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National bank of the Republic of Macedonia

Research Department



Working paper

Inflation Persistence and Price Dynamics in Macedonia: Theory and Empirical Analysis

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Abstract: We apply classical econometric method to characterize the dynamic behavior of the quarter-on-quarter inflation over the period 1997q1-2010q1. In particular, we estimate univariate autoregressive (AR) models for the aggregate consumer price inflation series and as well as for the consumer price inflation at representative product groups level, taking into account the influence of structural breaks in the mean of inflation on the level of persistence. We find strong evidence for a break in the mean for the housing, transport and communication services and culture and leisure inflation. Allowing for a break in the mean of inflation, the inflation measures generally exhibit relatively lower inflation persistence. We also analyze price dynamics in Macedonia at representative products level over the same period.

Key words: Inflation, inflation persistence, price dynamics

JEL classification: E31, C22, C11

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1. Introduction and Motivation

"Inflation persistence refers to the (possibly sluggish) return of the rate of inflation to its long-run mean after a shock occurred. For central banks this is important to know in order to assess the short-run impact of monetary policy decisions. Given that inflation is a monetary phenomenon in the long-run and a central banks main target is to achieve price stability, the degree of persistence has a strong influence for the conduct of monetary policy: The higher inflation persistence the earlier and the stronger a central bank will react to disturbances to inflation in order to maintain price stability"³.

A key aspect of our approach is to allow for the possibility of a structural break in the inflation process, "since a failure to account for such breaks could yield spuriously high estimates of the degree of persistence (Perron 1990)"⁴. Therefore, we proceed to evaluate persistence in each inflation series within the context of a model that allows for structural breaks in the intercept. As in Andrews and Chen (1994), we measure the degree of persistence of the process in terms of the sum of the AR coefficients, ρ (henceforth referred to as the "persistence parameter").

The remainder of the paper is organized as follows. In section 2 the data set used for the empirical analysis is described. The econometric methods for estimating the structural breaks and persistence measures are the focus of section 3. In sections 4 and 5 we present the estimates for the number and location of structural breaks and the degree of persistence in the inflation series, respectively. Section 6, concludes.

2. Data

2.1 Data Sets and Sources

Most of the empirical evidence in the related literature uses quarterly data to analyze the dynamic properties of the inflation process, since the monthly inflation observations are much more volatile, possibly because of temporary factors unrelated to the underlying inflation trends. Thus, we present the results for quarterly data.

We employ quarterly inflation data for different levels of aggregation covering the period from 1997q1 to 2010q1. In particular, as aggregate price series, we use the headline consumer price inflation (CPI inflation). For sectoral analysis, we employ CPI subaggregated time series ("use classification"⁵ is applied). Namely, when univariate models are carried out at a lower level of aggregation (across sub-indices), they can help investigate where the persistence properties of headline inflation come from. Also, another important issue--"a careful treatment of seasonality

³ BAUMGARTNER Josef, "Inflation Persistence in Austria: First Results for Aggregate and Sectoral Price Series", p.2, Working Paper, October 2002, *Austrian Institute of Economic Research*.

⁴ LEVIN, Andrew T., and PIGER Jeremy M., "Is Inflation Persistence Intrinsic In Industrial Economies?", p.2, Working Paper 2002-023E, October 2002, Revised November 2003, *Federal Reserve Bank of St. Louis*.

⁵ The 9 use-categories are: food (F); tobacco and beverages (TB); clothing and footwear (CF); housing (HO); hygiene and health (HH); culture and leisure (CL); transport and communication services (TC); restaurants and hotels (RH); miscellaneous services n.e.c (MS).

is extremely important in estimating the degree of persistence, as very volatile unadjusted series show considerably lower persistence"⁶. Thus, for seasonal adjustment we apply X12-ARIMA procedure to the total sample as the seasonal filter uses moving averages which are in principle able to account for the changing seasonal pattern.

3. Methodology

3.1 Persistence Measure

We define inflation π_t as the first differences of price series in logarithmic terms,

$$\pi_t = \log(P_t) - \log(P_{t-1})$$

on which the seasonal adjustment procedure described in the previous section is applied. As much of the related literature, we characterize the dynamics of each inflation time series by an univariate autoregressive (AR) model of order K .

$$\pi_t = \mu + \sum_{j=1}^K \alpha_j \pi_{t-j} + \varepsilon_t \quad (1)$$

where ε_t is a serially uncorrelated but possibly heteroskedastic random error term. As noted above, [Andrews and Chen \(1994\)](#) advocate the sum of AR coefficients, $\rho \equiv \sum \alpha_j$ as the best scalar measure of persistence.

To measure persistence in terms of the sum of AR coefficients, it is useful to consider the following equivalent expression:

$$\pi_t = \mu + \rho \pi_{t-1} + \sum_{j=1}^{K-1} \phi_j \Delta \pi_{t-j} + \varepsilon_t \quad (2)$$

In this formulation, the persistence parameter $\rho \equiv \sum \alpha_j$, while the higher-order dynamic parameters ϕ_j are simple transformations of the AR coefficients in equation (1); e.g., $\phi_{K-1} = -\alpha_K$. Note that $\rho = 1$ if the data-generating process has a unit root, whereas $|\rho| < 1$ if the data-generating process is stationary.

⁶ BAUMGARTNER Josef, "Inflation Persistence in Austria: First Results for Aggregate and Sectoral Price Series", p.5, Working Paper, October 2002, *Austrian Institute of Economic Research*.

The persistence parameter (ρ) is estimated for the total sample and for subsamples conditional on the occurrence of structural breaks in the mean of the inflation process which in the context of such models is seen as representing its equilibrium or long-run level. One can control for the changes in the mean of inflation either by introducing a break/breaks in the mean or by allowing for a time-varying mean. Still, the predominant approach for considering possible changes in the long-run mean of inflation is to account for structural break(s) especially in case of a change in the monetary policy regime or of other significant events which bring about permanent changes in the mean of inflation, e.g. VAT changes, administered prices adjustments, changes in the measurement of the consumer price index, etc. For the period under consideration, the monetary policy regime remained unchanged.

To obtain an estimate of ρ , an AR lag order K must be chosen for each inflation series. For this purpose, we utilize AIC, the information criterion proposed by Akaike (1973), with a maximum lag order of $K = 4$ considered. The lag order chosen for each series is reported in Table 2 in Section 4.

3.2 Methods for Identifying Structural Breaks

"As demonstrated by Perron (1990), the degree of persistence of a given time series will be exaggerated if the econometrician fails to recognize the presence of a break in the mean of the process. Thus, before drawing any firm conclusions about inflation persistence from the results in the previous section, it is important to obtain formal econometric evidence about the presence or absence of structural breaks in these series⁷". In this section, we present the classical methods used to evaluate the evidence for structural breaks.

"Most classical tests against changes in the coefficients of a linear regression model assume that there is just a single change under the alternative or that the timing and the type of change are known. More recently, there has been a surge of interest in recovering the date of a shift if one has occurred or in methods which allow for several shifts at once, see Bai (1997); Hawkins (2001); Sullivan (2002); Bai and Perron (2003), among many others"⁸. The package **Strucchange** in the R statistical software, incorporates these more recent methods, and therefore this package is used to test against and to date structural changes with unknown timing and multiplicity.

3.2.1 The model

"We consider the standard linear regression model

⁷ LEVIN, Andrew T., and PIGER Jeremy M., "Is Inflation Persistence Intrinsic In Industrial Economies?", p.13, Working Paper 2002-023E, October 2002, Revised November 2003, *Federal Reserve Bank of St. Louis*.

⁸ ZEILEIS Achim, KLEIBER Christian, KRAMER Walter, HORNIG Kurt, "Testing and dating of structural changes in practice", p. 1. This is a preprint of an article published in *Computational Statistics & Data Analysis* 44 (2003).

$$y_i = x_i^T \beta_i + u_i \quad (i = 1, \dots, n) \quad (3)$$

where at time i , y_i is the observation of the dependent variable, x_i is a $k \times 1$ vector of regressors, with the first component usually equal to unity, and β_i is the $k \times 1$ vector of regression coefficients, which may vary over time.

We aim at testing the hypothesis that the regression coefficients remain constant

$$H_0 : \beta_i = \beta_0 \quad (i = 1, \dots, n) \quad (4)$$

against the alternative that at least one coefficient varies over time. In many applications it is reasonable to assume that there are m breakpoints, where the coefficients shift from one stable regression relationship to a different one. Thus, there are $m + 1$ segments in which the regression coefficients are constant, and the model (1) can be rewritten as

$$y_i = x_i^T \beta_j + u_i \quad (i = i_{j-1} + 1, \dots, i_j) \quad (j = 1, \dots, m + 1) \quad (5)$$

where j is the segment index, $\zeta_{m,n} = \{i_1, \dots, i_m\}$ denotes the set of the breakpoints ($\zeta_{m,n}$ is also called m -partition), and by convention $i_0 = 0$ and $i_{m+1} = n$.

In practice, the breakpoints are rarely given exogenously but are unknown and have to be estimated from the data. This is what we do below.⁹

3.2.2 The tests

"Two frameworks for testing for structural change can be distinguished: (i) F statistics (Andrews 1993; Andrews and Ploberger 1994) that are designed for a specific alternative and (ii) generalized fluctuation tests (Kuan and Hornik 1995) that do not assume a particular pattern of deviation from the null hypothesis (the tests within these two frameworks are testing the hypothesis that the regression coefficients remain constant against the alternative that at least one coefficient varies over time. In many applications it is reasonable to assume that there are m breakpoints, where the coefficients shift from one stable regression relationship to a different one).

F statistics test against a single-shift alternative of unknown timing, i.e., model (5) with $m = 1$. Tests against this alternative are usually based on a sequence of F statistics for a change at time i : the OLS residuals $\hat{u}(i)$ from a segmented regression, i.e., one regression for each subsample, with breakpoint i , are compared to the residuals \hat{u} from the unsegmented model.

⁹ Ibid.

On the other hand, the generalized fluctuation test framework is essentially a technique which is designed to bring out departures from constancy in parameter estimates of the linear regression model in a graphic way instead of parametrizing particular types of departure in advance and then developing formal significance tests. More precisely, the model (3) is fitted to the data and an empirical process is derived that captures the fluctuation either in residuals or in parameter estimates. The trajectory of the process often sheds light on the type of deviation from the null hypothesis such as the dating of the structural breaks¹⁰. This particular research paper considers the OLS-based CUSUM test introduced by [Ploberger and Krämer \(1992\)](#) which is based on cumulated sums of standard OLS residuals.

3.2.3 Dating structural changes

"Given an m -partition i_1, \dots, i_m the least squares estimates for the β_j can easily be obtained. The resulting minimal residual sum of squares is given by

$$RSS(i_1, \dots, i_m) = \sum_{j=1}^{m+1} rss(i_{j-1} + 1, i_j) \quad (6)$$

where $rss(i_{j-1} + 1, i_j)$ is the usual minimal residual sum of squares in the j th segment. The problem of dating structural changes is to find the breakpoints $\hat{i}_1, \dots, \hat{i}_m$ that minimize the objective function

$$(\hat{i}_1, \dots, \hat{i}_m) = \arg \min_{(i_1, \dots, i_m)} RSS(i_1, \dots, i_m) \quad (7)$$

over all partitions (i_1, \dots, i_m) with $i_j - i_{j-1} \geq n_h \geq k$.

In applications, $n_h = nh$ is a trimming parameter that can be chosen by the practitioner. In our example we use $h = 0.15$, i.e. the default trimming. The trimming parameter determines the minimum time span between two possible breaks. In our case the minimum time span is 15% of the total length of the sample (constant trimming parameter also implies a shorter minimum span for the shorter sample).

Obtaining the global minimizers in (7) by an extensive grid search would be computationally burdensome for $m > 2$. Therefore, these can be found much easier by a dynamic programming approach. [Bai and Perron \(2003\)](#) present a version of that dynamic programming algorithm for structural change models in an OLS regression context, which we adopt here. For more details on this dynamic programming algorithm see [Bai and Perron \(2003\)](#)¹¹.

¹⁰ Ibid.

¹¹ Ibid.

3.3 Results from structural break tests

In this section we discuss the results on the estimated number and the dates of structural breaks for the inflation series described in the section 2.1. We applied break tests discussed in section 3. In the empirical implication to test for multiple breaks in the unconditional mean of inflation we selected a pure change model with an intercept only. We have chosen a trimming parameter for the total sample of 15%.

Table 1 – Structural Breaks for inflation series in Macedonia
Aggregate and CPI subaggregate indices (quarter-on-quarter inflation)
trimming parameter 15%

Inflation variable	Number of breaks	Structural break date
<i>Aggregate level</i>		
Headline CPI	0	
<i>Disaggregate level</i>		
Food	0	
Tobacco and beverages	0	
Clothing and footwear	0	
Housing	1	1999 q1
Hygiene and health	0	
Culture and leisure	1	1999 q1
Transport and communication services	1	2000 q2
Restaurants and hotels	0	
Miscellaneous services n.e.c	0	

I find strong evidence for a structural break in the inflation process for the following CPI subaggregate items: housing; culture and leisure, and transport and communication services. Associated to the identified structural break dates are the following three exogenous events: Kosovo crisis¹² (1999:Q1) for the housing inflation; Inclusion of the admission fees for higher education in the culture and leisure sub-index (1999:Q1), and the practical implementation of the new VAT and Excise Act¹³ (2000:Q2). We also find out that once we control for the break in the

¹² The Kosovo crisis affected the economies of the neighboring countries (notably Macedonia and Albania) through a number of channels. Most vividly, the displacement of large numbers of refugees puts strains on the social and economic infrastructures of these countries.

¹³ It refers to the reform on the indirect taxation in Macedonia to the point where there is extensive harmonization with the EU VAT Directive (Sixth Council Directive of 17 May 1977 on the harmonization of the laws of the Member States relating to

mean of these inflation series, estimates for persistence covering the Regime 2 (i.e. the period after the break), are considerably higher. This suggests that the weight of the backward looking part in the formation of these particular inflation expectations increased over time. For monetary policy analysis, and inflation forecasting especially, the last break date is the most important one, as forecasts based on data before the break occurred, could give misleading signals about the future dynamics of inflation. In other words, a presence of a structural break means that for each sub-sample (for instance 1 break splits the sample into 2 sub-samples) a different model specification is to be employed, otherwise the practitioner is about to be faced with a spurious regression problem.

4. Results of the quarter-on-quarter inflation persistence estimates using the OLS estimator

This research paper aims at answering whether the inflation tends to revert quickly to its initial level, or whether the effects of the shock persist – that is, lead to a changed level of inflation for an extended period. As we already pointed out, we employed the most prevalent way of measuring inflation persistence, which is to regress inflation on several of its own lags and then calculate the sum of the coefficients on lagged inflation. If the sum of the coefficients is close to 1.0, then shocks to inflation have long-lived effects on inflation. In other words, inflation behaves like a random walk, so that when inflation goes up, it stays up. If the sum of the coefficients drops well below 1.0, then a shock to inflation has only a temporary effect on inflation, and inflation soon reverts back to its trend level.

The results point to an *overall low level of inflation inertia in the case of Macedonian inflation* with a clear evidence of heterogeneity across sectors. More precisely, since the persistence parameter ρ does not exceed 0.70 we can conclude that the Macedonian inflation series display a low level of inertia, and therefore a potential downward bias on the obtained estimates is not a particular problem.

The differences in inflation persistence across sectors most likely reflect in parts the different price setting practices that depend on the various market structures in which firms operate. For instance, a sector which is heavily affected by end-of-season sales is clothing and footwear-which is also the sector that has a very low inertia. Housing, as well, is among the least persistent inflation series (during Regime 1 (i.e. the period before the break occurred), it displays no positive serial correlation). The housing item includes the most volatile component (i.e. the petroleum product prices--administered prices with very frequent adjustments) and consequently its inflation rate becomes comparatively less inertial. On the other hand, transport and communication services, restaurants and hotels, and body and healthcare services inflation series are comparatively much more persistent. These groups involve mainly services (services prices when compared to the goods prices represent less frequently changed group of prices, mainly due to their non-tradable nature). But still, if firms (like for instance, firms which operate within

turnover taxes - Common system of value-added tax: uniform basis of assessment) and the EU Directive on excise duties (92/12/EEC).

the services sector) can change prices less often, then, the sensitivity of inflation to changes in current and future marginal costs will be reduced. But, the reduced sensitivity of inflation to changes in marginal costs (the both, current and future ones) is not an explanation for why inflation should depend on its own history. Such dependence (dependence on its own history) can only be explained within the assumption of indexation behavior on the part of the price-setters. An increase in the fraction of firms that set prices in a backward-looking manner (taking only historic data into account) *ceteris paribus*, raises inflation persistence. Similarly, an increase in the importance of backward-looking indexation (such as indexation based on consumer price index or a fixed percentage adaptation) will generally also increase the degree of inflation persistence.

The persistence of headline inflation is higher than the average of the persistence of its subcomponents. This is the so-called aggregation effect which takes place when the more persistent series have a relatively large weight in the overall consumer price index (food inflation has the biggest individual weight in the headline CPI, as well as the biggest inertia over the full sample period).

Table 2 -Inflation persistence estimates

Quarter-on-quarter inflation rates, seasonally adjusted

Sample period: 1997:q1 - 2010:q1; **White heteroskedasticity consistent OLS estimates**

Inflation variable	Structural break date	ρ	P value	K	ρ Reg 1	P value	K	ρ Reg 2	p-value	K
<i>Aggregate level</i>										
Headline CPI		0.38	0.05*	3						
<i>Disaggregate level</i>										
Food		0.44	0.01*	3						
Tobacco and beverages		0.13	0.28	2						
Clothing and footwear		0.15	0.00*	2						
Housing	1999 q1				-1.24	0.03*	2	0.25	0.04*	2
Hygiene and health		0.33	0.00*	2						
Culture and leisure	1999 q1				-0.20	0.19	2	0.32	0.30	2
Transport and communication services	2000 q2				0.16	0.60	2	0.49	0.06**	2
Restaurants and hotels		0.38	0.11***	2						
Miscellaneous services n.e.c		0.28	0.42	2						

*significant at 5% ; **significant at 10%; ***significant at 15%;K is the order of the AR process. Reg1., and Reg.2 imply the sub-samples before and after the break occurred, respectively.

5. Analysis of price dynamics in Macedonia

In this section we analyze price dynamics in Macedonia using monthly data of representative product group prices over the period 1997 m1-2010 m3. We calculate the share of prices which are changed each month as the number of price changes (for a given product group or the overall consumer basket) divided by the total number of prices. Below, we use the terms "share of changed prices" and "frequency of price changes" interchangeably. In addition, we also study the average size of price changes (respectively, the average size of price increases and of price decreases) observed in the data over the period under investigation. A number of interesting stylized facts emerge from the analysis of patterns of price adjustments.

Table 3
Main characteristics of consumer price changes in Macedonia (average per month over the period 1997 m1-2010 m3)

	Share of goods with increased prices	Share of goods with decreased prices	Share of goods with changed prices	Average size of price increases	Average size of price decreases
Food	51.5%	46.1%	97.6%	1.8%	-1.7%
Tobacco and beverages	39.9%	26.6%	71.4%	4.1%	-3.1%
Clothing and footwear	54.1%	45.6%	99.7%	0.8%	-0.9%
Housing	45.3%	34.3%	80.7%	2.2%	-1.1%
Hygiene and health	42.6%	46.4%	89%	0.8%	-0.6%
Culture and leisure	52.5%	44.9%	97.5%	0.7%	-1.1%
Transport and communication services	47.2%	35.6%	82.8%	1.6%	-1.7%
Restaurants and hotels	16%	3%	19%	0.7%	-0.5%
Miscellaneous services n.e.c	8%	7%	15%	1.6%	-1.8%
Goods	57%	38%	95%	0.9%	-0.8%
Services	56%	23%	79%	0.7%	-0.5%
Headline CPI	57%	39%	96%	0.7%	-0.6%

Euro area overall CPI*	8%	6%	15%
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* For the Euro area we use the data summarized by Dhyne et al. (2005)¹⁴. Figures refers to the period 1998-2004. Conclusive statements about the size of price changes cannot be made because of the different nature of the data (averages of individual prices in Macedonia vs. individual prices themselves in the euro area (they focus on the analysis of 50 narrowly defined products, which are considered to be approximately representative of the full CPI basket).

First, as shown in Table 3, prices change frequently. Unsurprisingly, prices in Macedonia change much more frequently than in euro area. On average, a given month, approximately 96 percent of the consumer prices are changed. For the euro area, the frequency of consumer price adjustments is equal to 15 percent (i.e. on average, a given month 15 percent of prices are changed)¹⁵. When comparing the frequency of price changes, the source of the cross-country variation is likely to be both, structural (consumption patterns, structure of the retail sector--i.e. some countries may have stickier prices due to a larger market share of small traditional outlets), methodological (e.g. the treatment of sales and of quality adjustment by each national statistical institute), and a reflection of the differences in the relative importance of regulated prices across countries. The frequency of price changes is also determined by the economic developments, such changes in VAT rates, then, the collective wage agreements (rigidities in wage developments can translate into price rigidities), and as well as, by the level of aggregate and sectoral inflation. In the case of Macedonia, the higher frequency of Macedonian consumer price changes vis-a-vis the euro area consumer prices is largely accounted for the processes of price level convergence Macedonia has been undergoing. As a consequence of the convergence process, in Macedonia price increases are much more common than price decreases.

As shown in Table 3, food is the product group with very frequently changed prices each month in Macedonia (food is as well a group with largest individual share in total consumer price index). On average over the period 1997 m1-2010m3, 97.6 percent of all food prices are changed each month in Macedonia. The main reason for the high frequency of changes in food prices is their quick response to changes in input prices. Namely, given the high importance of supply shifts in this sector, this result is not surprising under the assumption that prices are reset in response to such shifts (the pricing structure is dominated by supply-side factors such as the seasonal nature of many unprocessed food items).

It can also be seen that services prices when compared to the goods prices represent less frequently changed group of prices, with frequency of price changes of 79 percent. Also decreases of prices in services are less frequent then in the goods category due to the following reasons: their non-tradable nature (the higher the competitive pressure is, the more frequent price changes are); higher share of labour input in the production costs of services and possible downward nominal wage rigidity (rigidities in wage developments can translate into price rigidities).

¹⁴ Price setting in the euro area: Some stylized facts from individual consumer price data, Dhyne et al. (2005), p.24, p.26, *Documentos de Trabajo, N.º 0528, Banco de España*.

¹⁵ The frequency and size of headline consumer price changes in Macedonia are then compared with the results obtained for the euro area on the overall HICP. For the latter, we use the data summarized by Dhyne et al. (2005).

There is a substantial degree of heterogeneity across product groups between the shares of price increases and price decreases. But, in terms of the share of price increases in all price changes, similarities across product groups are much stronger than differences. In Macedonia price increases are much more common than price decreases. These asymmetries in price adjustments, (i.e. this asymmetrically stronger reaction to positive than to negative shocks--reflected by the much more common price increases than price decreases) are important for the conduct of the monetary policy, as they imply, in a short run, different impacts of positive or negative shocks, which monetary policy might want to take into account in its reaction to these shocks. Some micro based surveys (elaborated in the inflation persistence literature) point out to the following general pattern: cost shocks are more relevant for price increases than for price decreases, whereas shocks to market conditions (competitive pressure) matter more when prices have to be decreased. Conversely, price decreases are much more affected by weakening demand or by decreasing prices of competitors than by a negative cost shock. Therefore, the central bank has to take a medium-term orientation and see through the temporary effects of various cost-push shocks. But, when a series of cost-push shocks in one direction risks increasing the perceived degree of persistence by the private sector, inflation expectations and inflation itself could become unanchored and costly to control. In such a case, if the communication by the central bank cannot alleviate this problem, it is advisable to respond quite aggressively and persistently to such shocks.

6. Conclusion

The results point to an overall low level of inflation inertia in the case of Macedonian inflation with a clear evidence of heterogeneity across sectors. The differences in inflation persistence across sectors most likely reflect in parts the different price setting practices that depend on the various market structures in which firms operate. Explanation for why inflation should depend on its own history can only be drawn within the assumption of indexation behavior on the part of the price-setters. An increase in the fraction of firms that set prices in a backward-looking manner (taking only historic data into account) *ceteris paribus*, raises inflation persistence. Similarly, an increase in the importance of backward-looking indexation (such as indexation based on consumer price index or a fixed percentage adaptation) will generally also increase the degree of inflation persistence.

Since the persistence parameter ρ does not exceed 0.70 we can conclude that the Macedonian inflation series display a low level of inertia, and therefore a potential downward bias on the obtained estimates is not a particular problem. It is straightforward that with a high persistence of inflation, in inflationary periods, high inflation rates will be accompanied by high inflation in future periods, while in periods of low inflation highly persistent series will lead to falling inflation rate in the future.

Inflation persistence and price-level stickiness are central issues in conducting monetary policy. Knowing the degree to which the inflation process is “persistent” (that is, the extent to which inflation tends to approach slowly, rather than instantly, its equilibrium level after shocks) gives

the central bank vital information on how (how much, how fast, how long) its policy instrument should be adjusted to achieve the desired target. Moreover, the nature of inflation dynamics, as well as the effectiveness of monetary policy, depends to a large extent on the characteristics and patterns of price-setting and the associated nominal rigidities. Specifically, high estimates of inflation persistence may call for institutional and labor market reforms that typically improve the flexibility of the domestic economy and subsequently reduce inflation persistence.

On the other hand, "it has been argued that the apparent fall in the degree of inflation persistence in many countries, has been the result of a better anchoring of private sector's inflation expectations to the central bank's price stability objective"¹⁶. Namely, "if economic agents have imperfect knowledge of the structure of the economy and the expectation formation on the part of the private sector is based on some form of learning mechanism, there is a clear relationship between the monetary policy regime and the ex post inflation persistence. In particular, it has been found that policy should respond more aggressively to inflation under imperfect knowledge in order to properly steer the learning mechanism of the private agents. In order to benefit from reduced inflation persistence, the central bank needs to keep inflation expectations well anchored. Therefore, the central bank has to take a medium-term orientation and see through the temporary effects of various cost-push shocks. But, when a series of cost-push shocks in one direction risks increasing the perceived degree of persistence by the private sector, inflation expectations and inflation itself could become unanchored and costly to control. In such a case, if the communication by the central bank cannot alleviate this problem, it is advisable to respond quite aggressively and persistently to such shocks"¹⁷.

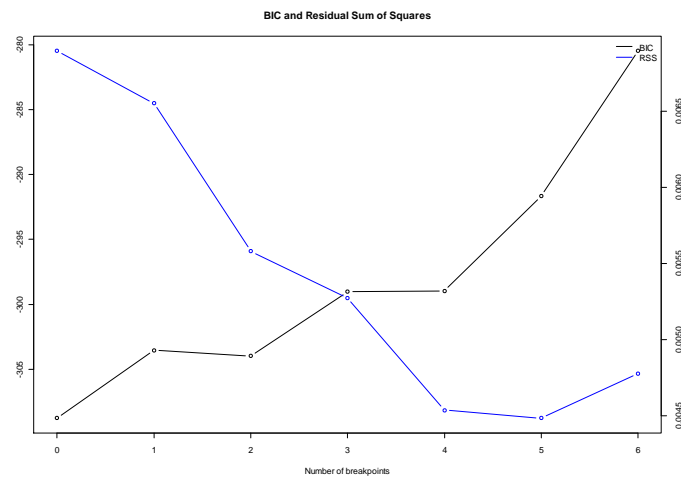
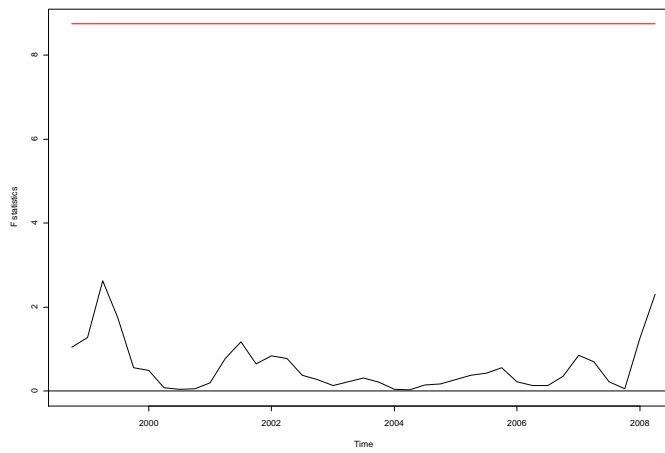
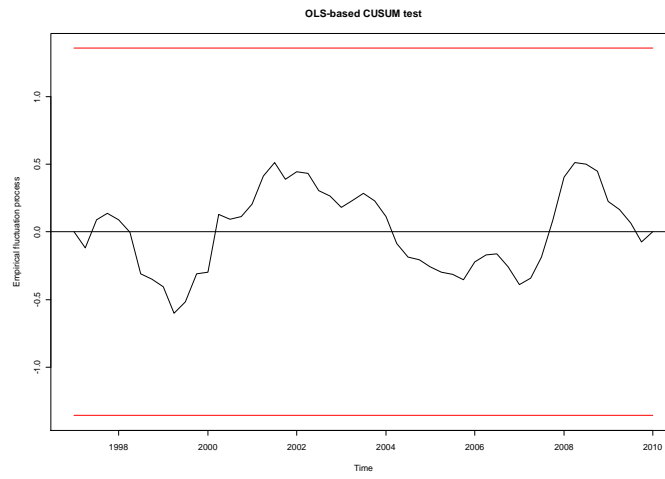
A number of interesting stylized facts emerge from the analysis of patterns of price adjustments. First, prices in Macedonia change frequently. Unsurprisingly, prices in Macedonia change much more frequently than in euro area. The higher frequency of Macedonian consumer price changes vis-a-vis the euro area consumer prices is largely accounted for the processes of price level convergence Macedonia has been undergoing. Also, as a consequence of the convergence process, in Macedonia price increases are much more common than price decreases. These asymmetries in price adjustments, are important for the conduct of the monetary policy, as they imply, in a short run, different impacts of positive or negative shocks, which monetary policy might want to take into account in its reaction to these shocks.

¹⁶ ALTISSIMO Filippo, EHRMANN Michael, SMETS Frank, "Inflation persistence and price-setting behaviour in the euro area: a summary of the Inflation Persistence Network evidence", p. 32-33. *Working paper no. 95, October 2006, National Bank of Belgium*.

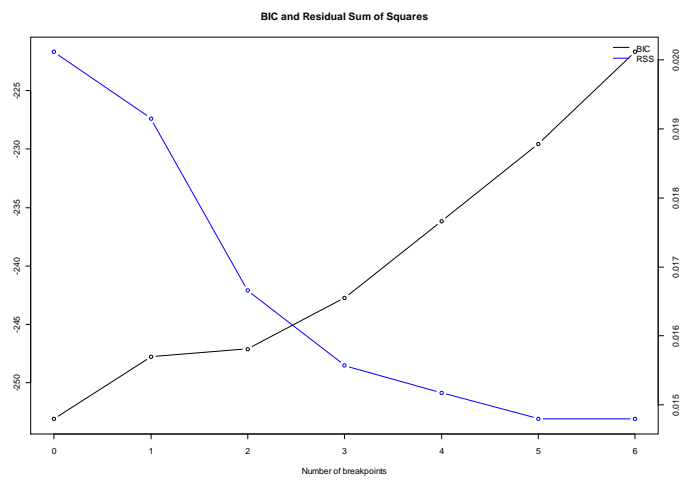
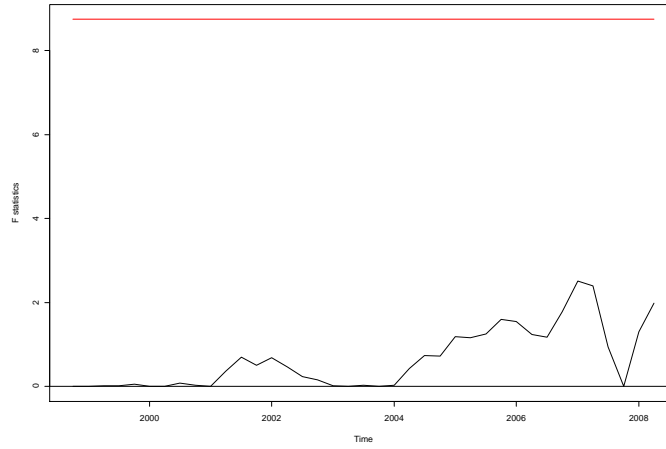
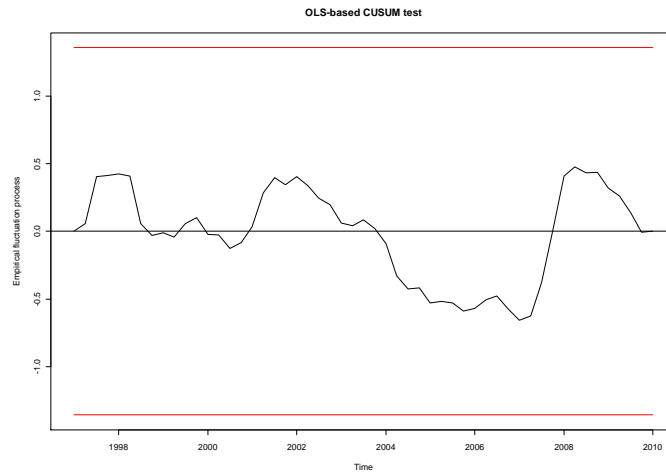
¹⁷ Ibid.

APPENDIX
Structural break tests

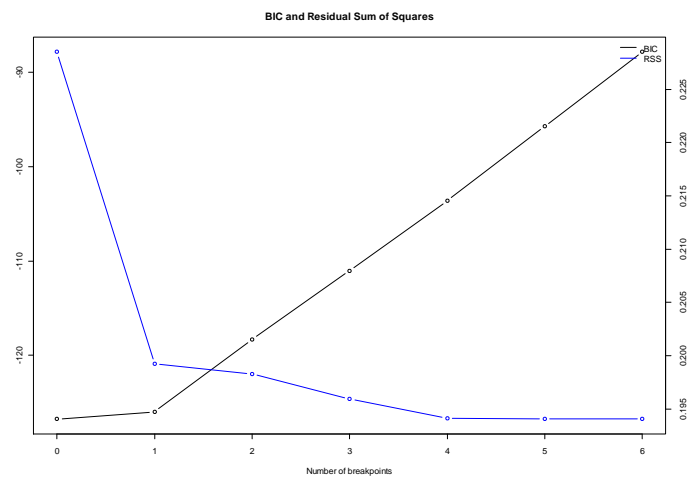
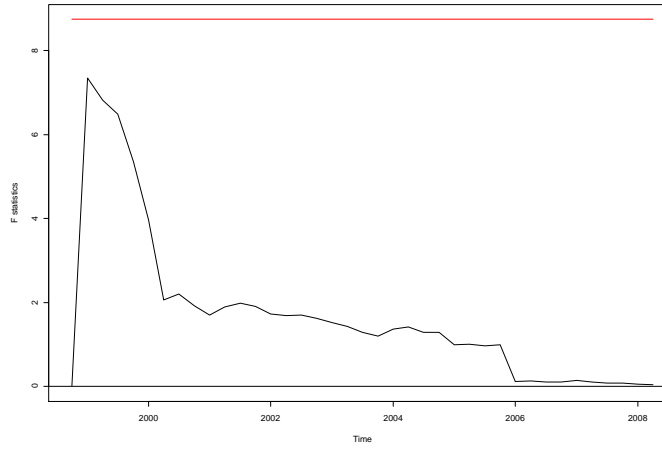
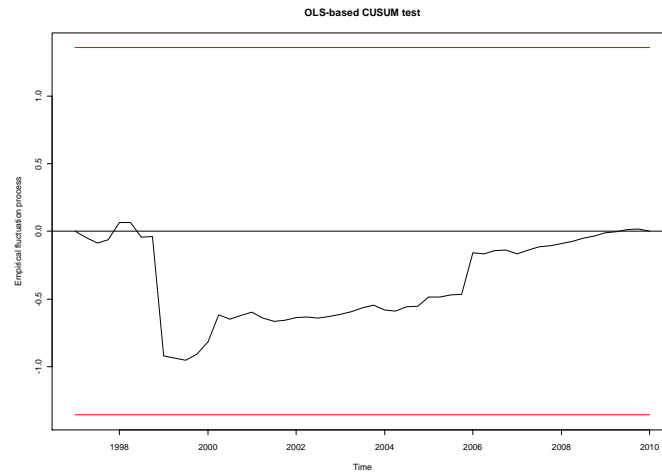
Headline inflation



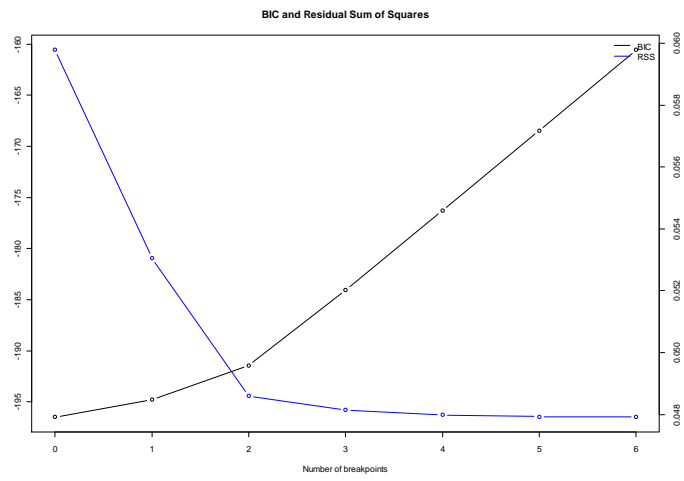
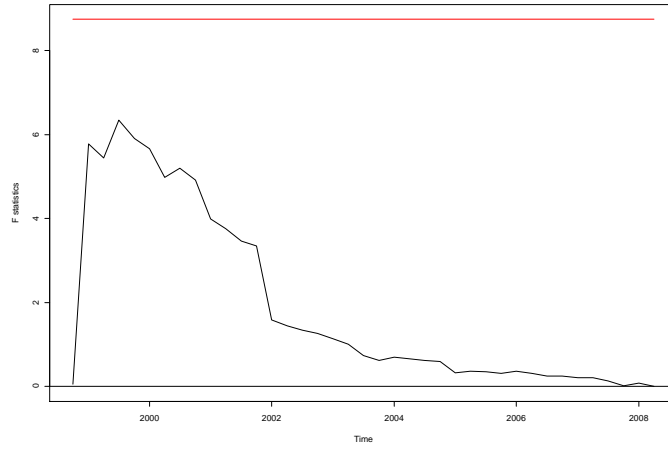
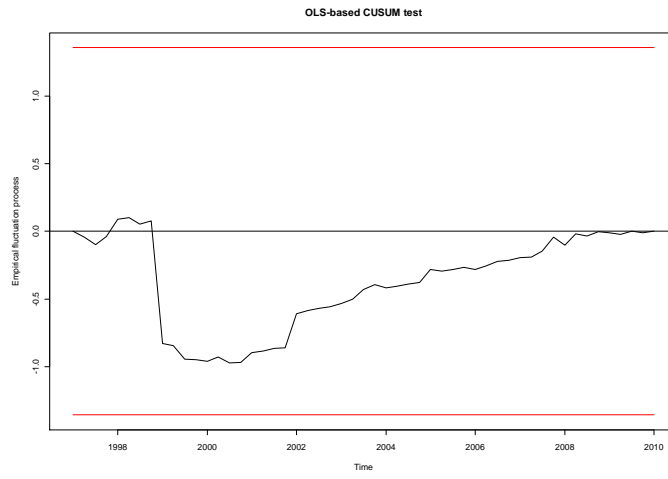
Food inflation



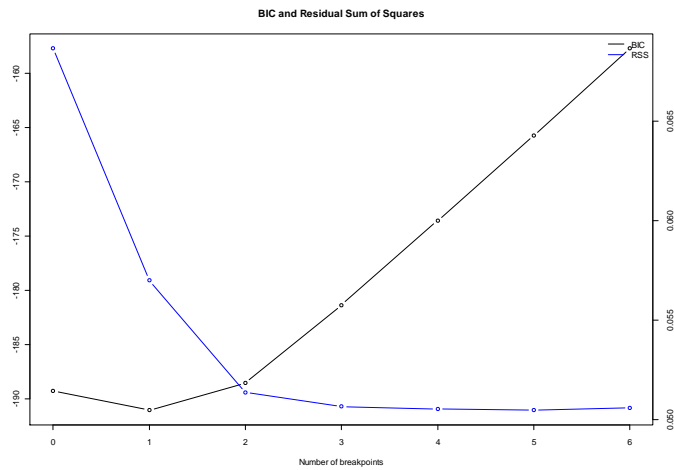
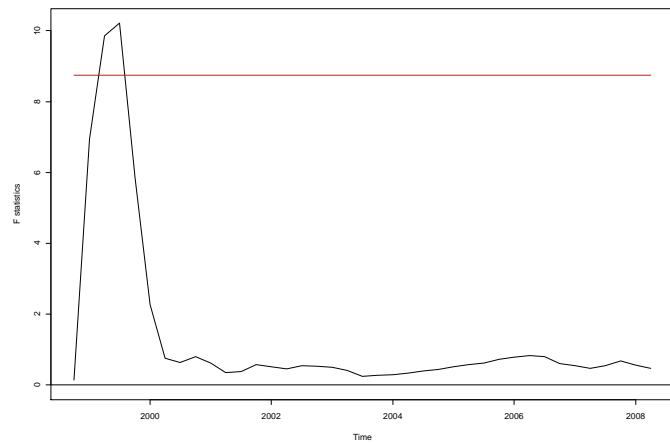
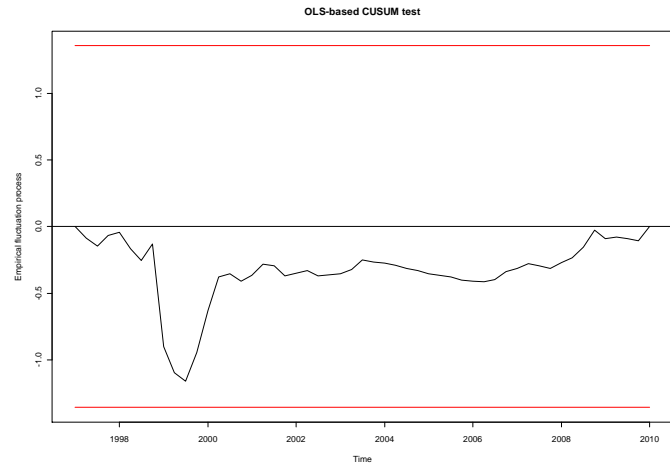
Tobacco and beverages inflation



Clothing and footwear inflation

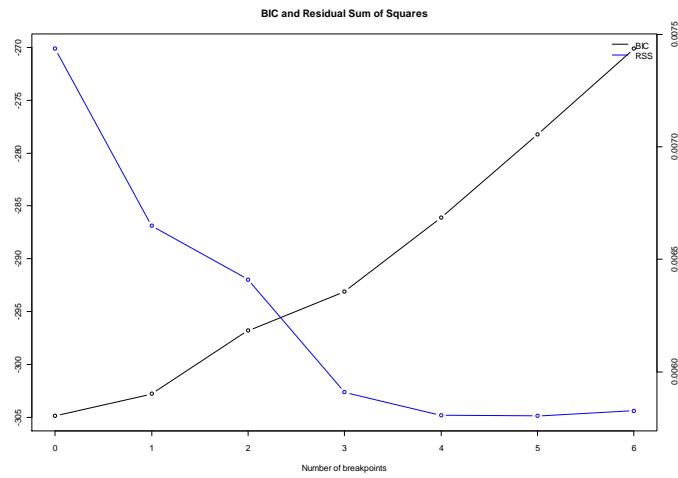
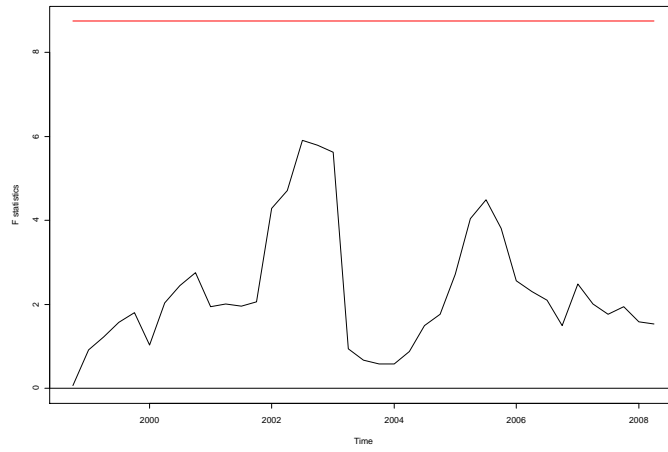
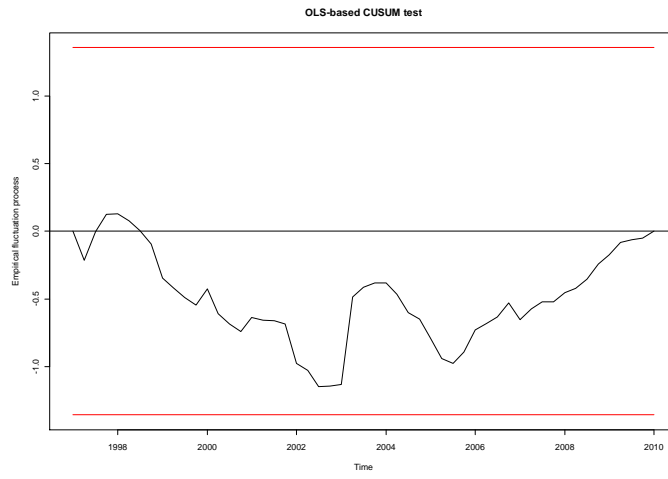


Housing inflation*

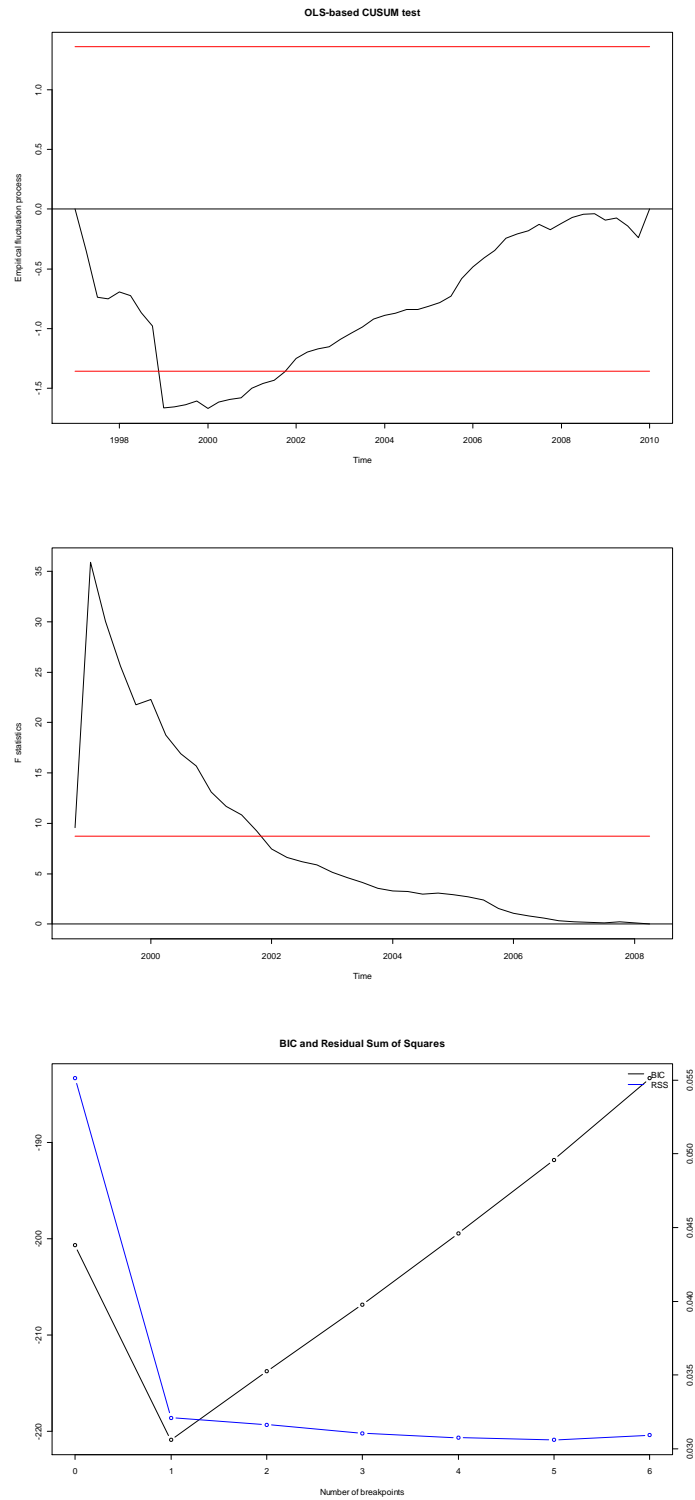


*The housing inflation has a peak around 1999 which exceeds the boundaries and hence indicates a clear structural shift at that time. The obvious reason is the Kosovo crisis which started in 1999 Q1. The BIC as shown in this Figure for Housing inflation would choose a model with 1 break.

Hygiene and health inflation

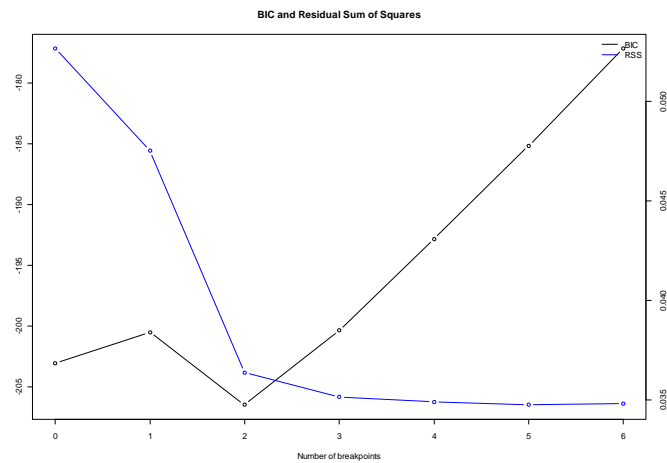
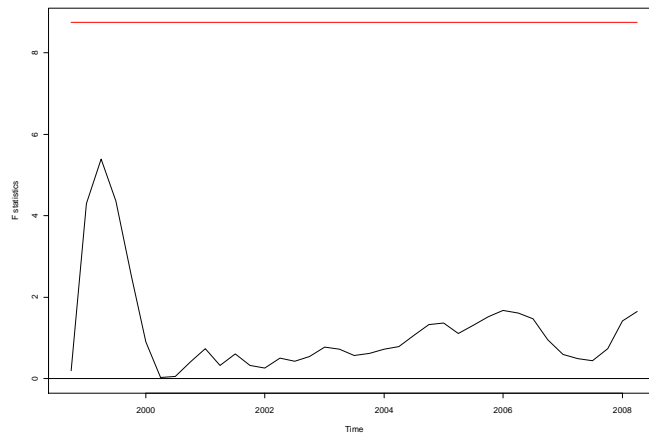
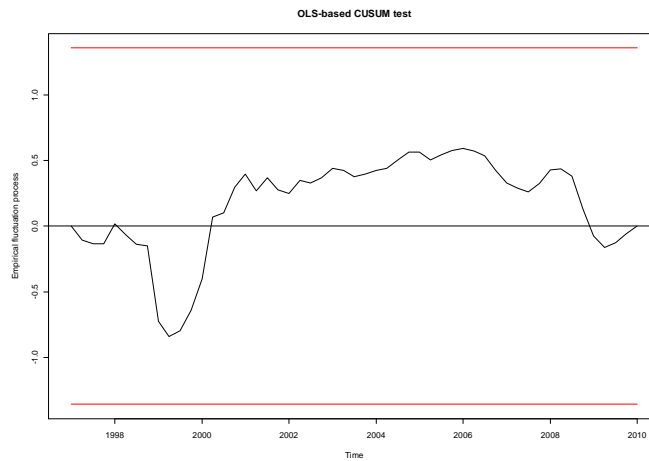


Culture and leisure inflation*



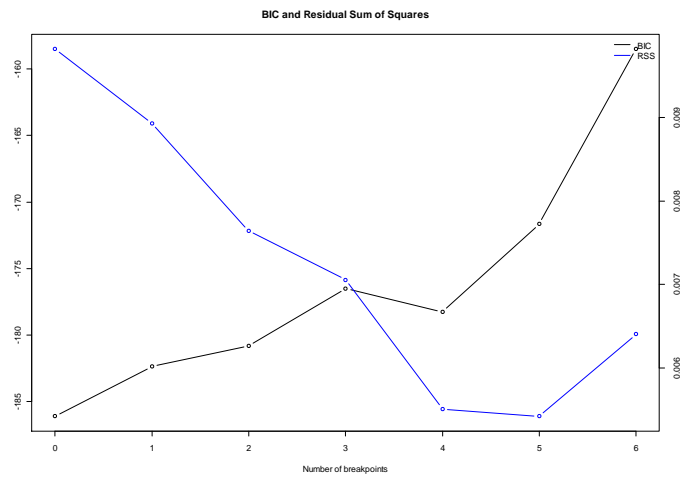
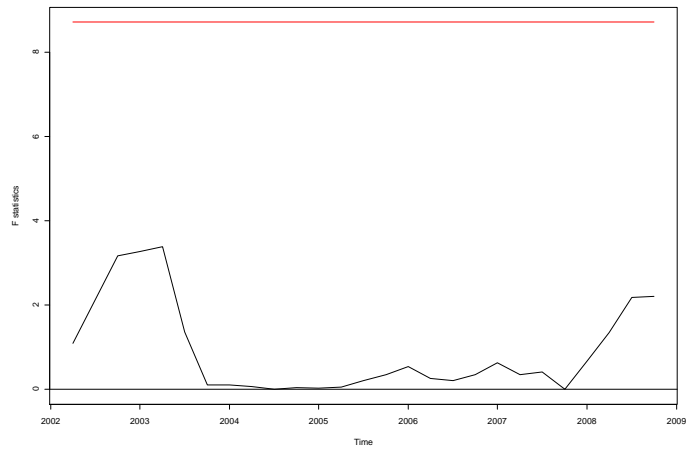
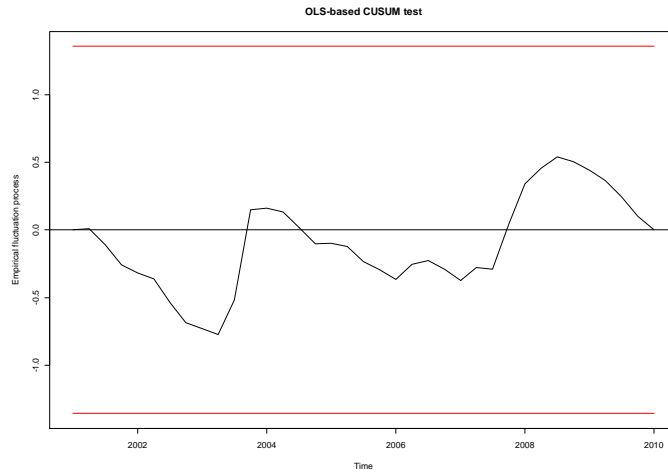
*The Culture and leisure inflation has a peak around 1999 which exceeds the boundaries and hence indicates a clear structural shift at that time. The obvious reason is the Kosovo crisis which started in 1999 Q1. The BIC as shown in this Figure for Culture and leisure inflation would choose a model with 1 break.

Transport and communication services inflation*



*The BIC as shown in this Figure would choose a model with 2 breaks for the Transport and communication services inflation. The obvious reason for one of the breaks is the practical implementation of the new VAT and Excise Act in 2000 Q2. Still, the second breakpoint was neglected because TRAMO-SEATS confirmed that the Kosovo crisis which started in 1999 Q1 affects this particular inflation series as a transitory change outlier.

Restaurants and hotel services inflation



Miscellaneous services inflation

