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The Stylized Facts of Greek Inflation: New Evidence on Persistence

Summary: This paper contributes to the existing empirical literature of inflation persistence by providing results on the level of inflation persistence for the Greek economy using an inflation series on both the aggregated and the disaggregated level. The empirical findings reveal substantial homogeneity across sectors as well as across price indices. These results suggest a very moderate degree of inflation persistence for both aggregate and disaggregate price indices. The results point to the need to account for the presence of a structural break typically related to the "Maastricht effect"; and entailed a structural increase in the persistence measure, though the average level of inflation declined. This could be a piece of evidence that although the monetary component of inflation in Greece was neutralized due to the implementation of the monetary policy by a central monetary authority, other idiosyncratic characteristics of the Greek inflation contribute to this persistent structure of the inflation series.

Paper by invitation

Key words: Inflation, Persistence, Aggregate and disaggregate prices, Greece.

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The study of inflation is of fundamental importance since it can have far-reaching implications for the economy both in terms of economic efficiency and wealth distribution. Moreover, this is reflected in the mandate of many monetary authorities to maintain price stability. Such central bank institutions pay special attention to the development of tools enabling them to better understand and monitor the properties of inflation dynamics.

A better understanding of the inflation process is important from a broader policy standpoint. In particular, for policy makers it is useful to know the degree to which inflation has been driven by common factors that affect all sectors in the economy as opposed to sector-specific factors related to domestic aggregate demand-supply conditions. Inflation is also costly. High inflation results in a redistribution of wealth from those with fixed incomes to those with flexible incomes (from lenders to borrowers) and reduces real returns on savings and investments. The characteristics driving inflation dynamics vary depending either on the time horizon or on the characteristics of a particular sector in the economy. Over the short-run, the structure of the consumption basket plays an important role for inflation. Thus, for given price shocks, inflation is expected to be higher in countries with higher energy and food price shares in the consumer basket. Over the long-run, factors, such as convergence of price levels across countries become a more important driving force.

At the same time, inflation in Greece, a variable that crucially characterizes the international competitiveness of the economy, is one of the most important topics in the "policy dialogue" between country authorities and the International Monetary Fund. This is especially the case for an economy with weak international competitiveness as well as weak institutions and capacity, making it particularly difficult to control inflation. Although the Greek economy has enjoyed, over the last 10 years solid economic growth, and after a period of low inflationary pressures, the economy is now experiencing inflationary pressures caused by higher commodity prices, which are mainly due to the lack of strong competitive forces in particular sectors in the economy as well as to high indirect taxes imposed through the agreement of the country with the IMF and the European Union supportive lending programme. Moreover, Greece cannot sustain inflation above its euro partners, since its international trade volume is heavily affected by inflation differentials between the country and those partners.

This study is organized as follows. Section 1 reviews the literature on inflation persistence, while Section 2 describes the methodology associated with the testing of inflation persistence. Section 3 provides a description of Greek inflation characteristics with Section 4 describing the data set and the empirical analysis. Finally, Section 5 concludes the paper.

1. Definitions and Literature

In the literature of inflation, as inflation persistence is defined the tendency of inflation to converge at a slow pace to the central bank's inflation goal, following various other shocks. This property of inflation seems important for many reasons, including forecasting. The phenomenon of inflation persistence assists the analysis of cross-country inflation differentials by helping distinguish between structural and shock-induced inflation differentials. Monetary authorities can entirely control the inflation rate in the long-run, implementing the proper monetary policy, but they can not entirely direct the short–run inflation rate towards the desirable inflation target, as miscellaneous macroeconomic shocks will temporarily incite the inflation divergence from the inflation target of the central bank. Thereby, it is highly important for the monetary authorities to know the speed with which the inflation rate returns to its long-run equilibrium level after a disturbance as an inflation process that exhibits persistence analogous to that of a random walk calls for more cautious monetary policy than if persistence were low.

Recent developments in the literature of inflation persistence argue that this phenomenon should not be necessarily considered as a time-invariant phenomenon. The literature argues that changes in the level of credibility of the central bank's commitment to attain its policy objectives should have an effect on the relative importance of forward-looking and backward-looking terms in inflation models, such as the New-Keynesian-Phillips-Curve (John Taylor 1998; Thomas Sargent 1999). Timothty Cogley and Sargent (2001) add to the discussion by claiming that such changes in inflation persistence are capable of explaining policy mistakes leading to high inflation rates, while the concept of persistence is important per se since it determines how important is the approach of the New Keynesian Phillips curve for ex-

plaining price stickiness. The implications of such models have to do with the impact on the level of inflation persistence. Without the hypothesis of persistence, then time-invariance implies that high inflation persistence trends need not be an intrinsic feature of economies (Michael Bordo and Anna Schwartz 1999; Marvin Goodfriend and Robert King 2001; Luca Benati 2003; Christopher Erceg and Andrews Levin 2003).

Many researchers have concluded that high inflation persistence is a "stylized fact" in industrial economies, while the alternative viewpoint is that the degree of inflation persistence is not an inherent structural characteristic of industrial economies, but rather varies with the stability and transparency of the monetary policy regime. Robert B. Barsky (1987) finds that U.S. inflation persistence was very high from 1960-1979, but was much lower from 1947-1959. Mark Evans and Paul Wachtel (1993) estimate a Markov-switching model for U.S. inflation and find that the series was generated by a low-persistence regime over the periods 1953-1967 and 1983-1993, but it was generated by a random-walk process over the period 1968-1982.

Moreover, the literature has attempted to measure empirically the characteristics of inflation persistence time-invariance. Studies by Barsky (1987), Evans and Wachtel (1993), William Brainard and George Perry (2000), Federico Ravenna (2000), Taylor (2000), Cogley and Sargent (2001), Chang-Jin Kim, Charles Nelson, and Jeremy M. Piger (2001), James H. Stock (2001), Benati (2003), Andrew T. Levin and Piger (2004), Gerald O'Reilly and Kirk Whelan (2004) and Frederic Pivetta and Ricardo Reis (2007) provide mixed results on inflation persistence, raising a debate about the constancy of inflation persistence along with changes in the monetary policy environment. Moreover, Pivetta and Reis (2007) and Stock and Mark W. Watson (2007) show that inflation persistence in the U.S. has not changed over the last 30 to 40 years, while two very recent studies by Zorica Mladenović and Aleksandra Nojković (2012) who measure inflation persistence for a number of Central and Southeastern countries and by Slok K. Sek and Wai M. Har (2012) who report evidence that inflation persistence gets more moderated in inflation targeting regimes, also contribute to the literature.

Levin and Piger (2004) estimate an AutoRegressive (AR) model allowing for structural breaks in the mean of the inflation process and re-estimate the model without considering any shifts in the central bank's inflation target, i.e. without any structural break. They do that because they argue that a chunk of the inflation persistence may be related to ignoring structural breaks in the mean inflation, which may reflect changes in central banks' inflation target over time. In other words, the restriction of not allowing structural breaks may result in misleadingly high inflation parameter estimates. Without accounting for possible breaks they find a persistence parameter for the U.S. GDP deflator spanning the period 1984-2003. Once they allow for a structural break, the persistence parameter falls sharply. Lucas Bilke (2004) makes use of disaggregated CPI time series to analyze the dynamics of French inflation. He first estimates inflation persistence by using the erratic hypothesis of a stable mean and finds that inflation persistence is strong, being unable to reject the hypothesis of a unit root for overall CPI, industrial goods and services. However, when allowing for a structural break in the mid-eighties, inflation persistence dramatically decreases in every case.

Maarten Dossche and Gerdie Everaert (2005) argue that in most of the empirical studies inflation is found to exhibit high to very high persistence over the post WWII period, possibly because these studies ignore the fact that the data generating process of inflation consists of a number of distinct components, each of them exhibiting its own level of persistence. They follow a structural time series approach to model the data generating process of inflation in the euro area and the U.S. using quarterly data from 1970 to 2003 and display that if these components are taken into account, intrinsic inflation persistence is found to be lower than the persistence of a random walk.

Todd E. Clark (2003), and Stephen Cecchetti and Guy Debelle (2004) suggest that the use of disaggregate price series can strengthen the diagnosis of overall inflation persistence. Peter Lunnemann and Tia Matha (2004) using disaggregate price indices from the Harmonized Index of Consumer Prices (HICP), study the degree of inflation persistence in the EU15, the euro area and its member states and show that most disaggregate inflation series such as, durables and services are characterized by a low to moderate degree of persistence. In addition, they find support for a positive aggregation effect, i.e. aggregate inflation exhibits a larger degree of inflation persistence than the weighted average of the disaggregate series, thus the aggregate inflation series, which is characterized by persistence close to that of a random walk process, is primarily contingent on the properties of its most persistent components.

George Hondroyiannis and Sofia Lazaretou (2004) study the inflation persistence in Greece spanning the period 1975 to 2003 and employ two empirical methodologies to estimate inflation persistence, namely a univariate autoregressive (AR) modelling and a second generation random coefficient modelling. They find that inflation persistence was high during the inflationary period and the first six years of the disinflationary period, while it started to decline after 1997, when inflationary expectations seem to have been stabilised, and thus, monetary policy was effective at reducing inflation.

Mladenović and Nojković (2012) find that the primary factors for detecting inflation persistence in a large number of Central and Southeastern countries are both the mechanics of real gross wages and a real broad measure of money supply, while Sek and Har (2012) provide empirical support to the evidence that the performance of inflation-targeting regime in three East-Asian economies is characterized by low levels of inflation persistence, thus, exemplified the importance of such a regime for those countries experienced high levels of both mean and volatility inflation persistence.

This paper contributes to the existing empirical literature of inflation persistence by providing results on the level of inflation persistence for the Greek economy using an inflation series on both the aggregated and the disaggregated level.

2. The Methodology of Testing for Inflation Persistence

In terms of the empirical analysis, the first part of this study makes use of measures of persistence that are based on univariate models of inflation. In this manner, the persistence results relate to the absorption of a shock. This type of analysis has the merit of providing valid results on persistence and constitutes a useful initial step in

the collection of information on the persistence of inflation series. Accordingly, we will make use of two different measures of inflation persistence on the basis of such univariate models, namely, the sum of the autoregressive coefficients and the half-life indicator. The measures of persistence are based on the following equation:

$$\pi_t = \mu_0 + \mu_1 D_t + \rho \pi_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta\pi_{t-i} + \varepsilon_t \quad (1)$$

where D_t allows for the presence of a structural break in the intercept to avoid spurious overestimation of the level of inflation persistence (Phillipe Perron 1989; Levin and Piger 2004). This break takes the form of a permanent shift; thus, assuming a break occurs at date T, then $D_t = 0$ for $t < T$ and 1 for $t \geq T$. In such a dynamic equation, a shift in the mean can be considered as a permanent shock to the inflation process. The above equation implies the swiftness of the movement to reach the new mean, following the presence of a break, is a function of ρ, which represents the degree of inflation persistence. This characteristic of the autoregressive process points a sluggish adjustment to permanent shifts in the monetary goal (Erceg and Levin 2003). It also yields that intercept breaks are considered as adequate tools to model temporary trending patterns observed in some inflation series, i.e. periods of deflation.

Therefore, the first measure of inflation persistence is the parameter ρ. This parameter also corresponds to the sum of the coefficients of the lagged dependent variables, when the equation is given in an autoregressive (AR) form. This parameter also captures important characteristics of the impulse response function. This function characterizes the pattern of absorption of shocks hitting the inflation process over time. In other words, the cumulative effect of a shock on inflation is given by $1 / (1-\rho)$. Therefore, the higher the value of ρ, the higher the cumulative impact of the shock on inflation. If the economy displays various different patterns of shocks dynamics, then the economy could absorb shocks more rapidly. In such a case, the measure of persistence is referred to the relative size of the overall effect of a shock on inflation, rather than providing information on the relative timing of shock absorption.

3. The Pattern of Greek Inflation

Figure 1 depicts three inflation series, i.e. CPI, GDP deflator and Core inflation, over the period 1981 through 2009, except for the definition of the core inflation where the sample spans the period 1989-2009. The figure presents the various phases of the Greek inflation experience for the period post of 1980. As it can be observed, the three inflation rates tend to move roughly in a parallel fashion. In addition, the inflation series experienced the following two distinct phases: prior and post the early 90s period.

In particular, in the 1990s, special attention was paid towards controlling the large fiscal deficit and lowering the high inflation rate as serious efforts to meet the criteria of the new European currency programme were made. In particular, spanning 1991-1994, a tight monetary policy, a tight fiscal policy and a slower devaluation of

the exchange rate were the key factors that helped Greece to exhibit for the first time after approximately 20 years single-digit inflation rates. At that point, experts believed that private-sector confidence in the government's anti-inflation policies had been boosted, making future reductions in the inflation rate very likely. This convergence programme for meeting the Maastricht criteria continued until 1998 when the drachma joined the European Exchange Rate Mechanism (ERM). Thereafter, inflation remained at very low levels until 2009.

4. Empirical Analysis

4.1 Data

The empirical analysis uses data on the Consumer Price Index (CPI) with 1995 as the base year (1995=100). Data spans the period 1981 to 2009. In addition, disaggregated (sectoral) data was also obtained for the CPI inflation measure. The index is Laspeyres chained. Data come from the Datastream database and are based on a quarterly basis. Finally, we employ the RATS 6.1 software to serve the goals of our empirical analysis.

4.2 Unit Root Testing (Identifying a Break)

Since Perron (1989), there has been widespread interest in allowing for structural breaks when carrying out unit root tests (Anindya Banerjee, Robin L. Lumsdaine, and Stock 1992; Eric Zivot and Donald W. K. Andrews 1992; Perron 1997). This complicates unit root testing because: (i) ignoring breaks greatly reduces the power of standard unit root tests, (ii) the break date may or may not been known *a priori* and "data mining" to choose the break date biases test results, and (iii) some unit root test procedures (Zivot and Andrews 1992) allow for a break only under the alternative hypothesis. That is, they test the null hypothesis of a unit root with no break against the alternative hypothesis of (mean or trend) stationarity with a break. This approach proves invalid for analysts who are interested in questions about the presence unit roots as well as structural breaks. Thus, it is natural to extend unit root tests to allow for breaks. This approach to unit root testing has the major advantage of allowing for a break(s) under both the null and the alternative hypotheses. Turning now to a case where the break date is unknown, we consider a unit root test criterion for identifying the unknown break date. This is the min-τ criterion proposed by Zivot and Andrews (1992). We investigate the one-break procedure here. The one-break min-τ LM unit root test statistics is denoted as follows:

$$\tau(\lambda_{AL}) = \inf_{\lambda \in \Lambda} \tau_{\alpha AL}(\lambda)) \tag{2}$$

where $\tau\alpha\ AL\ \tau$ is the t statistics on x_{t-1} in equation:

$$\Delta y = \mu + \alpha^{AL} x_{t-1} + d_1{}^{AL} D(DUM)_{\lambda T} + d_2{}^{AL}(DUM)_{\lambda T} + e_t{}^{AL} \tag{3}$$

where y is the price index, Δy denotes inflation rates, T is the total number of observations and λ is the portion of the sample before the break occurs. The dummy vari-

able DUMλT is zero for the first λT observations and one thereafter, while a "spike" dummy D (DUMλT) is also used to capture the effect of a level shift break under the null hypothesis of a unit root. The coefficient d1 determines the size of the level shift. The coefficient d2 determines the size of the spike dummy shift and Λ is the 15% trimmed sample. The min-τ criterion is used to estimate the break date, λAL.

Table 1 reports the results of the structural break analysis for the case of intercept showing the date of a significant break for Greece. The test estimates that most of the breaks occur around the period 1992-1993. In other words, an "EMU effect" or better a "Maastricht Treaty effect" seems to be in place. Thus, we reject the null hypothesis of the unit root for inflation, i.e. inflations are I(0) processes, at the 1% significance level. Although the dates vary accordingly to the definition of inflation, they point out that these breaks typically occur at the beginning of 90s and appear to correspond with the sign of the Maastricht Treaty in 1992. In other words, an EMU effect seems to play a substantial role here. Finally, the fact that a break point was identified will help us to avoid overestimation of the persistence parameter ρ in the event that such a break is present in the variables under investigation. In addition, the results deliver a clear finding of a change in inflation, which is mostly related to a major change in the conduct of monetary policy environment, a result supported by other studies for other economies (Stock and Watson 2007).

Next, we run a joint test for the presence of a break in all the parameters of the equation of persistence, conditional on the presence of a break in the intercept. In other words, this is an overall stability test. Thus, we perform a Chow test for the presence of a structural break in all of the AR coefficients, where the parameters are allowed to break at the same date as the intercept (as above). The reported results in Table 2 support the absence for any need to worry about any instability.

A common approach in the empirical literature (Nicoletta Batini and Edward Nelson 2001; Hondroyiannis and Lazaretou 2004; Levin and Piger 2004) for modeling inflation persistence is to estimate the univariate autoregressive (AR) model defined above. Let the persistence parameter $\rho=\sum_{i=1}^{p} a_i$ measuring the slugginess with which the inflation series responds to shocks. An AR(p) process can be written as $y_t(1-\alpha_1 L-a_2 L^2 \cdots - a_p L^p) = u_t$ and is stationary if all the p roots of the polynomial equation Φ(L)=0 are greater than one in absolute value and $\sum_{i=1}^{p} a_i < 1$. Therefore, inflation persistence can be measured as the sum of the estimated AR coefficients (Andrews and Young-Jae H. Chen 1994; Jeff Fuhrer and George Moore 1995; Pivetta and Reis 2004). Thus if $\sum_{i=1}^{p} a_i \approx 1$, then inflation persistence almost follows a random walk and the best way for the monetary authorities to herald the next inflation rate is to observe the current. Note that ρ=1, if the data-generating process has a unit root, whereas |ρ| < 1, if the data-generating process is stationary. To obtain an estimate of p, an AR lag order must be chosen for each inflation series. With a

maximum lag length of p=4 and based on the Akaike Information Criterion, we choose a particular lag order for each series that is reported in Table 3. The results are reported under both the absence of a break date and with the presence of a break date.

In order to determine the number of breaks in our sample, we also test for the case of multiple breaks using the test proposed by Jushan Bai and Perron (1998). We first look at the max FT (M, q) test to see if at least a structural break exists. In this study, the maximum number of breaks (*l*) is chosen to be 4. The estimated sup F(*l)* tests are:

GDP deflator: sup F(1)=39.87, sup F(2)=48.73, sup F(3)=57.65 and sup F(4) =65.68.
CPI = sup F(1)=44.15, sup F(2)=45.92, sup F(3)=52.38 and sup F(4)=62.81. (4)
Core = sup F(1)=46.14, sup F(2) =49.12, sup F(3)=49.98 and sup F(4)=53.44.

Only at the first lag the estimates are all significant at the 1% level*;* thus, the series appears to have one structural break. Based on the above statistics we can spot the break point between 1992 and 1993. For each inflation series for which a structural break in intercept was found to be statistically significant at the 5%, we perform a Chow test for the presence of a structural break in the persistence parameter at the same break date (Table 4).

The Chow test results show that the F values along with their corresponding p-values do exceed their critical values at the 1% significance level. These results imply that there is a structural change before and after the period of the Maastricht Treaty.

4.3 Half-Life Indicator Results

Due to the potential limitations of the parameter ρ, we also make use of the half-life indicator (HL). This indicator measures the number of periods during which a temporary shock displays more than half of its initial impact to the process of inflation. In this manner, this indicator is related to the impulse response function of the inflation process. This indicator implies that the test is based on whether the impulse response function is below 0.5 at a particular period after the shock. If this is the case, then we should continue decrementing this number of the period until we find the point at which the impulse response function is above 0.5. This indicator provides useful complementary information to the results provided by the ρ parameter. Thus, combining the two indicators we can reduce the risk of foregoing entirely all relevant information pertaining to the differences in the shape of the impulse response function. The results are reported in Table 5.

The results of Table 5 are very close to those reported above, indicating the low persistence. These results imply that the impact of a shock to the inflation process is already halved within the first quarter (when the value of the indicator is equal to one), indicating that inflation remained at low levels throughout the entire period under examination. Moreover, the half-live indicator confirms that persistence is low for the CPI measure.

4.4 Inflation Persistence without a Break

This part reports results for the persistence parameter ρ. These results are reported in Table 6. The results are reported for various inflation categories. In addition, this present study makes use of aggregated as well as disaggregated inflation time series. Clark (2003), and Cecchetti and Debelle (2004) argue that making use of sectoral inflation series strengthens the diagnosis of overall inflation. A study by Lunnemann and Matha (2004) also reach similar conclusions, however all of those studies do not include any break in their analysis. By contrast, this is a novelty in our work. Table 6 also reports the lag order used in each case based on the Akaike Information criterion.

The results in Table 6 suggest a moderate degree of inflation persistence in the majority of disaggregated indices. Durable goods tend to be relatively more persistence than other indices. Moreover, our results do not confirm the fact that aggregate inflation exhibits a higher degree of persistence than the disaggregated indices. The fact that price inflation is not necessarily more persistent at the aggregate level than at the disaggregated level is a feature that contrasts sharply with the conventional wisdom as well as with the evidence reported in Jean Boivin, Marc Giannoni, and Ilian Mihov (2007) for the United States. Moreover, the alignment between aggregate and disaggregated persistence contrasts also with the view of Filippo Altissimo, Benoit Mojon, and Paolo Zaffaroni (2007), who claim that persistence in aggregate inflation may reflect an aggregation bias due to the high degree of heterogeneity in the persistence of the disaggregated components of the price index.

Our results display that the support to the above fact is mixed, depending on the definition of the disaggregated index under investigation. With respect to the CPI index, 35 items out of 97 are falling within the range between 0.70 and 0.50, 35 items out of 97 are falling within the range between 0.49 and 0.40, while the remaining 27 items are falling within the range between 0.39 and 0.30. These empirical findings provide little evidence of a high degree of inflation persistence, but rather the majority of the disaggregated series are characterized by a low to moderate degree of persistence. Nevertheless, the estimated parameters vary substantially across disaggregated items. Moreover, the lowest persistence is shown in items related to food, vegetables, clothing and footwear since they are largely affected by either seasonality of harvesting or by the end of season sales. By contrast, items related to housing and equipments display a relatively high degree of persistence. Table 7 reports break dates at the sectoral level. The results point out that those dates are very similar to those reached above at the aggregate level. More specifically, sectoral level break dates appear to be impressively concentrated around the same break date.

Next, under the presence of a break, persistence was estimated before and after the Maastricht event. Table 8 reports the prior and post Maastricht persistent measures for the aggregate inflation indices.

The results in Table 8 denote that Greek inflation displays a small shift (upwards) in persistence prior and post the Maastricht Treaty event regarding all three alternative inflation definitions. Our results seem to be in line with those reached by Hondroyiannis and Lazaretou (2004) for the case of Greece as well as by Levin and Piger (2004), and Cogley and Argia Sbordone (2008) for the case of a sample of in-

dustrialized economies. They are also in line with those reached by Benati (2008) regarding the fact that inflation persistence depends closely on the effectiveness of a nominal anchor for monetary policy. Although the implementation of the monetary policy by a central monetary authority (the ECB) was expected to have lowered not only the mean of inflation but also its persistence, the results in Table 8 support that some other factors, i.e. fiscal or demographic, could have contributed to such an upward movement in the Greek inflation persistence (Zaffaroni 2004). They are, however, in contrast to those reached by Taylor (2000), Batini and Nelson (2001) and Sbordone (2002) for the cases of the U.S. and the U.K.

Next, this section investigates persistence estimates at sectoral level before and after the corresponding break dates. In the sectoral persistence results prior- and post the break data, reported in Table 9, the sector aggregates can be split into main categories: services and industrial goods in the first, and food and energy prices in the second. Inflation persistence measures included in the first category display higher values over the post break date period, while those included in the second category exhibit lower values over the same period. According to Baudry et al. (2004), these findings imply that the categories of disaggregated indices that display higher inflation persistent values are those sectors with the largest component that looks backward.

5. Conclusions

This study analysed the degree of inflation persistence in Greece through the CPI index and using classical methods to estimate univariate AR models of inflation over the period 1981-2009. Thanks to the use of highly disaggregated time series, the dynamics of Greek inflation could be clearly analyzed. In particular, the empirical findings revealed substantial homogeneity across sectors as well as across price indices. These results also suggested a very moderate degree of inflation persistence for both aggregate and disaggregate price indices. For the majority of alternative price indices the inflation persistence measures were estimated to be within the range of 0.50-0.70. In addition, we found support (at least for the majority of sectoral indices) for an aggregation effect in the sense of aggregate inflation exhibiting a greater degree of inflation persistence than the disaggregated series. In addition, our results pointed to the need to account for the presence of a structural break. The break was typically related to the "Maastricht effect"; and entailed a structural increase in the persistence measure, though the average level of inflation declined. The timing of this regime shift is highly suggestive of a link between monetary policy regimes and the persistence of inflation. Moreover, this could be a piece of evidence that although the monetary component of inflation in Greece was neutralized due to the implementation of the monetary policy by a central monetary authority (this new monetary regime could imply a relatively stable level of inflation in the long-run), other idiosyncratic characteristics of the Greek inflation, such as non-competitive forces in many sectors in the economy as well as public deficits, could have contributed to this persistent structure of the inflation series. Nevertheless, the omission of such a break could affect substantially the results, leading to invalid measurements of inflation persistence.

Finally, with regard to individual indices, the empirical results displayed that services and industrial goods were characterized by higher persistence measures than food and energy prices. These findings could insinuate that the categories of disaggregated indices that display higher inflation persistent values are those sectors with the largest component that looks backward.

A number of extensions could be envisaged. First, extending the framework of the empirical analysis to a multivariate analysis, which could enhance the robustness of our empirical findings, could control for a number of events. This would also enable us to analyze the extent to which shifts in monetary policy regimes could influence the dynamic behaviour of inflation. Finally, we could also apply these techniques to structural models of wage and price settings, thereby, enabling us to disentangle the extent to which estimates of inflation persistence can be confounded by occasional shifts in the monetary policy regime.

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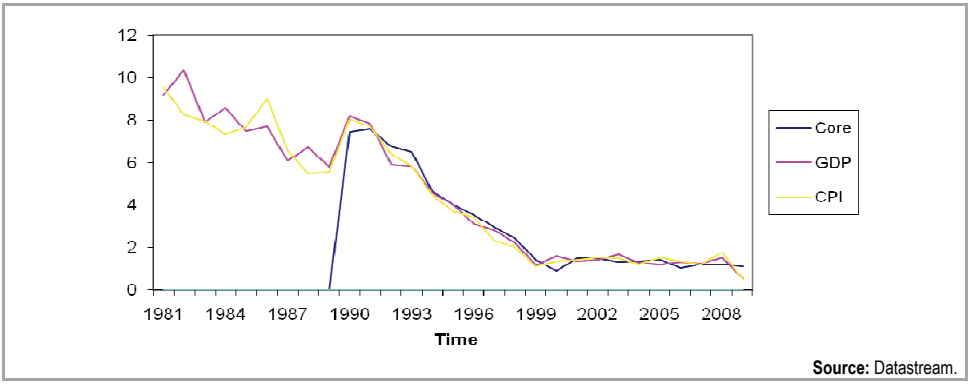
Appendix



Source: Datastream.

Figure 1 Inflation Rates: 1981-2009

Table 1 Structural Breaks in the Intercept

Inflation conclusion at 5%	τ-statistic	Break date
CPI inflation I (0)	-5.17	1993:2

Notes: Critical value of the τ statistic: -6.67.

Source: Own research findings.

Table 2 Structural Break in all AR Parameters Conditional on a Break in Intercept

Inflation	Date
CPI inflation	1993:2

Notes: Similar to Table 1.

Source: Own research findings.

Table 3 AIC Lag Order Selection

Inflation	Number of lags	
	Without break	With break
CPI	3	3

Notes: The heading "No break" indicates that no structural breaks were included in the model specification; that is AR lag order selection was performed using the entire sample. The heading "With break" refers to the lag order chosen using a model that allowed for structural change at the least squares estimate of the break date listed in Table 2.

Source: Own research findings.

Table 4 Testing the Stability of the Persistence Parameter (Conditional on a Structural Break in the Intercept)

	CPI Inflation
Chow test [p-value]	1993:2 F=4.95[0.00]

Notes: For each inflation series for which a structural break in intercept was identified at the 5% significance level, this table reports the F-statistic along with the p-value for the Wald test of the null hypothesis that the persistence parameter ρ does not exhibit a structural break for the intercept.

Source: Own research findings.

Table 5 Half-Life Results

CPI Inflation		
5	50	95
1	1	3

Notes: Results in the table report the number of periods in quarters during which an initial shock to the inflation process continues to display at least 0.5 of its initial impact.

Source: Own research findings.

Table 6 Estimates of the ρ Parameter (Without a Break)

Inflation measure	ρ estimates	Akaike determined lags
All items	0.56	3
Electricity	0.45	4
Electricity + gas + other fuels	0.48	2
Electricity + gas + solid fuels + heat energy	0.46	2
Energy	0.47	3
Energy + seasonal food	0.35	3
Energy + unprocessed food	0.36	4
Fresh food and vegetables	0.32	4
Fuels	0.58	3
Goods-food-non alcoholics	0.42	3
Services	0.35	4
Unprocessed food	0.39	4
Unprocessed food & energy	0.42	4
Accompany services	0.52	3
Actual rentals for housing	0.56	2
Alcoholic beverages	0.37	2
Alcoholic beverages + tobacco	0.38	3
Audio visual, photographic, info processing equipment	0.69	3
Beer	0.37	4
Books	0.35	4
Bread and cereals	0.38	3
Canteens	0.39	3
Carpets + other floor coverings	0.38	2
Catering services	0.44	2
Cleaning repair + hire of clothing	0.41	2
Clothing	0.46	3
Clothing and footwear	0.47	4
Clothing materials	0.45	4
Coffee, tea, cocoa	0.43	4
Combined passenger transport	0.58	3
Communications	0.40	4
Cultural services	0.67	4
Domestic + household services	0.39	2
Durables for recreation + musical instruments	0.62	3

Education	0.67	3
Education + health + social protection	0.52	3
Electrical appliances + products for personal care	0.62	3
Equipment for reception, recording of sound + pictures	0.59	3
Equipment for sport, camping + open air recreation	0.50	4
Food + non alcoholic beverages	0.37	4
Food + alcohol + tobacco	0.36	4
Footwear, including repair	0.47	4
Fruits	0.39	2
Fuel + lubricants for personal transportation equipment	0.65	3
Furnishing + household equipment + routine house maintenance	0.64	4
Furniture + furnishing + carpets + other floor coverings	0.62	3
Furniture + furnishing	0.53	3
Games, toys, hobbies	0.30	3
Gardens, plants, flowers	0.32	2
Garments	0.35	4
Gas	0.57	4
Glassware, tableware, household utensils	0.50	4
Goods, services for routine household maintenance	0.52	3
Goods – services	0.63	3
Hairdressing salons + personal grooming establishments	0.45	4
Health	0.48	4
Household appliances	0.64	3
Household appliances + electrical	0.63	3
Household textiles	0.31	3
Housing, water, electricity, gas, other fuels	0.42	2
Industrial goods	0.55	4
Information processing equipment	0.44	4
Insurance	0.49	3
Insurance connected with the dwelling	0.41	3
Insurance connected with the transportation	0.50	4
Jewelers, clocks, watches	0.45	4
Liquid fuels	0.48	4
Liquid fuels + lubricants for personal transportation equipment	0.67	3
Maintenance repair of personal + transportation equipment	0.58	2
Maintenance + repair of the dwelling	0.47	2
Materials for maintenance + repair of the dwelling	0.68	3
Meat	0.39	4
Medical products, appliances, equipment	0.68	4
Milk, cheese, eggs	0.40	4
Mineral water, soft drinks, fruits, vegetables juices	0.41	3
Miscellaneous printed materials, stationery + drawing materials	0.59	3
Miscellaneous goods and services	0.42	3
Motor cars	0.65	3
Motor cycles and bicycles	0.65	3
Newspapers and periodicals	0.39	2
Newspapers, books, stationery	0.38	3
Non alcoholic beverages	0.43	4
Non durable household goods	0.36	3
Non energy industrial goods	0.45	3
Non energy industrial goods (durables)	0.64	3
Non energy industrial goods (non durables)	0.45	3
Non energy industrial goods (semi durables)	0.43	4
Oil and fats	0.49	2
Operation of personal transport equipment	0.57	4
Other medical products, therapeutic appliances and equipment	0.58	3
Other articles of clothing and clothing accessories	0.41	3
Transport	0.59	3
Transport services	0.35	4
Unprocessed food	0.44	3

Vegetables	0.36	3
Water supply	0.46	3
Water supply + miscellaneous services related to the dwelling	0.47	4
Wine	0.40	2

Source: Own research findings.

Table 7 Estimated Break Dates: Sectoral Level

Inflation measure	Break date
Electricity	1993:2
Electricity + gas + other fuels	1993:2
Electricity + gas + solid fuels + heat energy	1993:2
Energy	1993:3
Energy + seasonal food	1993:2
Energy + unprocessed food	1993:2
Fresh food and vegetables	1993:1
Fuels	1993:3
Goods-food-non alcoholics	1993:3
Services	1993:2
Unprocessed food	1993:2
Unprocessed food & energy	1993:2
Accompany services	1993:3
Actual rentals for housing	1993:1
Alcoholic beverages	1993:3
Alcoholic beverages + tobacco	1993:3
Audio visual, photographic, info processing equipment	1993:2
Beer	1993:2
Books	1993:2
Bread and cereals	1993:3
Canteens	1993:3
Carpets + other floor coverings	1993:2
Catering services	1993:2
Cleaning repair + hire of clothing	1992:4
Clothing	1992:4
Clothing and footwear	1992:4
Clothing materials	1992:4
Coffee, tea, cocoa	1993:3
Combined passenger transport	1993:3
Communications	1993:2
Cultural services	1993:2
Domestic + household services	1993:2
Durables for recreation + musical instruments	1993:3
Education	1993:3
Education + health + social protection	1993:3
Electrical appliances + products for personal care	1993:2
Equipment for reception, recording of sound + pictures	1993:3
Equipment for sport, camping + open air recreation	1993:3
Food + non alcoholic beverages	1993:3
Food + alcohol + tobacco	1993:3
Footwear, including repair	1993:2
Fruits	1993:3
Fuel + lubricants for personal transportation equipment	1993:2
Furnishing + household equipment + routine house maintenance	1993:3
Furniture + furnishing + carpets + other floor coverings	1993:1
Furniture + furnishing	1993:1
Games, toys, hobbies	1992:3
Gardens, plants, flowers	1993:1
Garments	1993:1
Gas	1993:3

Glassware, tableware, household utensils	1993:2
Goods, services for routine household maintenance	1993:3
Goods – services	1993:3
Hairdressing salons + personal grooming establishments	1993:1
Health	1993:2
Household appliances	1993:3
Household appliances + electrical	1993:3
Household textiles	1993:3
Housing, water, electricity, gas, other fuels	1993:3
Industrial goods	1993:3
Information processing equipment	1993:3
Insurance	1993:2
Insurance connected with the dwelling	1993:2
Insurance connected with the transportation	1993:2
Jewelers, clocks, watches	1993:1
Liquid fuels	1993:3
Liquid fuels + lubricants for personal transportation equipment	1993:3
Maintenance repair of personal + transportation equipment	1993:3
Maintenance + repair of the dwelling	1993:2
Materials for maintenance + repair of the dwelling	1993:3
Meat	1993:2
Medical products, appliances, equipment	1993:3
Milk, cheese, eggs	1993:2
Mineral water, soft drinks, fruits, vegetables juices	1993:2
Miscellaneous printed materials, stationery + drawing materials	1993:1
Miscellaneous goods and services	1993:3
Motor cars	1993:3
Motor cycles and bicycles	1993:3
Newspapers and periodicals	1993:1
Newspapers, books, stationery	1993:1
Non alcoholic beverages	1993:2
Non durable household goods	1993:1
Non energy industrial goods	1992:4
Non energy industrial goods (durables)	1993:1
Non energy industrial goods (non durables)	1993:1
Non energy industrial goods (semi durables)	1993:2
Oil and fats	1993:3
Operation of personal transport equipment	1993:3
Other medical products, therapeutic appliances and equipment	1993:3
Other articles of clothing and clothing accessories	1993:2
Transport	1993:3
Transport services	1993:3
Unprocessed food	1993:2
Vegetables	1993:3
Water supply	1993:3
Water supply + miscellaneous services related to the dwelling	1993:3
Wine	1993:2

Source: Own research findings.

Table 8 Inflation Persistence Measures (With a Break in the Intercept)

CPI-break point, 1993:2	
Prior 1993:2	0.51
Post 1993:2	0.57

Source: Own research findings.

Table 9 Estimates of Inflation Persistence (With a Break in the Intercept): Sectoral Series

Inflation measure	Persistence measure	Break date
Electricity	0.49-0.53	1993:2
Electricity + gas + other fuels	0.48-0.53	1993:2
Electricity + gas + solid fuels + heat energy	0.50-0.55	1993:2
Energy	0.49-0.55	1993:3
Energy + seasonal food	0.51-0.56	1993:2
Energy + unprocessed food	0.51-0.57	1993:2
Fresh food and vegetables	0.49-0.54	1993:1
Fuels	0.52-0.56	1993:3
Goods-food-non alcoholics	0.50-0.62	1993:3
Services	0.53-0.64	1993:2
Unprocessed food	0.51-0.56	1993:2
Unprocessed food & energy	0.49-0.55	1993:2
Accompany services	0.52-0.68	1993:3
Actual rentals for housing	0.52-0.61	1993:1
Alcoholic beverages	0.54-0.59	1993:3
Alcoholic beverages + tobacco	0.53-0.60	1993:3
Audio visual, photographic, info processing equipment	0.50-0.67	1993:2
Beer	0.51-0.56	1993:2
Books	0.48-0.65	1993:2
Bread and cereals	0.51-0.55	1993:3
Canteens	0.50-0.56	1993:3
Carpets + other floor coverings	0.53-0.61	1993:2
Catering services	0.50-0.65	1993:2
Cleaning repair + hire of clothing	0.52-0.61	1992:4
Clothing	0.50-0.62	1992:4
Clothing and footwear	0.52-0.63	1992:4
Clothing materials	0.48-0.62	1992:4
Coffee, tea, cocoa	0.51-0.56	1993:3
Combined passenger transport	0.53-0.63	1993:3
Communications	0.50-0.64	1993:2
Cultural services	0.53-0.66	1993:2
Domestic + household services	0.50-0.62	1993:2
Durables for recreation + musical instruments	0.53-0.62	1993:3
Education	0.52-0.65	1993:3
Education + health + social protection	0.53-0.64	1993:3
Electrical appliances + products for personal care	0.53-0.67	1993:2
Equipment for reception, recording of sound + pictures	0.52-0.65	1993:3
Equipment for sport, camping + open air recreation	0.50-0.64	1993:3
Food + non alcoholic beverages	0.52-0.55	1993:3
Food + alcohol + tobacco	0.54-0.56	1993:3
Footwear, including repair	0.52-0.58	1993:2
Fruits	0.52-0.57	1993:3
Fuel + lubricants for personal transportation equipment	0.54-0.58	1993:2
Furnishing + household equipment +routine house maintenance	0.52-0.61	1993:3
Furniture + furnishing + carpets + other floor coverings	0.50-0.62	1993:1
Furniture + furnishing	0.52-0.63	1993:1
Games, toys, hobbies	0.54-0.62	1992:3
Gardens, plants, flowers	0.54-0.65	1993:1
Garments	0.53-0.65	1993:1
Gas	0.52-0.58	1993:3
Glassware, tableware, household utensils	0.52-0.61	1993:2
Goods, services for routine household maintenance	0.52-0.62	1993:3
Goods – services	0.53-0.64	1993:3
Hairdressing salons + personal grooming establishments	0.55-0.64	1993:1
Health	0.49-0.67	1993:2
Household appliances	0.50-0.62	1993:3
Household appliances + electrical	0.51-0.61	1993:3

Household textiles	0.49-0.60	1993:3
Housing, water, electricity, gas, other fuels	0.50-0.64	1993:3
Industrial goods	0.54-0.66	1993:3
Information processing equipment	0.49-0.62	1993:3
Insurance	0.49-0.68	1993:2
Insurance connected with the dwelling	0.49-0.65	1993:2
Insurance connected with the transportation	0.50-0.66	1993:2
Jewelers, clocks, watches	0.55-0.62	1993:1
Liquid fuels	0.52-0.58	1993:3
Liquid fuels + lubricants for personal transportation equipment	0.47-0.55	1993:3
Maintenance repair of personal + transportation equipment	0.53-0.64	1993:3
Maintenance + repair of the dwelling	0.49-0.62	1993:2
Materials for maintenance + repair of the dwelling	0.50-0.63	1993:3
Meat	0.50-0.56	1993:2
Medical products, appliances, equipment	0.49-0.61	1993:3
Milk, cheese, eggs	0.50-0.56	1993:2
Mineral water, soft drinks, fruits, vegetables juices	0.51-0.58	1993:2
Miscellaneous printed materials, stationery + drawing materials	0.50-0.60	1993:1
Miscellaneous goods and services	0.52-0.61	1993:3
Motor cars	0.55-0.68	1993:3
Motor cycles and bicycles	0.52-0.67	1993:3
Newspapers and periodicals	0.49-0.63	1993:1
Newspapers, books, stationery	0.50-0.58	1993:1
Non alcoholic beverages	0.53-0.57	1993:2
Non durable household goods	0.51-0.59	1993:1
Non energy industrial goods	0.55-0.66	1992:4
Non energy industrial goods (durables)	0.54-0.65	1993:1
Non energy industrial goods (non durables)	0.52-0.67	1993:1
Non energy industrial goods (semi durables)	0.53-0.67	1993:2
Oil and fats	0.48-0.69	1993:3
Operation of personal transport equipment	0.49-0.64	1993:3
Other medical products, therapeutic appliances and equipment	0.49-0.63	1993:3
Other articles of clothing and clothing accessories	0.51-0.60	1993:2
Transport	0.50-0.65	1993:3
Transport services	0.51-0.66	1993:3
Unprocessed food	0.48-0.59	1993:2
Vegetables	0.52-0.58	1993:3
Water supply	0.51-0.58	1993:3
Water supply + miscellaneous services related to the dwelling	0.50-0.57	1993:3
Wine	0.50-0.56	1993:2

Notes: Figures before the – denote persistence measures prior to the break date, while those after the – denote persistence measures post the break date.

Source: Own research findings.

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