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The European Unemployment Gap and the Role of Monetary Policy

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Abstract

This study will shed some light on the debate on the impact of monetary policy on the labour market in Europe. The Phillips curve implies that demand-induced changes in inflation tend to lag behind movements in the unemployment rate, which means that a comparison between the actual unemployment rate and the NAIRU may be helpful in forecasting future changes in inflation. By using an unobserved component model with a Kalman filter we estimate the NAIRU for three countries in the euro area. Moreover, using a Markov switching model we investigate whether European monetary policy is responsible for these unemployment gaps and whether the interest rate is transmitted asymmetrically across countries

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1 Introduction

The last two decades have witnessed the primacy of monetary policy as the main tool used by policymakers in the stabilisation of inflation and output. Concurrently, commentators and analysts pay close attention to changes in policy rates in the belief that such changes, particularly unexpected changes, can influence the real economy. Reflecting these issues, greater attention has been paid to the qualitative and quantitative impact of monetary policy changes on output and asset markets but, less attention has been paid to the impact of monetary policy and the unemployment gap. The impact of any monetary change on the labour market is of great importance if we think that the Phillips curve implies that demand-induced changes in inflation tend to lag behind movements in the unemployment rate. This implies that a comparison between the actual unemployment rate and the NAIRU may be helpful in forecasting future changes in inflation.

This study will shed some light on the more general debate on the impact of monetary policy on the labour market in Europe. There are various policy lessons to be learnt if a significant and stable relationship between monetary policy and the NAIRU is found. First, by letting short-term interest rates deviate from a certain equilibrium level, the central bank may have a significant impact on output and subsequently, on unemployment. Second, in principle the European Central Bank is able to manage the policy for all the EMU countries. The question, however, arises whether the ECB chooses its policy in a context of countries that face divergent NAIRUs. In this case, the ECB's monetary policy will have an asymmetric impact on unemployment.

There are multiple aspects in our paper's contribution to the existing literature on the real effects of monetary policy. One of the major problems associated with the NAIRU is its unobservable nature; in the literature various statistical and theoretical techniques have been employed (see e.g. Turner *et al.* (2001)), however there is a substantial disagreement on which is the best technique to employ to measure the unemployment gap. We differentiate from the previous literature in attempting to measure the NAIRU in three European countries using an unobserved component model. This statistical technique allows us to measure our unobserved variable without depending on any theoretical assumption or on any *a priori* imposed restriction.

After having derived the unemployment gap, we assess the possibility of a non-linear relationship between three large EMU's countries labour markets and ECB's monetary policy. The non-linearity is modelled using a Markov-switching (MS) regime autoregressive model. We intend to investigate the empirical performance of the univariate MS models used to describe the switches between different economic regimes for the three EUM countries' NAIRU and, furthermore, extending these models to verify if the inclusion of monetary policy shock as an exogenous variable improves the ability of each specification to identify. Moreover, we investigate if the shocks are both, symmetric or asymmetric throughout the three large EUM countries. Hence, we study asymmetries using an extension of the Markov switching model described by Hamilton (1989).

We measure the persistence of each economic regime, as well as the ability of each MS model to detect the impact of monetary policy on three countries' unemployment gaps. Our empirical findings can be summarized as follows. First, the null hypothesis of linearity against the alternative of a MS specification is always rejected by the data. Second, the introduction of the monetary shock specifications is never rejected. Finally, models with exogenous shocks variables generally outperform the corresponding univariate specifications which exclude shocks from the analysis.

In particular, asymmetries are supposed to exist where the estimated parameters of the alternative MS specifications are indicative of different regime-dependent responses of NAIRU. Most of the empirical studies which use an MS modelling approach focus almost exclusively on univariate models. Here we explicitly assess the dynamic impact of monetary policy changes on the movements of European NAIRU in the case of both an economic expansion and a recession. Furthermore we assess the impact of a change of risk-free interest rate on the unemployment gap.
The reminder of the paper is structured as follows. Section 2 briefly reviews the empirical literature on NAIRU, explains the methodology we use to measure the unemployment gap and presents the results obtained for the NAIRU in the three countries. Section 3 describes the MS framework and our model selection strategy and discusses the empirical findings obtained by using MS models. Section 4 concludes.

2. Measuring the unemployment gap

Following the standard economic analysis, the NAIRU is defined as the rate of unemployment consistent with a stable rate of inflation; which is, unemployment will tend to rise above its natural rate when inflation tends to fall. The well accepted theoretical consideration is, therefore, of a negative relationship between inflation and unemployment gap (i.e. downward sloping Phillips curve).
It is well known that the trade-off between inflation and unemployment is only temporary and cannot be systematically exploited by monetary policies aimed at permanently lowering the unemployment rate. However, the Phillips curve also implies that demand-induced changes in inflation tend to lag behind movements in the unemployment rate, which means that a comparison between the actual unemployment rate and the NAIRU may be helpful in forecasting future changes in inflation. If the NAIRU helps forecast future inflation, then it can be particularly important in an inflation targeting policy.
The great problem associated with the NAIRU is its unobservable nature. Labour market conditions, technological changes, demography, economic policy, are all factors that might have an impact on this variable.
Various econometric models have been employed in the literature to estimate the NAIRU. The two most common approaches are the "pure statistical method" and the "reduced form approach"[1]. The latter approach reflect the conventional wisdom of a stable inflation-unemployment trade-off; the dynamic model consist of an expectation-augmented Phillips curve, where changes in inflation are explained by the unemployment gap (i.e. the actual unemployment minus the estimated NAIRU) plus some other exogenous variables introduced to control for supply shocks. The unobservable NAIRU is then assumed to follow some preferred structure; finally the model is estimated recursively by maximum likelihood. What is striking among these studies is the dissimilarities of the estimates obtained; Laubach (2001) employs various specifications, and although his results show a general imprecision of the estimates, more importantly, he shows how the level of the unemployment gap does not significantly affect inflation. Opposite results are obtained by Turner *et al.* (2001) for several OECD countries, and Batini and Greenslade (2006) for the UK. Given the similarities of the model estimated it is easy to infer that either the dataset used or the model used to define the NAIRU is unable to consistently capture the joint process of inflation and unemployment. Similar criticism of the NAIRU estimates is made by Staiger *et al.* (2001); they test for

[1] See Turner *et al.* (2001) for a review of the literature.

various inflation measures and conclude that the NAIRU cannot be estimated with much precision.
One conclusion worth to note in Laubach's (2001, p.230) results is that when the NAIRU estimate using a bivariate model and it is assumed to follow an I(2) process it appears "to match low-frequency movements in the unemployment data rather well raising the question whether it is in fact only the unemployment data that determine the estimates, that is, whether there is still any relationship between the estimated unemployment gaps and changes in inflation as expressed by the Phillips relation".
Taking into account previous empirical works, and in the absence of a *superior* reduced form model to use in order to estimate the NAIRU, we use a pure statistical method to decompose the unemployment in a short-term and a long-term component. Thee NAIRU will then be defined as the long-term and less volatile component.
We define the unemployment series as:

$$Y_t = Y_t^{LR} + Y_t^{SR} \tag{2.1}$$

Where the terms on the right hand side describe the long run component and the second the short term component, respectively. The former can then be further decomposed as:

$$\begin{aligned} (1-L)Y_t^{LR} &= \mu_{t-1} + \varepsilon_t^{LR} \\ (1-L)\mu_{t-1} &= \varepsilon_t^{\mu} \end{aligned} \tag{2.2}$$

The innovations $\left(\varepsilon_t^{\mu}, \varepsilon_t^{LR}\right)$ are white noises with variances σ^{μ}, and σ^{LR}. The above formulation for the trend has the advantage of being very general; a deterministic trend can be obtained by removing both the error terms. At the same time we obtain a random walk plus drift if the variance of the innovation on the slope component is equal to zero (or fixed), $\sigma^{\mu} = 0$. In this case the trend becomes *I(1)* instead of *I(2)*. A smooth trend is obtained when $\sigma^{LR} = 0$. The short term component is modelled as an AR2 model:

$$Y_t^{SR} = \sum_{j=1}^{n} \lambda_j Y_{t-j}^{SR} + \varepsilon_t^{S} \tag{2.3}$$

Where ε_t^S is $\left(0, \sigma^S\right)$

The state-space model (2.1), (2.2) and (2.3) allows us to recover the NAIRU and derive the unemployment gap.
The model can be estimated using the Kalman filter algorithm as presented in Durbin and Koopman (2001).
The estimation is computed on the unemployment rate[2] for three European countries (France, Germany and Italy). The choice of the sample is essentially based on the need of including all the main events that have characterized government and monetary policies in the last few years: the seventies with the Bretton-Woods crisis, the eighties with the introduction of the European Monetary System (EMS), the nineties with the EMS's crisis and finally the introduction of the single currency. In light of this, for all the three countries the sample 1972:1 -2007:1
The results are presented in Figures 1-3, and Table I.

[2] Data are from the IMF International Financial Statistics collected from DATASTREAM.

Table I The Kalman filter

	France	Germany	Italy
AR1	1.647 (0.0694)	1.728 (0.0588)	0.9624 (0.1291)
AR2	-0.673 (0.0656)	-0.761 (0.0580)	-0.0013 (0.1062)
Trend innov var	0.100E+00	3.738E-03	1.006E-02
Trend slope var	1.700E-04	3.463E-05	3.899E-04
Cycle innov var	2.301E-02	2.339E-02	7.382E-02
-2*log-likelihood	-109.0253	-81.3593	60.8097
Residuals diagnostics			
Ljung-Box stat. Q(4)	2.0353 (0.7293)	2.5084 (0.6431)	13.5329 (0.1089)

Notes: Values in parentesis for AR1 and AR2 refer to the standard error.
The Ljung-Box statistics is for a check of autocorrelation for the first four autocorrelations Value in parenthesis is the probability of accepting the hull hypothesis of no serial correlation.

Figure 1: France Unemployment Gap

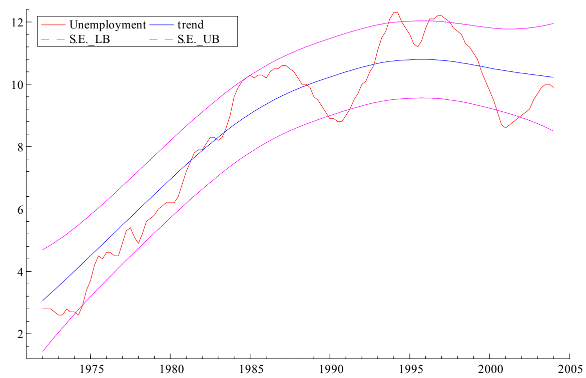


Figure 2: Germany Unemployment Gap

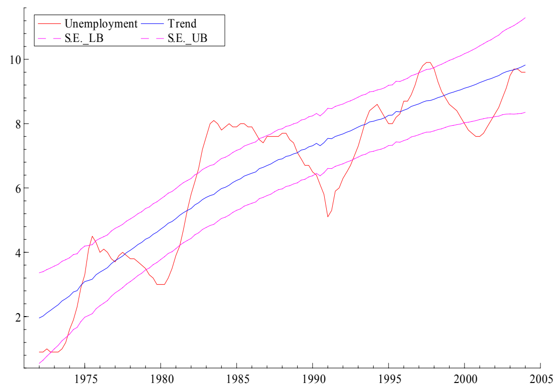
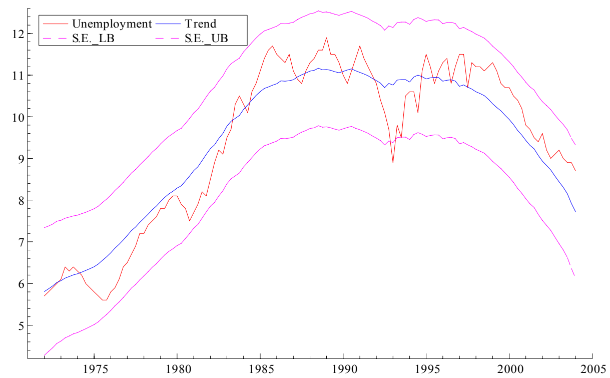


Figure 3: Italy Unemployment Gap



The NAIRU estimates indicates that our statistical model seem to capture quite well the dynamic of the data. The Ljung-Box statistics for serial correlation accept the hypothesis that the residuals are randomly distributed.
For Germany and France there is a strong trend component, while for Italy the results follow the dynamic of unemployment with a negative shaped parabola. However, the results for Italy are surrounded by a much bigger uncertainty, and they are of difficult interpretation.
The estimates show that the unemployment gap is highly procyclical as suggested by economic theory; during period of economic expansion gap widens since the level of unemployment falls below its long-run rate, the opposite occurs following an economic downturn. Finally, according to these measures the

3. Markov switching framework and the model

There is mounting evidence that empirical models of many economic time series, particularly macroeconomic, are characterized by parameter instability (Staiger *et al.* 2001, Crosby and Olekalns 2002, Favero and Milani 2005). Using this notion, in this section we estimate the impact of the monetary policy changes on the unemployment gap (U-gap hereafter) allowing for regime switching in the dynamic of unemployment
We investigate the ability of Markov Switching model to capture asymmetric reactions of U-gap series to monetary policy stance under different states of the economy (expansion and recession). We define the U-gap series as:

$$U_{i,t} = \phi_0 s_t + \phi_{U,s_t} U_{i,t-n} + \phi_{r,j} R_t + \varepsilon_t \qquad (3.1)$$

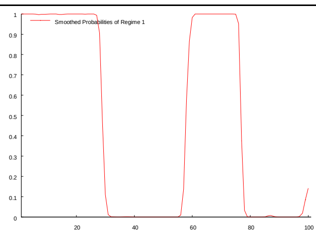
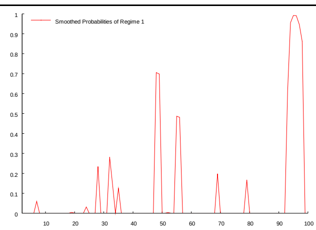
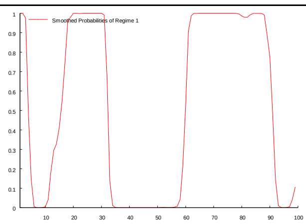
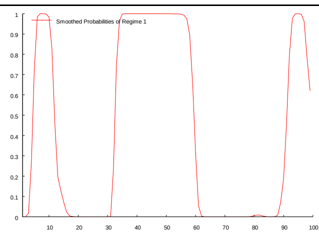
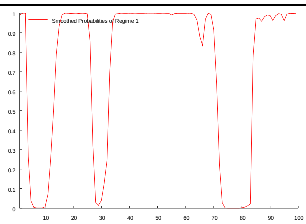
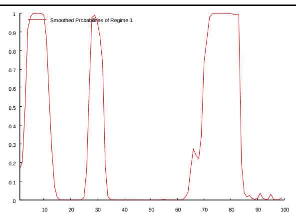
where U_{it} is the unemployment gap generates from equations (2.1)-(2.3) in section 2, where the subscript $i=1,2,3$ indicates the three European counties. s_t is governed by an unobservable, discrete, first order Markov chain that can assume k values (states) and ε_t is normally identically distributed, $\varepsilon_t \sim i.i.d.N\left(0,\sigma_{st}^2\right)$ error term. R_t is the innovation in monetary policy[3], it is a *(kx1)* vector that contains all the monetary policy innovations in which, $r_{i,t}^{1-98}$ and $r_{i,t}^{1-07}$ capture a negative change in the policy instrument before and after the introduction of the single currency, respectively and, $r_{i,t}^{2-98}$ and $r_{i,t}^{2-07}$ represent a positive change for the two sample periods.
Thus, the aim of this part is to establish whether a change in monetary policy ultimately results in an increase of the unemployment gap and, as final remark, whether the effects of monetary policy on labour markets are symmetric or asymmetric. That is, whether a monetary policy can have different impact in an expansion and a recession period across the three major European economies.
The introduction of Markov switching allows the coefficients ϕ_i and ϕ_r to switch between the two different states s_t = 0 and s_t = 1. If our hypothesis that U-gap at times has specific effects is correct, the unobserved state variable s_t is a latent dummy variable taking values either 1 or 2, which indicates upward/downward phases. Nevertheless, we do not impose *a priori* neither different signs on the coefficients nor force the process to switch into the other regime at a certain time. The only restriction we impose is that there are two different regimes, while everything else is determined from the data in the estimation.

[3] A change in monetary policy is defined as the first difference of the call money interest rate as reported by the International Financial Statistics, IMF.

3 Empirical results

We first estimate the model without multiple equilibria using ordinary least squares, in order to test a purely linear model[4]. The results provide strong evidence in favour of a two state regime-switching specification. The explanatory powers of the linear models seem to be poor. Some coefficients do not have the expected signs and are statistically not significant. In Table II, the relation improves when the model is estimated taking into account an additional state.
The second relevant issue is how to determine the number of states required by each model to be an adequate characterisation of the observed data. Our empirical procedure follows Psaradakis and Spagnolo (2003), who suggest selecting the number of regimes using Akaike Information Criterion (AIC hereafter).[5] Using Monte Carlo experiments they show that selection procedure based on AIC are generally successful in choosing the correct dimension. The values reported indicate that a switching model is preferred for all the three countries[6].
The coefficient $\phi_{r,1}$ indicates how the U-gap responds to the impact of monetary policy innovation during a recession. On the other hand, the coefficient $\phi_{r,2}$ can be interpreted as the monetary policy effect on U-gap in an expansionary phase.
Figures 4-5 plot the smoothing probability of state 1 using estimation of equation 3.1. Simply taking 0.5 as the cut-off value for State 1 and 2; hence, the period with smoothing probabilities greater than 0.5 are associated to an expansionary regime while, periods with smoothing probabilities less than 0.5 are related to a recessionary regimes. In most cases, the smoothing probabilities estimated from U-gap suggest consistent periods of recession and expansion phases for the three countries.

Figure 4. Smoothed probabilities Pre-EMU

	$r^1_{i,t}$	$r^2_{i,t}$
France		
Germany		
Italy		

[4] These results are available from the authors upon request.
[5] We compute the value of the AIC for the linear models and the corresponding Markov switching models.
[6] The AIC values for linearity versus two-states Markov switching model are: (-45.27) and (-51.28) for Italy; (-43.12) and (-74.96) for Germany; (-71.91) and (-73.85) for France.

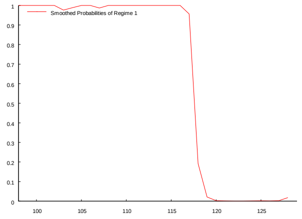
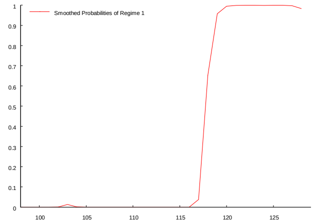
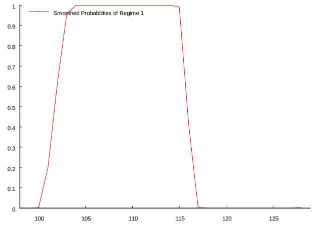
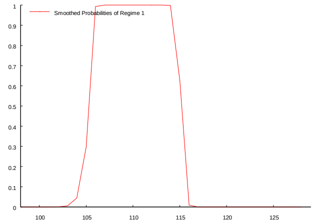
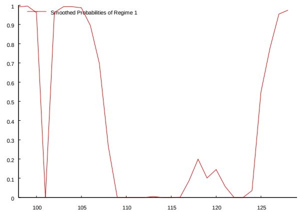
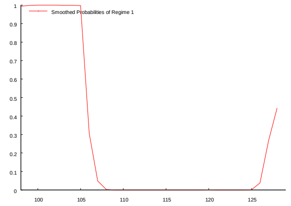
Table II: Estimates of Regime Switching Model for three European unemployment gaps and Monetary Policy Innovations

Markov	Italy				Germany				France			
Parameter	Pre-EMU	Post-EMU	Pre-EMU	Post-EMU	Pre-EMU	Post-EMU	Pre-EMU	Post-EMU	Pre-EMU	Post-EMU	Pre-EMU	Post-EMU
	$r_{i,t}^{1\_98}$	$r_{i,t}^{1\_07}$	$r_{i,t}^{2\_98}$	$r_{i,t}^{2\_07}$	$r_{i,t}^{1\_98}$	$r_{i,t}^{1\_07}$	$r_{i,t}^{2\_98}$	$r_{i,t}^{2\_07}$	$r_{i,t}^{1\_98}$	$r_{i,t}^{1\_07}$	$r_{i,t}^{2\_98}$	$r_{i,t}^{2\_07}$
$\phi_{0,1}$	0.5139	0.1658*	-0.616**	0.3166♦	-0.297**	-0.889*	1.4570	-1.007**	-0.5557*	-0.844**	-0.112**	-0.4264**
$\phi_{0,2}$	-0.3569*	-0.4012	0.427	-0.2236**	1.0607	0.2314	0.0562**	0.2301	0.9215*	-0.372**	1.1074	-0.5955♦
$\phi_{U,1}$	-0.085**	-0.1264*	-0.0032	-0.0554**	-0.113**	-0.5458*	-0.1149*	-0.044**	-0.051**	-0.117**	-0.027**	-0.0613
$\phi_{U,2}$	-0.0472♦	-0.0399**	-0.0225*	-0.0976*	-0.029**	-0.359**	-0.0708*	-0.0027*	-0.03**	-0.0356*	-0.015**	-0.0984**
$\phi_{r,1(1-98)}$	-0.0479*				-0.233**				-0.5863*			
$\phi_{r,2(1-98)}$	-1.0626*				0.7822**				0.2738**			
$\phi_{r,1(1-07)}$		-1.9011**				-0.4069*				-0.291**		
$\phi_{r,2(1-07)}$		2.6839**				0.8531*				0.9542**		
$\phi_{r,1(2-98)}$			-0.2845*				-0.999**				-0.081**	
$\phi_{r,2(2-98)}$			-0.2059*				0.8929*				-0.3108♦	
$\phi_{r,1(2-07)}$				-0.2772**				-0.219**				-0.4395**
$\phi_{r,2(2-07)}$				0.7148**				1.4759**				1.5177**
p_{11}	0.95	0.83	0.88	0.94	0.95	0.91	0.93	0.87	0.92	0.97	0.96	0.95
p_{22}	0.87	0.84	0.95	0.95	0.94	0.96	0.95	0.96	0.97	0.95	0.97	0.97
σ^2_{S1}	0.405	0.154	0.503	0.145	0.724	0.379	0.570	0.274	0.349	0.259	0.521	0.105
σ^2_{S2}	0.427	0.286	0.392	0.289	0.567	0.196	0.667	0.254	0.542	0.109	0.379	0.106
Log-likelihood	-67.53	-6.51	-69.14	-3.87	-109.92	-8.716	-106.96	-8.345	-83.37	-21.19	-70.81	-19.75
AIC	-75.53	-14.51	-77.15	-11.86	-117.91	-16.72	-114.96	-16.34	-91.36	-29.20	-78.81	-27.76

♦significant at the 0.10 level; *significant at the 0.05 level; **significant at the 0.01 level .

Since we are interested in identify the effects of tight and loose monetary policy, we construct two monetary policy innovation variables. The first one $r_{i,t}^{1}$ refers to negative changes in monetary policy (loose monetary policy), while the second one $r_{i,t}^{2}$ refers to positive changes in monetary policy (tight monetary policy).

Figure 5. Smoothed probabilities Post-Emu

	$r_{i,t}^{1}$	$r_{i,t}^{2}$
France		
Germany		
Italy		

This historical pattern of regime changes suggests that recession or expansion regime for the three EMU countries can be substantially divided into two main groups each one related to the duration of the single regime. The regime duration can play an important rule for central bank monetary policy implications.

The smoothed probabilities are conditional on all available gaps and the same maximum likelihood estimates. The main thing to notice about the probabilities is that, for Germany and France unemployment gaps, there are seemingly periodic 3–6-year regime shifts (state 1 or 2) during the entire sample. While for Italy there are also regime shifts (from state 1 to 2) in the same period but they come at much less regular intervals 1-3 years. These results are presented in Table III.

Table III Conditional of being in state one or two, the expected duration of a typical "Positive U-Gap" and "Negative U-Gap".

Duration	**Italy**	**France**	**Germany**	***Average Duration***
Positive U-Gap State 1 $[1/(1-p_{11})]$	7.19	14.49	12.19	11.29
Negative U-Gap State 2 $[1/(1-p_{22})]$	34.48	26.31	30.30	30.36

Furthermore, for the three countries analyzed the results show that a positive monetary policy innovation increases unemployment gap. An economic interpretation of this statement could be that a positive increase in the aggregate demand generates a positive, but temporary, increase in the demand for labour; this pushes the unemployment rate above the NAIRU, actual GDP above its potential, resulting in a positive output gap. As a consequence, there is a tendency to increase the wage rate which is then transmitted into higher costs for the firms and, therefore, higher prices for consumers' goods and services; and the central bank raises the short-term interest rate. This process does not happen immediately, changes in the firms' costs of productions take time to work their way into changes at the macro level. If we accept these steps, then, changes in monetary policy stance should be positively linked with the U-gap. More specifically, a positive relationship between policy changes and U-gap implies an unemployment rate above its long run rate and/or negative supply shocks or expectation of higher inflation (Batini and Greenslade, 2006)
Table II shows different signs of $\phi_{r,1}$ and $\phi_{r,2}$, before and after the EMU, for Italy, Germany and France. For state one, all the countries have the expected signs and are statistically significant at the usual confidence intervals. The indication is that during a recessionary phase an increase in the interest rate reduces the unemployment gap. For the second state of the economy, we note a positive sign for the three countries when the post EMU is taken while for Italy and France when the pre EMU is taken the coefficients have negative signs. Hence there is an indicator that during an expansionary period, a positive change in monetary policy tends to decrease the unemployment gap.

Table IV Asymmetric effects of policy innovation on the U-gap

	Italy	
	$r_{i,t}^{1}$	$r_{i,t}^{2}$
Pre-EMU	$\left\|\varphi_{r,2}^{1\_98}\right\| < \left\|\varphi_{r,1}^{1\_98}\right\|$	$\left\|\varphi_{r,2}^{2\_98}\right\| > \left\|\varphi_{r,1}^{2\_98}\right\|$
Post-EMU	$\left\|\varphi_{r,2}^{1\_07}\right\| < \left\|\varphi_{r,1}^{1\_07}\right\|$	$\left\|\varphi_{r,2}^{2\_07}\right\| < \left\|\varphi_{r,1}^{2\_07}\right\|$
	France	
	$r_{i,t}^{1}$	$r_{i,t}^{2}$
Pre-EMU	$\left\|\varphi_{r,2}^{1\_98}\right\| > \left\|\varphi_{r,1}^{1\_98}\right\|$	$\left\|\varphi_{r,2}^{2\_98}\right\| < \left\|\varphi_{r,1}^{2\_98}\right\|$
Post-EMU	$\left\|\varphi_{r,2}^{1\_07}\right\| < \left\|\varphi_{r,1}^{1\_07}\right\|$	$\left\|\varphi_{r,2}^{2\_07}\right\| < \left\|\varphi_{r,1}^{2\_07}\right\|$

	Germany	
	$r_{i,t}^{1}$	$r_{i,t}^{2}$
Pre-EMU	$\left\|\varphi_{r,2}^{1\_98}\right\| < \left\|\varphi_{r,1}^{1\_98}\right\|$	$\left\|\varphi_{r,2}^{2\_98}\right\| > \left\|\varphi_{r,1}^{2\_98}\right\|$
Post-EMU	$\left\|\varphi_{r,2}^{1\_07}\right\| < \left\|\varphi_{r,1}^{1\_07}\right\|$	$\left\|\varphi_{r,2}^{2\_07}\right\| < \left\|\varphi_{r,1}^{2\_07}\right\|$

The variance of the two states (σ_{1t}^{2} and σ_{2t}^{2}) changes from country to country. In particular, it is worth noting that for all countries, the variances of state one and two are smaller for the post-EMU than for the pre-EMU.

Finally, we have to look at the possible asymmetric effects of policy innovation on the U-gap for the three EMU countries. The asymmetric effects of monetary policy come out in the estimations since we have $\left|\phi_{r,2}\right| \neq \left|\phi_{r,1}\right|$. From table IV it is also discernible that the asymmetric effect were different before and after the EMU process.

In particular, in the post EMU phase, for the all countries $\left|\varphi_{r,1}\right| < \left|\varphi_{r,2}\right|$ holds. This implies that changes in monetary policy instrument have a stronger impact during expansionary phases.

Moreover, if the ECB follows a contractionary monetary policy then the effect on the U-gap returns to its long run trend (NAIRU) will be lengthier and larger during a recession. On the other hand, following the same policy, the effect of the ECB policy on two EMU countries will be smaller in expansionary periods. The results suggest that monetary policy is not neutral, at least in the short run and, there is some role for anticipated ECB monetary policy to affect the real sectors but that this role will also have asymmetric impacts on each single EMU country's business cycle.

Although the direction of the response to a change in the risk free interest rate is similar, with few exceptions, the magnitude is substantially different in both periods.

This is in line with the results from other empirical studies. In particular, the results obtained by Kakes and Pattanaik 2000, Peersman and Smets 2001 (using VAR methodology) and Maria-Dolores R. 2002 (using Markov switching model). It is beyond the scope of this paper to investigate the causes of these differences, but we can suggest few working hypothesis. Firstly, the labour market is intrinsically different in the three economies under consideration. For example, as noted in Calmfors and Driffill (1988) labour market concentration has an impact on the misery index[7].

Another cause of the problem could be the different fiscal system which is not harmonised across countries. At the same time, the lack of synchronization of fiscal policy across the European member states could worse these differences[8].

[7] The misery index is the sum of the unemployment rate and the inflation rate.

[8] For a discussion of the effect of different fiscal policies in a monetary union see De Grawue (2005)

5. Conclusions

In the last few years a number of empirical works have tried to assess the impact of the euro and more specifically the impact that the single monetary policy has had on the economies of the member states. In this paper we have approach the problem looking at the unemployment gap and how it has reacted to changes in monetary policy.
We started our analysis using a pure statistical model to decompose the unemployment in a short-term and a long-term component. This allowed us to derive the unemployment gap.
In the second part of the paper we employed a Markov-switching model to see how our dependent variable has reacted to changes in monetary policy. We made use of two policy variables. First we use a policy shock calculated as a residual from a Taylor rule, and then we use a change in risk free interest rate. We have shown that in both cases there is asymmetry of response across the three countries. Moreover, our results indicate that the cross sectional differences in the magnitude of the change in unemployment gap following a monetary policy variation has not been reduced after the introduction of the single central bank.

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