WORKING PAPER

THE PERSISTENCE OF INFLATION IN ALBANIA

02 (25) 2011

Vasilika Kota*

BANK OF ALBANIA

*Vasilika Kota: Research Department, Bank of Albania,
e-mail: vkota@bankofalbania.org

Views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Albania.

CONTENTS

ABSTRACT

The objective of this paper is to estimate inflation persistence in Albania for the period 1993 to 2008. We apply the univariate approach with constant and time varying mean of inflation for headline and core inflation, and also test whether there are structural changes of persistence. The empirical results suggest that persistence of headline inflation was somehow higher during the inflationary periods while it started to decline after 1997, when inflationary expectations seem to have been stabilized. Therefore monetary policy appears to be effective at reducing inflation. Empirical results for core inflation suggest that there is no structural break of persistence, which is relatively higher that persistence of headline inflation.

I. INTRODUCTION

Over the past decade, inflation persistence has been widely noted and investigated. Inflation characteristics play a central role in the design of monetary policy and have important implications for the behaviour of private agents. Many authors conclude that persistence is a "stylised fact", with Phillips Curve being the source of this persistence. This is one key reason of using backward-looking (persistent) elements in the Phillips Curve as a good approximation of inflation movements.

However, no consensus has been achieved yet about the most appropriate way of modelling inflation. Even if inflation persistence is observed, it is difficult to accurately measure its degree and its continual changes. Nevertheless, understanding the dynamics of inflation is crucial for conducting monetary policy. The degree of inflation persistence is a key element of monetary transmission mechanism. It is crucial for the success of monetary policy in maintaining inflation on target. Also, detecting whether inflation persistence has changed over time will greatly impact monetary policy decisions.

Many empirical findings suggest that postwar inflation exhibits high persistence in industrial countries (Fryher and Moore (1995), Pivetta and Reis (2004) for the United States and O'Reilly and Whelan (2004) for euro zone etc). However, these findings are very sensitive to the statistical techniques employed. The inflation persistence which is observed may result due to unaccounted structural changes, modifications of inflation targets by the central banks, different exchange rates regimes, price shock etc. (Levin and Piger (2003)). Lack of consensus exists also in the analysis of persistence stability. Authors such as Taylor (2000), Cogley and Sargent (2001) and Kim, Nelson and Piger (2004)) find that inflation persistence in US has diminished over the recent years. On the other hand, using different econometric techniques, authors such as Stock (2001) and Pivetta and Reis (2004), conclude that inflation persistence in US is better described as unchanged over the last decades. The same conclusion is given by Batini (2002) and O'Relly and Whelan (2004) for the euro area and Levin and Piger (2003) for the industrialized countries.

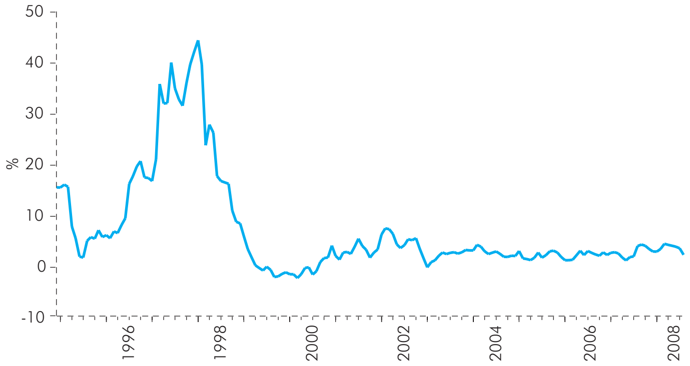
The aim of this paper is to measure for the first time, inflation persistence in Albania. As the Bank of Albania is preparing to launch inflation targeting regime in the near future, this study will be useful in determining inflation characteristics. Generally, the literature suggests two distinct approaches for measuring inflation persistence. The first method evaluates inflation persistence with simple univariate time-series representation of inflation (univariate approach). The second method uses structural econometric models that aim to explain inflation behaviour with other variables beside inflation (multivariate approach). Under the univariate approach, inflation is assumed to follow an autoregressive process and shocks are measured in the white noise components. The multivariate approach assumes a causal economic relationship between inflation and its determinants, and measures persistence as the duration of the effects on inflation of the shocks to its determinants. The basic difference between these two methods is that shocks to inflation are not identified in the univariate approach, while the multivariate method allows the identification of shocks hitting inflation. Therefore, the multivariate approach provides a deeper analysis of persistence and its cause.

This paper measures inflation persistence in Albania for headline and core inflation with the univariate approach. We also test whether there is any structural break during the period 1993-2008. The remainder of the paper is organised as follows. Section II briefly introduces inflation development in Albania and monetary policy changes, before proceeding to the definition of inflation persistence given in Section III. Section IV presents different measures of inflation persistence with the univariate approach and also the results obtained for each of the measures. Section V tests for structural changes in inflation persistence and presents the results for the different periods. Finally, Section VI concludes.

II. INFLATION DEVELOPMENTS, HISTORICAL EVIDENCE

Figure 1 presents year on year changes in the CPI for Albania starting from 1994. As the figure suggests, the country has undergone different phases of inflation behaviour; the transition period of the '90 is characterized by high inflation rates which by the 1995 appeared to slow down. However, starting from 1996 there is a new area of price increase with a strong impact following the crisis of 1997. The post-crisis area is characterized by considerable disinflation and after 2000, inflation rates appear to be stable to around the actual target of Bank of Albania, 3 per cent. In fact, inflation averages 2.75 per cent, with 1.72 per cent volatility.

Graphic 1. Headline inflation in Albania, 1994-2008



Source:INSTAT

During the overall period, monetary policy has been cautious in trying to achieve and maintain consumer prices stability. The collapse of communism in Albania in the beginning of '90 was followed by a year of economic collapse. Stabilization measures introduced in 1992 had as a key objective the reduction of annual inflation. Restriction of money growth was the main nominal anchor of the stabilization program, supported by a careful fiscal policy aiming to eliminate monetary deficit financing and to tight credit policy. Also, a two-tier banking system was introduced around this time. Given the poor state of the banking system, external debt situation and the large budget deficit, monetary policy was based on direct instruments of money control. At the beginning of 1996, several foreign banks began to operate in Albania, thus creating a market for the banking system and monetary policy.

During 2000, the Bank of Albania introduced the indirect instruments of monetary policy, which included a required reserve, a refinancing window and a liquidity requirement. At the same time, monetary policy also eliminated the direct control over interest rates.

Currently, the Bank of Albania is following a monetary target regime, with inflation being directed through changes in the repo rate. Its main target is to achieve an annual inflation rate of 3 per cent. However, in the near future, Bank of Albania is preparing to launch Inflation Targeting regime.

III. DEFINING INFLATION PERSISTENCE

The literature presents several definitions of inflation persistence. In their work, Batini and Nelson (2002) distinguish three different types of persistence: a. “positive serial correlation in inflation”; b. “lags between systematic monetary policy actions and their (peak) effect on inflation” and c. “lagged responses of inflation to non-systematic policy actions (i.e. policy shocks)”.

Evidence of type (a) of persistence may be found using simple estimations of AR(1) coefficients. Following this type of definition, the high serial correlation of inflation in postwar data has been used to introduce Philips curves for monetary policy, thus inertia in inflation. Many studies find a decline of type (a) inflation persistence which does not appear to be an acceptable definition of persistence. The other definitions of inflation persistence deal with the idea of speed, i.e., the speed of the response of inflation to a shock. If the speed is low then inflation is (highly) persistent while if the speed is high we say that inflation is not (very) persistent.

Willis (2003) defines inflation persistence as “the speed with which inflation returns to baseline after a shock”. What remains to be determined is the so called baseline or the equilibrium level of inflation. So far, when computing estimates of persistence using the univariate approach, the empirical literature has assumed a constant long run equilibrium level of inflation. This assumption may or may not hold under different circumstances. Regardless of the method used to estimate persistence, its reliability depends on how realistic the assumed inflation equilibrium (baseline) is. As Marques (2004) argues, there is a trade off between persistence and flexibility of inflation equilibrium. A constant equilibrium will provide a higher estimation of inflation persistence and vice versa. However, once we allow for flexibility of inflation equilibrium, persistence will also change.

In our approach, inflation persistence will be defined as the speed with which inflation returns to equilibrium after a shock. We also assume that inflation equilibrium is exogenous and does not change due to different shocks. In the following section, various approaches to measure inflation persistence are introduced. We start with the naïve estimates that assume a constant mean of inflation (equilibrium) and then move on to the time varying mean approach. For each of the measures, the results of inflation persistence estimation are presented.

IV. MEASURING INFLATION PERSISTENCE

IV.1 CLASSICAL ANALYSIS

The most widely used measure of persistence across the literature is the sum of autoregressive coefficients. We start by assuming that inflation follows a stationary autoregressive process of order p (AR(p)) which can be written as:

$$\pi_t = \alpha + \sum_{j=1}^{k} \beta_j \pi_{t-j} + \varepsilon_t \qquad (1)$$

where π_t denotes inflation at time t and ε_t is the residual series uncorrelated. To measure persistence, equation (1) can be reparameterised as:

$$\pi_t = \alpha + \sum_{j=1}^{k-1} \delta_j \Delta\pi_{t-j} + \rho\, \pi_{t-1} + \varepsilon_t \qquad (2)$$

where $r = \sum_{i=1}^{k} b_i$ is the persistence parameter, while δ_j parameters are transformation of the AR coefficients in equation (1), $\delta_{j=1} = -\beta_k$.

According to this model, inflation persistence can be defined as the speed with which inflation converges to equilibrium after a shock in the disturbance term: given a shock that raises inflation today by 1 %, how long does it take for the effect of the shock to die off?

Following this definition, inflation persistence is closely linked to the impulse response function (IRF) of the AR(p) process. However, given that IRF is an infinite-length vector, it can not serve as a useful measure of inflation persistence; thus "the sum of autoregressive coefficients" $(\rho = \sum_{j=1}^{k} \beta_j)$ has been introduced as a good indicator of persistence. Beside this approximation, the literature suggests several other scalar statistics to measure inflation persistence such as: "the spectrum at zero frequency", "the largest autoregressive root" and the "half life" (Marques, (2004))

For a AR(p) process , "the spectrum at zero frequency" is given as $h(0) = \frac{\sigma_\varepsilon^2}{(1-\rho)^2}$ where σ_ε^2 stands for the variance of ε_t. For a fixeσ_ε^2

there is a simple correspondence between this concept and ρ, and so they can be seen as equivalent measures of persistence. However, the two measures can deliver different results when testing for changes in inflation persistence over time. In the case of "the spectrum at zero frequency" changes may be due to σ_{ε}^{2} or, ρ which is one of the drawbacks of this indicator. Further more, ρ has an advantage over h(0) as it is more intuitive, with a clearly defined range of potential variation (for a stationary process it varies between -1 and 1), which is not the case for h(0) indicator.

"The largest autoregressive root" has been used in the literature as indicator of persistence (Stock, 2001). The main disadvantage of this statistic is that it is a very poor summary measure of IRF as its shape depends also on other roots and not only on the largest one (Andrews and Chen, 2004).

Finally, the indicator of "half-life" is a useful indicator of persistence, as it measures the number of periods during which a temporary shock displays more than half of its initial impact to the process. In the case of an AR(1) process given by: $\pi_t = \rho \pi_{t-1} + \varepsilon_t$, the "half-life" indicator may be computed as HL=$\frac{\ln(1/2)}{\ln(\rho)}$ For the AR(p) process, the exact computation of the half-life is difficult, thus the simple formula above is used as an approximation.

Pivetta and Reis (2004) present several drawbacks for this indicator. First, if IRF is oscillating over time, the "half life" estimation can understate the persistence of the process. Second, the HL indicator does not distinguish between different IRF speed, which may be diverse at the beginning and at the end of the shock. Third, for highly persistent processes, the "half life" indicator is always large but is not able to indicate whether there is any change in inflation persistence over time. On the positive side, the "half-life" outperforms the rest of the indicators as it measures persistence in units of time. This unit is easier to be comprehended and discussed as compared to other indicators presented above.

We should keep in mind that the above mentioned indicators provide only an estimation of the persistence and not the true measures of this process. This is because they can not fully capture the existence of different shapes in the impulse response functions of inflation following a given shock. In general, any scalar measure of persistence should be seen as providing only an estimate of the "average speed" with which inflation converges to equilibrium after a shock. The more uniform is the speed at convergence throughout the convergence period, the more reliable is the scalar measure of persistence.

By summarizing, we can conclude that two of the four measures of persistence discussed above, "the sum of autoregressive coefficients" and the "spectrum at zero frequency" can be referred to as close substitutes for a fixed sample period. The largest autoregressive root appears to be a poor measure of persistence, while despite its limitations, the "half-life" indicator measures persistence in units of time, which is useful for communication purposes.

In the following sections, we focus on ρ parameter and the "half life indicator" to measure persistence. "The sum of the autoregressive coefficients" is linked directly to the mean reversion coefficient of the series, while the half life measure persistence in units of time.

IV.1.A RESULTS FOR THE PARAMETER ρ

To obtain a measure of inflation persistence, we estimate the following equation:

$$\pi_t = \alpha + \sum_{j=1}^{k-1} \delta_j \pi_{t-j} + \rho\, \pi_{t-1} + \varepsilon_t \qquad (3)$$

where π_t is annual inflation, i.e. $\pi_t = p_t - p_{t-12}$ and p_t is the logarithm of CPI. There are a few reasons why we study the persistence of annual inflation. First, other possibilities such as using month on month and quarter on quarter changes of price level are associated with seasonality, which may contaminate the true extent of persistence. Second, central banks set their inflation targets as year on year changes of price level. Third, there are many findings such as from Aron and Muellbauer (2006) that claim that year on year inflation rates also capture the dynamics of month on month inflation. On the other, when using annual inflation to measure persistence, it is expected to get high autoregression coefficients due to the presence of a moving average component. This may result in estimating higher persistence then what it is exhibited from the actual series of inflation. Therefore, in the current paper inflation is also calculated as month-on-month annualized inflation. As inflation is calculated on monthly basis, one has to take into account seasonality, which we have done by applying Tramo/Seats procedure.

To ensure that our results are not specific to a particular measure of inflation, we analyze the properties of two different price indices: the consumer price index (CPI) and the core CPI. Core CPI is obtained with the method of permanent exclusion of certain volatile CPI components as presented by Celiku and Hoxholli (2007). We focus our analysis on the sample period from 1993 to 2008, the time period for which headline CPI data are available, and 1998-2008 for core CPI.

Results for the persistence parameter ρ, based on the estimation of Equation (3) are reported in Table 1 below. Estimated persistence reaches 0.93 for headline annual inflation, indicating that consumer prices appear to be persistent during the overall period. As expected, inflation in monthly terms exhibits less persistence compared to the annual base. The behaviour of core inflation indicates the same tendency. Annual core inflation displays high persistence, while monthly figures result with no persistence at all. However, compared to the previous estimation of inflation, core inflation displays higher persistence than headline CPI on an annual basis. This result could point to the lower persistence of the components (i.e., energy and unprocessed food) of CPI that are excluded from its computation.

Table 1. Estimation results- parameter

	1993m12-2008m8			
	Annual inflation	Monthly inflation	Annual core inflation	Monthly core inflation
Sum of autoregressive coefficient	ρ=0.93	ρ=0.68	ρ=0.94	ρ=0.26
Sample mean	6.7 %	0.6 %	1.3 %	1.5 %

Parameter ρ provides information on the relative size of the cumulative impact of a shock across series but cannot be relied upon to get information on the relative timing of the absorption of a shock. To get information on the latter, we need to rely on the HL indicator instead even though HL provides only a rough summarization of the full timing information contained in the entire impulse response function.

IV.1.B RESULTS FOR THE "HALF-LIFE" INDICATOR

The "half life" (HL) indicator is defined as the number of periods that a shock needs to vanish by 50 percent. Table 2 reports the results for the half life parameter HL, based on the estimation of Equation (3).

Table 2. Results for the "half-life" indicator

	1993m12-2008m8			
	Annual inflation	Monthly inflation	Annual core inflation	Monthly core inflation
Half life indicator	HL=9.6	HL=1.8	HL=11.5	HL=0.5

Results for the HL indicator suggest that inflation persistence is lower when using CPI inflation data and higher when using Core inflation data, in annual terms. Noteworthy is the fact that some processes that appear to have a random walk (i.e., ρ close to 1) display finite half-life measures nonetheless, suggesting they still have a substantial mean-reverting component bringing down their IRF below the 0.5 mark within a given time, though the shock never dies out completely. So, for the annual headline inflation HL measures indicates that the impact of a shock to the inflation is halved within the 10 months while for annual core inflation, the shock is halved within just 1 year. For monthly inflation of core and headline CPI, the shock to inflation is already halved within 0.5-2 months indicating that there appear to be no persistence in monthly terms, conditioned on an assumed constant mean of inflation.

IV.2 ALTERNATIVE MEASURES OF INFLATION PERSISTENCE-MEAN REVERSION

As already argued, there is a close relationship between inflation persistence and mean reversion. Marques (2004) presents a detailed description of this relationship, suggesting that persistence should be estimated taking into consideration mean reversion properties of the series. The series that exhibits low mean reversion, thus crosses the mean less frequently, shows more persistence.

An important step to estimate persistence is proper evaluation of inflation mean. The classical approach represented above, assumes a constant mean for the whole period. However, this may not always be the case, so a time varying mean appears to be more useful than a constant one. In order to stay within the univariate approach, we use statistical models to extract the mean of inflation. We also check by using Hodrick-Prescott filter as another useful estimation of time varying mean of inflation.

In this section we represent a new measure of inflation persistence as given by Marques (2004), defined as:

$$\gamma = 1 - \frac{n}{T} \tag{4}$$

where γ- persistence indicator, n stands for the number of times the series crosses the mean during a time interval with T+1 observations.

The γ[1] statistic has the advantage of not requiring estimating a model for the inflation process. Thus, it is expected to be a robust statistics against model misspecification. The values of γ are always between zero and one. As Marques (2004) proves, values of γ close to 0.5 signal the absence of any significant persistence (white noise behavior), while figures significantly above 0.5 signal significant persistence. On the other hand, figures below 0.5 signal a negative ρ, that is, negative long run autocorrelation. Under the assumption of a symmetric white noise process for inflation (zero

[1] We note that ρ=0.50 implies a half-life equal to 1 and thus absence of a significant persistence.

persistence), the following result holds:

$$\frac{\gamma - 0.5}{0.5/\sqrt{T}} \cap N(0;1) \tag{5}$$

Result (5) allows us to carry out some simple tests on the statistical significance of the estimated persistence. We note however that the result (5) is valid only under the assumption of a pure white noise process and that if the null of $\gamma = 0.5$ is rejected we should expect γ to have a more complicated distribution.

Below we consider estimating inflation persistence with a time varying mean for inflation. We will use two measure of inflation persistence: γ parameter and a new approach for ρ parameter. The new "sum of autoregressive coefficients" will be determined from estimating persistence of the deviations from the time varying mean. We start with the same autoregressive representation of inflation:

$$\pi_t = \alpha + \sum_{j=1}^{k} \beta_j \pi_{t-j} + \varepsilon_t \tag{6}$$

This equation can be equivalently represented as:

$$(\pi_t - \mu_t) = \alpha + \sum_{j=1}^{k} \beta_j (\pi_{t-j} - \mu_{t-j}) + \varepsilon_t \tag{7}$$

or further as:

$$(\pi_t - \mu_t) = \sum_{j=1}^{k} \delta_j \Delta(\pi_{t-j} - \mu_{t-j}) + \rho(\pi_{t-1} - \mu_{t-1}) + \varepsilon_t \tag{8}$$

which corresponds to the classical model used in section IV.1. Since we estimate the deviations of inflation from its mean, there is no constant term.

IV.2.A RESULTS FOR THE PARAMETER AND PARAMETER WITH TIME VARYING MEAN

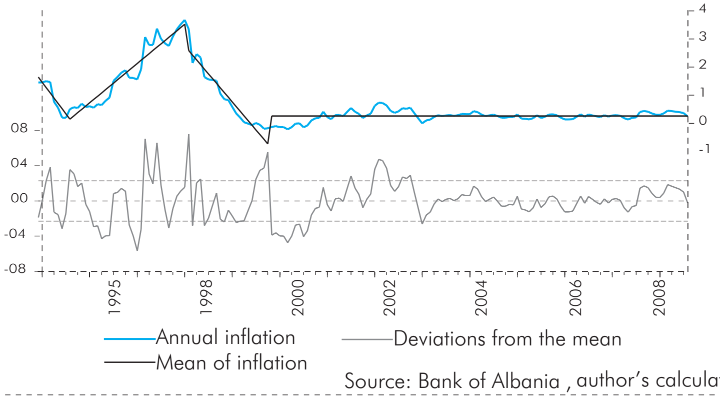
First, we start by using statistical estimations to extract the time varying mean of inflation. Graphic 2 presents annual inflation rate developments for headline CPI. Simple visual inspection suggests that we can distinguish four distinct periods of annual inflation development. The first period stretches from the beginning of the sample until the middle of 1995 exhibiting a downward trend. During the second period, from mid 1995 to beginning of 1997, inflation exhibits an obvious upward trend. This is a clear example of why assuming a constant mean of inflation does not appear to be a realistic approach. The third period is composed of a downward trend that took place during 1998-1999. Finally, during the fourth period from 2000 onward, inflation seems not to exhibit a clear increasing or decreasing trend.

The mean of annual inflation in graph 2 is obtained as the fitted values of the regression model:

π_t =-0.089+0.03*t1+0.012*t2+0.017*t3+0.17*c1
p-value (0.00) (0.00) (0.00) (0.00) (0.00)

estimated for the period 1994m12 to 2008m08. The variables are defined as follows: t1-time trend for the period 1993m12-1995m7; t2-time trend for the period 1995m8- 1998m1; t3-time trend for the period 1998m2- 1999m10 and c1-constant for the period 1999m11-2008m8.

Graphic 2. Annual headline inflation and time varying mean



Source: Bank of Albania , author's calculations

Using the definition presented in section IV.2 we measure inflation persistence as the portion of mean crossings () and test for its statistical significance. In order to check for other behaviors of time varying mean, we also estimate inflation mean using Hodrick-

Prescott filter. Finally, "the sum of autoregressive coefficient" is derived from estimating equation (8). The same approach is followed for monthly headline inflation and core inflation indicators. The estimation process of time varying mean for these indicators is given in Annex. Below we present just the results of parameter and parameter.

Table 3. Results for parameter and parameter-time varying mean

	1993m12-2008m8			
	Annual inflation	Monthly inflation	Annual core inflation	Monthly core inflation
parameter-statistical estimation	γ=0.72	γ=0.69	γ=0.79	γ=0.65
parameter- HP filter	γ=0.79	γ=0.63	γ=0.91	γ=0.67
parameter- time varying mean	ρ=0.6	ρ=0.41	ρ=0.7	ρ=0.3

All the estimates for inflation persistence using the parameter are statistically significant. Mean reversion properties of headline inflation in annual and monthly terms indicate the presence of persistence. However, ρ parameter of annual inflation is much lower when measured with time varying mean, than with constant mean, indicating that inflation exhibits some persistence but not as high as suggested by the classical approach. As in the case of classical analysis, annual core inflation exhibits higher persistence than headline inflation. While, monthly core inflation does not indicate persistence using the ρ parameter, the portion of mean crossing results statistically significant. Following from this indicator, even monthly core inflation exhibits some low persistence. From here we can see that the evidence of inflation persistence can change noticeably with the assumption of the mean of inflation.

By putting together the results of classical analysis and time varying mean estimation, we can conclude that headline inflation in annual and monthly terms in Albania, exhibits persistence. Inflation persistence in annual terms is always higher than in monthly terms. Other authors such as Altissimo, Ehrmann and Smets (2006) find similar results, as the same series is found less persistent if considered in quarter on quarter changes compared to year on year changes.

Annual core inflation indicates relatively higher persistence than headline inflation. Other authors find similar results for core inflation. Hondroyiannis and Lazaretou (2004) indicate that core CPI inflation reveals a substantial rise in the serial correlation of Greek inflation compared to headline inflation. Gadzinski and Orlandi (2004) also conclude that core inflation usually displays higher persistence than the other inflation measurement, for the Euro era and USA. Monthly core inflation in Albania indicates the presence of some persistence if the assumption of constant mean is abandoned.

V. TESTING FOR STRUCTURAL CHANGES IN INFLATION PERSISTENCE

Recent literature suggests that there might be possible shifts in inflation persistence over the sample taken into consideration. To test for a change in inflation persistence in Albania, we apply the Quandt-Andrews Breakpoint test. The Quandt-Andrews Breakpoint Test tests for one or more unknown structural breakpoints in the sample for a specified equation. The idea behind the Quandt-Andrews test is that a single Chow Breakpoint Test is performed at every observation between two dates, or observations, τ_1 and τ_2. The test statistics from those Chow tests are then summarized into one test statistic for a test against the null hypothesis of no breakpoints between τ_1 and τ_2. From each individual Chow Breakpoint Test two statistics are retained, the Likelihood Ratio F-statistic and the Wald F-statistic. The individual test statistics can be summarized into three different statistics: the Sup or Maximum statistic, the Exp Statistic and the Ave statistic.

- The Maximum statistic is simply the maximum of the individual Chow F-statistics:

$$MaxF = \max_{\tau_1 < \tau < \tau_2}(F(\tau)) \tag{9}$$

- The Exp statistic takes the form:

$$ExpF = \ln\left(\frac{1}{k}\sum_{\tau=\tau_1}^{\tau_2}\exp\left(\frac{1}{2}F(\tau)\right)\right) \tag{10}$$

- The Ave statistic is the simple average of the individual F-statistics:

$$AveF = \frac{1}{k}\sum_{\tau=\tau_1}^{\tau_2}F(\tau) \tag{11}$$

These tests statistics are used to dictate any structural breakpoints in the sample for the equations we use to estimate inflation persistence.

V.1 STRUCTURAL BREAK IN INFLATION PERSISTENCE-CONSTANT MEAN

We start by testing for structural changes in inflation persistence for headline CPI with a constant mean. All the three summary statistic measures reject the null hypothesis of no structural breakpoint at the 5 % level for the annual figures, thus one break point between the first and second month of 1998 is detected. The regressions of equation (3), therefore, are estimated over the two sub-samples 1993m12-1998m1 and 1998m2-2008m8. When conducting the analysis on monthly inflation, the test suggests that there is a structural break during 1997m04. The indicators of persistence are estimated over the two sub-samples 1993m12-1998m1 and 1998m2-2008m8.

Table 4 presents the estimates of persistence and the sample mean in the form of univariate representation of annual and inflation rate for the two sub-samples.

Table 4. Inflation persistence-structural break

	1993-1998m1	1998m2-2008m8	1993-1997m4	1997m5-2008m8
	Annual inflation	Annual inflation	Monthly inflation	Monthly inflation
Sum of autoregressive coefficients	ρ=0.89	ρ=0.83	NA	ρ=0.7
Sample mean	16.4 %	3.76 %	15.5 %	3.9 %
Half life	5.9	4.3	NA	1.9

As it can be seen from the table, Albania experienced a sizeable shift in the average level of CPI inflation. The sample mean of headline inflation rate falls significantly between two periods, both for annual and monthly inflation. The results indicate that there is a substantial drop in the sample mean from a yearly average level of 16 percent to 4 percent after 1998. Furthermore, the variance before and after the break decreases; headline inflation is 2.1 times less volatile in disinflation relative to the period of high inflation. However, the shift in persistence is rather small, ρ decreases from 0.89 to about 0.83. The half life indicator also confirms that IRF is brought down below the 0.5 mark in 5-6 months for the first sub-sample, and 4-5 months for the second one. Overall, according to the autoregressive estimates, there appears to have been a sizeable shift in annual inflation mean in Albania over the last 15 years, but only a small shift in inflation persistence.

The results for monthly inflation are different. It appears that there is a substantial drop in the sample mean from an average level of 15.5 percent to 3.9 percent after 1997m4. However, autoregressive estimation does not indicate persistence for the first sup-period. After 1997m4, monthly inflation exhibits somehow higher persistence than when estimated over the whole sample. The variance before and after the break decreases; monthly inflation is 1.8 times less volatile in disinflation relative to the period of high inflation. From these preliminary results, we can suggest that monthly inflation persistence measured for the whole period, may be attributed mainly to the second sub-sample. This is a clear example of why it is important to distinguish persistence developments over a given period, as it may change considerably due to structural changes.

We also use Quandt-Andrews Breakpoint test on annual and monthly core inflation. All the three summary statistic measures do not reject the null hypothesis of no structural breakpoint at the 5 % level for the annual and monthly figures. Therefore we don't detect any break point of inflation persistence for core inflation over the sample 1998m1-2008m8.

We can conclude this section by suggesting that there is evidence of structural change of persistence for headline inflation. There is a substantial drop in the sample mean between the two sub-samples; however the shift in annual inflation persistence is rather small. Generally speaking, inflation persistence does not have the same notion in an inflationary period as in disinflation. Therefore, the persistence of the first period characterized by high mean values of inflation would be generally associated with negative effects –it basically indicates that inflation raised by a shock returned slowly to its previous low level. By contrast, the persistence of the second period results from gradual and continues reduction of inflation, which can hardly be negative phenomena.

The shift in monthly inflation persistence appears to be sizeable, as the first sub-sample does not indicate persistence, while the second one exhibits higher persistence than in the whole sample. Core inflation appears to not indicate the presence of structural breaks in persistence.

However, one should keep in mind that the above estimation of structural changes in inflation persistence, are valid under the assumption of a constant mean of inflation. Below, we conduct the analysis of structural change even for time varying mean, which as already shown, is important for persistence estimation.

V.2 STRUCTURAL BREAK IN INFLATION PERSISTENCE-TIME VARYING MEAN

In this section we consider whether there is any structural break in inflation persistence estimated with a time varying mean for inflation. We apply the Quandt-Andrews Breakpoint test for equation (8) and find that for annual headline inflation, the three summary statistic measures reject the null hypothesis of no structural breakpoint at the 5 % level. On the basis of these statistics, we can detect one break point between the eleventh and twelfth month of 1999. Therefore, the regressions are estimated over the two sub-samples 1993m12-1999m11 and 1998m12-2008m8. For monthly headline inflation, we find one break point for 1997m04, and estimate two regressions for the sub-samples 1993m12-1997m04 and 1997m05-2008m08.

Table 5 presents the estimates of persistence and parameters for annual and monthly inflation, with structural break points.

Table 5. Inflation persistence-structural break with time varying mean

	1993-1999m11	1999m12-2008m8	1993-1997m04	1997m5-2008m8
	Annual inflation	Annual inflation	Monthly inflation	Monthly inflation
Sum of autoregressive coefficients	ρ=0.61	ρ=0.58	NA	ρ=0.55
Parameter-statistical models	γ=0.73	γ=0.71	γ=0.75	γ=0.68
Parameter-HP filter	γ=0.92	γ=0.71	γ=0.7	γ=0.6

The results don't differ from the estimation with a constant mean of inflation. There appears to be a small shift of annual inflation persistence, ρ decreases from 0.61 to about 0.58. γ parameter confirms that persistence of annual inflation is significant with no particular change between the two sub-samples. This estimation goes from γ=0.73 before 1999m11 to γ=0.71 after this period.

Autoregressive estimation for monthly inflation indicates that there is no persistence before 1997m04 (as with the constant mean), while after this period, persistence is noticeable and statistically significant. However, it is interesting that when measured with the portion of mean crossing, even before 1997m04 it appears that monthly inflation exhibits persistence. It becomes clear, that when estimating persistence, one has to use different measures in order to have a clear view of this process. The γ statistic has the advantage of not requiring estimating a model for the inflation process. Thus, it is expected to be a robust statistics against model misspecification. In our case, autoregressive estimation is not able to capture persistence of monthly inflation for the first sample. On the other hand, when using the γ statistic we find that inflation exhibits persistence and that there is no substantial shift of this process between the two sub-samples.

CONCLUSION

This paper presents some basic assessments of inflation persistence in Albania over the period 1993-2008. We adopt three alternative indicators of inflation persistence proposed in the empirical literature: (1) by looking at the autocorrelation properties of the inflation series (2) by measuring the number of periods that a shock to inflation needs to vanish by 50 percent and (3) by determining the mean properties of inflation series. The alternative indicators are estimated using a constant estimation of inflation mean, and also a time varying estimation. To capture possible shifts in inflation persistence, we develop Quandt-Andrews Breakpoint Test for annual and monthly inflation. The results indicate that inflation in Albania is rather persistent according to all methodologies employed. Headline inflation in annual and monthly terms, exhibits persistence. Inflation persistence in annual terms is always higher than in monthly terms. Annual core inflation indicates relatively higher persistence than headline inflation. Monthly core inflation in Albania indicates the presence of some persistence if the assumption of constant mean is relaxed.

Empirical findings for structural break of inflation persistence can be summarized as follows. First, classical estimations show that CPI inflation persistence was somehow higher during the inflationary period and smaller during disinflation period (the persistence parameter took the value of 0.89 and approximately 0.85 for annual headline inflation). Second, it appears that there has been a sizeable shift in the mean of inflation over the past but a small shift in inflation persistence. Persistence of core inflation does not indicate any structural break in annual and monthly terms.

Further improvement of the analysis of this paper could be useful for future research in this area. For example, a multivariate analysis appears to be a necessary extension as it could enhance the robustness of the results by controlling for a number of events.

REFERENCES

Altissimo, F., Ehrmann, M. and F. Smets, (2006), "Inflation Persistence and Price Setting Behaviour in the Euro Area – A Summary of the IPN Evidence", European Central Bank, Occasional Paper, No. 46.

Andrews, D. and Chen, W.K. (1994), "Approximately Median-Unbiased Estimation of Autoregressive Models", Journal of Business and Statistics, 12(2), 187-204.

Aron, J. and Muellbauer J., (2006), "A Framework for Forecasting the Components of Consumer Price Index: Application to South Africa", paper presented at the 21st Annual Congress of European Economic Association, August 25, 2006.

Batini, N., (2002), "Euro Area Inflation Persistence." Working Paper No. 201, European Central Bank.

Batini, N., Nelson, E., (2002), "The lag from monetary policy actions to inflation: Friedman revisited", Bank of England, Discussion Paper No.6; Celiku E. and Hoxholli R. (2008), "New core inflation measures: Their usage in forecasts and analysis", Bank of Albania, Working Paper, March.

Cogley T., and Sargent T.,(2001), "Evolving Post World War II US inflation dynamics", NBER, Macroeconomics Annual 16.

Fuhrer, J.., and Moore G (1995), 'Inflation Persistence', Quarterly Journal of Economics.

Gadzinski G. and Orlandi F., (2004), "Inflation persistence in the European Union, the Euro area, and the United States", ECB Working paper, no. 414.

Hondroyiannis G., and Lazaretou S.,(2004), " Inflation persistence during periods of structural change: An assessment using Greek data", Bank of Greece, Working Paper, no.13.

Kim, Ch., Nelson Ch., and Piger J., (2004), "The Less-Volatile U.S. Economy: A Bayesian Investigation of Timing, Breadth, and Potential Explanations." Journal of Business and Economic Statistics 22 (1): 80–93.

Levin A. T., Piger J. M., (2003), "Is inflation persistence intrinsic in industrial economies"? mimeo.

Marques, C.R. (2004), "Inflation Persistence: Facts or Artefacts?", ECB Working Paper, 371.

O'Reilly, G., Whelan, K. (2004), "Has Euro-Area Inflation Persistence Changed Over Time?", ECB Working Paper, 335.

Pivetta, F. and Reis, R. (2004), "The Persistence of Inflation in the United States", mimeo, Harvard University.

Stock, J. (2001), "Comment on Evolving Post-World War II U.S. Inflation Dynamics", NBER Macroeconomics Annual 2001, 379-387.

Taylor, J. (2000), "Low Inflation, Pass-Through, and the Pricing Power of Firms", European Economic Review, 44, 1389-1408.

Willis, J., L., (2003), "Implications of structural changes in the U.S. economy for pricing behavior and inflation dynamics", Economic Review, First Quarter 2003, Federal Reserve Bank of Kansas City.

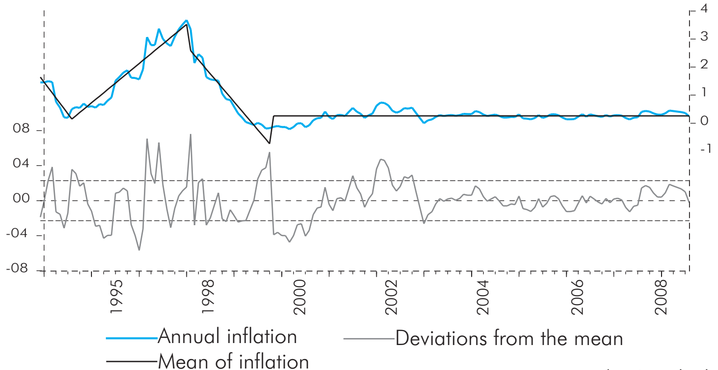
ANNEX

Table 6 . Autoregressive estimation results

Annual inflation:1994m12-2008m08	Monthly inflation:1994m1-2008m08
$\underset{(0.01)}{\pi_t = 0.005} + \underset{(0.00)}{0.93}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.96, se=0.02, DW=1.76	$\underset{(0.29)}{\pi_t = 0.02} + \underset{(0.00)}{0.68}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.23, se=0.15, DW=2.03
Annual core inflation:1999m1-2008m08	**Monthly core inflation:1998m2-2008m08**
$\pi_t = \underset{(0.32)}{0.0006} + \underset{(0.00)}{0.94}*\pi_{t-1}$ adj-R2=0.91, se=0.005, DW=1.5	$\underset{(0.02)}{\pi_t = 0.01} + \underset{(0.00)}{0.26}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.07, se=0.05, DW=2.08
Annual inflation: 1994m12-2008m08	**Monthly inflation: 1994m1-2008m08**
$(\pi_t - \mu_t) = \underset{(0.00)}{0.56}*(\pi_{t-1} - \mu_{t-1}) + \sum_{j=1}^{k-1}\delta_j(\pi_{t-j} - \mu_{t-j})$ adj-R2=0.43, se=0.02, DW=2	$(\pi_t - \mu_t) = \underset{(0.00)}{0.41}*(\pi_{t-1} - \mu_{t-1}) + \sum_{j=1}^{k-1}\delta_j(\pi_{t-j} - \mu_{t-j})$ adj-R2=0.16, se=0.15, DW=2.08
Annual core inflation: 1999m1-2008m08	**Monthly core inflation: 1998m2-2008m08**
$(\pi_t - \mu_t) = \underset{(0.00)}{0.7}*(\pi_{t-1} - \mu_{t-1})$ adj-R2=0.53, se=0.005, DW=1.7	$(\pi_t - \mu_t) = \underset{(0.41)}{0.26}*(\pi_{t-1} - \mu_{t-1})$ adj-R2=0.08, se=0.05, DW=2.07

Time varying mean estimation

Graphic 2. Annual headline inflation and time varying mean



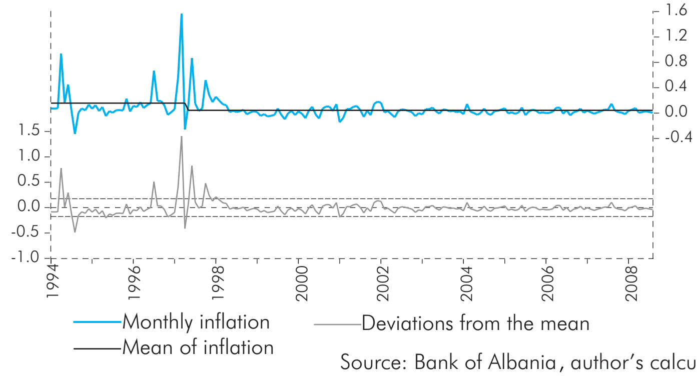
Source: Bank of Albania , author's calculations

Inflation mean: π_t =-0.089+0.03*t1+0.012*t2+0.017*t3+0.17*c1

p-value (0.00) (0.00) (0.00) (0.00) (0.00)

estimated for the period 1994m12 to 2008m08. The variables are defined as follows: t1-time trend for the period 1993m12-1995m7; t2-time trend for the period 1995m8- 1998m1; t3-time trend for the period 1998m2- 1999m10 and c1-constant for the period 1999m11-2008m8.

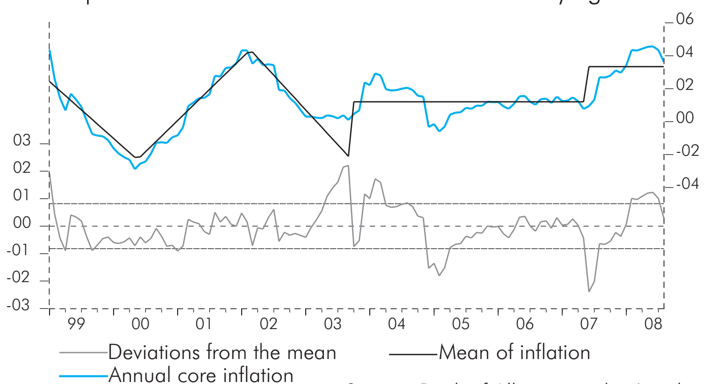
Graphic 3. Monthly headline inflation and time varying mean



Source: Bank of Albania, author's calculations

Inflation mean: π_t = 0.16*c1 +0.04*c2
p-value (0.00) (0.00)

Graphic 4 . Annual core inflation and time varying mean



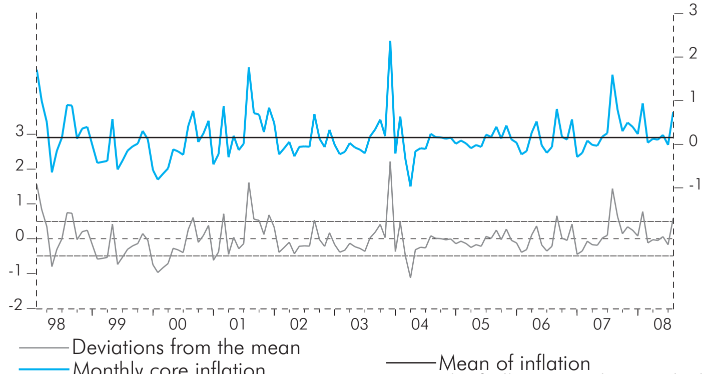
Source: Bank of Albania, author's calculations estimated for the period 1994m12 to 2008m08. The variables are defined as follows: c1- constant for the period 1993m12-1997m04; c2- constant for the period 1997m05- 2008m08

Inflation mean: $\pi_t = -0.02 + 0.003{*}t1 + 0.003{*}t2 + 0.004{*}t3 + 0.04{*}c1 + 0.06{*}c2$

p-value (0.00) (0.00) (0.00) (0.00) (0.00) (0.00)

estimated for the period 1998m1 to 2008m08. The variables are defined as follows: t1- time trend for the period 1999m1-2000m05; t2- time trend for the period 2000m06- 2002m02; t3-time trend for the period 2002m03-2003m09 ; c1- constant for the period 2003m10-2007m05; c2- constant for the period 2007m06-2008m08

Graphic 5. Monthly core inflation and time varying mean



Source: Bank of Albania, author's calculations

Inflation mean: $\pi_t = 0.015{*}c1$
p-value (0.00)

estimated for the period 1998m1 to 2008m08; c1- constant for the whole period.

Table 7. Structural break estimation

Annual headline inflation:1994m12-1998m1	Annual headline inflation:1998m2-2008m8
$\pi_t = \underset{(0.01)}{0.03} + \underset{(0.00)}{0.89}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.93, se=0.03, DW=2.5	$\pi_t = \underset{(0.41)}{0.003} + \underset{(0.00)}{0.83}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.94, se=0.01, DW=2.3
Monthly headline inflation:1994m1-1997m04	Monthly headline inflation:1997m5-2008m8
$\pi_t = \underset{(0.1)}{0.15} + \underset{(0.74)}{0.05}*\pi_{t-1}$ adj-R2=-0.02, se=0.31, DW=1.93	$\pi_t = \underset{(0.2)}{0.008} + \underset{(0.00)}{0.7}*\pi_{t-1} + \sum_{j=1}^{k-1}\delta_j\pi_{t-j}$ adj-R2=0.58, se=0.07,, DW=1.97
Annual headline inflation:1994m12-1999m11	Annual headline inflation:1999m12-2008m8
$(\pi_t - \mu_t) = \underset{(0.00)}{0.61}*(\pi_{t-1} - \mu_{t-1}) + \sum_{j=1}^{k-1}\delta_j(\pi_{t-j} - \mu_{t-j})$ adj-R2=0.36, se=0.02, DW=1.8	$(\pi_t - \mu_t) = \underset{(0.41)}{0.68}*(\pi_{t-1} - \mu_{t-1}) + \sum_{j=1}^{k-1}\delta_j(\pi_{t-j} - \mu_{t-j})$ adj-R2=0.42, se=0.02, DW=2.06
Monthly headline inflation:1994m1-1997m4	Monthly headline inflation:1997m5-2008m8
$(\pi_t - \mu_t) = \underset{(0.74)}{0.05}*(\pi_{t-1} - \mu_{t-1})$ dj-R2=0.003, se=0.31, DW=1.9	$(\pi_t - \mu_t) = \underset{(0.00)}{0.55}*(\pi_{t-1} - \mu_{t-1}) + \sum_{j=1}^{k-1}\delta_j(\pi_{t-j} - \mu_{t-j})$ adj-R2=0.52, se=0.07, DW=1.24

CIP Katalogimi në botim BK Tiranë

Vasilika Kota
The persistence of inflation in Albania /
/ Kota Vasilika - Tiranë:
Bank of Albania, 2011

-36 f; 15.3 x 23 cm. (material diskutimi ..)

Bibliogr.
ISBN: 978-99956-42-44-0

You may find this paper in the following address:

www.bankofalbania.org

If you want to receive a hard copy of this paper, write to us at:

Bank of Albania
Sheshi "Avni Rustemi", Nr. 24, Tiranë, Shqipëri
Tel.: + 355 4 2419301/2/3; + 355 4 2419409/10/11
Fax: + 355 4 2419408

or send an e-mail to:

public@bankofalbania.org

Printed in 500 copies