Central Bank Independence,
Exchange Rate Policy
and Inflation Persistence

Empirical Evidence
on Selected EMU Countries

by

Athanasios P. Papadopoulos

University of Crete, Department of Economics (Greece)

and

Moïse G. Sidiropoulos

Université Louis Pasteur and BETA-Theme - Strasbourg (France)

Abstract: The purpose of this paper is to provide theoretical arguments and explore for empirical evidence for the rationale that low inflation persistence may be achieved either by setting up an independent Central Bank or by an exchange-rate based policy. Our theoretical analysis states that the degree of Central Bank independence and exchange rate policy changes affect the inflation persistence. In addition, our empirical analysis, which concerns with selected EMU countries (France, Germany, Greece, Italy and Spain for the period 1980-1998) validates the argument. In this exercise the most likely date for the change in regime is detected by a procedure based upon the recent work of Perron (1997), where the null hypothesis of a unit root is set against the alternative of stationarity about a single broken trend line.

Key words : Exchange rate policy, Central Bank independence, inflation persistence, EMU

Jel Classification : E31, E42, E58, C22

Mailing address : Athanasios P. Papadopoulos, University of Crete,
Department of Economics, Rethymno, GR 741 00 GREECE
Tel +3083177418, Fax +3083177406, e-mail : appapa@econ.soc.uoc.gr

Moïse G. Sidiropoulos, Université Louis Pasteur, BETA
61, Avenue de la Forêt Noire – 67000 Strasbourg Cedex – FRANCE
Fax +33 90 4140 64, e-mail : sidiro@cournot.u-strasbg.fr

1. Introduction

It has been well established that the effectiveness of disinflation programmes depends crucially on the role of credibility factors. If the announced policies lack of credibility, private agents would eventually recognize that the publicised disinflation programme would not be sustainable in the long run. On the contrary, if agents are confident in the ability of the authorities to carry out a newly announced disinflation programme, changing inflationary expectations will reduce downward rigidities that characterize the inflationary process and therefore a reduction in the actual inflation may result.

The recent literature on the credibility of a disinflationary policy and the recent experience of stabilisation programs in the European countries, indicate that disinflation may be achieved either by setting up a Central Banks which is independent from the government influence on monetary financing budget deficits, or by an exchange-rate policy based on a hard peg with respect to a low inflation currency in order to import credibility.

The independent Central Bank proposition may be explained by two arguments. The first relies on the employment motivation for monetary expansion based upon the assumption that political forces in democratic societies may tempted to trade price stability for temporary decreases in unemployment. The second argument is revenue motivation for monetary expansion. This argument relies on the risk of the government exploiting the Central Bank's capacity to create seigniorage to finance expenditure that the government is unwilling to finance out of current or future taxation.

Grilli, Masciandaro and Tabellini (1991) compare the monetary regimes of eighteen industrial countries during the post-war period by focusing on political and economic independence of the Central Bank. According to their proposition the Political independence is defined as the capacity of the monetary authority to choose the final goals of monetary policy, such as inflation or the unemployment. On the other hand the Economic independence is identified with the nature of the monetary instruments under the control of the Central Bank and with the influence of the government in borrowing from the Central Bank.

The latter aspect seems particularly relevant for some European countries where monetary financing of budget deficits was common practice[1]. Thus the domestic monetary regime matters for the average inflation rate. Countries with a low degree of Central Bank independence experienced disinflation programs based on the exchange rate hard pegging

[1] Grilli, Masciandaro and Tabellini (1991) find empirical evidence (using cross section data over the period 1950-1989) that Greece, Italy, Portugal and Spain were associated with very little economic independence whilst the central banks of Austria, Switzerland, the U.S and West Germany indeed had high economic independence.

vis-à-vis to a strong currency in order to import credibility from a low inflation country with an independent Central Bank such Germany. In this context, disinflation is usually a fairly persistent process in the sense that if inflation becomes very high, it does not quickly revert to its earlier level. In this respect Alogoskoufis and Smith (1991) find empirical evidence that exchange-rate regimes matter for the persistence of inflation. They demonstrate that fixed exchange rate regimes appear to be associated with negligible persistence of inflation, while regimes of managed exchange rates are associated with very high inflation persistence. They propose that the higher inflation persistence is the result of the higher monetary and exchange rate accommodation of price changes in exchange rate regimes.

The purpose of this paper is to advance the theoretical arguments that low inflation persistence may be achieved either by setting up an independent Central Banks or by using an exchange rate policy pegging the currency to a low inflation currency and support them with empirical evidence. Our theoretical analysis on the inflation persistence is closely related to the Lucas critique, which states that policy regime changes affect the parameters of reduced-form models. On the other hand, our empirical analysis concerns a group of selected EMU countries (France, Germany, Italy, Spain and Greece) for the period 1980-1999. The procedure used in the past for testing the relevance of the Lucas critique and examine the timing of the change in the stochastic process driving inflation was the time-varying parameters procedure with the Kalman filter approach (see Agenor and Taylor, 1992). However, this approach ignores the time series properties of the variables in question. The approach used in this paper, although similar with the one applied by Burdekin and Siklos (1999), it endogenously determines the most likely date for the change in regime. It consists of testing for an unknown break point in a time series and it is based upon the recently advanced work by Perron (1997), which proposes series of tests where the null hypothesis of a unit root is set against the alternative of stationarity about a single broken trend line.

The rest of the paper is organized as follows. Section 2 sets up the theoretical framework. In section 3 we discuss how the degree of Central Bank independence and the exchange rate policy affect the inflation persistence. Section 4 presents the econometric methodology and the empirical results. Section 5 summarises the main conclusions of the paper.

2. The theoretical framework

In this section, a simple open economy macroeconomic model is presented in order to build up the theoretical propositions. The model consists of aggregate demand and aggregate supply equations where the role of government is introduced by the budget constraint and the actions of monetary authorities are shaped by exchange rate accommodation rules.

2.1.The model

The aggregate demand-aggregate supply model is characterised with overlapping wage contracts[2] and comprises five relationships, listed as equations (1) through (5) below:

$$y_t = a\,(m_t - p_t) + b\,q_t + d_t\,, \quad a, b > 0 \tag{1}$$

$$q_t = e_t + p_t^* - p_t \tag{2}$$

$$p_t = (1/2)(w_t + w_{t-1}) - q_t \tag{3}$$

$$w_t = (1/2)(p_t^c + E_t p_{t+1}^c) + (g/2)(y_t + E_t y_{t+1}) \tag{4}$$

$$p_t^c = p_t + (1-d)\,q_t\,, \qquad 0 < d < 1 \tag{5}$$

All variables, except interest rate, are in logarithms. The aggregate demand is given by equation (1), where y_t is the log of the real output, m_t is the log of the nominal money stock, p_t is the log of the domestic output price level, q_t is the log of the real exchange rate and d_t is the log of the real budget deficit. The real exchange rate defined in equation (2), where e_t is the log of the nominal exchange rate (units of domestic currency per unit of foreign currency) and p_t^* the log of the foreign price level.

Equations (3), (4) and (5) define the model's supply side. They take a similar form to that of the Taylor's (1980) staggered contract model. Equation (3) is a mark-up equation, where q_t is a productivity shock with zero mean and constant variance. Domestic output price level is a constant mark-up over weighted average contract nominal wages in the current and preceding periods. Equation (4) is the wage-contracting equation, where w_t is the log of nominal wages, p_t^c denotes the log of the consumption price level and E_t is the operator of rational expectations conditional on the information at period t. Under this specification, wage contracts are set for half the labour force each period and last two periods, and wage-setters aim to achieve a constant real wage for the duration of the contract. According to equation (4), cost-push (first term) and demand-pull inflationary factors (second term)

[2] The theoretical model presented in the text is similar to the model employed by Agénor and Taylor (1992) to determine the link between credibility and inflation persistence. An alternative theoretical framework is used by Alogoskoufis and Smith (1991) to study the link between inflation persistence and policy rules.

determine the wage setting. Finally, equation (5) defines the consumers' price level as a weighted average of domestic prices and foreign imported goods prices.

2.2. The financing of budget deficits

We introduce now the government budget constraint that links monetary and fiscal policy by getting the log-linear version of the government budget flow constraint as follows (see appendix A) :

$$d_t + p_t = (y / l)(b_t - b_{t-1}) + ((1-y)/l)(m_t - m_{t-1}) \qquad (6)$$

According to (6) given the price level, the authorities (the Central Bank and the government) have three policy variables: monetary policy, m_t, fiscal policy, d_t, and bond sales to the public, b_t. Given the price level and the bond sales to the public to be chosen independently, the two policy variables, m_t and d_t, are interdependent and the extent to which (6) binds m_t given d_t or vice versa, depends on the way monetary and fiscal policies are coordinated.

According to Sargent and Wallace (1981), we consider two alternative forms of monetary and fiscal coordination. On the one hand, monetary policy dominates fiscal policy. The Central Bank sets monetary policy by choosing m_t and therefore, determines the amount revenue it will supply the government through monetary seignorage. On the other hand, fiscal policy dominates monetary policy. The government sets its deficit d_t. Under this coordination scheme the Central Bank faces the constraints imposed by the private sector demand for government bonds, since it must finance with seignorage any discrepancy between the revenue demanded by government and the amount of bonds b_t that can be sold to the pubic. Thus, for a Central Bank to be able to control inflation permanently, the first coordination scheme is more powerful than the second coordination scheme. If the government's deficit cannot be financed solely by new private bond sales, then the Central Bank is forced towards monetary accommodation of the government budget deficit.

In this respect, taking into account that a fraction f of the nominal budget deficit is financed by private bond sales, and that the remaining $(1-f)$ is financed by money supply, we can write that the private bond sales are governed by [3]:

[3] We suppose that, in natural variables, private bond sales are governed by $\Delta B_t = f(P_t D_t)$ where $0 \le f \le 1$. By log linearizing this equation, we obtain equation (7). This specification is similar to this used by Schalling (1995).

$$b_t = b_{t-1} + f(l/y)(d_t + p_t), \qquad 0 \le f \le 1 \qquad (7)$$

Then, substituting (7) into (6), we can describe the extent to which the money supply accommodates changes in nominal budget deficits as follows:

$$m_t = m_{t-1} + (1-f)[l/(1-y)](d_t + p_t) \qquad (8)$$

where $(1-f)$ denotes the monetary accommodation coefficient. In other words, this coefficient may be interpreted as an institutional parameter reflecting the independence degree of the Central Bank. The greater the economic independence of the Central Bank, the lower the degree of monetary accommodation. It can be seen from equation (8) that if Central Bank is completely independent ($f = 1$) money growth is equal to zero and hence monetary policy completely dominates fiscal policy. On the other hand, if Central Bank is completely dependent ($f = 0$) money growth is completely determined by the nominal budget deficit and hence fiscal policy completely dominates monetary policy. Consequently, the fraction of the budget deficit that is financed by private bond sales, f, reflects the degree of monetary policy dominance, which reflects the concept of economic independence of Central Bank (Grilli, Masciandaro, Tabellini, 1991). Thus the greater f, the greater the economic independence of Central Bank.

2.3.The exchange rate policy

Finally, we assume that monetary authorities decide on the degree to which the exchange rate is adjusted to the inflation rate. We consider a simple equation relating to the degree of exchange rate accommodation:

$$e_t = m\ p_t, \qquad 0 \le m \le 1 \qquad (9)$$

where the accommodation coefficient m describes the extent to which the nominal exchange rate accommodates changes in price level. If authorities choose a flexible exchange rate regime, the degree of exchange rate accommodation will be between zero and unity. If they opt for a fixed exchange rate regime, the degree of exchange rate accommodation is equal to zero. The case $m = 0$ implies no accommodation, while $m = 1$ implies full accommodation. Finally, under rational expectations, agents are assumed to know the authorities' reaction function and consequently the values of the parameters f and m.

3. Central Bank independence and exchange rate policy

From the solution of the model for a closed form for expected inflation, we derive two relationships between the degree of Central Bank independence and the degree of exchange rate accommodation, on the one hand, and the persistence of inflation, on the other hand.

3.1. The closed form solution for inflation

Solving equations (1) through (5) for domestic price level and taking into account equations (8) and (9) , we obtain [4] :

$$p_t = (k/4)\left(p_t + E_{t-1}p_t + p_{t-1} + E_t p_{t+1} \right) + h_t - q_t \qquad (10)$$

where $k \equiv d + m(1-d+gb) + agl\left[(1-f)/(1-y)\right] - g(a+b)$,

and $h_t \equiv (g/4)\left[(s(1-y) + a(1-f))/(1-y)\right]\left(d_t + d_{t-1} + E_{t-1}d_t + E_t d_{t+1}\right)$.

Taking rational expectations of the expression (10) conditional on all available information at period $t-1$ for t, we obtain the following second-order difference equation :

$$k\,E_{t-1}p_{t+1} - (4-2k)\,E_{t-1}p_t + kp_{t-1} = -4E_{t-1}(h_t - q_t) \qquad (11)$$

Equation (11) can be rewritten as follows:

$$\left(F^2 - (r_1 + r_2)F + r_1 r_2\right)LE_{t-1}p_t = -(4/k)E_{t-1}(h_t - q_t) \qquad (12)$$

with $r_1 + r_2 = (4-2k)/k$ and $r_1 r_2 = 1$

where F is the forward operator, L is the lag operator, and r_1 and r_2 are the roots of the difference equation (11). From the definition of k and taking into account the parameter restrictions of the model, we can show that for reasonable parameter values k lies in the interval (0,1). With $0 < k < 1$, we have $4 > 2k$ and thus, $r_1 + r_2 > 0$. This imply that both roots are real, distinct and positive and they are on either side of unity: $0 < r_1 < 1 < r_2$ [5] . Adopting the bubble-free solution in the manner outlined by McCallum (1983), we take the

---

[4] To simplify, the foreign price level p_t^* and the money stock m_{t-1} are normalized to zero in logs.

[5] It is presumed that r_1 is the stable root and that r_2 is the unstable or « suppressing » root.

"minimal state variable" solution for r, given by $r_1 = [(2-k)/k] - (2/k)(1-k)^{1/2}$. Consequently, a saddle path solution results. Taking the first differences of equation (11) and solving forward yields the following closed form solution for expected inflation:

$$E_{t-1}\Delta p_t = r_1 \Delta p_{t-1} + 4(r_2 k)^{-1} \sum_{i=0}^{\infty} r_2^{-i} E_{t-1}(\Delta h_{t+i} - \Delta q_{t+i}) \tag{13}$$

Furthermore, assuming that government's budget deficit shocks affecting aggregate demand, d_t, and productivity, q_t, are simple random walks (v_t and u_t denoting white-noise shocks) :

$$d_t = d_{t-1} + v_t \quad , \quad v_t \sim N(0, s_v^2)$$
$$q_t = q_{t-1} + u_t \quad , \quad u_t \sim N(0, s_u^2),$$

the expected inflation in equation (13) is given by :

$$E_{t-1}\Delta p_t = r_1 \Delta p_{t-1} \tag{14}$$

Finally, a closed-form solution for inflation may be derived from (10) and (11), as follows :

$$\Delta p_t = r_1 \Delta p_{t-1} + e_t , \qquad \text{with} \qquad E_{t-1} e_t = 0 \tag{15}$$

According to equation (15), inflation follows an AR(1) process with an autoregressive parameter r_1 denoting the degree of inflation persistence and which depends on the degree of monetary and exchange rate accommodation.

3.2. Monetary and exchange rate accommodation

To check now the effects of the degree of monetary accommodation, $1-f$, and the degree of exchange rate accommodation, m, on the inflation persistence r_1, we state the characteristic equation of equation (12) as follows:

$$z^2 + bz + c = 0 , \quad \text{with} \quad b = -(r_1 + r_2) < 0 \ , \quad c = r_1 r_2 = 1 \tag{16}$$

where the root r_1 can be rewritten as :

$$r_1 = -(1/2)b - (1/2)\sqrt{b^2 - 4c} \quad \text{whith} \quad b^2 > 4c \tag{17}$$

By using the definitions of parameters k, b and c, we can show that the inflation persistence depends on the degree of Central Bank's economic independence, f, and the degree of exchange rate accommodation, m. Using equation (17), two propositions can be established.

Proposition 1: The greater the economic independence of the Central Bank (the higher f), the lower the persistence of inflation (the lower r_1).

Proof : Taking the first derivative of r_1 with respect to f, we can find :

$$\frac{\partial r_1}{\partial f} = \frac{\partial r_1}{\partial b} \cdot \frac{\partial b}{\partial f} < 0 \qquad (18)$$

where $\frac{\partial r_1}{\partial b} = -\frac{1}{2}\left[1 + b\left(b^2 - 4c\right)^{-1/2}\right] > 0$,

and $\frac{\partial b}{\partial f} = -\frac{4agl}{\left[d + (1-d+gb)m + agl\left((1-f)/(1-y)\right) - g(a+b)\right]^2} < 0$.

The explanation for this result is the following. On the one hand, an aggregate demand shock due to an exogenous increase in the real budget deficit raises the price level and thus increases the nominal budget deficit. According to equation (8), the higher nominal deficit raises the money supply, giving an additional inflationary impulse, which raises the nominal deficit even further, and causes additional monetary accommodation. Thus, inflation persists. On the other hand, the higher independence of central the bank f, the lower the degree of monetary accommodation $1-f$ of nominal budget deficits. According to the rational expectations, the rule for the money evolution (8) is known to the private agents and thus wage setters form their expectations of the price level taking into account (8). If the Central Bank gains more independence (f increases), wage setters realise that monetary policy becomes less accommodative to government budget deficits and thus expected inflation will be lower. Consequently, lower wages are reflected through the path of prices and the net outcome is lower inflation persistence.

Proposition 2: The lower the degree of exchange rate accommodation (the smaller m), the lower the persistence of inflation (the lower r_1).

Proof : Taking the first derivative of r_1 with respect to m, we can find :

$$\frac{\partial r_1}{\partial m} = \frac{\partial r_1}{\partial b} \cdot \frac{\partial b}{\partial m} > 0 \qquad (19)$$

where $\frac{\partial r_1}{\partial b} = -\frac{1}{2}\left[1 + b\left(b^2 - 4c\right)^{-1/2}\right] > 0$,

and $\frac{\partial b}{\partial m} = \frac{\left(1 - d + gb\right)}{\left[d + \left(1 - d + gb\right)m + agl\left((1-f)/(1-y)\right) - g\left(a + b\right)\right]^2} > 0$

According to (19), a sufficient condition for having a positive relation between the degree of exchange rate accommodation and the inflation persistence is to assume that: $1 - d + gb > 0$. The explanation for this result is the following. An increase in the degree of exchange rate accommodation causes a rise in the persistence of inflation via the real exchange rate channel (b), via the wage cost channel (g), but a decrease via the lower openness degree of the economy (high values of parameter d). This condition implies a high degree of openness of the economy realised by lower values of the parameter d . The parameter restrictions in the model (i.e. $0 < d < 1$) imply that the relation between the degree of exchange rate accommodation and the inflation persistence is unambiguously positive.

4. Econometric methodology and empirical results

4.1. Methodology

The reduced form equation (15) provides the theoretical framework for testing inflation persistence and its reformulated as follows:

$$\Delta p_t = r_0 + r_1 \Delta p_{t-1} + e_t \qquad (15.a)$$

where p_t is the log of the consumer price index , Δ indicates first difference and e_t is the error term. The testing hypothesis involves that change in inflation persistence affects significantly the coefficient on lagged inflation in the equation 15.a. We also allow for shifts on the constant term to capture the effect on the mean inflation rate. The dates of the shifts in the coefficients indicate the change in the policy regime. To prevent ourselves from possible subjective break date specification, we adopt a framework, which detects multiple coefficients shifts determined by the data. This framework is based upon earlier work carried out by Perron (1989), Perron and Vogelsang (1992) and Zivot and Andrews (1992) and has recently advanced by Perron (1997). According to this framework, the null hypothesis of a unit root is set against the stationarity about a single broken line for alternative equation specifications. Details on model specifications are found in Perron (1989,1997) and for the exposition of our results we will briefly refer on them. The first model is called “innovational outlier model 1” and it has the form of equation (16)

$$y_t = m + qDU_t + bt + dD(T_b)_t + a\, y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \qquad (16)$$

where m is a constant, a measures the inflation persistence, t is a time trend the dummy DU captures the effect on inflation when the break occurs (the innovation term) and the dummy $D(T_b)$ captures shifts in inflation persistence. The term $\sum_{i=1}^{k} c_i \Delta y_{t-i}$ corresponds to the number of additional lagged regressors of the first differenced depended variable included to remove serial correlation. The unit root test is performed using the t-statistic for testing $a = 1$ in the above equation. This model allows only a change in the intercept under both the null and alternative hypothesis.

The second model is called “innovational outlier model 2” and it has the form of equation :

$$y_t = m + qDU_t + bt + gDT_t + dD(T_b)_t + a\, y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \qquad (17)$$

where the dummy D(T) captures the change in slope. The unit root test is performed using the t-statistic for testing $a = 1$ in the above equation. This model allows changes in the intercept and the slope under both the null and alternative hypothesis.

Finally, the third model allows for the changes in slope but both segments of the trend function are joined at the time break. This is called the “additive outlier model” described by the following equations:

$$y_t = m + bt + g\, DT_t^* + \tilde{y}_t \qquad (18a)$$

and

$$\tilde{y}_t = a\, \tilde{y}_{t-1} + \sum_{i=1}^{k} c_i \Delta \tilde{y}_{t-i} + e_t \qquad (18b)$$

The Unit Root test $a = 1$ is performed on 18b using the t-statistic. In all equations, T_b and k are treated as unknown. The methods on choosing the proper break dates and k are described in Perron (1997).

We employ the procedure written by Colletaz and Serranito (1998) for Rats as developed by Doan (1997), to identify T_b and k. Monthly data obtained from IMS CD-ROM, for selected EU countries (France, Germany, Greece, Italy, and Spain). The first sample period is chosen to cover the years 1980:1 until 1999:6 to capture the possible changing in the inflation persistence since the emergence of the EMS. The second sub period covers 1990:1-1999:6, to detect any effects on inflation persistence due to institutional changes relative to the degree of the independence of the Central Banks in the economies under examination.

4.2. The empirical results

The results for the respective models are reported in Table 1. In most of the cases, the null hypothesis for a unit root is accepted despite the identified breaks in the intercept. Similarly, in most of the cases, the breaks are significant and accompanied by significant shifts in the mean inflation rate. The persistence of inflation appears to be influenced in all countries but in Spain.

Table 1:
Perron (1997) Sequential Tests for Break Points in the Inflation Equations: Innovational outlier model 1 (Change in Intercept)

Estimated equation: $y_t = m + qDU_t + bt + dD(T_b)_t + a\, y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t$

Dependent variable	Sample	k	Persistence term (a)	Constant (m)	Innovation Term (q)	Change in Inflation Persistence (d)	Break Point	t_a^* (Unit root) term (a)
French Inflation	1980:01-1999:06	19	.93 (61.19)	.0071(3.80)**	-0.0032(-3.54)**	.0043(2.06)**	1984:09	-3.94
	1990:01-1999:06	16	.59 (5.95)	.0151(3.90)**	0.0329(3.17)**	-0.004(-2.07)**	1995:06	-4.03
German Inflation	1980:01-1999:06	19	.89 (34.31)	.0055(3.86)**	.0048(3.76)**	.0043(1.04)	1991:01	-4.46
	1990:01-1999:06	19	.67(11.21)	.017(5.4)**	.00	-.0154(-3.45)**	1991:08	-5.35**
Greek Inflation	1980:01-1999:06	17	.90(34.31)	.0203(3.49)**	- .0048(2.45)**	.015(2.18)**	1994:06	-3.67
	1990:01-1999:06	18	.44(3.44)	.113(4.16)**	-.0083(-3.77)**	.008(1.45)	1993:07	-4.40
Italian Inflation	1980:01-1999:06	14	.97(123.33)	.0038(2.41)**	-.0012(-1.64)	.0133(5.95)**	1982:07	-3.70
	1990:01-1999:06	17	.69(9.84)	.0236(4.42)**	.0050(3.83)**	-.0046(-1.96)**	1994:10	-4.49
Spanish Inflation	1980:01-1999:06	12	.91(31.56)	.0124(2.91)**	-.0036(-2.81)**	.005(1.19)	1984:02	-3.83
	1990:01-1999:06	19	.59(5.79)	.027(3.84)**	-.0037(-2.89)**	.004(1.47)	1996:11	-3.9

For the case of France, a significant change of the mean inflation and a shift in inflation persistence occur on 1984:09 when the estimation sample covers the periods 1980:01-1999:06. This break point occurs with a lag of 19 periods and seems to correlate quite well with the decision of French authorities to opt for a hard peg with respect to the Deutschmark in March 1983. The idea behind this decision was that these four countries hoped to avert an inflation-depreciation spiral by begging their currencies to a strong currency such as the Deutschmark. This "hard franc" exchange rate policy, implemented in France after the third devaluation of the socialist government in March 1983, focused in pegging the franc/mark exchange rate in order to import credibility from a low inflation country such as Germany. Although we observe a fall in the inflation rate when the break occurs, this is not followed by a similar fall of the inflation persistence, implying therefore that the economic agents have not perceived this policy as credible, at least for this period of time. In the second estimation period (1990:1-1999:6) the results reveal a break on 1995:06, which coincides with the announcements of major institutional changes concerning the role of the Central Bank as an independent monetary authority. These announcements appear to be credible and they are followed by a fall of the inflation persistence.

For the case of Germany, we find a break in inflation rate on 1991:01, which can be identified with the German unification. However, the policy followed since 1990:1 appears as credible by the private agents, since there is a fall in the inflation persistence, which is possibly owed to the role of the Bundesbank.

For the case of Italy, the break is identified on 1982:07 and nearly corresponds the third consequent change in parity of Italian lira within EMS. However, this policy of realignments has not been perceived as credible maintaining therefore the inflation persistence. The decision of monetary authorities at the end of 1994 to follow a stable exchange rate of lira *vis-à-vis* the Deutschmark in order to become a low inflation EMU member, coincides with our findings (breakpoint on 1994:10) and indicates that this decision has been accepted as credible.

Inflation data from Spain reveal a break on 1984:02 for the first estimation period (1980:1-1999:6) and a break on 1996:11 for the second estimation period (1990:1-1999:6). The first breakpoint is identified with a period when the monetary authorities are engaged to a stable currency policy, in order to stabilise inflation to prepare the Spanish peseta for entry in the ERM. The second breakpoint (1996:11 with a 19 periods lag) appears to correspond with the decision to grant the Bank of Spain autonomy in June 1994.

The statistical finding for Greece reveals a break on 1994:06 and a break on 1993:07 respectively. Although the second break nearly coincides with the formal announcement of the hard drachma policy by the government, this announcement has not been perceived as credible.

5. Conclusions

The purpose of this paper was to provide theoretical arguments and find empirical evidence that the low inflation persistence may be achieved either by setting an independent Central Bank or by using an exchange rate policy that pegs the home currency to a low inflation currency. The approach used to determine of the most likely date for the change in regime was based on Perron (1997) where the null hypothesis of a unit root is set against the alternative of stationarity about a single broken trend.

Among the suggested break points for the inflation equations of selected EMU countries, evidence shifts that occur in different time intervals after the commitment to fixed parities in Exchange Rate Mechanism of the EMS. This probably means that the EMS has not affect the inflation performance uniformly the countries under examination. We also find some evidence of additional breaks in the inflation equation that correspond to the institutional changes in the setting for monetary policy in France and Spain and the high degree of the independence of the Central Bank in Germany. The above empirical results confirm the theoretical intuition of the model where the exchange rate policy and the Central Bank Independence can affect the inflation persistence.

Appendix A : The government budget constraint

The government monetary versus bond financing constraint is written in terms of natural variables as follows :

$$\Delta F_t = P_t(G_t - T_t) + r_{t-1}B_{t-1} \quad \text{(A1)}$$

$$F_t = M_t + B_t \quad \text{(A2)}$$

Equations (A1) and (A2) assert that the primary nominal budget deficit, $P_t(G_t - T_t) \equiv P_t D_t$, plus the interest owing on outstanding government debt, $r_{t-1}B_{t-1}$, must be financed either by creating money, M_t, or selling bonds, B_t, to the private sector. F_t denotes the nominal financial wealth. Log-linearizing (A1) and (A2) around a steady state and simplifying by assuming $r_{t-1}B_{t-1}$ equal to zero, yields:

$$\Delta f_t = l(d_t + p_t) \quad \text{(A3)}$$

$$f_t = y b_t + (1-y)m_t, \quad 0 < y < 1 \quad \text{(A4)}$$

where lower-case letters refer to logarithmic deviations from steady values as follows : $f_t \equiv (F_t - F_0)/F_0$, $b_t \equiv (B_t - B_0)/B_0$, $d_t \equiv (D_t - D_0)/D_0$, $p_t \equiv (P_t - P_0)/P_0$ and $m_t \equiv (M_t - M_0)/M_0$. $l \equiv P_0 D_0 / F_0$ is the steady growth rate on the reference path and $y \equiv B_0 / F_0$ is the reference share of bonds in financial wealth. Upon substituting (A.4) in (A.3) and some rearrangement, we obtain the equation (6).

References

Agénor, Pierre-Richard, and Mark P. Taylor (1992), Testing for Credibility Effects, IMF Staff Papers, 39,545-571.

Alogoskoufis, George S., and Ron Smith (1991), The Phillips Curve, The Persistence of Inflation, and the Lucas Critique: Evidence from Exchange-RateRegimes, The American Economic Review, 81, 1254-1275.

Burdekin, Richard, and Pierre Siklos (1999), Exchange Rate regimes and shifts in Inflatio Persistence : Does Nothing Else Matter ? , Journal of Money, Credit, and Banking, Vol 31, No. 2, May, pp. 235-247.

Doan, T. A. (1997), RATS for Windows v.4.3, Estima

Grilli, V., Masciandaro, D., and Tabellini, G. (1991), Political and Monetary Institutions and public Financial Policies in the Industrial Countries, Economic Policy, Vol. 6, N° 13, pp.342-392.

Lucas, Jr., R. Å. (1976). `Econometric Policy Evaluation: Á Critique', in Brunner, Ê. and Meltzer Á. Ç. (eds.), *The Ñhillips Curve and Labor Markets*, North-Holland, Amsterdam.

McCallum, Bennett T. (1983), On Non-uniqueness in Rational Expectations Models: An Attempt at Perspective, Journal of Monetary Economics, 11,139-68.

Sargent, T., Wallace N. (1981), Some Unpleasant Monetarist Arithmetic, Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 5, 1-17.

Schalling, E. (1995), Institutions and Monetary Policy : Credibility, Flexibility and Central Bank Independence, Edgard Elgar, UK.

Perron, P. (1997) “Further evidence on breaking trend functions in macroeconomic variables” *Journal of Econometrics*, 80 pp 355-385.

Perron and Vogelsang (1992) “Nonstationarity and level shifts with an application to purchasing power parity”. *Journal of Business and Economic Statistics* 10, 301-320.

Taylor, John B. (1980), Aggregate Dynamics and Staggered Contracts, Journal of Political Economy, 88,1-23.

Zivot, E. and Andrews, D. W. K. (1992) “Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit Root Hypothesis”, *Journal of Business & Economic Statistics*, 10, 251-270.