Discovering the Link between Algerian Inflation and Inflation Uncertainty Using Markov Switching Model

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Abstract

Inflation appears as a first challenge for recent economy performance in Algeria. This study uses the Markov Switching model to examine the relationship between Algerian Inflation and inflation Uncertainty using quarterly data for the period 1974-2014. The main result supports the Friedman-Ball hypothesis for the Algerian case that there is a positive association between the level of inflation and inflation uncertainty. This means that the increase in the level of inflation in Algeria leads to a rise in inflation uncertainty.

Keywords: *Inflation, Inflation Uncertainty, Markov Switching Model*

1. Introduction

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[1] 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. This study helps track inflation uncertainty at any time horizon letting policymakers decide to disinflate or increase inflation rate on local economy by capturing switching regimes of inflation uncertainty; See more Ball and Cecchetti´s (1990), Evans and Wachtel (1993), Kim and Nelson (1999), Castillo and Humala (2012). The goal of this

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

study is to estimate a time-varying Markov Switching Model of inflation producing measures of inflation uncertainty in Algeria. In order to bring out the evolution over time of monetary policy, we shall be using the Markov Switching Model to examine the relationship between Algerian inflation and inflation uncertainty upon quarterly data for the period 1974-2014

The rest of the paper is organized as follows. In section 2 we examine a Literature Review on the subject, followed by Section 3 that presents Model and Methodology. Section 4 draws on results and discussion and Section 5 contains the main conclusion.

2. Literature Review

Economics Research has drudged for many decades to examine inflation topics, such as the main determinants of inflation; (see Dornbusch et al. (1990), Click (1998) , Arize et al.(2004), Klein and Kyei (2009), Kandil and Morsy (2011), Ibrahim A. O and Akinwande A, (2010)). Other previous studies highlighted the relationship between inflation and economic growth. Baroo (1991), Bruno and Easterly (1998), Khan and Senhadji (2001), Nicholas (2009)…

The relationship between Inflation and inflation uncertainty is grasped from many angles. Okun (1971) and Friedman 1977, Ball 1990 argued that high inflation creates more uncertainty about future inflation. Furthermore, many empirical investigations have drawn upon the positive side of the relationship between inflation and Inflation uncertainty. See: Fisher (1981), Taylor (1981), Ball and Cecchetti (1990), whilst, On the contrary of Friedman Hypothesis, Pourgerami and Maskus (1987) found a negative relation between inflation and inflation uncertainty.

Between the two arguments, Holland (1995) demonstrated that inflation raised inflation uncertainty in the United States and increased uncertainty about future monetary policy while deflation would not affect inflation uncertainty

Hwang (2001) in similar study using ARFIMA-GARCH-type models over monthly US inflation for the period 1926 – 1992, pointed that inflation affects negatively but slightly its uncertainty, whereas the latter affects the inflation insignificantly

Fountas et al (2004) investigated the relationship between inflation and inflation uncertainty during the period 1960-1999 in six European Union countries. They found rising inflation uncertainly to cause significant inflation in these countries except for Germany.

Özcan Karahan (2012) examined the relationship between inflation and inflation uncertainty in Turkey from 2002 to 2011 using ARMA-GARCH model and Granger causality tests. His result confirmed Friedman-Ball hypothesis that inflationary period is always followed by high inflation uncertainty

Many empirical studies used GARCH, ARCH family models, and ARIMA to check Friedman and Friedman-Ball hypotheses; Thornton (2006,2007, 2008) for India, emerging markets and Argentina respectively; Qayyum (2006) for Pakistan; Brunner and Hess (1993), and Grier and Perry (1998) for G-7 countries, Jiranyakul and Opiela (2010) in the ASEAN- 5 economies …..

Ricketts and Rose (1995) argue in favor of Markov Switching Models for the establishment of an elastical association between inflation and inflation uncertainly for a group of G7 countries.

Simon (1996) concluded that inflation presents a good response to inflation uncertainly and output gap by applying the methodology of Markov-switching models to describe the inflation process in Australia.

Jin Kim (2004) discovered the link between inflation and its uncertainty in an empirical comparative study between Hamilton's Markov-switching heteroskedasticity and autoregressive conditional heteroskedasticity over the period 1958:1-1990:4. He found a strong relationship between studied variables when higher inflation is associated with higher long-run uncertainty.

Białowolski et al (2005) used Markov Switching Models in the Case of Poland during the period March 1992 and October 2005 using the Ball-Friedman hypothesis to capture the association of inflation with it variance.

Miles and vijverberg (2009) applied the Markov Switching model with regime- varying variance to detect changing Inflation Dynamics and Uncertainty in the United States.

Castillo and Humala (2012) illustrated the link between inflation and inflation uncertainty in Peru using Markov regime-switching heteroskedasticity model and highlighted the fact that high inflation always goes with periods of short and long-run high inflation uncertainty. We shall present hereafter the model and the methodology to deal with this relationship.

3. Model and Methodology

3.1 Data source

The sample comprises 148 quarterly data for the period 1974 - 2014. Inflation rate is used for our estimation purpose. Data is collected from International financial Statistics.

3.2 Econometric approach

L. E. Baum (1966) developed a hidden Markov model (HMM) applied to economic topics for the estimation of macroeconomic variables such as inflation and money, exchange rate….etc. See Hamilton (1989, 1990), Lewis (1989), Laxton, Ricketts and Rose (1994) and Ricketts and Rose (1995).

The Hidden Markov Model is a finite set of states, each of which is associated with a (generally multidimensional) probability distribution. Transitions among the states are governed by a set of probabilities called transition probabilities. See Warakagoda et al (1996). In order to define completely an HMM, the following elements are needed. See Warakagoda et al (1996):

$A = \{aij\}$

$aij = p\{q_{t+1} = \frac{j}{q_t} = i, 1 \leq i, j \leq N\}$

- Where qt denotes the current state, the number of observation symbols in the alphabet, *M*. If the observations are continuous then *M* is infinite, the number of states of the model, *N*.
- Transition probabilities should satisfy the normal stochastic constraints,

$aij \geq 0, 1 \leq i, j \leq N$

And

$\sum_{i=0}^{N} aij = 1, 1 \leq i \leq N$

A probability distribution in each of the states,

$B = \{bj(k)\}$

$bj(k) = p\left\{o_t = \frac{v_k}{q_t} = j\right\}, 1 \leq j \leq N, 1 \leq k \leq M$

Where v_k denotes the k^{th} observation symbol in the alphabet, and o_t the current parameter vector. The Following stochastic constraints must be satisfied.

$bj(k) \geq 0, 1 \leq j \leq N, 1 \leq k \leq M$

And

$\sum_{k=1}^{M} b_j(k) = 1, 1 \leq j \leq N$

If the observations are continuous then we will have to use a continuous probability density function, instead of a set of discrete probabilities. In this case we specify the parameters of the probability density function. Usually the probability density is approximated by a weighted sum of M Gaussian distributions$N$,

$b_j(o_t) = \sum_{m=1}^{M} c_{jm} N(u_{jm}, \sum jm, o_t)$

Where: c_{jm}=Weighting coefficients

u_{jm}=mean vectors

$\sum jm$=covariance matrices

c_{jm}Should satisfy the stochastic constrains,

$c_{jm} \geq 0, 1 \leq j \leq N, 1 \leq m \leq M$

And

$\sum_{m=1}^{M} c_{jm} = 1, 1 \leq j \leq N$

$\pi = \{\pi_i\}$

- The initial state distribution, where,

$\pi_i = p\{q_t = i\}, 1 \leq i \leq N$

Therefore, we can use the compact notation

$\gamma = (A, B, \pi)$

To denote an HMM with discrete probability distributions, while:

$\gamma = (A, c_{jm}, u_{jm}, \sum jm, \pi)$

4. Results and Comment

Much econometric estimations, which use the least square method (GLS), produce spurious regression and their statistics indicate false and bias elasticity (Granger and Newbold, 1974)). In this paper, Augmented Dickey-Fuller (1979, 1981) and Phillips and Perron, (1988) tests drawn from the stationary tests represented in figure 1 below, enable an acceptance at a level that signifies integration of the variables at order 1.

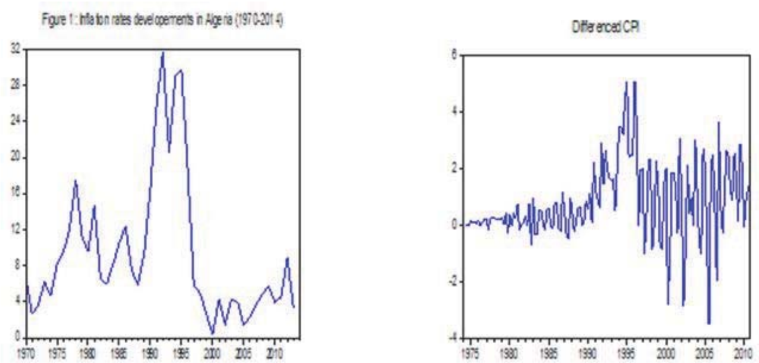

Figure 1: Unit Root Tests

Here, we try to check the significant association between inflation and it's uncertainly using Markov Switching (MS) of discrete hidden states according to an unobserved process, Hamilton 1989 and Białowolski (2005).

Before illustrating the results from the Markov Switching model**,** it would be preferable to run a Markov simple- two-state model to show the static ex-post probabilities between Algerian Inflation and inflation Uncertainty. The mathematical representation of the equation is: $e^2_t = \alpha + \beta \, CPI_{t+1} + \epsilon$

Where e^2_t is the Markov switching exponential Standard error, CPI is consumer price index, t is time, α and β are parameters.

The estimation result show that the inflation Uncertainty coefficient is greater than 1:(1.06) with p-value lower than 0.05 which can be taken as an evidence to accept the alternative hypothesis, meaning that changes in inflation rates cause the inflation uncertainty to vary with great discrepancy.

In this case that characterizes time series behaviors of inflation and uncertain inflation, we can apply the Markov Switching model as it offers more advantages through two regimes

Table 01: the Link between Algerian Inflation and inflation Uncertainty using Markov Switching

	Regime 1	Regime2
Mean	0.980034	0.975176
Variance	0.006533	0.010151
P11	50.08447	
P21	40.28342	
Log likelihood	-191	

Table 01 shows that the variance for all series is close to zero. Furthermore, we observe the mean in two regimes are 0.980034 and 0.975176 respectively. On the contrary, variance of the second regime is higher than first regime, so, Friedman assumption is accepted and variability of inflation uncertain in the second regime is more persistent compared to the first regime.

Regime transition Results show the stable persistence with small convergence between two regimes. During the first half of 1980s characterized by repetitive devaluation of Algerian Dinar against a stronger dollar and during Algeria war since 1990, we note high level of inflation associated with higher variance of inflation as evidenced by the Ball-Friedman hypothesis, (See Figure 2).

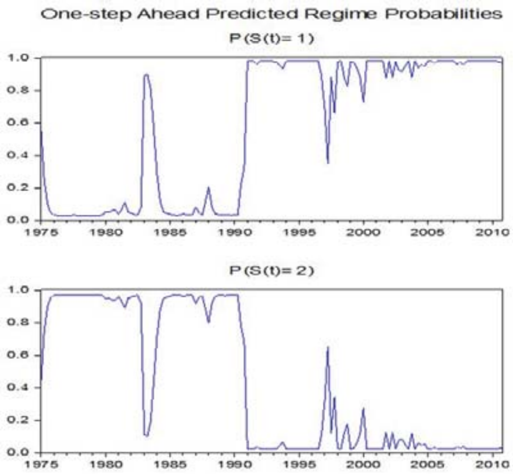

Figure 2

5. Conclusion

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%. 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. This high-volatility and mass inflation instability during five decades allowed us to focus on the Markov-switching models for modeling inflation pressure. Our results confirm that inflation is reasonably well delineated within uncertainly inflation in Algeria.

References

Arize, Augustine C., John Malindretos and SrinivasNippani (2004) "Variations in Exchange Rates and Inflation in 82 Countries: An Empirical Investigation", the North American Journal of Economics and Finance, 15, 227-247.
Baillie, Richard T., Ching-Fan Chung, Margie A. Tieslau (1996). Analyzing Inflation by the Fractionally Integrated ARFIMA-GARCH Model. Journal of Applied Econometrics. Vol. 11, No. 1 (Jan. – Feb. 1996), pp. 23-40
Ball, L., and Cecchetti,S. G. (1990),"Inflation and Uncertainty at Short and Long Horizons," Brookings Papers on Economic Activity, I, 215-254.
Barro, R. (1991),Economic growth in a cross section of countries. Quarterly Journal of Economics, 407–443.
Bokil, M., Schimmelpfennig, A. (2005), "Three Attempts at Inflation Forecasting in Pakistan" IMF Working Paper, Middle East and Central Asia Department.
Brunner, Allan D., Gregory D. Hess (1993). Are Higher Levels of. Inflation Less Predictable? A State-Dependent. Conditional Heteroskedasticity Approach. Journal of Business and Economic Statistics, Vol. 11. No. 2 (Apr. 1993), pp. 187-197
Bruno, M. and W. Easterly, (1998)."Inflation crises and long-run growth", Journal of Monetary Economics, vol. 41, pp. 3-26.
Chang-Jin Kim Unobserved-Component Time Series Models With Markov-Switching Heteroscedasticity:Changes in Regime and the Link Between Inflation Rates andInflation Uncertainty, *ournal of Business & Economic Statistics* Vol. 11, No. 3 (Jul., 1993), pp. 341-349
Click, R., (1998), "Seigniorage in a cross-section of countries", Journal of Money, Credit and Banking 30, 154–163
Cukierman, A. and A. Meltzer (1986), "A theory of ambiguity, credibility and inflation under discretion and asymmetric information", Econometrica, 54, 1099- 1128.
Dickey DA, Fuller WA (1979). Distribution of the Estimator for Autoregressive Time Series with a Unit Root. Am. J. Statist. Assoc. 74:427-431.
Dornbush, Rudiger, Sturzenegger, Fedrico, Wolf, Holger, Fischer, Stanley and Robert Barro (1990), "Extreme Inflation: Dynamics and Stabilization", Brookings Papers on Economic Activity, 2, 1-84.
Fisher, S.,1981. Towards an understanding of the costs of inflation: II. Carnegie Rochester Conferences Series on Public Policy 15, 5–42

Fountas S., Ioannidis, A., Karanasos, M., 2004, "Inflation, Inflation Uncertainty and a Common European Monetary Policy" Manchester School, 72, p. 221-242

Friedman, Milton (1977). Nobel Lecture: Inflation and Unemployment. Journal of Political Economy, Vol. 85, pp. 451-472

Grier, K., & Perry, M. (1998). On inflation and inflation uncertainty in the G-7 countries. Journal of International Money and Finance, 17, 671–689

Habermeier, Karl Friedrich ; Ötker, Inci ; Jácome, Luis Ignacio ; Giustiniani, Alessandro ; Ishi, Kotaro ; Vávra, David ; Kisinbay, Turgut ; Vázquez, Francisco F. (2009), "Inflation Pressures and Monetary Policy Options in Emerging and Developing Countries: A Cross Regional Perspective," IMF Working Paper 09/01 (Washington: International Monetary Fund)

Hamilton, James D. (1989), A new approach to the economic analysis of nonstationary time series and the business cycle. Econometrica, Vol. 57, No. 2 ,pp. 357–384.

Hamilton, James D. 1990. "Specification Testing in Markov-Switching Time-Series Models." Discussion Paper 209. The Thomas Jefferson Centre for Political Economy, University of Virginia.

Holland, S.A., 1995. Inflation and uncertainty: Tests for temporal ordering. Journal of Money, Credit, and Banking 27, 827–837.

Hwang, Y., (2001), Relationship between inflation rate and inflation uncertainty, Economics Letters 73, 179–186

illiam Miles* and Chu-Ping C. Vijverbergf (2009), changing Inflation Dynamics and Uncertainty in theUnited States, southern Economic Journal 2009, 75(3), 736-749

Khan, M. and Senhadji, A. (2000), Threshold effects in the relationship between inflation and growth, IMF Working Papers 110.

Komain Jiranyakul and Timothy Opiela (2010), Inflation and Inflation Uncertainty in the Asean-5 Economies, Journal of Asian Economics, Vol.21, No. 2, pp. 105-112, 2010

Lewis, Karen K. 1989. "Changing Beliefs and Systematic Rational Forecast Errors with Evidence from Foreign Exchange." American Economic Review 79: 621–36.

Laxton, Douglas, Nicholas Ricketts and David Rose. 1994. "Uncertainty, Learning and Policy Credibility." In Economic Behaviour and Policy Choice Under Price Stability: Proceedings of a Conference Held at the Bank of Canada, October 1993, 173–234. Ottawa: Bank of Canada

Magda Kandil and HananMorsy (2011), determinants of inflation in GCC, Middle East. Dev. J.03, 141 (2011).

Narada Dilp Warakagoda (1996) A Hybrid ANN-HMM ASR system with NN based adaptive preprocessing, *May. Web: http://jedlik.phy.bme.hu/~gerjanos/HMM/hoved.html*

Odhiambo, Nicholas M., (2009). "Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach,",Energy Policy, Elsevier, vol. 37(2), pages 617-622, February.

Odusanya, I. A. and A. A., Atanda (2010): Analysis of Inflation and Its Determinants in Nigeria. PakistanJournal of Social Sciences, Volume 7, No. 2. Pg. 97-100.

Okun,A. M. (1971), "TheMirageof SteadyInflation,"Brookings Papers on Economic Activity, 2, 486-498.

Özcan Karahan (2012), The Relationship between Inflation and Inflation Uncertainty: Evidence from the Turkish Economy, Procedia Economics and Finance 1, 219 – 228

Paul Castillo , Alberto Humala and Vicente Tuesta Reátegui (2012), Regime Shifts and Inflation Uncertainty in Peru, Journal of Applied Economics, Vol XV, No. 1, pp. 71-87, May 2012

Phillips PCB, Perron P. (1988). Testing for a Unit Root in Time Series Regression. Biometrica75: 335-346.

Phillips, P., Perron, P. (1988). Testing for a unit root in time series regressions. Biometrika, 75, 335-346

Piotr Białowolski, Modelling Inflation Using Markov Switching Models, Case of Poland, 1992 – 2005, (2005),Warsaw School of Economics (WSE),

Pourgerami, A. and K. Maskus, (1987). "The effects of inflation on the predictability of price changes in Latin America: some estimates and policy implications". World Development, Vol. 15 (2), 287–290.

Qayyum, A. (2006), "Money, Inflation, and Growth in Pakistan." The Pakistan Development Review, Pakistan Institute of Development Economics, 45(2), 203-212.

Quispe, Zenón (2000), Monetary policy in a dollarized economy, the case of Peru, in L. Mahadeva and G. Sterne, eds., *monetary policy framework in a global context*, London, Routledge.

Ricketts, Nicholas, David Rose (1995), Inflation, Learning And Monetary Policy Regimes In The G-7 Economies. Working Papers 95-6, Bank of Canada.

Sajid Amin Javed, Saud Ahmad KhanAzad Haider and Farzana Shaheen, (2012), Inflation and Inflation Uncertainty Nexus: Empirical Evidence from PakistanInternational Journal of Economics and Financial Issues Vol. 2, No. 3, pp.348-356

Simon, John (1996), A Markov-Switching Model of Inflation in Australia. Research Discussion Paper 9611, Reserve Bank of Australia (Dec. 1996).

Taylor, J., 1981. On the relation between the variability of inflation and the average inflation rate. Carnegie Rochester Conferences Series on Public Policy 15, 57–86.

Thornton, J. (2007). The relationship between inflation and inflation uncertainty in emerging market economies. Southern Economic Journal, 73, 858–870.

Thorton J., 2007, "The Relationship between Inflation and Inflation Uncertainty in Emerging Market

Thorton J., 2008, "Inflation and Inflation Uncertainty in Argentina, 1810-2005", Economic Letters, 98, p.247-252.

Wilson, B.K. (2006). The links between inflation, inflation uncertainty and output growth: New time series evidence from Japan. Journal of Macroeconomics, 28, 609–620.