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Asymmetries in the Cyclical Effects of Monetary Policy on Output: Some European Evidence *

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Abstract

In this paper, I present empirical evidence for five European countries (Germany, France, UK, Spain and Italy) and the Euro-zone on whether monetary policy shocks produce different effects on real output growth depending on the phase of the business cycle that the economy is undergoing (the so-called 'state' asymmetry). To do so, I apply a multivariate extension of the Hamilton(1989)'s Markov switching methodology. I find evidence in favour of 'state' asymmetries at the aggregate level in all the countries whereby interest-rate shocks have larger effects in recessions than in expansions. I also carry out the analysis at the sectorial level and observe that this asymmetric effect seems to be different in the analysed countries when I focus on a sectorial analysis.

JEL Classification: C32, D92, E52, E58

Keywords: monetary policy, Taylor rule, asymmetries, Generalised Method of the Moments and Markov switching models

1 Introduction

The main goal of this paper is to analyse how monetary policy affects real activity depending on the state of the economy, in five European countries (Germany, France, UK, Italy and Spain) and the Euro-zone.

For this purpose, I follow Ravn and Sola(1996), Garcia and Schaller(1995), Kakes(2000), Dolado and Maria-Dolores(2001) and Peersman and Smets(2000) in applying the Hamilton(1989)'s Markov Switching methodology (MS henceforth) to endogenously determine from the data the dating and the transition probabilities from one cyclical phase to another in multivariate models with regime shifts, where output growth is allowed to depend on shocks to monetary policy rule. The use of the MS methodology is appropriate to analyze the cyclical effects of a monetary policy in these European countries since, unlike what happens with the NBER dating for the US cycle, an official dating for the cycle is not yet available. Hence, the MS approach will allow me to examine an interesting number of questions such as whether monetary policy shocks have different effects on output depending on the phase in which the change in monetary policy took place or whether changes in the monetary policy stance are also able to alter the transition probabilities from a recession to a boom and conversely. The MS approach has also been used in Peersman and Smets(2000) to analyse this issue on the output growth but they take an Euro area-wide approach considering a common cycle in seven European countries (Germany, France, Italy, Spain, Austria, Belgium and the Netherlands) and analyse the effects of an area-wide monetary policy shock on output in all the countries. In this paper I prefer to consider a country-by-country analysis because the evidence on a common cycle in

Europe is rather inconclusive and also because no assumption on common monetary policy shocks would be necessary in this case. All the literature on the European business cycle seems to agree that if a European business cycle exists, among the continental countries, it is with the UK cycle being considerably out of phase with the continental one.[1]

Although it has received far less attention in the literature, there are many theoretical contributions that provide the microfoundations of this asymmetry. I find at least two justifying arguments for it. Firstly, the price adjustment models leading to a convex aggregate supply curve.[2] This implication could be re-interpreted as implying that monetary policy will have stronger real effects during recessions, when output is below its long-run level, than in expansions, when the aggregate supply curve is almost vertical. Secondly, there is a broad class of models which provide support for the *'state'* asymmetry by explicitly modelling the credit or lending channel of the monetary transmission mechanism. According to this interpretation, if financial markets face information asymmetries, credit and liquidity may be readily available in booms whilst agents may find it harder to obtain funds in recessions. Therefore, it is likely that monetary policy will have stronger effects on the consumption and investment decisions during recessions than during expansions. This is the mechanism derived from the extensive research on financial market imperfections, including agency costs and debt overhang models, de-

[1] For more detailed arguments in favour of an individual analysis see Artis and Zhang(1997, 1999).

[2] Ball and Romer (1989), Caballero and Engel (1992) and Tsiddon (1991), *inter alia*, have analysed S-s type price adjustment rules which lead to convex aggregate supply curves.

veloped, *inter alia*, by Bernanke and Gertler (1989), Gertler (1988), Gertler and Gilchrist (1994), Kiyotaki and Moore (1998) and Lamont (1993).

The contribution of this study may be interesting for three reasons: (i) Some European financial markets have been less developed over the sample period than in the US and, in this sense, we can obtain a good illustration of economies where the factors highlighted by the credit channel might be operative, (ii) the analysis at the sectorial level may be useful as it helps to ascertain which sectors are more important in explaining the aggregate results and which behave in a different way in each country, and (iii) the response in this five countries in our sample and the Euro-zone might have been different.

To measure the stance of monetary policy I estimate monetary policy reaction functions for five central banks: the *Bundesbank*, the *Banque de France*, the *Bank of England*, the *Banco de España*, the *Banca di Italia* and the (surrogate) *European Central Bank* using quarterly data. The sample periods have been determined on the basis of choosing homogeneous spells where there was a virtually autonomous control over domestic monetary policy in each case. So, they correspond to 1978(1)-1998(4) for Germany, 1978(1)-1998(4) for France, 1978(2)-1998(4) for England, 1977(4)-1998(4) for Spain and 1982(2)-1998(4) for Italy. Finally, I will carry out a similar exercise for the Euro-zone area using country weighted quarterly data for the Member states which has been constructed by Fagan *et al.*(2000) over the period 1984(1) to 2001(2). As for the short-term interest rates, they are chosen as follows: (i) the three-month interbank market rate in Germany, France and Italy, (ii) the marginal intervention rate of the Bank of England

and the Bank of Spain and (iii) a weighted average of short-term intervention rates for the Euro-zone countries.

My analysis is executed in two steps. First, I estimate reaction functions using a generalised Taylor rule specification. Second, once the interest rate shocks have been obtained from the Central Banks´reaction functions, I observe whether there are asymmetric effects of monetary policy on output growth, both at the aggregate and the sectorial level(only for the five countries), depending on the business cycle phase that the economy was undergoing at the time the shock took place.

Proceeding in this way I obtain two interesting results: (i) I find evidence in favour of *'state'* asymmetries at the aggregate level in the five European countries and the Euro-zone, whereby interest rate shocks have larger effects in recessions than in expansions, and (ii) I observe that the previous asymmetries seem to be different in the five analysed countries when I proceed to do a sectorial analysis.

The rest of the paper is organised as follows. In section 2, I estimate forward-looking monetary policy reaction functions for five central banks. Section 3 offers a brief explanation of the MS methodology which is used throughout the rest of the paper and presents the results for the aggregate and sectorial GDP in a model with constant transition probabilities. Section 4 relaxes the previous assumption by allowing the transition probabilities to be affected by monetary policy shocks in a direct way. Finally, section 5 draws some conclusions.

2 Estimation of central banks´reaction functions

In this section I estimate a linear '*forward-looking*' Taylor rule following the arguments in Svensson (1997), and Clarida *et al* (1998, 1999).[3]

As can be observed in Clarida et al(1998) the first order necessary conditions for a symmetric loss function in the central bank preferences yield the following policy reaction function:

$$i_t^* = \bar{\imath} + \beta_1(E_t(\pi_{t+k}) - \pi_{t+k}^*) + \beta_2 E_t(y_{t+p} - y_{t+p}^*), \tag{1}$$

which, under the assumption that central banks smooth interest rate changes by adopting an AR(1) partial adjustment rule, derives:[4]

$$i_t = \rho i_{t-1} + (1-\rho) i_t^*, \tag{2}$$

Hence, the estimable specification of the Taylor rule is the following:

$$i_t = \rho i_{t-1} + (1-\rho)\left\{\bar{\imath} + \beta_1(\pi_{t+k} - \pi_{t+k}^*) + \beta_2(y_{t+p} - y_{t+p}^*) + \beta_3\prime X_t\right\} + \varepsilon_t, \tag{3}$$

where X_t denotes a set of observable variables, besides inflation and output gaps, that may potentially affect interest rate setting independently of their

[3]Svensson(1999) and Svensson and Woodford(1999) also discuss how inflation-forecast targeting can be interpreted as a 'targeting rule' and is different from a commitment to a simple "instrument rule" like a Taylor rule.

[4]See Goodfriend(1991) and Sack(1997).

role in helping to forecast the above-mentioned variables. They include, for instance, variations in real exchange rate, foreign interest rate and the evolution of the money supply. Notice that, by exploiting the rational hypothesis in expectation formation I can replace forecast variables by their realized values so that the error term follows the stochastic process:

$$\varepsilon_t = \xi_t - (1-\rho)(\beta_1 e^{\pi}_{t+k/t} + \beta_2 e^{y}_{t+p/t}), \tag{4}$$

where ξ_t is an $i.i.d$ disturbance, $e^{\pi}_{t+k/t} \equiv \pi_{t+k} - E(\pi_{t+k})$ is the k-period ahead forecast error for inflation and $e^{y}_{t+p/t} \equiv y_{t+p} - E(y_{t+p})$ is the corresponding p-period ahead forecast error for the output gap[5]. Finally, let z_t be a vector of variables within the central bank's information set, such as lagged variables that help forecast inflation and output or any other contemporaneous variables that are uncorrelated with the policy rule shock, ε_t. Then, the Generalized Method of Moments (*GMM*) can be used to estimate the parameter vector in (1), (2) and (3) by exploiting the set of orthogonality conditions.

$$E(\varepsilon_t / z_t) = 0. \tag{5}$$

Further, since the composite disturbance has an MA(max{*k,p*}-*1*) representation due to the overlapping nature of the forecast errors, the weighting var-cov matrix used to implement GMM is the one proposed by Newey and

[5]Note that equation (1) is derived when the monetary authorities commit to a state contingent sequence of short-term interest rates in order to minimize an intertemporal loss function. In this framework it is supposed that interest rate affects output with p-period lag and affects inflation with a k-period lag. For a detailed description see Svensson(1997) and Clarida et al(1998,1999)

West (1987). Moreover, Hansen (1982)'s J test is used to test the overidentification restrictions.

To obtain a measure of output gap, I detrend the Gross Domestic Product using the Hodrick-Prescott(HP) filter.[6] As regards the inflation target, π^*, I depart from the assumption that it is constant, as in Clarida *et al.*(1997) and assume instead that it has a time variation. I follow Dolado, Maria-Dolores and Naveira(2000), according to the next two considerations: (i) in the case of Germany, I take the inflation target established in official reports,[7] and (ii) in the case of France, I take it to be the German inflation rate. In the cases of UK, Spain and Italy, I have generated the inflation gap using again the HP filter.

Notice that the choice of a time-varying target rate is sensible for the analysis of asymmetries since some of the countries in the sample have experienced long disinflationary periods making it difficult to believe that a constant long-term inflation rate was guiding monetary policy in the short-run.

Table 1 reports the results for the Taylor(1993)'s rule specifications in each country and the Euro-zone.

I begin with the Bundesbank, where the list of instruments includes a constant term and the current value and four lags of the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the DM/$ real exchange rate change(second column), and US interest rate (third column) which are variables included in the X_t

[6] Peersman and Smets(1999) examine the estimation error impact of the output gap on the efficient feedback parameters in the performance of the Taylor rule.

[7] The annual target rate has been interpolated to a quarterly frequency.

set. For the choice of k and p, I only report specifications with $k=4$ and $p=1$ which turned out to have the best fit.[8] Having added each of the X_t variables one by one, I found that the specification containing the US interest rate was the best.[9] The results in the third column point out that the degree of persistence is very high ($\rho \approx 0.71$) and that the Bundesbank responds to the inflation gap more than proportionally ($\beta_1 = 1.79$). The estimated coefficient for the output gap is positive and weakly significant ($\beta_2 = 0.92$).[10] Given the estimate of the latter variable ($\beta_3 = 0.27$) I can interpret the policy rule as a weighted average of the USA interest rate (0.27) and the baseline policy rule (0.73).[11]

With regard to the *Banque de France*, the preferred specification is the one that contain the FF/DM real exchange rate change(second column) within the X_t set.[12] I only report specifications with $k=4$ and $p=2$ which turn out to have the best fit. One big difference with the Bundesbank is that the Bank of France has responded to the inflation gap less than proportionally ($\beta_1 = 0.44$), indicating the monetary policy stance has been fairly accommodating,

[8] I also used the variable 'deviations of M3 with respect to its target level' but it was not significant.

[9] Henceforth, I always choose the specification with the lowest root mean square error.

[10] Smets(1998) argues that estimation error in the output gap may in part explain why the actual central bank response to movements in the output gap is less than optimal control exercises suggest.

[11] Note that the real interest rate target will be determined by the following expression: $i_t^* - E_t(\pi_{t+k})$.

[12] The list of instruments includes a constant term and the current value and four lags of the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the FF/DM real exchange rate change(second column), and German interest rate (third column).

with the increases in the short-term interest rates not being high enough to keep the real interest rate from declining. Moreover the response to the output gap is much weaker than in Germany although more statistically significant ($\beta_2 = 0.32$).

As for as the *Bank of England* is concerned, I report specifications with *k=1* and *p=0* which turned out to have the best fit.[13] The best specification is the one that contains German interest rate being the response to inflation gap smaller than unity ($\beta_1 = 0.82$). As we know monetary policy in the European countries appears to fight inflation by following Bundesbank and inflation has dropped from the mid-1980s. The expected result would not be an accommodative monetary policy as in this case however we must take into account that financial markets could force these markets to have high real interest rates to maintain exchange rates. Clarida *et al*(1998) point out that the British real rates were high both in absolute terms and relative to the German rates. However, the response to the output gap is about the same size as in Germany ($\beta_2 = 0.89$) and strongly significant. Nevertheless, the size of the estimated coefficient on the German interest rate is larger than in France ($\beta_3 = 0.58$).

With reference to the *Banco de España* I report specifications with *k=2* and *p=0* which turned out to have the best fit.[14] As it happened with the

[13]The list of instruments includes a constant term and the current value and four lags of the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the ℓ/DM real exchange rate change(second column), and German interest rate (third column). I also used the variable 'deviations of M3 with respect to its target level' but it was not significant.

[14]The list of instruments includes a constant term and the current value and four lags of

Bank of England the best specification again is the one that includes the German interest rate. The results are fairly similar to the ones found for the British case with the response to the inflation gap being smaller than unity ($\beta_1 = 0.68$). The same argument for the British case possibly applies here.[15] During the sample period of our analysis the real rates in Spain were higher than in Germany. With regard to the response to the output gap, it is also about the same size as in Germany and weakly significant($\beta_2 = 0.84$). Finally, the size of the estimated coefficient on the German interest rate is 0.78 and I interpret again this monetary policy rule as a weighted average of the German interest rate (0.87) and the baseline policy rule(0.13).

As regards the *Banca di Italia* are similar to those obtained for the Bank of England policy rule.[16] I observe that the more statistically significant variable inside the X_t is the Lira/DM real exchange rate change. I report specifications with k=4 and p=0 and the responses are 0.54 for the inflation gap and 0.18 for the output gap.

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the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the pts/DM real exchange rate change(second column), and German interest rate (third column). A dummy variable in 1987 is needed to get stability in the estimated model. This dummy can be justified by the change in the monetary policy instrumentation in Spain.

[15]This finding should get more attention and further research is needed. Maybe this result could be different if we had information on central banks' inflation projections(see Orphanides, 2001).

[16]The list of instruments includes a constant term and the current value and four lags of the following variables: inflation, output gap and interest rate (in the first column of each specification) and two lags of the Lira/DM real exchange rate change(second column), and German interest rate (third column).

Finally, the policy rule for the Euro-zone has been estimated with k=4 and p=0 both without and with the X_t variables. In this case the best specification corresponds to the one that takes the Euro/$ real exchange rate changes. The responses of the interest rate to inflation deviations ($\beta_1 = 1.07$) and the output gap ($\beta_2 = 0.35$) are in line with those estimated for the Bundesbank indicating that, with the possible exception of the turbulent period around 1992-93, a Taylor rule fares well in predicting a short-term intervention rate in the Euro-area.

In most of the specifications the J-test takes p-values above 0.05, non rejecting the set of overidentifying restrictions. Figure 1A-F portrays the fitted values of the chosen specification in each country.[17] It thus appears that the models fairly well predict the evolution of the short-term interest rate, particularly in the cases of Germany, France, Spain and the Euro-zone[18].

3 Extended Markov switching models for aggregate and sectorial real GDP growth including monetary policy shocks

In this section I present the econometric model which I apply to analyse asymmetries in monetary policy effects. Next, I introduce a brief explana-

[17] I chose the specification with the lowest mean root squared error in the dynamic forecast of the model.

[18] The mean root squared error for the chosen specifications are: Germany(0.75), France(1.43), UK(2.50), Spain(1.43), Italy(5.11) and Euro-zone(1.60), respectively.

tion of the basic aspects of the MS methodology in a multivariate extension of the original univariate model (see Hamilton, 1989) and how the *'state'* asymmetric effects of monetary policy can be observed by allowing monetary policy shocks to affect the output growth rate.

To observe the asymmetric effects of monetary policy on output growth I will follow Garcia and Schaller(1995), Kakes(2000), Dolado and Maria-Dolores(2001) and Peersman and Smets(2000) in considering a multivariate extension of the MS model. In these models, output growth is allowed to be affected by interest-rate shocks which is the measure I will choose to gauge the stance of monetary policy. This monetary policy shocks are derived from the term ξ_t in equation (4) to obtain *i.i.d* disturbances.[19] I only consider a version of the extended model where the effects of monetary policy on output growth depend on the state of the economy at the time when policy action was taken. Another possibility is to assume that these effects are different depending on the current state of the economy, rather than on the state at the time when the shock took place.[20]

Hamilton's(1989) approach is based on the assumption that the actual state of the economy, i.e., recession(r) or expansion(e), is determined by an unobserved latent random variable which follows a Markov process. In the original version of the MS methodology the average growth rate of GDP(μ) is allowed to vary depending on whether the economy is expanding (μ_e) or recessing (μ_r). The GDP growth is assumed to be determined by an AR(p)

[19] The term ε_t captures deviations of the actual interest rates from the rates that should have prevailed according to the estimated rules. This term is not an *i.i.d* disturbance.

[20] Dolado and Maria-Dolores(2001) and Peersman and Smets check robustness in their results using both methods and they always obtain similar results.

process.

Thus, once the interest rate shocks have been obtained from the forward-looking Taylor rule, I address whether there are asymmetric effects of monetary policy on output growth depending on the business cycle phase that the economy was undergoing at the time the shock took place. For this purpose, I estimate the following extended MS specification.

$$\begin{aligned}\Delta y_t = {} & \phi_1 \Delta y_{t-1} + ... + \phi_p \Delta y_{t-p} + \mu_r (1 - \phi_1 - ... - \phi_p) + \\ & \Delta\mu (S_t - \phi_1 S_{t-1} - ... - \phi_p S_{t-p}) + \beta_{or} \xi_t + \Delta\beta_o S_t \xi_t + \\ & \beta_{1r} \xi_{t-1} + \Delta\beta_1 S_{t-1} \xi_{t-1} + ... + \beta_{pr} \xi_{t-p} + \Delta\beta_p S_{t-p} \xi_{t-p} + \sigma \eta_t,\end{aligned} \tag{6}$$

where Δy is the quarterly growth rate seasonally adjusted GDP, $\Delta\mu = \mu_e - \mu_r$, S_t is the state variable and η_t is distributed N(0,1). $\Delta\beta = \beta_e - \beta_r$, and β_r and β_e are the coefficients on the shocks in recessions and expansions in each country, respectively.

The state variable in the model, S_t, is assumed to follow a discrete-time Markov process which is characterized by the following transition probability matrix:

$$\begin{bmatrix} p_{rr} \; p_{er} \\ p_{re} \; p_{ee} \end{bmatrix} = \begin{bmatrix} p_{rr} & 1 - p_{ee} \\ 1 - p_{rr} & p_{ee} \end{bmatrix}, \tag{7}$$

where:

$$p_{ij} = \Pr(S_t = j / S_{t-1} = i), \text{ with } \sum_{j=r}^{e} p_{ij} = 1 \text{ for all i}, \tag{8}$$

and p_{ij} is the probability of going from state i to state j (e.g. , p_{re} is the probability of going from a recession to an expansion, etc.). Initially, we assume that the transition probabilities are constant over time and are determined by the following logistic distribution functions:

$$p_{rr} = \Pr(S_t = r/S_{t-1} = r) = \frac{\exp(\theta_r)}{1+\exp(\theta_r)}, \tag{9}$$

$$p_{ee} = \Pr(S_t = e/S_{t-1} = e) = \frac{\exp(\theta_e)}{1+\exp(\theta_e)}, \tag{10}$$

where θ_r and θ_e are the parameters that determine the probabilities of being in a recession and in an expansion, respectively.

As Hamilton(1989) has shown, the above assumptions allow us to obtain a sequence of joint conditional probabilities $\Pr(S_t = i, ..., S_{t-s} = j/\Phi_t)$, which are the probabilities that the GDP growth series is in state i or j (i, j = r,e) at times t, t-1, until t-s respectively, conditioned by the information available at time t. By adding those joint probabilities we can obtain the so-called smoothed filter probabilities, namely, the probabilities of being in state r or e at time t, given information available at time t:

$$\Pr(S_t = j/\Phi_t) = \sum_{i=r}^{e} ... \sum_{j=r}^{e} \Pr(S_t = i, ..., S_{t-s} = j/\Phi_t) \text{ i,j = e,r.} \tag{11}$$

where Φ_t is a set information in period t. The smoothed filter probabilities provide information about the regime in which the series are most likely to have been in time t at every point in the sample. Therefore, they turn out to be very useful tools for dating phase switches and will be reported for each of the models estimated throughout the paper.

Table 2 shows the results obtained from the estimation of the MS model in (6) with $p = 1$ for the following sample periods: 1978(2)-1998(4) for Germany, 1978(2)-1998(4) for France, 1978(3)-1998(4) for UK, 1978(1)-1998(4) for Spain, 1982(3)-1998(4) for Italy, and 1984(1)-2001(2) for the Euro-zone.[21] The choice of one lag turns out to be appropriate to obtain serially uncorrelated residuals.[22] The first regime corresponds to a low growth phase with a quarterly growth rate of 0.19%(0.80% annually) for Germany, 0.16%(0.64% annually) for France, 0.17%(0.68% annually) for Spain, 0.26%(1.04% annually) for Italy and 0.24%(0.96% annually) for the Euro-zone.[23] These results imply that it is more appropriate to interpret that phase as one of mild growth rather than as a proper recession in these countries. I only clearly identify a recession phase in the British case with an annual growth rate of -0.12%(-0.49% annually). The second regime, in turn, corresponds more clearly to an expansion phase with a quarterly growth rate of 0.60%(2.40% annually) for Germany, 0.50%(2.00% annually) for France, 0.48%(1.92% annually) for UK, 0.41%(1.64% annually) for Spain, 0.81%(3.24% annually) for Italy and 0.81%(3.24% annually) for the Euro-zone.

As regards the probabilities of remaining in each regime, they are esti-

[21]The data series in Germany are built considering the GDP growth in West Germany from 1977 to 1993 and in the unified Germany from 1994 to 1998.

[22]Moreover, when extending the maximum lag to $p_{max} = 4$, the BIC lag length criterion chooses p=1.

[23]I test the constant variance/mean-shift specification against a linear AR(1) specification using Hansen's(1992) approach, where linearity constitutes the null hypothesis. I find a p-value of 0.04 rejecting linearity at the 5% level.

mated to be 0.88, 0.81, 0.47, 0.81, 0.97 and 0.96 for a recession and 0.95, 0.97, 0.89, 0.93, 0.94 and 0.84 for an expansion in Germany, France, UK, Spain, Italy and the Euro-zone, respectively. These probabilities imply mean durations of 5.26 quarters in recessions and 20 quarters in expansions for Germany.[24] In Spain and Italy we obtain a similar mean duration for an expansion, 14.28 and 16.67 quarters, respectively. The main divergence is in the mean duration of a recession phase. The larger mild-growth phases are in Italy (33.33 quarters) and the smaller in UK where we clearly identify a recession phase. For the Euro-zone I obtain mean durations of 25 quarters for mild-growth phases and 6.25 for expansions. These results are very similar to the derived for Germany.

Figure 2(A,F) plots quarterly GDP growth rates in each country and the filter probabilities of being in an expansion. As can be observed in the majority of the countries, the highest probabilities are those in the second half of the 1980s, whilst the lowest probabilities correspond to the recession in the first half of the 1990s.

Figure 3(A-F), in turn, depicts the GDP growth rate impulse response function to a one-standard deviation increase in ξ_t for the five countries and the Euro-zone.[25] It becomes clear that the effects are much larger in mild growth phases than in expansions. As I can see in all the countries the monetary policy effects are larger during recessions/mild-growth phases than during expansions. The estimated coefficients for the monetary policy shocks during booms are also significant in the majority of the countries, except the

[24] Mean duration in state i is defined as $1/(1\text{-}p_{ii})$, i=e,r.

[25] The dynamic simulations in the impulse-responses are based on one-period increase in one-standard deviation in ξ_t.

UK and Italy. Indeed, the null hypothesis of symmetry ($H_0 : \beta_{ie} = \beta_{ir}$) is clearly rejected with a p-value of 0.04(for Germany), 0.02(for France), 0.005(for UK), 0.002(for Spain), 0.004(for Italy) and 0.01(for the Euro-zone)

In this framework I also proceed to analyse monetary policy transmission on sectors. There are at least two reasons why the sectorial analysis may be useful. First, because it helps to ascertain how robust the results obtained at the aggregate level are in sectors which may have undergone more severe recessions than the mild growth phase found for total GDP in the majority of the countries. Second, because finding which sectors are more likely to suffer from *'state'* asymmetries on the basis of their financial characteristics it is an interesting exercise. For instance, the case could be that sectors which can be expected to have more asymmetric information problems (e.g. smaller firms, bank dependent) respond stronger to monetary policy(e.g. because of credit rationing). For this purpose, I split total GDP into its four major components, namely, Agriculture(A), Manufacturing(M), Construction(C) and Services(S). To give an idea of the importance of value added in each sector relative to total GDP, I report the corresponding GDP shares at both extremes of the sample period in each country. In Germany(1977 and 1998): 1.45%-1.33% (A), 51.47%-30.45% (M), and 47.04%-68.22% (S).[26] In France(1978 and 1998): 3.41%-3.36% (A), 23.48%-23.90% (M), 7.44%-4.29% (C) and 65.64%-68.45% (S). In Italy(1982 and 1998): 3.70%-3.15% (A), 25.09%-24.47% (M), 6.95%-4.94% (C) and 64.25%-

[26] For the West Germany there is no data for the Construction sector. That is the reason why we join this sector with Manufacturing. The data series are also built considering the value added growth in each sector in the West Germany from 1977 to 1993 and in the unified Germany from 1994 to 1998.

67.42% (S). In Spain(1977 and 1998): 9.8%-4.5% (A), 34.1%-29.6% (M), 7.1%-7.8% (C) and 49%-58.1% (S).[27] France, Spain and Italy have a similar sectorial structure. The exception being Germany where the Manufacturing sector plays an important role and maintains an important share in GDP even after the unification. I do not repeat same analysis for the Euro-zone because there is no available sectorial data.

Figures 4 to 7(A,E) show the value added growth rate in each sector in each country together with the filter probabilities of an expansion estimated for the model in (6). Table 3 presents a summary of results, comprising the estimates of the different growth rates in expansions and recessions (μ_r and μ_e) and the mean durations in each phase (d_e and d_r).[28] I can observe how the difference between average growth rates in expansions and recessions is much larger in Agriculture and Construction than in the total economy and the remaining two sectors in the majority of the countries. In particular, the Construction sector undergoes severe recessions, observing quarterly growth rates of -0.68%(France), -0.67% (UK), -0.24%(Spain) and -0.35%(Italy) unlike what happens in Services where recession phases are better interpreted as mild growth phases. I obtain a quarterly growth rate of 0.21%(Germany), 0.05%(France), 0.02%(UK), 0.17%(Spain) and 0.15%(Italy). As for Services, given that it has the largest share in GDP, it is not surprising that its regime shifts (probabilities and durations) are found to be similar to those obtained for the aggregate case. As regards the transition probabilities, the probability of moving from a recession to an expansion is lower than the probability

[27] I cannot offer similar results for the UK because the data for the GDP and value added in each sector are a mere index.

[28] The results of the complete estimated models are not reported to save space.

of moving in the opposite direction for all the sectors, as it was the case with the total GDP.

With reference to Manufacturing, I show the impulse response function of the value added growth rate to one-standard deviation increase in ξ_t in Figure 9(A-E).[29] I observe how the monetary policy effects are larger during recessions than during expansions in three countries. This effect is more pronounced in Germany[30] and the UK. In the UK the expansion coefficients are not significant. With regard to Spain the monetary policy effects are weak in recession phases.

With respect to Construction, I only find evidence in Spain and the UK where I reject the null hypothesis of symmetry with a p-value of 0.01 and 0.03, respectively.[31] Figure 10(A-D) portrays the impulse response function of the value added growth rates in this sector to one-standard deviation increase in ξ_t. In France and Italy I observe the opposite, larger effects during expansions than recessions.

In the Services sector I find evidence in all the countries. In France, the coefficients in expansion are not significant though in the rest of the countries they are statistically significant.[32] This is the expected result due

[29] The results of the tests for Manufacturing and Services are not reported to save space. However, they are available upon request.

[30] This evidence is in agreement with the results in Mojon, Smets and Vermoulen(2000) where the impact effect of a change in the short-term interest rate on the investment-capital ratio is larger in Italy and Germany in Manufacturing firms' investment.

[31] I do not report results for Germany because I do not have any data.

[32] The results of the tests for Services are not reported to save space but they are very similar to the results obtained for the aggregate case. However, they are available upon request.

to the obtained evidence in the aggregate level and because this sector is the most important as a percentage of GDP. Figure 11(A-E) shows the impulse response function of the value added growth rates in this sector to one-standard deviation increase in ξ_t.

The fact that generally I tend to find stronger asymmetries in Services (in the five countries) and Construction (Germany, UK and Spain) could be somewhat justified in terms of the strength with which tight credit conditions may impinge on their cyclical behaviour. For example, small firms represent a larger share of total firms in Services and they are likely to face larger barriers to outside finance than larger firms do; for example the fixed costs associated with issuing public traded bonds may be much more important for small firms(see Gertler and Gilchrist, 1994). Likewise, mortgage loans in the Construction sector are generally financed by banks which tend to transmit changes in the intervention rate onto mortgage rates rather quickly and in this way, will exacerbate the effects of debt overhang during recessions. Mojon, Smets and Vermeulen(2000) obtain interesting results about this topic for Germany, France, Italy and Spain using Manufacturing firm's investment. They find that the investment of smaller firms is more sensitive to monetary policy changes than the investment of larger firms and firms with a better than average cash-flow situation.

4 Effects of Monetary Policy on State Switches

Whereas in the previous sections I allowed for state dependence in the effects of interest rate shocks on output growth, the transition probabilities from one phase to another were not allowed to depend on those shocks. Thus, while I was able to test whether shocks had different incremental effects on output in each state, I was not able to examine the issue of whether those shocks might have a further effect on output growth by directly affecting the probability of a state switch. In this section, I address this issue by allowing those probabilities to depend directly on the shocks.[33] Hence, the logit functions (9) and (10) are replaced by:

$$p_{rr} = \Pr(S_t = r/S_{t-1} = r) = \frac{\exp(\theta_{or} + \theta_{1r}\xi_{t-1})}{1 + \exp(\theta_{or} + \theta_{1r}\xi_{t-1})} \quad (12)$$

$$p_{ee} = \Pr(S_t = e/S_{t-1} = e) = \frac{\exp(\theta_{0e} + \theta_{1e}\xi_{t-1})}{1 + \exp(\theta_{oe} + \theta_{1e}\xi_{t-1})} \quad (13)$$

where only one lag of ξ_t has been chosen in (12) and (13) to keep the number of parameters manageable.[34] Further, as in García and Schaller(1995), to isolate the effect of the shocks from the linear effect examined above, I constrain the latter to be zero. Thus, I estimate the MS specification (6) without monetary policy shocks as explanatory variables. Notice that since the probability of remaining in a recession (expansion) is increasing in the $\theta_{ir}(\theta_{ie})$ parameters, I should expect θ_{ir} to be positive and θ_{ie} to be negative when considering a shock that raises interest rates. In other words, an increase in interest rates reduces the probability of remaining in an expansion and increases the probability of remaining in a recession.

[33]The maximization algorithm with variable transition probabilities is considered in Filardo(1994)

[34]Moreover, when trying specifications with more lags, some coefficients were not significant.

The results of the different models for aggregate and sectorial GDP are offered in Tables 4-7, where it can be observed that the signs of the θ coefficients are broadly in agreement with the above interpretation. Thus, a positive interest rate shock increases p_{rr} and decreases p_{ee} while the converse happens with a negative shock.

To ascertain the effects of interest rate shocks on the transition probabilities I propose a similar experiment to the one undertaken by Garcia and Schaller(1995) and Dolado and María-Dolores(2001), who use changes in the Fed Funds rate and the marginal interest rate of the Bank of Spain to illustrate those effects in the US and Spain, respectively. Suppose that the central banks were able to have produced a positive (contractionary) interest rate shock of 100 basis points in one quarter(from t to t-1) with which ξ_t appears to affect p_{rr} and p_{ee} in (12) and (13). Then, the question is: How would that shock affect the transition probability from an expansion to a recession?. Likewise, if instead I considered a negative (expansionary) shock of the identical magnitude, how would it affect the probability of a converse switch?.

Tables 8-11 show the estimated changes for total GDP and its four components in each country, based on the estimates obtained for the θ coefficients in Tables 4-7. I report the changes in p_{er} (p_{re}) when a positive(negative) interest rate shock is considered[35].

As for the aggregate GDP model, I find that before the string of positive shocks takes place, the probabilities of going from an expansion to

[35] Agriculture & Hunting results are not reported in this model to save space but they are available upon request.

a recession (p_{er}) are 0.21(Germany), 0.37(France), 0.44(UK), 0.48(Spain) and 0.44(Italy). These probabilities result in 0.39(Germany), 0.64(France), 0.47(UK), 0.49(Spain), 0.44(Italy) and 0.37(Euro-zone), after the shock has taken place. With regard to the effects of the negative shock, we find that the probability of moving from a recession to an expansion (p_{re}) increases from: 0.38 to 0.62(Germany), 0.38 to 0.64(France), 0.43 to 0.70(UK), 0.48 to 0.81(Spain), 0.41 to 0.93(Italy) and 0.42 to 0.77 (Euro-zone).

Next, I introduce a summary of the obtained results with reference to the sectorial evidence. I only focus on Manufacturing, Construction and Services sectors. I find that the increase in the previous transition probability (p_{re}) in Manufacturing sector is larger in France(from 0.38 to 0.64), UK (from 0.33 to 0.64) and Italy(from 0.49 to 0.67) than in the rest of countries. In the Construction sector the largest increase in p_{re} is in France(from 0.38 to 0.62), UK(from 0.37 to 0.68) and Spain(from 0.47 to 0.88). Finally, with regard to the Services sector we can observe how all countries experiment a big increase in the probability of moving from a recession to an expansion.

Summing up, the overall evidence presented in this section is in line with the results previously obtained, namely, *'state'* asymmetries of monetary policy. Such results, which this time stem from the potential direct effects of policy shocks on the transition probabilities are present at the aggregate level and seem to be particularly relevant in Construction and Services.

5 Conclusions

In this paper I have researched asymmetric effects of monetary policy shocks on output growth in five countries and the Euro-zone. This type of asymmetry is the so-called *'state'* asymmetries of monetary policy, according to which the effects of policy actions on output may depend on the current phase/state of the business cycle that the economy is undergoing. Furthermore, the possibility that policy shocks may affect the transition probabilities of one phase to another has also been addressed. My analysis is undertaken both at the aggregate and sectorial levels with the aim of identifying sectors in which 'state' asymmetries are larger.

I find strong evidence that monetary policy shocks, measured as shocks to the short-term interest rate obtained from a forward-looking Taylor rule, have significantly larger effects during a recession/mild growth phase than during an expansion phase for five European countries and the Euro-zone. The analysis at the sectorial level, comprising the four main components of GDP, reinforces the above-mentioned results when I consider the results in Construction and Services, two sectors which depend heavily on bank lending and in which, therefore, the credit channel of the monetary transmission mechanism is likely to be most relevant in explaining their cyclical fluctuations.

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Table 1: Estimated Reaction functions for central banks

	GE			FR			**UK**		
	$k=4$	$k=4$	$k=4$	$k=4$	$k=4$	$k=4$	$k=1$	$k=1$	$k=1$
	$p=1$	$p=1$	$p=1$	$p=2$	$p=2$	$p=2$	$p=0$	$p=0$	$p=0$
ρ	.84	.88	.71	.89	.96	.79	.85	.85	.63
	(24.76)	(21.12)	(13.87)	(23.53)	(25.25)	(19.50)	(24.56)	(15.76)	(13.02)
$\bar{\imath}$	5.50	3.10	3.45	6.24	4.53	4.75	6.68	2.31	2.66
	(12.02)	(4.94)	(6.10)	(5.60)	(2.90)	(5.19)	(9.35)	(5.44)	(8.18)
β_1	1.94	1.81	1.79	.64	.44	.47	.98	.94	.82
	(5.17)	(7.55)	(6.08)	(3.17)	(3.34)	(4.12)	(1.83)	(9.03)	(12.73)
β_2	.87	.95	.92	.72	.32	.53	.32	.82	.89
	(1.01)	(.66)	(1.72)	(1.78)	(2.48)	(1.48)	(1.59)	(9.73)	(3.41)
β_3	–	.17	.27	–	.20	1.11	–	.41	.58
	–	(3.66)	(5.34)	–	(2.21)	(7.26)	–	(.85)	(8.05)
σ_ε	.76	.82	.66	.87	.77	.88	.71	.85	.76
p	.08	.07	.10	.09	.07	.08	.09	.09	.08
	Sample Period 1978:01 1998:4			1978:01 1998:4			1978:02 1998:4		

	SP			**IT**			**EZ**		
	$k=2$	$k=2$	$k=2$	$k=4$	$k=4$	$k=4$	$k=4$	$k=4$	$k=4$
	$p=0$	$p=0$	$p=0$	$p=0$	$p=0$	$p=0$	$p=0$	$p=0$	$p=0$
ρ	.78	.86	.64	.91	.91	.90	.93	.78	.92
	(14.23)	(20.74)	(18.55)	(23.49)	(28.37)	(18.55)	(10.86)	(15.34)	(16.65)
$\bar{\imath}$	4.02	3.26	7.22	8.07	8.87	7.97	8.14	2.40	1.19
	(1.96)	(2.49)	(2.66)	(5.48)	(6.07)	(4.44)	(6.60)	(2.76)	(9.15)
β_1	.68	.54	.68	.62	.54	.84	1.32	1.07	1.27
	(5.45)	(3.87)	(5.45)	(2.28)	(1.87)	(3.62)	(1.72)	(5.84)	(6.35)
β_2	.13	.14	.84	.14	.18	.26	1.55	.35	.23
	(1.88)	(1.57)	(1.79)	(2.56)	(2.80)	(2.46)	(1.42)	(1.48)	(2.17)
β_3	–	.54	.87	–	.36	.19	–	.18	.78
	–	(.27)	(4.87)	–	(2.94)	(2.33)	–	(6.55)	(2.33)
σ_ε	.78	.80	.77	.82	.81	.84	.73	.76	.75
p	.05	.07	.09	.10	.08	.11	.04	.08	.09
	1977:04 1998:4			1982:02 1998:4			1984:01 2001:2		

GE~Germany;FR~France;UK~United Kingdom;SP~Spain;IT~Italy;EZ~Euro-zone

β_3^{GE} :Variations in DM/$ real exchange rate(second column); US interest rate(third column)

β_3^{FR} :Variations FF/DM real exchange rate(second column);German interest rate(third column)

β_3^{UK} : ℓ/DM real exchange rate changes(second column);German interest rate(third column)

β_3^{SP} : pta/DM real exchange rate changes(second column);German interest rate(third column)

β_3^{IT} :Lira/DM real exchange rate changes(second column);German interest rate(third column)

β_3^{EZ} :Euro/$ real exchange rate changes(second column);USA interest rate(third column)

Note: t-value in parentheses.p, is the p-value of the J-test for overidentifying restrictions

Table 2

Models for GDP growth

Dependent variable Ay_t

Estimated coefficients	Germany	France	UK	Spain	Italy	Euro-Zone
W_r	.19 (2.52)	.16 (1.97)	-.12 (2.74)	.17 (2.90)	.26 (1.91)	.24 (8.27)
W_e	.60 (2.93)	.50 (1.93)	.48 (2.07)	.41 (3.52)	.81 (2.61)	.81 (6.63)
d_1	.82 (10.93)	.86 (17.47)	.72 (10.58)	.90 (22.98)	.78 (29.76)	.14 (11.05)
K_{1r}	-.096 (3.31)	-.113 (2.21)	-.114 (3.68)	-.150 (3.84)	-.304 (2.06)	-.15 (5.08)
K_{1e}	-.049 (2.34)	-.053 (0.13)	-.027 (3.87)	-.007 (1.14)	-.038 (1.78)	-.066 (2.63)
a	.92 (3.87)	.41 (5.13)	.31 (8.95)	.21 (4.56)	.57 (5.28)	.16 (4.20)
p_{rr}	.88 (5.82)	.81 (4.05)	.47 (3.26)	.81 (3.77)	.97 (12.33)	.96 (78.11)
p_{ee}	.95 (25.63)	.97 (51.57)	.89 (21.43)	.93 (49.11)	.94 (11.47)	.84 (5.60)
d_r	5.26	8.33	1.88	5.26	33.33	25
d_e	20	33.33	9.09	14.28	16.67	6.25
Log-Likelihood	40.97	13.22	32.42	105.07	18.97	84.04

Note: t -values in parenthesis

Table 3: Models for Sectoral GDP growth

Agriculture & Hunting

Estimated coefficients	Germany	France	UK	Spain	Italy
W_r	-.34 (7.66)	.14 (3.63)	-.20 (5.69)	-.01 (2.09)	-.21 (4.52)
W_e	.17 (6.18)	.46 (5.38)	.42 (6.18)	.20 (1.81)	.26 (3.08)
$d_r(quarters)$	1.66	2.56	5.26	11.11	1.58
$d_e(quarters)$	2.44	1.16	9.09	7.14	25

Manufacturing

Estimated Coefficients	Germany	France	UK	Spain	Italy
W_r	-.05 (2.29)	-.03 (2.49)	-.29 (2.53)	-.22 (2.05)	-.13 (1.98)
W_e	.46 (7.41)	.42 (4.19)	.93 (2.73)	.31 (2.88)	.34 (3.42)
$d_r(quarters)$	3.45	5.68	8.33	5.88	6.66
$d_e(quarters)$	25	7.69	33.33	33.33	20

Construction

Estimated Coefficients	Germany	France	UK	Spain	Italy
W_r	-	-.68 (2.87)	-.67 (3.03)	-.24 (2.43)	-.35 (3.36)
W_e	-	.04 (2.28)	.31 (1.84)	.33 (1.96)	.12 (2.51)
$d_r(quarters)$	-	2.17	5.88	7.14	4.17
$d_e(quarters)$	-	33.33	33.33	14.28	20

Services

Estimated Coefficients	Germany	France	UK	Spain	Italy
W_r	.21 (2.04)	.05 (3.38)	.02 (2.21)	.17 (4.53)	.16 (1.95)
W_e	.51 (2.93)	.43 (4.11)	.30 (4.41)	.32 (4.96)	.27 (2.75)
$d_r(quarters)$	3.57	2.63	5.26	1.63	2.86
$d_e(quarters)$	8.33	3.33	33.33	5.88	7.69

Note: t -values in parenthesis

Table 4

Markov Switching Models with variable transition probabilities in GDP growth

Coefficients	Germany	France	UK	Spain	Italy	Euro-zone
W_r	.25 (2.27)	.27 (2.15)	.73 (2.07)	.97 (2.84)	.58 (2.23)	.56 (2.31)
W_e	2.40 (3.21)	1.91 (3.12)	1.35 (3.87)	2.83 (2.59)	2.13 (7.18)	2.12 (4.01)
d_1	.82 (10.93)	.86 (7.31)	.72 (9.53)	.96 (8.15)	.78 (8.77)	.72 (9.55)
a	.92 (10.33)	.41 (7.31)	.52 (6.14)	.24 (6.38)	.67 (4.89)	.55 (7.01)
S_{0r}	.49 (0.14)	.53 (.23)	.27 (3.87)	.07 (2.34)	.38 (4.24)	.34 (2.16)
S_{1r}	.96 (3.31)	1.13 (2.13)	1.14 (3.68)	1.50 (3.84)	3.04 (2.06)	1.56 (3.24)
S_{0e}	1.31 (1.90)	.95 (1.71)	.23 (3.21)	.06 (2.30)	.25 (2.41)	.55 (2.34)
S_{1e}	-.87 (2.14)	-.51 (2.37)	-.13 (1.11)	-.02 (.30)	-.00 (1.65)	-.31 (1.58)
Log-Likelihood	40.97	13.22	32.42	105.07	18.97	42.13

Note: t-value in parenthesis

Table 5

Markov Switching Models with variable transition probabilities in Manufacturing

Coefficients	Germany	France	UK	Spain	Italy
W_r	-.08 (2.01)	-.03 (2.13)	-.48 (3.11)	-.03 (2.32)	-.13 (2.07)
W_e	.48 (5.25)	.43 (1.99)	.21 (3.25)	.24 (3.15)	.36 (3.87)
d_1	.56 5.85	.52 (14.239)	.85 (10.89)	.91 (17.14)	.76 (8.98)
a	.76 (4.62)	1.03 (3.72)	.39 (4.81)	.16 (6.08)	.47 (6.08)
S_{0r}	.38 (2.05)	1.64 (3.06)	.69 (1.67)	.20 (2.77)	.05 (3.86)
S_{1r}	.31 (1.98)	4.56 (2.11)	1.27 (.24)	.43 (.43)	.74 (3.21)
S_{0e}	.44 (2.38)	-.12 (2.17)	.80 1.84)	.17 (2.17)	.27 (3.68)
S_{1e}	-.27 (1.74)	-.22 (2.33)	-.41 (2.02)	-.43 (.80)	-.45 (.33)
Log-Likelihood	44.12	11.96	13.67	26.77	18.74

Note: t-value in parenthesis

Table 6: **MSM with variable transition probabilities in Construction**

Coefficients	France	UK	Spain	Italy
W_r	-.74 (1.99)	-.52 (2.07)	-.18 (1.97)	-.41 (1.81)
W_e	.05 (1.84)	.19 (2.15)	.54 (1.75)	.04 (2.06)
d_1	.80 (23.25)	.84 (27.86)	.96 (32.01)	.86 (13.77)
a	1.13 (3.78)	1.29 (4.18)	.43 (4.80)	.56 (5.48)
S_{0r}	.50 (2.56)	.33 (3.15)	.13 (3.36)	.12 (2.21)
S_{1r}	.99 (1.85)	.34 (1.74)	2.10 (1.87)	.16 (1.21)
S_{0e}	.52 (1.77)	.54 (1.89)	1.52 (1.89)	.39 (1.92)
S_{1e}	.06 (.78)	-1.29 (3.02)	-.33 (.81)	-.3.05 (2.91)
Log-Likelihood	54.35	57.97	6.53	13.63

Note: t-value in parenthesis

Table 7: MSM with variable transition probabilities in Services

Coefficients	Germany	France	UK	Spain	Italy
W_r	.08 (1.82)	.04 (2.14)	.02 (2.03)	.07 (2.02)	.17 (2.16)
W_e	.47 (1.95)	.26 (2.14)	.26 (2.19)	.29 (1.87)	.35 (1.65)
d_1	.92 (17.19)	.88 (13.11)	.88 (6.98)	.95 (28.29)	.66 (14.04)
a	.08 (33.75)	.05 (27.84)	.05 (6.57)	.03 (4.12)	.03 (4.79)
S_{0r}	.81 (2.37)	1.09 (2.33)	.46 (2.26)	.08 (2.23)	-.19 (2.46)
S_{1r}	.59 (1.68)	3.84 (1.56)	1.34 (2.32)	1.69 (2.11)	.72 (2.72)
S_{0e}	.98 (1.23)	.84 (1.95)	.29 (2.27)	.24 (1.95)	.45 (2.41)
S_{1e}	-.19 (4.41)	-.34 (4.02)	-.37 (.94)	-.20 (.21)	-.83 (.16)
Log-Likelihood	37.22	74.95	44.24	18.04	70.18

Note: t-value in parenthesis

Table 8

Effects of interest rates shocks on transition probabilities in GDP

a/ u_t = ?100b.p.(t to t+1)

	GE		FR		UK		SP		IT		EZ	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
p_{rr}	0.62	0.38	0.62	0.36	0.57	0.30	0.52	0.19	0.59	0.07	0.58	0.23
p_{re}	0.38	0.62	0.38	0.64	0.43	0.70	0.48	0.81	0.41	0.93	0.42	0.77

b/ u_t =100b.p.(t to t+1)

	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
p_{ee}	0.79	0.61	0.63	0.36	0.56	0.53	0.51	0.52	0.56	0.56	0.63	0.56
p_{er}	0.21	0.39	0.37	0.64	0.44	0.47	0.48	0.49	0.44	0.44	0.37	0.44

Table 9

Effects of interest rates shocks on transition probabilities in Manufacturing

a/ u_t = ?100b.p.(t to t+1)

	GE		FR		UK		SP		IT	
	Before	After	Before	After	Before	After	Before	After	Before	After
p_{rr}	0.59	0.52	0.62	0.36	0.67	0.36	0.55	0.44	0.51	0.33
p_{re}	0.41	0.48	0.38	0.64	0.33	0.64	0.45	0.56	0.49	0.67

b/ u_t = +100b.p.(t to t+1)

	Before	After	Before	After	Before	After	Before	After	Before	After
p_{ee}	0.61	0.54	0.72	0.62	0.69	0.60	0.54	0.44	0.57	0.46
p_{er}	0.39	0.46	0.28	0.38	0.31	0.40	0.46	0.56	0.43	0.54

GE ~Germany;FR~France;UK ~United Kingdom;SP ~Spain;IT ~Italy

Table 10

Effects of interest rates shocks on transition probabilities in Construction

a/ u_t = ?100b.p.(t to t+1)

	FR		UK		SP		IT	
	Before	After	Before	After	Before	After	Before	After
p_{rr}	0.62	0.38	0.63	0.32	0.53	0.12	0.53	0.49
p_{re}	0.38	0.62	0.37	0.68	0.47	0.88	0.47	0.51

b/ u_t = +100b.p.(t to t+1)

	Before	After	Before	After	Before	After	Before	After
p_{ee}	0.63	0.64	0.58	0.50	0.82	0.86	0.60	0.07
p_{er}	0.37	0.36	0.42	0.50	0.18	0.14	0.40	0.93

Table 11

Effects of interest rates shocks on transition probabilities in Services

a/ u_t = ?100b.p.(t to t+1)

	GE		FR		UK		SP		IT	
	Before	After	Before	After	Before	After	Before	After	Before	After
p_{rr}	0.65	0.49	0.75	0.06	0.57	0.30	0.52	0.17	0.45	0.29
p_{re}	0.35	0.51	0.25	0.94	0.43	0.70	0.48	0.83	0.55	0.71

b/ u_t = +100b.p.(t to t+1)

	Before	After	Before	After	Before	After	Before	After	Before	After
p_{ee}	0.71	0.62	0.70	0.62	0.56	0.53	0.56	0.51	0.61	0.41
p_{er}	0.29	0.38	0.30	0.38	0.44	0.47	0.44	0.49	0.39	0.59

GE ~Germany;FR~France;UK ~United Kingdom;SP ~Spain;IT ~Italy

Figure 1: Taylor rule predictions

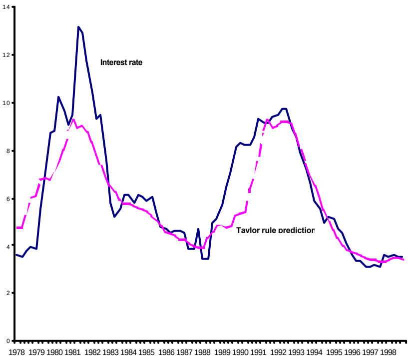


Figure 1A: Taylor rule in Germany

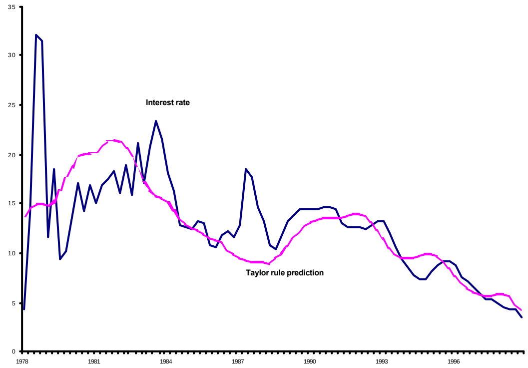


Figure 1D: Taylor rule in Spain

Figure 1B: Taylor rule in France

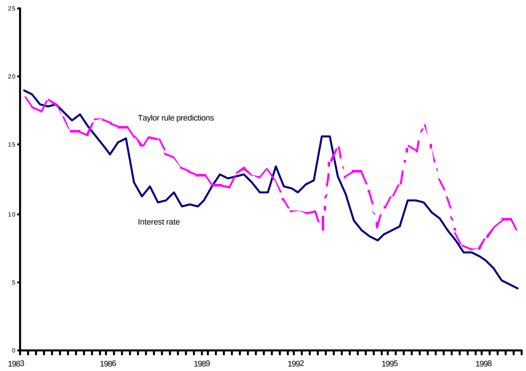


Figure 1E: Taylor rule in Italy

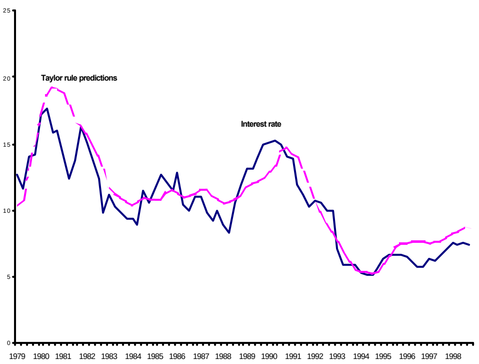


Figure 1C: Taylor rule in UK

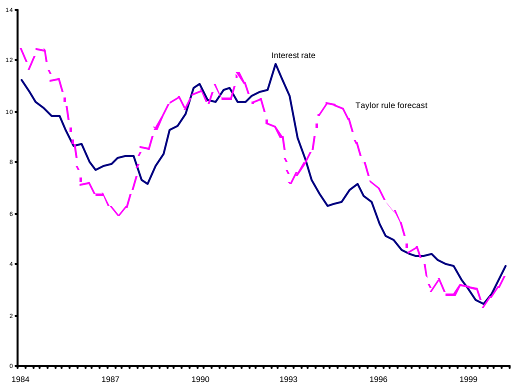
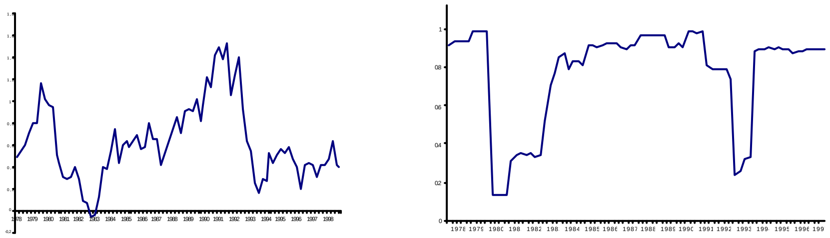


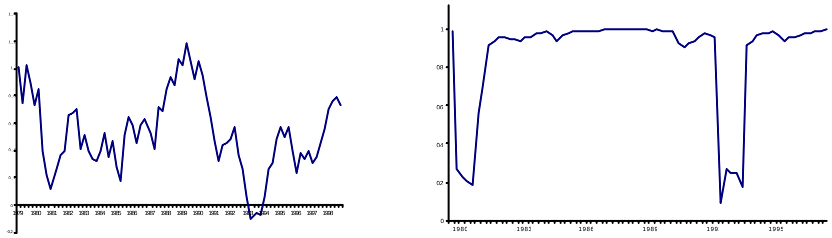
Figure 1F: Taylor rule in the Euro-zone

Figure 2: Hamilton Model for the GDP growth and estimated probabilities of an expansion

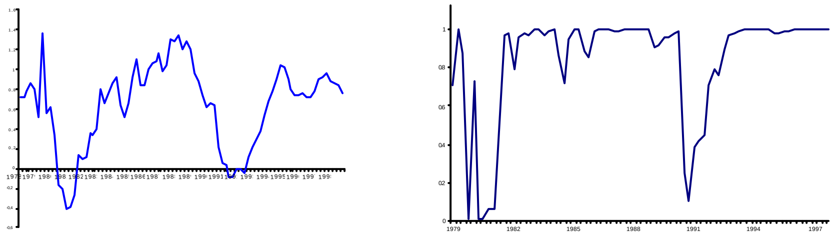
2A Germany



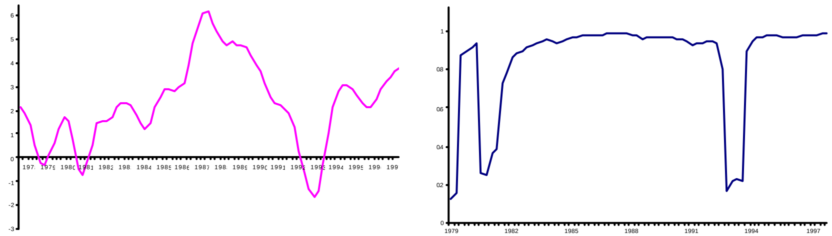
2B France



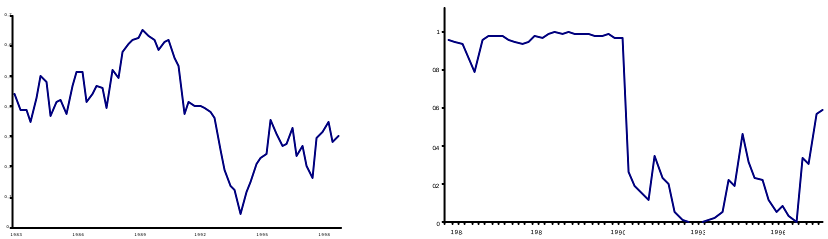
2C: UK



2D: Spain



2E: Italy



2F: Euro-zone

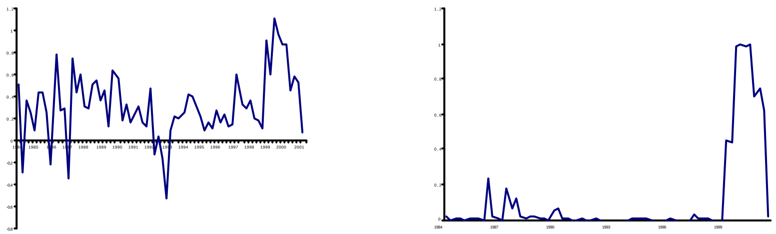
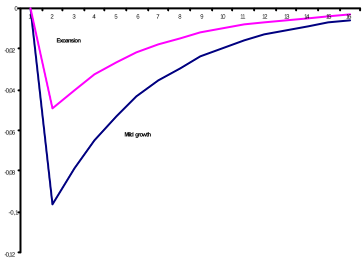
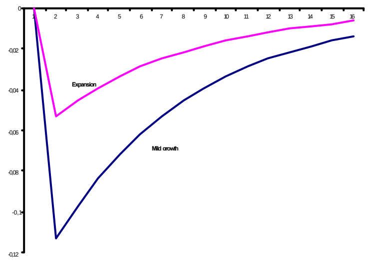


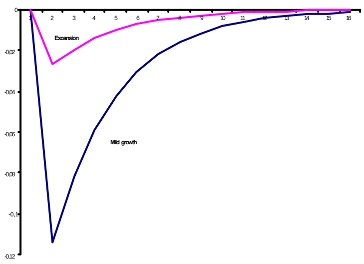
Figure 3: GDP growth Impulse- Response functions to an unanticipated increase in interest rate



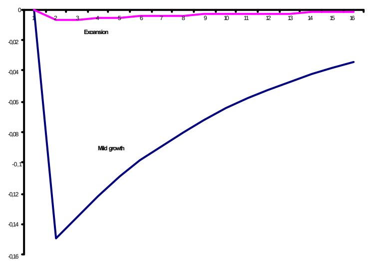
3A: Germany



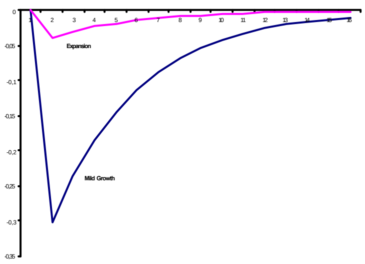
3B: France



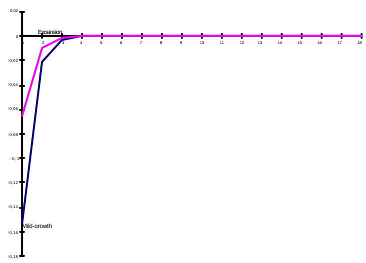
3C: UK



3D: Spain



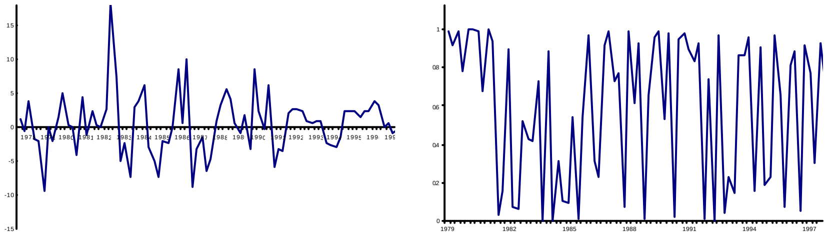
3E: Italy



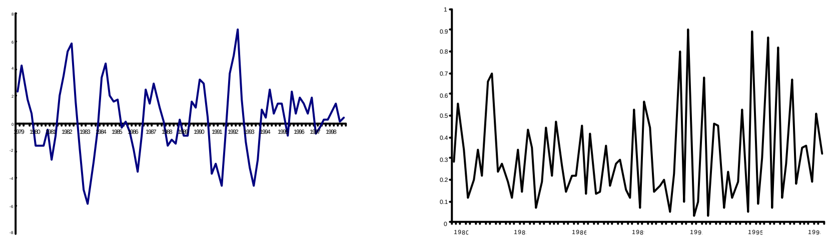
3F: Euro-zone

Figure 4: Hamilton Model for the Value Added growth in Agriculture and estimated probabilities of an expansion

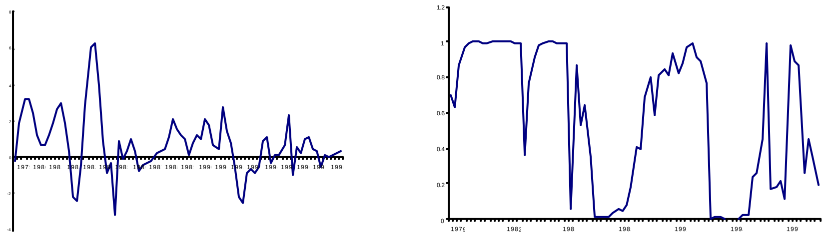
4A Germany



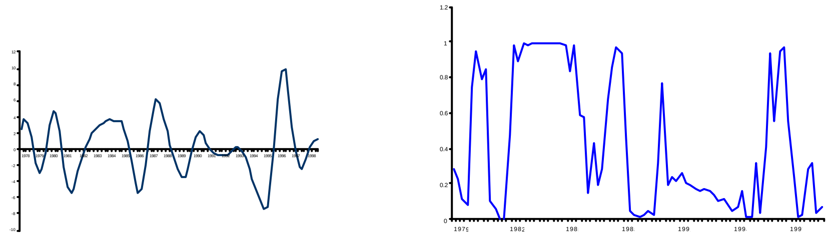
4B France



4C: UK



4D: Spain



4E: Italy

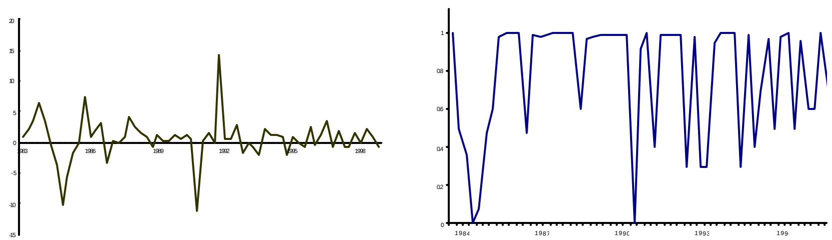
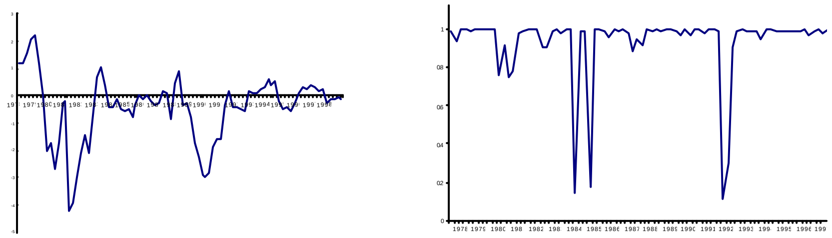
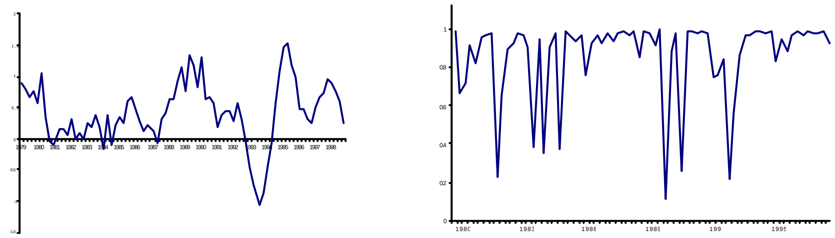


Figure 5: Hamilton Model for the Value Added growth in Manufacturing and estimated probabilities of an expansion

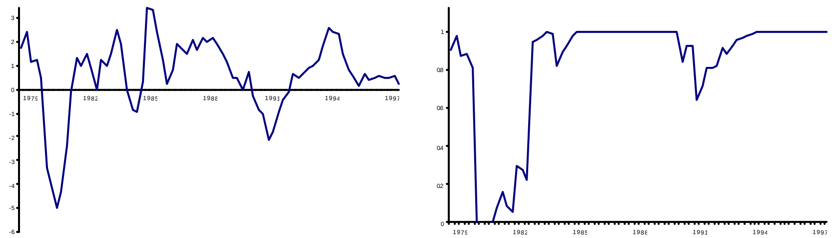
5A Germany



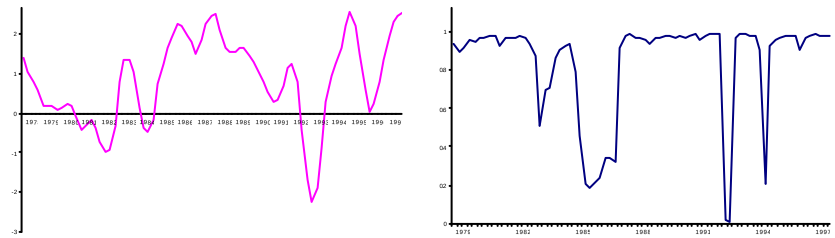
5B France



5C: UK



5D: Spain



5E: Italy

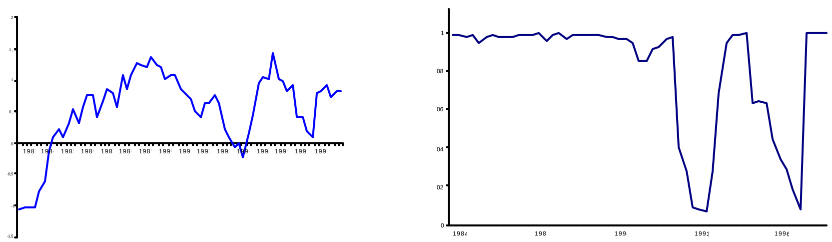
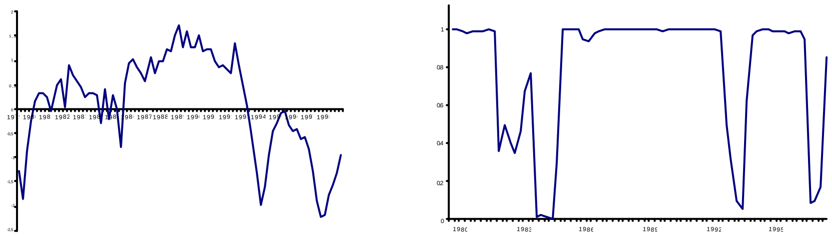
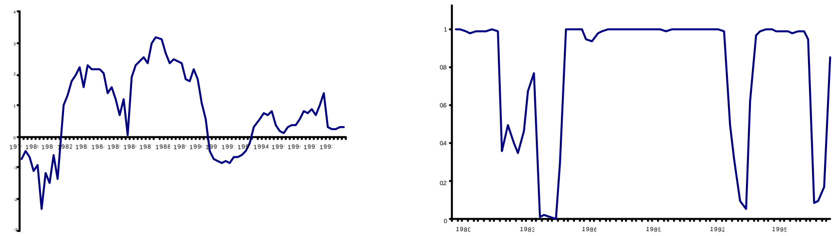


Figure 6: Hamilton Model for the Value Added growth in Construction and estimated probabilities of an expansion

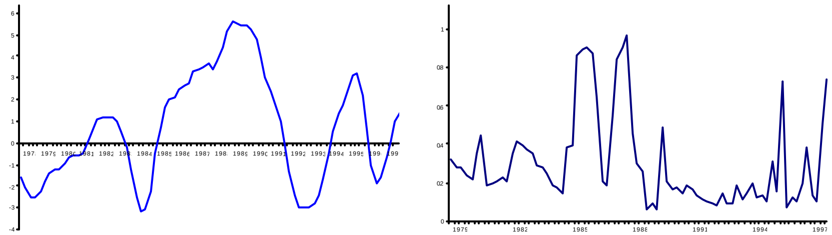
6A: France



6B: UK



6C: Spain



6D: Italy

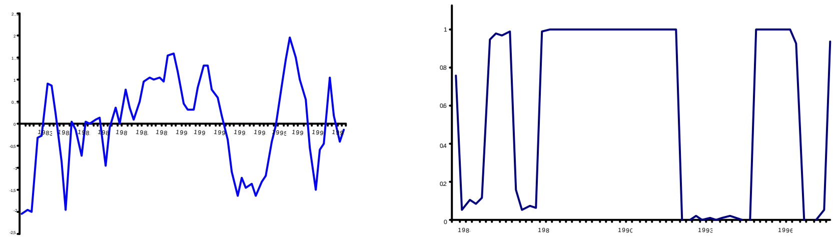


Figure 7: Hamilton Model for the Value Added growth in Services and estimated probabilities of an expansion

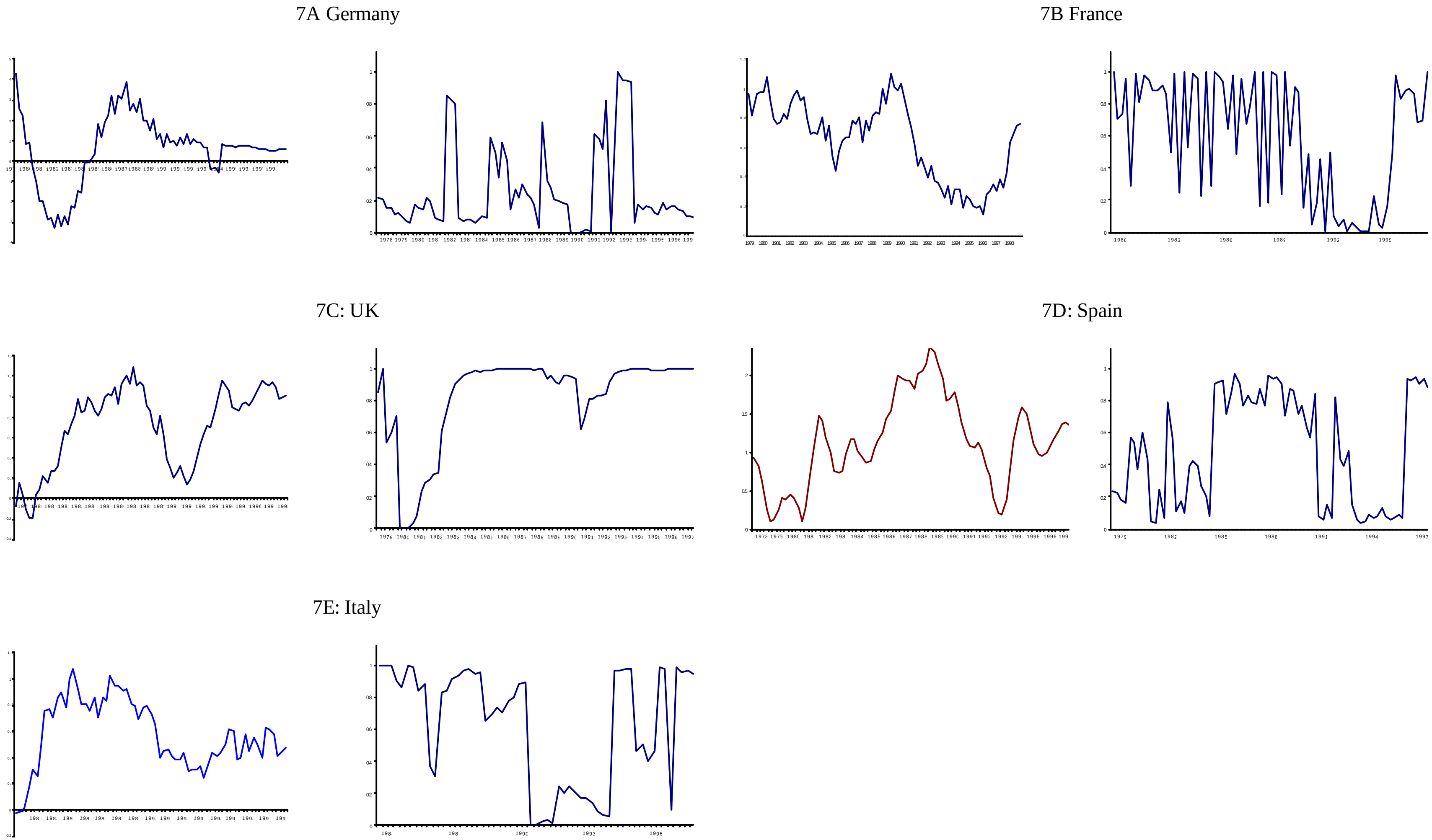


Figure 8: Agriculture Impulse-Response functions to an unanticipated increase in interest rate

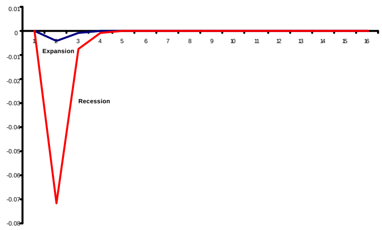


Figure 8A: Germany

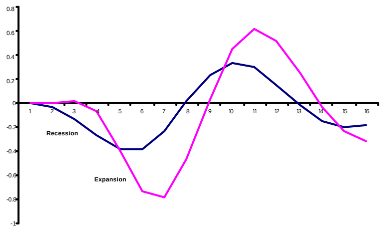


Figure 8B: France

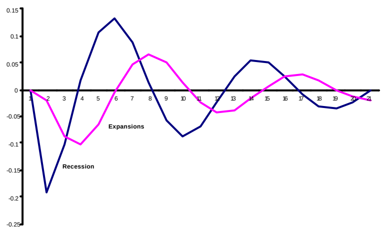


Figure 8C: UK

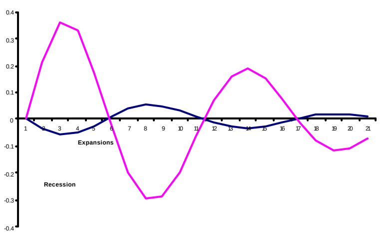


Figure 8D: Spain

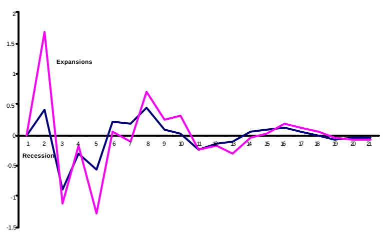


Figure 8E: Italy

Figure 9: Manufacturing Impulse- Response functions to an unanticipated increase in interest rate

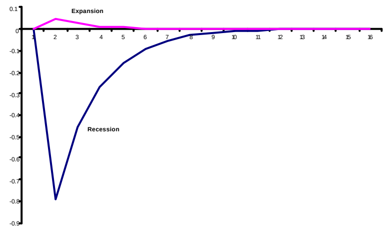


Figure 9A: Germany

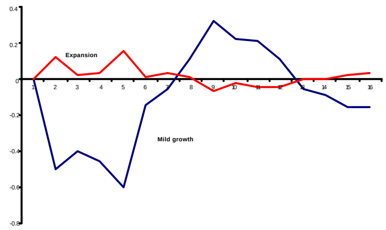


Figure 9B: France

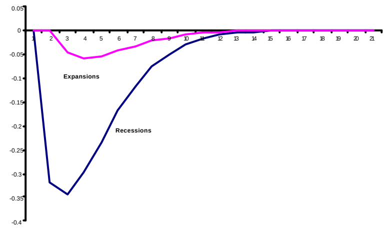


Figure 9C: UK

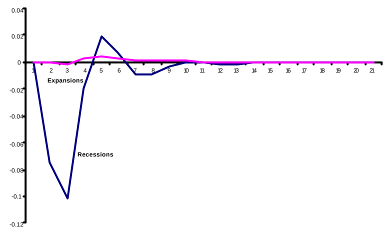


Figure 9D: Spain

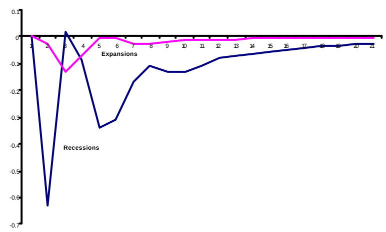


Figure 9E: Italy

Figure 10: Construction Impulse- Response functions to an unanticipated increase in interest rate

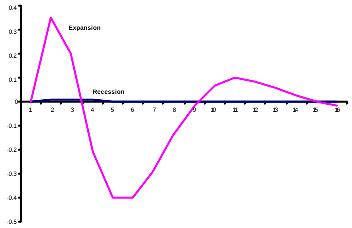


Figure 10A: France

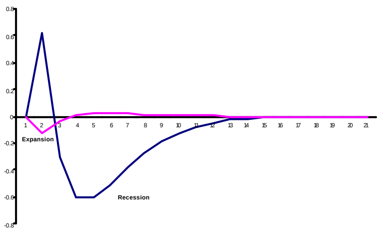


Figure 10B: UK

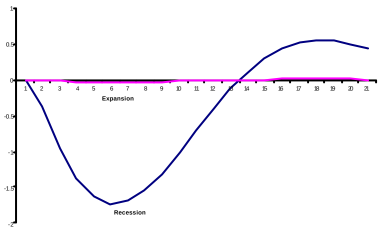


Figure 10C: Spain

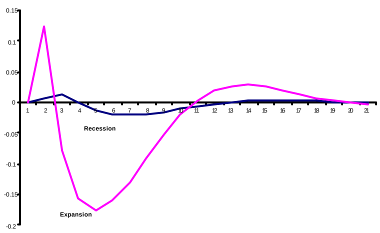


Figure 10D: Italy

Figure 11: Services Impulse- Response functions to an unanticipated increase in interest rate

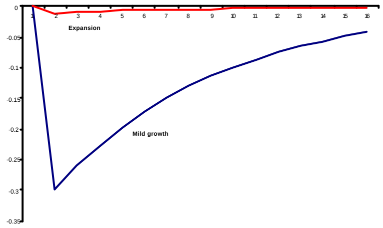


Figure 11A: Germany

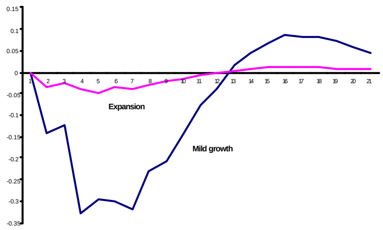


Figure 11B: France

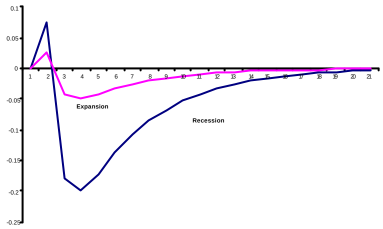


Figure 11C: UK

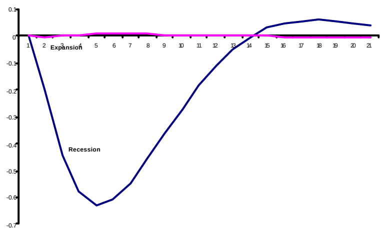


Figure 11D: Spain

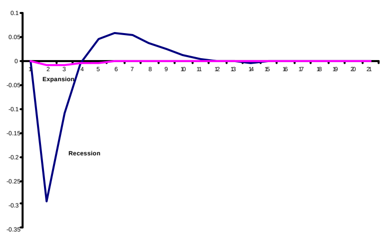


Figure 11E: Italy