZ exchange rate shocks explain more than one-third of the fluctuations in consumer inflation; contribution that is quite large comparing to euro innovations and other inflation innovations even consumer inflation on itself. Consumer inflation is less persistent than import and then producer inflation.

CONCLUSION

The extent of exchange rate pass-through is still an important policy question in developing economy as well as in Algeria. This extent, that can be identified by any external vulnerability, explains fear of floating behavior and is a condition to frame inflation targeting implementation.

In Algeria, exchange rates are less volatile than exchange reserves; their relative volatility remains less than unity. This finding enables to conclude that foreign exchange reserves are used to defend national parity. Furthermore, the probability that changes in exchange rate within a relatively narrow band is high while the reserve exchange one is low. These results are in accordance with results classifying fear of floating countries. In some, even Bank of Algeria announced a managed float since 1996 and underline it in its published reports, the present study on monthly data from 1990 to 2015 through three sub-periods, provides evidence that it may be reluctant to allow large depreciations of Dinar.

To support fear of floating theory in Algeria, we estimate VAR using a model of pricing along a distribution chain and examine the pass-through of exchange rates (US/DZ and EU/DZ) and import price fluctuations to producer and consumer inflation. Responses to EU/DZ exchange rate shock are not significantly different from zero, for all stages of inflation. Although not conclusive, depreciation from US dollar response are significant for producer inflation in the short term and consumer inflation during a year.

Even impulse responses doesn't indicate a precise extent of exchange rate pass-through, decomposition variance indicate how important these shocks have been in inflation. Contribution of exchange rate in explaining the three stage of inflation increases gradually as the forecast horizon expands and the part of US/DZ is higher. In long term, percentage of US/DZ innovations exchange rate are so high in explaining import price variance. More, its contribution in consumer inflation is more than one-third, the highest percentage and higher than contribution of consumer inflation on itself.

However, these results are in my opinion underestimated. They would be more precise if black market rates were taken into account.

Beyond this, the results in the paper have a number of implications for monetary policy, mainly the non negligible inertia of import and consumer inflation.

Overall, the results of this paper are close to Reinhart and Rogoff (2002) finding on what in practice, Algerian Dinar is relatively more aligned with US dollar than EURO.

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