THE CONDUCT OF MONETARY POLICY AND INFLATION TARGETING: THE CASE OF GREECE

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ABSTRACT

Inflation targeting serves as monetary policy framework in several countries where it has enhanced policy transparency and accountability. This paper considers its applicability to Greece along with the independence of the Central Bank of Greece free of any fiscal commitment. In addition, it considers the ability to forecast inflation reasonably well over policy-relevant time horizons.

INTRODUCTION

Although inflation targets have been the fashion of the 1990s, the idea that policy should explicitly target the price level has a long and respectable pedigree. Both Irving Fisher and Maynard Keynes advocated targeting a price index, and in the 1930s, following the earlier writings of Wicksell, Sweden adopted a price target and, thus avoiding the worst of the depression when the gold Standard collapsed. In 1990s, a number of countries have shown a resurgence of interest towards price stability targeting or inflation targeting, switched from monetary or output targeting. Inflation targets have generally been introduced either after a disappointing with monetary targeting or to provide a new nominal anchor when a country has been forced off fixed exchange rate and also, after a recent history of unacceptably high inflation. Among the countries that adopted inflation targeting are New Zealand (1990), Canada (1991), the United Kingdom (1992), Sweden (1993) and more recently, Spain (1994) and Greece(1998). The United Kingdom and Sweden adopted their inflation targets in the wake of sizable currency devaluations as they withdraw from the European exchange rate mechanism. Germany and Switzerland adopted IT as a response to the breakdown of the Bretton Woods system. Greece (1998) seems to fail on the same category as Spain, due to its commitment of attaining the goal of monetary union participation.

As a strategy for conducting monetary policy, inflation targeting (which is usually associated with a high degree of exchange rate flexibility) serves two purposes: a) an anchor or coordination device for those involved in financial markets and the price and wage setting process and b) a transparent guide to the national policy actions of the fiscal and monetary authorities, revealing their commitment, discipline and accountability for the achievement of price stability. The appealing features of inflation targeting, include greater ease in explaining policy objectives to the public, and, the avoidance of the velocity instability problem that can arise when policy relies heavily on a single intermediate target. On the other hand, potential serious problems, with inflation targeting, include the difficulty of making accurate inflation forecasts (due to sufficient information needed to produce a reliable forecast of inflation) and reduces accountability arising from the substantial lags between policy actions and inflation outcomes.

The inflation targeting can be represented as setting the authorities' inflation forecast as an intermediate target (Svensson, 1997) and then, the authorities set monetary policy instruments to bring their medium-term forecast for inflation to the target. (The central bank produces a forecast of the future path of inflation; the forecast is compared to the target inflation rate; the difference between the forecast

and the target determines the necessary adjustment of the monetary policy instrument)[i]. In practice, monetary policy should respond to any deviation between the inflation target and the inflation forecast at the policy horizon. Or, the alternative is to adjust short-term interest rates to keep inflation continuously on target,-which this would required larger adjustments of the interest rate to compensate for their limited short-run effectiveness. This is called forward-looking monetary policy which affects inflation not immediately but rather with a lag, which can be from 12 months to two or three years time span[ii]
This paper empirically examines the efficacy of inflation targeting in Greece. Firstly, with the use of some econometric tools, we examine whether there have been perceptible changes-structural brakes- in the inflation process since 1980. After carefully discern the variables that can be characterized as leading indicators of inflation, we proceed in formulating the Bayesian VAR in forecasting inflation.

The remainder of the paper proceeds as follows. Section II deals with Central Bank's independence, section III with Greek economic developments in 1980s and 1990s and test for any changes in inflation regimes. Section IV describes the data, leading indicators, the model its estimation and results respectively. Finally, section V contains the concluding remarks.

CENTRAL BANK INDEPENDENCE

The shift towards inflation targets has run parallel to the growing trend of Central bank independence and accountability. A fundamental requirement of an inflation targeting framework is that the central bank has the ability to pursue the inflation target without any political interference. The central bank must be able to set its instruments of monetary policy with a primary focus on the inflation target. It should not be required to finance the budget deficit, nor seek to attain low interest rates on public debt, nor attempt to maintain a particular nominal exchange rate. Finally, it should be no political pressure on the central bank to increase the rate of economic growth in a manner inconsistent with the achievement of the inflation target. Thus, it should be no pressure for the central bank to accommodate mainly fiscal policy slippages.

The case of Greece

In Greece, the government granted independence to the Bank of Greece (in line with Article 108 of the Maastricht criteria) as was set in the law 2548, dated in December 17 1997, with the primary goal of the BoG to maintain and secure price stability. At the same time, inflation targeting was introduced to enhance the credibility of monetary policy and consequently aid the disinflationary process towards meeting the criteria for the EMU participation. At that time, inflation was at around 4.9 percent.

Since April 1998, the BoG was no longer to pursue the objectives of the maintenance of the stability of the money aggregate (velocity was perceived as being too variable) and the exchange rate 'hard drachma' policy but was entrusted with the primary goal of price stability. In addition, the responsibilities of the BoG include the definition and implementation of monetary policy, while the exchange rate policy was delegated by the ministry of finance.[iii] The Monetary Policy Council which consists of 6 members and the governor presides is entrusted for setting the monetary policy. The tenure of the members varies with the governor's to be the longer, 6 years and the shorter to be 2 years, so there should be continuity over time.

The Central Bank's charter share elements reminiscent of those in countries that set their monetary policy according to an inflationary targeting framework. One thing that it varies is the definition of the inflation that it is tracked. Some countries target underline inflation, thus excluding volatile items like food and vegetables, energy, and in the case of England, mortgage payments while others target headline inflation. The BoG targets headline inflation and it closely monitors the underline inflation. In terms of the numerical target, the BoG set a 2% target at the end of 1999 in an effort to reduce inflation expectations, strengthen public confidence policy and meet the appropriate EMU criterion. Most Central Banks announce the monetary plan as well as the minutes of the monetary board meeting from their periodically public hearings. Also, in practice, the central banks of all countries that adopted inflation targeting use short-term interest rates as the main operating instrument and rely on well developed financial markets to transmit the effects of changes in the instrument to aggregate demand and inflation.

IDENTIFYING INFLATION REGIMES

This section investigates the Greek inflation environment since 1980 in an attempt to isolate distinct inflation regimes. A shift in the inflation regime is equated with a change in the time-series properties of the measured inflation rat. A number of statistical procedures used to detect discrete shifts in the inflation process.

The Greek inflation experience for the period of 1980 and after is illustrated in Figure 2. There are two distinct phases with high peaks during the period at hand. The first correspond to the period of 1985 to 1986 with inflation reaching as high as 25% in 1986 and the second in 1990.The first 'hyperinflation' period was the product of specific economic policies followed.

The extensively expansionary stance of macroeconomic policy pursued in the period 1981-1985 (i.e. expansionary monetary and exchange rate policies) resulted to public sector debt explosion to almost 76.5% in 1985, from 28.3% in 1979. This was attributed to structural facts as well as to political cycles (the peaks in deficit coincide with election held at that time)[iv]. As a result, the Bank of Greece was obliged to monetize the increasing public debt . In terms of the inflation rate, the persistence of inflation in high levels was partly a product of the automatic wage-price indexation regime. The automatic indexation adjustment was introduced in 1982 and wages were raised every four months on the basis of past and official projected inflation. Noteworthy in that period at hand, there were two election held in 1981 and 1985 which contributed to the increase of inflation.

In 1986 the first two-year stabilization program initiated aiming at bringing to a halt the fiscal imbalances, public debt and the inflationary trends. According to the stabilization program, a 15% devaluation of the exchange rate was deemed necessary in preserving the competitiveness of the economy. Also, it was agreed to modify the wage-price indexation policy, which from that point on would be adjusted according to forecasted inflation minus imported inflation. As can be seen from diagram 2, inflation was managed to decrease significantly for about 10 percentage points. But in 1988, the relaxation of the restrictive policies and the successive election that took place within a two year period (this period could be considered as a political instability period) increase the inflation rate to more than 20% annually.

The 1990 decade was characterized by the attempt to tackle all the macroeconomic imbalances in the context of the introduction of the new European currency program. The new adjustment programme 1991-1993 introduced in 1990 mainly called for a drastic tightening of the macroeconomic policy stance and the introduction of structural reform. A special emphasis was given on the persistence of inflation with the implementation of a slower devaluation of the exchange rate and the decreasing rate of monetizing public debt. Consumer price inflation fell to 13.5% in July 1992 but run-up again to 15.5% at the end of 1992 due to a sharp indirect tax increase in August 1992 which was aimed at bringing the Public Sector Borrowing Requirements (PSBR) to a downward path. At the end of 1992, the government presented the first Convergence Programme 1993-1998 (setting the goal of meeting the Maastricht criteria) with the main focus again of bringing PSBR down to 0.2% of GDP and inflation to 4% by end of 1998. Since 1993, the inflation rate has drifted significantly downwards from 15.1% to 4.3% in 1998.

PERSISTENCE OF INFLATION

Certainly the reduction of inflation in Greece represents a genuine achievement, and it was the result of forces that had already been put in place before the adoption of inflation targeting. But did the adoption of an inflation target in Greece was timely correct and in addition had an effect on inflation and on its interaction with real economic variables? In the following section we'll try to analyze the inflation process prior to the adoption of inflation target and to undertake a forecast exercise to examine the pattern of behavior between the inflation rate and the other variables.

In order to provide a more formal analysis of the inflation process over the last two decades, we examine the time-series properties of the inflation rate using an autoregressive model given by

where π_t is the inflation rate and e_t is a random error term with zero mean and variance σ^2 . In this model we incorporate the possibility of shifts in the inflation process by letting the mean (which is the sum of all

$$\pi_t = a_0 + \sum_{i=1}^{2} \beta_i \pi_{t-i} + e_t$$

autoregressive parameters and set equal to 1) and the variance vary over time at discrete intervals. The parameters are allowed to have different values in the superiods around the break point and some statistical procedures are used to detect any possible time variation of the parameters.

Is there a shift in the conditional mean of inflation?

We examine the possibility of discrete shifts in the mean inflation rate in the context of the AR(1) model. The recursive estimation procedure entails estimating the parameters using data up to period t and then forecasting inflation one period ahead. One then re-estimates the parameters using data up to period t+1 and again forecast one period ahead i.e. t+2. This recursive procedure results in a series of parameter estimates and residuals obtained using the entire sample period. The recursive estimates are useful for determining the timing of possible shifts in the parameters.

Based on casual observations it is difficult to pint point any changes in the mean of the inflation rate. As noted above, there were two distinct but brief phases with rising and persistent inflation. Also, one can test for shifts in the conditional mean of inflation by examining the cumulated sums of recursive residuals (CUSUM) obtained from the autoregressive model. This is illustrated in figure 3 where the cumulated sums of recursive residuals indicate that the conditional mean drifted upwards from the beginning of 1985 due to the devaluation of the drachma. Then subsequently drifted downwards shortly followed by another upward move. From 1991 and on, there was continuously a downward procedure which suggests that the steady-state inflation rate was stable throughout the 1990 decade. Overall, the steady-state inflation rate shifted gradually with an overall downward trend. Therefore, we can conclude that the mean of inflation appears to be fairly stable throughout the last two decades with the largest shift occurred in 1986, when the devaluation of the exchange rate took place.

Shifts in Inflation Dynamics

The time-series properties of the inflation rate can be summarized by its autocorellation and partial autocorrelation functions, which are depicted in figure 5. There are two sub-periods examined (1980:1-1985:3 and 1985:4-1998:4) based on the Chow brake point. The autocorrelations of the two sub-samples are different. In particular, the autocorrelations of the second sub-sample decline more gradually relative to the first, which indicates that innovations in inflation became more persistent. In addition, the innovations in inflation tended to persist beyond the two-year horizon. In the first sub-sample the autocorrelations are smaller in magnitude.

DATA, LEADING INDICATORS AND CAUSALITY RESULTS.

The following set of data transformations were carried out for the time series. All variables were seasonally adjusted and in logs except for the interest rate. The sample period is the same as before (1980:1-1998:4) and all variables have been first differenced to take care of stationarity considerations.[v] Given the emphasis on forecasting in the information variable approach, the need for identifying a set of indicators that contain information on future inflation is deemed more than essential. Therefore, a good way of going about this is to conduct various econometric tests to discover the variables that have predictive power over inflation. To test the predictive content of various economic variables for inflation, likelihood ratio tests were carried out for the null hypothesis that the indicator variable does not Granger-cause inflation. The variables selected are: Industrial production as a proxy of economic growth, w; hourly earned wages, pi; the wholesale price, ex; the exchange rate of drachma with respect to ECU, itb; the 12-month interest rate, m; money supply, gap; the actual output minus potential, im; import prices and π; inflation rate. As can been seen from table 2, all variables examined Granger-cause inflation (i.e. variables contain a high degree of information on inflation at different periods) except for the broad money supply.

VARIANCE DECOMPOSITION

The bi-variate variance decomposition and impulse response functions results reinforce the findings of the Granger-causality tests. Firstly, the impulse response functions (figure 6) reveal that the variables examined can influence the inflation rates. Secondly, table 3 summarizes the results of the variance decomposition. Analytically, the variance of changes in the wholesale price index explains a significant proportion of the variance in inflation rising from 35 percent to 40 percent at the beginning of the second year and 50 percent after 20 quarters. Changes in the exchange rate with ECU explain a significant proportion of the variance accounting for 25 percent in the first quarter and 32 percent at the end of the first year. Therefore, the past-through effect of changes in the exchange rate on inflation is relatively fast as shown by the large forecast variance of the first quarter. The changes in the prices of import goods are reasonably good predictors of inflation variance accounting for about 25%. Lastly, the output gap and wages although do not explaining much of the inflation variance in the first quarter gradually increase and explain more than 20% and 17% respectively at the end of first year.

Forecast

This section examines the efficiency of the variables examined in forecasting inflation under the inflation-targeting framework. Possible benefits of inflation targeting, by using out of sample predictions of a VAR to assess long-term forecasting accuracy and whether inflation behaved differently in the inflation targeting period than would have been predicted on the basis of its previous relationship with the other variables included in the system. One way to examine the relationship among the variables is to construct a general model. In such instances, a VAR model with 9 variables was fitted to the Greek data as follows.

$$X_t = D + \sum_{i=1}^{n} B_i X_{t-i} + e_{tr}$$

$$E[e(t)e(s)'] = \Sigma \quad if\ s = t$$

Here X_t ={y, w, pi, ex, is, m, gap, im, π}, where y; industrial production as a proxy for growth, w; hourly earned wages, pi; the wholesale price, ex; the exchange rate of drachma with respect to ECU/EURO, is; the 12-month interest rate, m; money supply, gap; the actual output minus potential, im; import prices and π; inflation rate. The D captures the deterministic component of X_t and is a linear function of an n x d matrix of parameters.

However, under this specification a potential problem of overparameterization can arise. In order to address this problem we use a variant VAR modeling approach, namely, the Bayesian method (BVAR) developed by Litterman and Sims which based on the mixing estimation methodology of Theil[vi]. This estimation framework uses more plausible set of assumptions about the time-series of the variables included and mainly has been used to improve long-term forecasting accuracy by estimating coefficients using both data and reasonable priors. It is based on the view that useful information about the future is likely to be spread across a wide spectrum of economic data. Therefore, the inclusion of more variables in our system, rather than narrowly focused on only few explanatory variables can increase the forecasting ability of our model. However, in order to do that we should specify the Bayesian priors or more well known as 'Minnesota Priors' that give appropriate weights on the information used. The prior information is introduced in the way of hyper-parameters that influence, in each equation, the degree of interaction with dependent variable's own lags as well as across different variables in general, rather than specific individual coefficients.

This framework is useful since a modeler can choose specific values for the priors by means of optimizing criterion to a particular sub-sample. Thus, one could tailor the model specification to incorporate the dynamic structure of the data, or economy, in the sense of a set of prior restrictions on coefficients.[vii] Consequently, by fixing the priors to the values determined at the earlier stage in subsequent estimations, one could preserve the dynamic structure of the baseline estimation period. This idea is implemented in the following way. First, an ordinary VAR was estimated using data from 1980Q1 to 93Q1. Second, a set of hyper-parameters representing 'priors' are determined so as to minimize the one-to four- quarter ahead out-of-sample forecast of the VAR model for 1991Q1-97Q1. The end product of step two is the BVAR version of (1). The prior distribution for the coefficients (bis) are specified as follows:

$$b_i \sim (N1, f(a, \beta, \gamma)), for\ i = 1 \quad and$$

$$b_i \sim N(0, f(a, \beta, \gamma)), \ for\ i > 1.$$

Here the subscript i denotes the lag length. This set of priors amounts to a random walk. The variance of the prior distribution for a coefficient is given as $f(.)$ which inversely reflects the degree to how certain the prior being imposed should be. That is, a small $f(.)$ suggests that the chosen prior is very tightly distributed around the mean value. A large value of $f(.)$ conversely suggests that the imposed prior has a large variance , hence a loose prior. The final estimation of coefficients is done by combining the prior and the actual data. Relatively speaking, the larger $f(.)$, the stronger the influence of actual data on determining the coefficients. The variance $f(.)$ is determined as a function of three parameters; a, β, γ. The three parameters each represents the overall tightness of the prior, how fast the influence of lagged values decay, and the degree of cross-variable dynamics[viii].

RESULTS

Once the hyper-parameter values are chosen, we generate out of sample forecasts starting with 1997:1 and ending in 1999:3. We measure forecast performance with the root-mean square error criterion and compute sequences of dynamic, out-of-sample forecasts over a one-through eight-quarter-ahead horizon. The results of forecasting are presented in table 4 with the mean error (ME), root mean square error (RMSE), and Theil statistics. Also, figure 5 depicts the forecast performance of the model. The Theil statistics, for the all steps of forecasting exhibit stability and accuracy of our model selection. An examination of the figure 7 shows that the model consistently predicts the actual inflation rate (captures quite well the movement of the inflation rate) but misses the second quarter of 1999 probably due to the 13% devaluation of the exchange rate that directly fed and impacted the inflation rate.

CONCLUSION

This paper presents a small-scale macroeconomic time series model that is useful for generating short to medium term forecasts for the Greek inflation rate under the newly adopted monetary framework of inflation targeting. After analyzing the inflation process prior to the inflation targeting period we specified a model-which is in the Bayesian VAR framework and included variables that were tested to be causal prior and contain information about inflation.

The out-of-sample dynamic forecast performance of the model is documented over the sample period starting on 1980 and extends through 1997:1. The BVAR specification which gives a solution to overidentification problem performs relatively well and consistently predicts the inflation rate.

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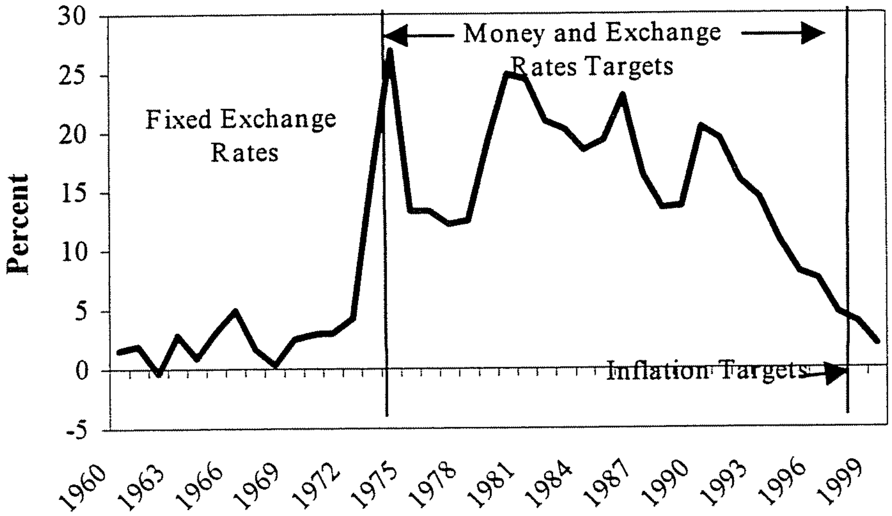
Figure 1: Annual Greek Inflation 1960-1999*



* Inflation is measured as the annual increase in the CPI index from 1960-1999, and 1999 figure is an estimation.

Figure 2: Greek Inflation Rate since 1980

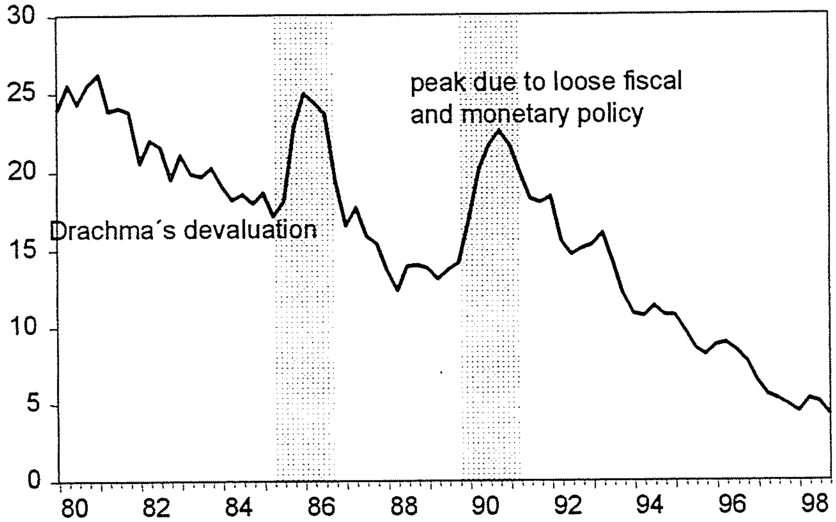


Figure 3: Cumulated sums of recursive residuals

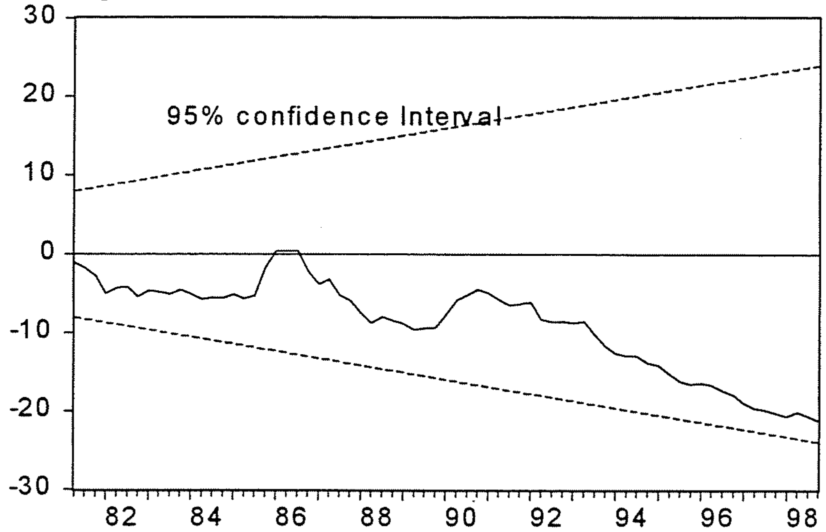
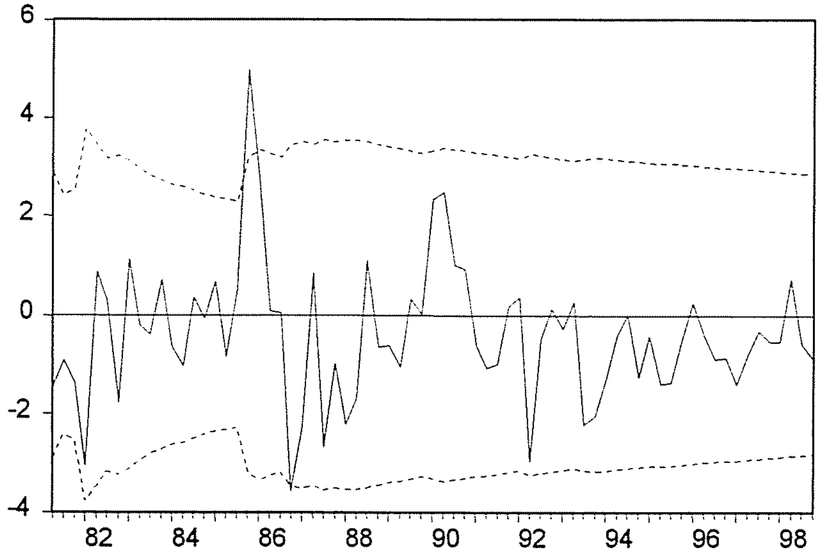
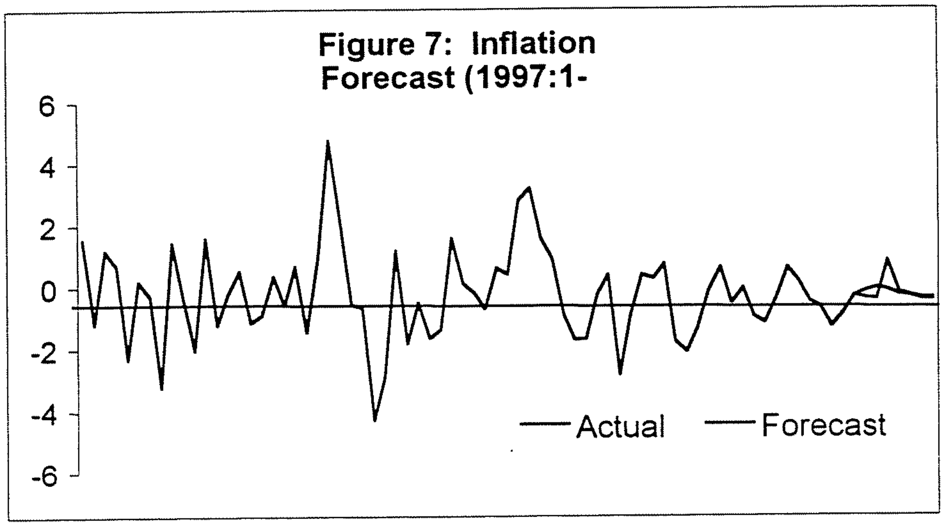


Figure 4: Recursive Residuals



(based on autoregressive model of quartely changes in the CPI)

Figure 5
Autocorrelation Functions



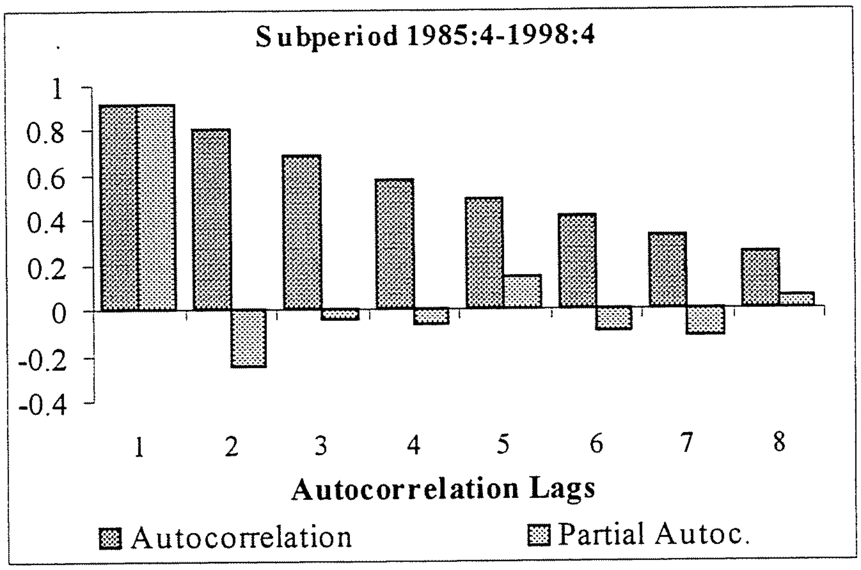


Table 1. **Summary of Inflation Targeting Frameworks**

Country	Greece	New Zealand	Canada	U.K.	Sweden	Finland	Spain
Date	Apr-98	Mar-90	Feb-91	Oct-92	Jan-93	Apr-93	Nov-94
Inflation measure	CPI	Underlying CPI	CPI	RPIX (ex. mortgage)	CPI	Underlying CPI	CPI
Target	2%	0-2%	1-3%	2 1/2% (+-1%	2% (+- 1%)	2%	2%
Time frame	End-1999	5 years	onwards			onwards	onwards
Inflation forecast published	No	Yes	No	Yes	No	No	No
Institutional Arrangement fo IT	Target set by the Bank of Greece	By Bank of N. Zealand and Minister of Finance	By the Minister of Finance and Bank of Canada	By the U.K. Treasury*	By the Bank of Sweden	By the Bank Of Finland	By the Bank Of Spain

Notes:
* In May 1997, the Chancellor of the Exchequer announced tha the Bank of England would be given operational independence to set interest ra order to achieve the inflation target. Inflation outside the target range would require the Government to write an open letter to the Chancellor to explain the reasons for the deviation.

Table 2: Leading Indicators of Inflation: Bivariate Granger-Causality Tests

Indicator	Number of Lags						
variables	1	2	3	4	5	6	7
Industrial	0.941	0.525	0.587	0.004	0.013	0.034	0.065
Import prices	0.001	0.078	0.004	0.348	0.314	0.347	0.521
Wages	0.083	0.909	0.001	0.003	0.003	0.004	0.017
Exchange rate(ECU)	0.015	0.072	0.169	0.043	0.044	0.134	0.279
Money	0.459	0.891	0.976	0.422	0.461	0.644	0.839
WPI	0.002	0.000	0.000	0.095	0.022	0.022	0.137
Output Gap	0.524	0.485	0.471	0.029	0.003	0.008	0.016
TB12	0.006	0.096	0.149	0.011	0.039	0.066	0.008

P-values are shown for the likelihood ratio tests of the null hypothesis that the indicator does not Granger-cause CPI. All variables are differenced in logs and the equations are estimated from 1980q1-1998q4.

Table 3: Forecast error Variance of Inflation explained by the Indicator Variable (in percent)

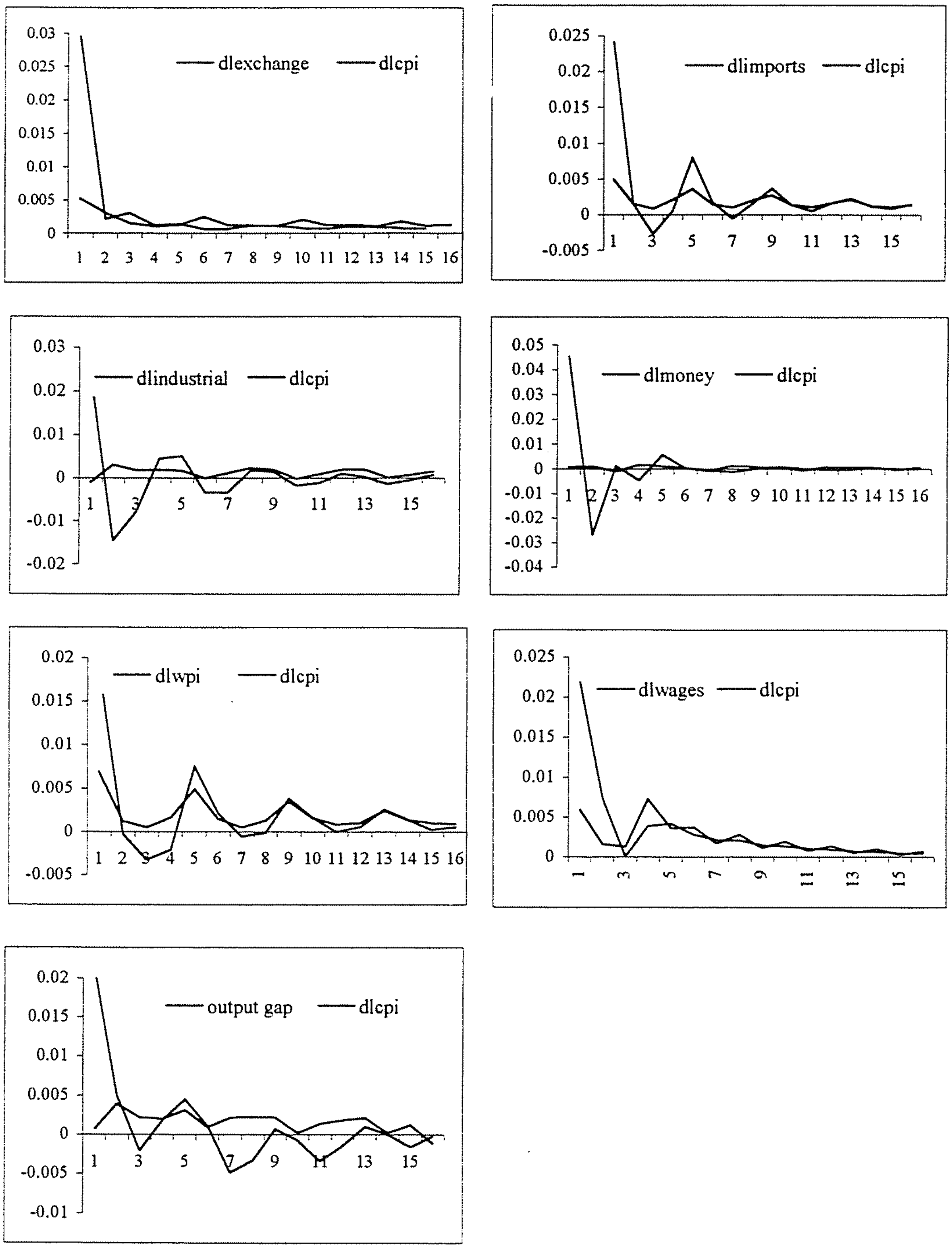
Indicator variables	Horizon (in quarters)							
	1	2	3	4	5	10	15	20
Industrial	0.901	0.66	0.9	0.884	0.943	1.76	2.4	2.57
Import prices	20.82	22.49	22.61	25.07	24.13	26.1	25.85	26.02
Wages	0.463	0.719	0.801	17.59	13.58	20.09	21.69	24.24
Exchange rate(ECU)	25.4	31.4	32.04	32.62	23.42	23.67	21.87	21.52
Money	0.289	0.218	0.442	0.493	0.488	0.692	0.844	0.884
WPI	35.04	34.47	34.25	33.49	40.28	45.75	48.56	50.33
Output Gap	0.66	14.44	18.1	20.72	19.14	21.15	20.84	20.89
TB12	0.024	7.54	17.34	21.57	15.75	20.9	21.71	22.21

Equations estimated as VARs with lags between 4-6 based on Schwarz criterion. The orthogonalization is the Choleski decomposition.

Table 4: Forecast statistics for Inflation

Step	Mean Error	MA Error	RMSE	THEIL U
1	0.2548	0.4797	0.5486	0.7243
2	0.0774	0.5844	0.6350	0.5608
3	-0.1906	0.6177	0.6806	0.5019
4	-0.3957	0.6198	0.6736	0.5012
5	-0.5664	0.7183	0.7886	0.7589
6	-0.4739	0.6208	0.7481	0.9840
7	-0.4090	0.6790	0.8055	1.1832
8	-0.2584	0.6490	0.7194	0.5986

Figure 6: Orthogonalized Impulse Responses of Inflation to one Standard Deviation Shock



End notes

[i] The two year horizon needed may also be regarded as a shorthand for a feedback rule in which the monetary policy responds to deviations of inflation from target. This is the so-called Taylor rule (Taylor, 1993) in which the authorities adjust interest rates from their "normal" real level in response both to deviations of inflation from target.

[ii] Recent studies by the Bank of England revealed that the interest rate change impacts inflation with a lag varying from 15 months to two years.

[iii] BoG is also responsible for the implementation process of the exchange rate policy.

[iv] General government spending increased significantly led by a dramatic rise in unemployment. In addition, Pension expenditures also increase leading to a deficit of the pension funds. On the same note Subsidies increased markedly.

[v] Unit root tests were performed on all variables.

[vi] Other than the problem of overfiting, the Bayesian VAR technique has another advantage over traditional approaches. Usually, structural models are often specified with many identifying assumption that reflect the model builder's personal views on how the economy works, but also excludes other reasonable views. The Bayesian approach, in contrast, allows an analyst to give non-zero weight to many different views of the economy-specifying a reduced form forecasting model.

[vii] The imposed restrictions may be referred as instrumental. The intuition is to capture more accurately uncertain a priori information.

[viii] The element β dictates the rate of decrease in the value of f(.) as the lag length increases. Additionally, the parameter i dictates the influence of (p_{t-2}, p_{t-3} ...y_{t-2}, y_{t-3}..)on p_t. Thus a rapid decay means a tighter prior on the lagged values of the variable. The parameter γ would determine how much the other variables (eg., y_{t-1}, y_{t-2}, y_{t-3}.....) could influence p_t. A larger γ allows more influence from other variables in the inflation equation. For example, a combination of rapid decay and a small γ would reduce the role of lagged values beyond the first lag, and at the same time, reduce the role of the other variables. Hence the combination pushes the model towards a univariate random walk specification.