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 currencies1 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 uncertainty 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 uncertainty for a group of G7 countries.

Simon (1996) concluded that inflation presents a good response to inflation uncertainty 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.

Bialowolski 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):

\[ a_{ij} = p(q_{t+1} = j | q_t = i) \]

- Where \( q_t \) 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,

\[ \sum_{i=1}^{N} a_{ij} = 1, 1 \leq i \leq N \]

\[ \text{A probability distribution in each of the states,} \]

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

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.

\[ b_j(k) \geq 0, 1 \leq j \leq N, 1 \leq k \leq M \]

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

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
\[ b_j(o_t) = \sum_{m=1}^{M} c_{jm} N(u_{jm}, \Sigma_{jm}, o_t) \]

Where: \( c_{jm} \) = Weighting coefficients

\( u_{jm} \) = mean vectors

\( \Sigma_{jm} \) = covariance matrices

\( c_{jm} \) Should satisfy the stochastic constrains,

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

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

\[ \pi = \{ \pi_i \} \]

- The initial state distribution, where,

\[ \pi_i = p(q_t = i), 1 \leq i \leq N \]

Therefore, we can use the compact notation

\[ y = (A, B, \pi) \]

To denote an HMM with discrete probability distributions, while:

\[ y = (A, c_{jm}, u_{jm}, \Sigma_{jm}, \pi) \]
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 its uncertainty 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: $e^2_{t+1} = \alpha + \beta CPI_{t} + \epsilon$

Where $e^2_{t}$ is the Markov switching exponential Standard error, CPI is consumer price index, t is time, $\alpha$ and $\beta$ 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   | Regime 2   |
|----------------|------------|------------|
| 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).
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.

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