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Sacrifice Ratios in Europe: a Comparison

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RÉSUMÉ

L'inflation décroît depuis plusieurs années en Europe et est maintenant inférieure à 2% l'an en France, en Allemagne et en Italie. Dans le même temps, le chômage européen n'a cessé de croître. Peut-on pour autant mettre en évidence un lien entre l'augmentation du chômage et la désinflation ?

Dans la mesure où l'on admet que la courbe de Phillips est verticale à long terme, il est difficile de défendre qu'il aurait été possible de réduire durablement le chômage en acceptant un niveau plus élevé d'inflation. Cependant, à partir du moment où les politiques de désinflation pèsent sur la demande pour ralentir l'inflation, la baisse de l'activité ainsi provoquée peut induire à court terme une augmentation du chômage, quel que soit l'instrument utilisé. On peut alors supposer que les politiques de désinflation peuvent contribuer à expliquer la persistance du chômage européen, sans remettre en question la verticalité de la courbe de Phillips.

L'approche utilisée ici est délibérément empirique : nous cherchons à mesurer le coût en chômage des politiques de désinflation à un horizon de moyen terme. Pour cela, nous mettons en œuvre une analyse temporelle des séries d'inflation et de chômage qui décrit de manière simplifiée la dynamique des principales économies européennes (France, Allemagne, Italie, Royaume-Uni). Nous faisons donc l'hypothèse que le chômage et l'inflation sont des fonctions de chocs d'offre et de demande identifiés dans le cadre de modèles VAR. Ceci nous permet alors de mesurer le coût en chômage de politiques de désinflation passant par une réduction de la demande finale, que l'on dénomme ici “ ratios de sacrifice ”.

Ce coût peut différer selon les pays, puisque les modes d'ajustements des marchés du travail ne sont pas les mêmes. Nos résultats indiquent que sous des hypothèses relativement restrictives, les “ ratios de sacrifice ” sont homogènes dans les quatre pays.

Nos estimations ne mettent pas en évidence de réduction des disparités structurelles entre les pays. Malgré la convergence des taux d'inflation et la communauté de tendance des taux de chômage, les mécanismes sous-jacents d'ajustement entre prix et quantités sur les marchés du travail ne deviennent pas plus uniformes d'un pays à l'autre. En revanche, on observe dans les 4 pays qu'une même variation de l'inflation requiert une plus forte variation du chômage dans les quinze dernières années que dans les années 1960 et 1970. En France en particulier, l'élasticité de l'inflation au chômage est devenue très faible ces dernières années. Le coût en chômage des politiques de désinflation par la demande apparaît d'autant plus élevé que le niveau de l'inflation est bas.

SUMMARY

Inflation seems now well below 3% almost everywhere in Europe and has been so for a number of years in a number of EU countries. At the same time, unemployment has steadily risen, and seems now stabilised at records high level. Even if the Phillips curve is vertical in the long term, this observation yields questions about the short to medium term impact of the disinflationary policies implemented throughout the eighties and the nineties. Could they partly explain the level and the persistence of the European unemployment rates?

The European System of Central Bank’s main objective is to control inflation. This objective may be achieved through slowing final demand which at least in the short-run, would imply rising unemployment. An important body of literature provides evidence on structural differences in European labour markets. It can be expected that these latter will be reflected by differences in the way monetary policy is transmitted through the labour market. If that is the case, the costs of disinflationary policies, in terms of unemployment, is likely to vary across European countries.

The aim of this paper is twofold. First, we try to assess to what extent the transmission mechanisms are different across Europe. We concentrate on Europe’s four biggest economies: France, Germany, Italy and UK. Second, we seek to evaluate whether the building of Europe (through the Single Market implementation and the run-up to EMU) has triggered a process of convergence among European countries.

The econometric methodology takes its root in the ‘*revisionist history of the Phillips curve’* of King and Watson (1994). The idea is that, although there is no long-run trade-off between inflation and unemployment (i.e these two I(1) series are not cointegrated), there might exist a relationship in the short to medium run, due to adjustment lags and labour market rigidities. We build up a bivariate VAR for inflation and unemployment, in which a demand shock is defined as a shock which moves the two series in opposite direction. The VAR impulse response function then allow the persistence effect of shocks onto inflation and unemployment to be computed, from which we derive an assessment of the degree of symmetry in the transmission of monetary policy through the labour market in Europe.

We shall see that quite restrictive assumptions are required for the sacrifice ratios to be of similar magnitude across countries. Furthermore, we cannot provide evidence of a structural convergence process in Europe. Finally, we show that the sacrifice ratios have been rising since the mid-eighties for the four countries we study, which means that the cost of disinflationary policies is higher today (when the inflation rate is already low) than it used to be. This suggests that the short-run inflation-unemployment trade-off is non linear with respect to inflation.

SACRIFICE RATIOS IN EUROPE : A COMPARISON

Laurence Boone and Benoît Mojon[1]

1. INTRODUCTION

European inflation is now reaching records low level. The peaks attained after the oil price shocks seem old memories. Initiated by Paul Volker in the US in 1979, the disinflation processes might have followed different paths but finally succeeded in Europe. The Bundesbank never allowed the imported inflation to contaminate the rest of the economy. Margaret Thatcher followed the path opened by Paul Volker, to master inflation. France used the pegging of the exchange rate to the DM within the ERM to stabilise inflation in the second half of the eighties. Italy followed the same strategy as France, although with some delay in achieving low inflation.

Inflation is now well below 3% almost everywhere in Europe and has been so for a number of years in a number of EU countries. At the same time, unemployment has steadily risen. It now seems stabilised at records high level. This appears as a major failure of European economic policies, especially at a time when the US reaches record low levels of unemployment while performing as well as Europe on inflation.

To what extent are the disinflationary policies implemented throughout the eighties and the nineties responsible of the persistent trend in European unemployment ? This will probably remain an endless debate among economists, from a theoretical as well as an empirical point of view (Bean, 1994). As such, this is beyond the scope of this paper. Our ambition is much more modest : it focuses on the transmission of disinflationary policies through the labour market, across European countries. Under EMU, this seems an essential information for the European System of Central Banks, especially since its objective is to control inflation. Inflation will be fought through slowing final demand, which could have an impact on unemployment. The extent and the significance of the impact of monetary policy on the labour market is likely to differ across EMU candidates (Demertzis and Hughes-Hallett 1998). But the construction of Europe might have triggered a process of convergence of the inflation-unemployment trade-off.

The aim of this paper is twofold. First, we try to assess the potential costs, in terms of unemployment, of disinflationary policies in four major European economies (France, Italy, Germany and the UK) that we call the E4. Then, we try to provide evidence regarding convergence in the inflation unemployment trade-off across Europe. We shall put a particular emphasis on the (a)symmetries across the labour markets and how they have evolved. Demertzis and Hughes-Hallet (1998) show that structural differences in European labour markets might be responsible for different national natural rates of unemployment (NAIRU). These differences in NAIRU will in turn correspond to different costs, in terms

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of unemployment, of a disinflationary policy. Furthermore, they also point out that a process of convergence in those costs seems to have taken place until 1991, but that it paused thereafter. Yet, they do not try to identify the source of the differences, whether they might come from the shocks themselves or the policy transmission (Bean 1994).

This paper adds to this stream of research by analysing how demand shocks are transmitted to the labour market in Europe, and whether the transmission processes have gone more symmetric in the run-up to EMU. For that, we use an econometric methodology that is essentially empirical, taking its roots in the '*revisionist history of the Phillips curve'* of King and Watson (1994). They show that even if there is no long-run Phillips curve, there is an inflation unemployment trade-off at the business cycle horizon, which means that a sacrifice ratio may be computed. The computation of the sacrifice ratios come from a bivariate VAR model in which a demand shock is defined as a shock which moves the time series of inflation and unemployment in opposite direction. The VAR impulse response functions then allow the persistence effect of shocks onto inflation and unemployment to be measured. From this we provide an evaluation of the degree of symmetry in the transmission of monetary policy through the labour market in Europe.

The work is organised as follows. In a first part we detrend the data of inflation and unemployment, in the UK, France, Germany and Italy (E4 thereafter), in order to look for a potential negative correlation at the business cycle frequency (i.e. short-run fluctuations). The idea is to unveil the existence of a short run trade-off between inflation and unemployment, as was done by King and Watson (1994) for the US. The existence of such a trade-off in the short-run allows demand management of inflation in Europe by monetary policy. The magnitude and significativity of the correlation coefficient is also a first assessment of structural similarities in the inflation-output trade-off across Europe.

This is further investigated with bi-variate (inflation and unemployment) VAR. Quoting Dolado et al. (1996) our approach is *'both structural and eclectic'*. Indeed, King and Watson (1994) show that the same reduced bi-variate VAR can be given several economic interpretations according to the identification restrictions of the model. The costs in unemployment of a disinflationary policy vary accordingly. King and Watson strategy was to derive sacrifice ratios under different theoretical assumptions. But no tests of the reliability of the chosen assumptions was provided. We choose a different route in that we analyse the inflation-unemployment trade-off under a continuum of hypotheses, without prior on the underlying theory shaping the economic system.

This is done in four steps. First, we focus on the reduced forms of the VAR. They provide information on the joint dynamic behaviour of inflation and unemployment, with an indication of the direction of the causality between the two variables. In a second step we calculate the whole spectrum of long-run trade-offs and sacrifice ratios across Europe. We will see that, under certain conditions, sacrifice ratios are of a similar magnitude. In a final part of the paper, the robustness of the results is investigated, and the convergence process is examined. We show that sacrifice ratios have been rising since the mid-eighties for all the countries we studied, which means that the cost of disinflationary policies are higher today (when the inflation rate is low) than they used to be. This might suggest that the short-run inflation-unemployment trade-off is non linear with respect to inflation.

The paper is organised as follows. Section 2 presents the data and analyses the correlation between inflation and unemployment at different frequencies. Section 3 explains the econometric methodology. Section 4 provides an assessment of the transmission mechanisms of monetary policy through the labour market across European countries. Finally, section 5 looks for the possibility of a convergence process in the structure of labour markets across Europe. Then we conclude.

2. A FIRST LOOK AT THE INFLATION-OUTPUT TRADE-OFF

In this section we revisit the inflation output trade-off. Assuming that output and unemployment are linked by a mechanism such as the Okun's law, this can be done through the inflation unemployment correlation. We study four countries, France, Germany, Italy and the UK that we call E4. The data are quarterly, cover the period 1962-1997, and come from the OECD National Accounts (except for the French unemployment that was given to us by P. Villa, 1997).

Appendix A presents the graphs of inflation and the unemployment rate for the E4 and the US. Europe is characterised by a diverse evolution of the inflation and unemployment data. The two variables appear very low in level at the beginning of the sixties until the first oil shock. Then a period of both rising inflation and unemployment starts in France, Italy and the United Kingdom. However, from the mid-eighties onward, this bivariate trend is reversed. While the unemployment rate carries on rising to reach record high levels, inflation declines in all European countries.

This pattern is to be contrasted with the US, where inflation has strongly risen following the oil price shock, but declined quickly in the early eighties with the Volker plan. At the same time, the unemployment rate appears much more stable from one period to the other and seems to oscillate around a mean.

Table 1. Stylised facts in inflation and unemployment : the EU and the US

FRANCE	1961-1996	1961-1973	1974-1986	1987-1996
Inflation rate (standard deviation)	5,7 (3,5)	4,4 (1,6)	9,4 (3,0)	2,6 (0,7)
Unemployment rate (standard deviation)	6,1 (3,82)	2,0 (0,6)	6,8 (2,4)	10,6 (1,3)
Correlation coefficient	*-0.2*	*0.58*	*-0.63*	*-0.86*
GERMANY	1962-1996	1962-1973	1974-1986	1987-1996
Inflation rate (standard deviation)	3.3 (1.7)	3.3 (1,6)	3.9 (1.9)	2,5 (1,4)
Unemployment rate (standard deviation)	4.9 (3.39)	1,0 (0,4)	6,0 (2,4)	8.2 (1,2)
Correlation coefficient	*-0.32*	*-0.14*	*-0.63*	*-0.63*
ITALY	1961-1996	1961-1973	1974-1986	1987-1996
Inflation rate (standard deviation)	8.0 (5.2)	4.6 (2,4)	13.7 (4.1)	5,0 (0,9)
Unemployment rate (standard deviation)	8.1 (2.71)	5,32 (0,8)	8,2 (1,7)	11.4 (0,7)
Correlation coefficient	*-0.06*	*-0.03*	*-0.65*	*0.04*
UNITED KINGDOM	1961-1996	1961-1973	1974-1982	1983-1996
Inflation rate (standard deviation)	6.9 (4.8)	4.9 (2,3)	13.7 (4.5)	4,50 (2.0)
Unemployment rate (standard deviation)	5.5 (3.41)	2,11 (0,49)	5,0 (2,3)	9.0 (1,7)
Correlation coefficient	*-0.22*	*0.33*	*-0.53*	*-0.54*
UNITED STATES	1961-1996	1961-1973	1974-1982	1983-1996
Inflation rate (standard deviation)	4.6 (2.9)	3.1 (1,8)	8.6 (2.5)	3,47 (1.0)
Unemployment rate (standard deviation)	6.1 (1.51)	4.9 (1,0)	7.2 (1.3)	6.6 (1,2)
Correlation coefficient	*0.20*	*-0.39*	*-0.41*	*-0.22*

Note : Quarterly data on annual growth rate of the consumer price index and unemployment rate. Source : OECD National Accounts and P.Villa.

Table 1 summarises some stylised facts for Europe and the US on inflation and unemployment. The first striking feature of this table is the instability of the relationship between the two variables, as well as their respective great variability across the sub-samples. Indeed, both the mean and the volatility of inflation and unemployment vary greatly across periods, even if the recent one looks more stable. Furthermore, the correlation coefficient between the two time series, inflation and unemployment, also display great diversity across periods. They are negative for the whole sample in all European countries, but not significantly different from zero in Italy. Looking at the sub-samples provides evidence of the non-stability of this coefficient over time. For France, Germany and the UK, the correlation coefficient between the two variables is weakly positive in the first sub-period (1960-75), but significantly negative after the first oil shock, a fact that persists throughout the last ten years.

This first look suggests that one needs to assess the relationship on different horizons, maybe distinguishing between a long term tendency and short-run fluctuations.

For that, we follow King and Watson (1994) in detrending the series of observation. We use two types of methods to detrend the series : the Hodrick-Prescott (HP thereafter) filter, that is employed by King and Watson for the US, and the Stochastic Trend Model (STM thereafter[2]). The HP filter is the most commonly used method to detrend time series. Yet, its drawbacks (arbitrary fixing of the smoothing coefficient, end and beginning of the sample effects, modification of the first and second order time properties, and hence of the correlation coefficient[3]) are well known. So we compare the HP results with those obtained from another method, based on the Stochastic Trend Model (STM thereafter), developed by Boone and Hall (1995a and b). The STM approach is a modelling methodology which takes into account structural shocks and changes in regime. Boone and Hall (1995a) show, both analytically and using a Monte Carlo study, that the STM approach provides a more accurate decomposition of the series than the HP filter, especially when the trend is deterministic with breaks. The STM requires that an hypothesis on the functional form of the trend be made for just identification. We choose to impose a deterministic trend with breaks as in Perron (1989)[4]. We report the results with the two methods. The results based on the HP filter allow direct comparisons with King and Watson's results for the US. Yet, since they are subject to criticisms, we rather rely on STM estimates to assess the correlation between the short-run fluctuations of the variables.

Table 2. Correlation over the business cycle of inflation and unemployment

		Total sample	1960-1973	1973-1986	1987-1996
Germany	**H-P**	-0,25	-0,36	-0,23	-0,21
	MTS	-0,51	-0,50	-0,77	-0,96
France	**H-P**	-0,16	0,15	-0,36	-0,29
	MTS	-0,38	-0,23	-0,86	0,02
Italy	**H-P**	-0,12	-0,14	-0,21	0,12
	MTS	-0,40	-0,60	-0,82	-0,59
United Kingdom	**H-P**	-0,32	-0,24	-0,32	-0,41
	MTS	-0,40	0,01	-0,79	0,10
United States	**H-P**	-0,51	-0,48	-0,54	-0,39
	MTS	-0,24	0,49	0,24	-0,55

Note : the sample starts in 1960 Q2 for all countries except Germany, which starts in Q3, and ends in 96 Q4. The smoothing coefficient for the HP filter is the standard one for quarterly data, 1600.

2 For a detailed explanation on the STM methodology, see Boone and Hall (1995a), and for an application of the methodology see Boone and Hall (1995b).

3 King and Rebelo (1993) also show that the HP filter affect the properties of the detrended series in a way that is not constant from one series to the other, hence rendering any comparisons impossible. Further, Canova (1993) provides evidence that the time properties of a detrended series reflect more the time properties of the filter used than the original series themselves.

4 Implicitely we hereby assume that both inflation and unemployment series fluctuate around a trend. When the trend reverts (as it is the case for most inflation series), we allow for a break and change the sign of the slope of the trend.

The divergence between the HP and STM estimates underlines the need to interpret with great care the results. Hence, the stable short-run negative correlation reported for the US by King and Watson can legitimately be put into question, since it is not confirmed by the STM decomposition on the first two sub-samples.

Roughly speaking, the results in the European countries are in line with the ones for the US : the correlation is negative over the whole period. This could suggest the existence of inflation-output trade-off at the business cycle horizon. Yet this statistic varies greatly across periods. Furthermore, the EU countries present a certain number of common features, at the business cycle horizon, that are different from the US evolution. Table 2 displays a significantly negative correlation coefficient for all countries, over the period 1960-96 (though of a different magnitude according to the observed country). The four European countries are also very homogenous during the high inflation period, where the trade-off is strongly negative. This shows that, despite a rising trend in inflation and unemployment, due to the oil shock, there still existed a trade-off between the short-run fluctuations of these variables. Hence, observing the gross series provides evidence of the strength of the supply shock, but looking at the business cycle horizon shows that the demand side explanation was still present. The last sub-sample offers a contrasted pattern. Like the US, Germany and Italy still present a strongly negative correlation coefficient, while it is insignificant in France and in the UK.

These results are quite worrying in the sense that they do not provide any evidence of a converging inflation-unemployment relationship in Europe. On the contrary, there seems to be a greater disparity in the last sub-period. However, they look more similar between themselves than compared to the US. This may have two interpretations. Either the Phillips curve is a spurious phenomenon and there exists no negative correlation of inflation and unemployment at whatever horizon. Or there are asymmetries across nations, that would be far more troublesome within a monetary union perspective. Such asymmetries may arise from differences in shocks, in the transmission of the shocks or in the persistence effects (Bean, 1994). Below we focus on the differences that may arise from the transmission mechanisms and the persistence effects.

3. A VAR ANALYSIS OF THE INFLATION-UNEMPLOYMENT TRADE-OFF

This section presents the methodology. Definitions and notations are thoroughly presented. The computation of the measure of persistence effect and sacrifice ratio is explained.

3.1. Properties of time series and computation of the Phillips trade-off

Although there is a consensus that a Phillips curve cannot be tested in the form of neutrality tests between inflation and unemployment in levels, recent developments in time series modelling are at the origin of the renewal of interest for such tests in differences (Fischer and Seater, 1993). Hence, a reduction of the inflation rate, via a restrictive demand policy, could yield a temporary rise in the unemployment rate. This would be reversed in the long term, but might persist in the short to medium run, due to market imperfections and other lags in the adjustment mechanisms. King and Watson (1994) formalise these ideas as follows.

The persistence effect of a demand shock ε^d on a variable x is given by the long run derivative of this variable with respect to the demand shock :

$$\lim_{k\to\infty} \frac{\partial x_{t+k}}{\partial \varepsilon_t^d} \tag{1}$$

This measures the change in the variable x that persists at time t+k following a demand shock at time t.

A Phillips type of trade-off between the variations of unemployment and inflation may then be given by the relative ***persistence effect*** of a demand shock on the two variables:

$$\lim_{k\to\infty} \frac{\partial u_{t+k}}{\partial \pi_{t+k}} = \lim_{t+k} \frac{\partial u_{t+k} / \partial \varepsilon_t^d}{\partial \pi_{t+k} / \partial \varepsilon_t^d} \tag{2}$$

It is simply the limit of the ratio of the long-run derivatives of each variable with respect to the demand shock. There is a trade-off if this limit is different from zero.

The cumulative sum of adjustment costs, in terms of unemployment, following a demand shock that permanently lowers inflation is given by the ***sacrifice ratio***:

$$SR_k = -\frac{\int_t^{t+k} \partial u_{t+k} \,/\, \partial \varepsilon_t^d}{\int_t^{t+k} \partial \pi_{t+k} \,/\, \partial \varepsilon_t^d} \tag{3}$$

The formal definition of the sacrifice ratio is the cumulative annual percentage point changes in unemployment, at time t+k, required to produce a 1% permanent reduction in inflation, following a negative demand shock at time t. While the long run derivative is the ratio of the impact on the two variables of a demand shock, the sacrifice ratio (SR) is the relative cumulative sum of the derivative of each variable with respect to the demand shock.

From this, it can be clearly seen that if inflation is not a mean-reverting process ($\frac{\partial \pi_{t+k}}{\partial \varepsilon_t^d} \neq 0$), then a trade-off at horizon k between the first difference of the two variables may be observed. Before turning to formal testing, we present the other points of the methodology.

3.2. The methodology

From section 3.1 it can easily be seen that the first step is to check for the time series properties of the variables. We test for non stationarity (whether it may arise from a trend or not). As both inflation and unemployment exhibit a unit root, we tested for cointegration. There might be two stochastic trends in the series and one cointegrating vector. Accepting the hypothesis of a significantly negative cointegrating vector would lead to accept that there is a long-run Phillips trade-off. Rejecting this hypothesis will lead to accept the verticality of the long run Phillips curve[5]. Yet this does not put an end to the analysis of the dynamic of inflation and unemployment. In the absence of cointegration, this can be studied using VAR analysis. Section 2 summarised the time series properties of inflation and unemployment. Both series are non-stationary and do not cointegrate. Therefore we can proceed to the analysis of long-run derivatives and sacrifice ratios using the VAR methodology. The rest of this section presents the VAR methodology within this framework.

From the reduced-form VAR to the structural VAR

Let's consider a simplified general representation of the economy.

$$\Delta u_t = \lambda \Delta \pi_t + \sum_{i=1}^{p} \phi_{u\pi,i} \Delta \pi_{t-i} + \sum \phi_{uu,i} \Delta u_{t-i} + \varepsilon_{St} \tag{4}$$

$$\Delta \pi_t = \delta \Delta u_t + \sum_{i=1}^{p} \phi_{\pi\pi,i} \Delta \pi_{t-i} + \sum_{i=1}^{p} \phi_{\pi u,i} \Delta u_{t-i} + \varepsilon_{Dt} \qquad (5)^6$$

where u represents the unemployment rate, π is the inflation rate, Δ denotes first differences, and the $\phi_{xy,i}$ coefficients are the parameters measuring the impact of variable y on variable x at time t-i. λ measures the instantaneous impact of inflation on unemployment and δ measures of the instantaneous impact of unemployment on inflation. The two series are written in first differences since they are both I(1) and do not cointegrate.

This system may be given several interpretations. Equation (4) represents the supply side of the economy. For Keynesians, it works through a dynamic generalised representation of the Phillips curve. For Monetarists, it is an aggregate supply curve. Equation (5) is a demand equation. Keynesians interpret unemployment as a proxy for the stance of aggregate demand. Monetarists would rather interpret it as a reduced form for an

[5] An extension of this research would be to increase the possibility of cointegrating vectors, that would include other variables such as the wedge, measures of competitiveness and others. We intend to pursue this direction in future research.

[6] The ε are the structural supply and demand shocks.

Okun's law and a quantity equation. A Real Business Cycle interpretation of the system would put forward that unemployment is a pure real phenomenon so that nominal shocks do not interfere in its dynamic in equation (4).

In effect, the system (4)-(5) is under-identified by one degree : λ and δ can not be estimated simultaneously unless an identifying assumption is added to the model. This means that these models, Keynesian, Monetarist or RBC, are observationally equivalent, and the system (4)-(5) can not be used to test one model against the other. In other words, one can pick up the identifying assumption that suits best one priors and interpret the behaviour of the time series of inflation and unemployment along one's favourite theory. King and Watson (1994), and Dolado et al. (1996), impose sequentially the three identifying assumption on the series, which they label Keynesian, Monetarist and RBC. They show that the same data are consistent with the three models and that, as one would expect, the Keynesian model delivers the highest sacrifice ratio and the RBC model the smallest.

In this paper, we do not wish to take side for one model against another. Rather, the aim is to assess the potential cost of disinflationary policies and their convergence in the E4, independently from the chosen model. Hence, instead of imposing theoretical restrictions (that cannot be tested), we will evaluate the whole range of sacrifice ratios that may arise from such a system.

More formally, we cannot directly estimate the reduced form (4-5). But we can re-write it in a stacked form:

$$\Delta u_t = a(L)\Delta u_{t-1} + b(L)\Delta \pi_{t-1} + e_{ut} \tag{6}$$

$$\Delta \pi_t = c(L)\Delta \pi_{t-1} + d(L)\Delta u_{t-1} + e_{pt} \tag{7}$$

where L is the lag operator, and the estimated residuals e_{ut} and e_{pt} are the innovations in unemployment and inflation. They are linked to the structural shocks , ε_D and ε_S by the following relationships:

$$e_{ut} = (1-\lambda\delta)^{-1}(\lambda\varepsilon_{D,t} + \varepsilon_{S,t}) \tag{8}$$

$$e_{\pi t} = (1-\lambda\delta)^{-1}(\varepsilon_{D,t} + \delta\varepsilon_{S,t}) \tag{9}$$

To go from the reduced-form of the VAR (6-7) to the structural representation (4-5), we need some identification rules. First, structural shocks are assumed to be orthogonal between themselves so that we can distinguish between supply and demand shocks[7]. This provides a link between the two elasticities :

$$\delta = \frac{\omega_{12} - \lambda\omega_{22}}{\omega_{11} - \lambda\omega_{12}} \qquad (10)$$

where ω_{ij} is the element on line i, column j, of the variance covariance matrix of the innovations.

To complete the identification, we need another restriction. Two options are available in the literature :

1. to use a Choleskiy decomposition : this would be equivalent to set one of the two contemporaneous elasticities (λ or δ) to zero;

2. King and Watson methodology : to fix one of the two elasticities to an arbitrary value, based on theoretical (and empirical) priors.

The main problem with these two strategies is that the corresponding restrictions cannot be tested. Hence, they may be subject to discussion about their reliability[8], which may cast doubt about the sacrifice ratio they imply.

We choose another strategy. Rather than imposing one value, we use a whole range of values, whose bounds are defined as follows : the relative volatility of the change in inflation and unemployment may not exhibit bigger fluctuations than the ones observed in the past. Of course, we are aware of the Lucas critique, but table 1 shows that the variance of these two variables tend to lower over time rather than getting bigger. If this trend is persistent, then our estimates are good indicators of upper limits of sacrifice ratios.

Computation of sacrifice ratios

Once the structural shocks are identified, we can compute sacrifice ratios. Using the above notations, we can re-write equations (2) computing the persistence effect (King and Watson 1994) as :

$$\lim_{k\to\infty} \frac{\partial u_{t+k}/\partial \varepsilon_{dt}}{\partial \pi_{t+k}/\partial \varepsilon_{dt}} = \frac{\left[(1-c(1))\lambda + b(1)\right]}{\left[(1-a(1)) + \lambda d(1)\right]} \qquad (13)$$

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7 This assumption is independant from the economic assumptions. This is necessary for the shocks to be interpretable.

8 Indeed, we present in appendix C the restrictions that were used by the previous literature and show that some restrictions that were imposed on λ implied irrealistic values for δ. We also apply those restrictions to the E4.

where a(1), b(1), c(1) and d(1) are the long-run impacts estimated from model (6-7). The sacrifice ratio, which is a ratio of integrals given by (3) can not be written in the same short analytical form, as it is a cumulative sum, but can be computed quite easily from the impulse response function of the VAR and is related to this limit.

From this, we can see the crucial role of the identification restriction. For *b*(1) small enough, the persistence effect on unemployment of a demand shock, and subsequently the sacrifice ratio, is a growing function of λ. Therefore, picking up an identification restriction which delivers a big λ leads to a big sacrifice ratio. This is why the same reduced form can lead to very different assessment of the cost of disinflationary policies. Hence, King and Watson (1994) argue that a Real Business Cycle proponent would set λ to be nil and would subsequently get a zero cost in terms of unemployment of disinflationary policies. At the other end of the spectrum, Dolado et al (1996) use what they call a Traditional Keynesian identification which sets λ so as to maximise the instantaneous impact of demand shocks on unemployment. This gives the biggest sacrifice ratio. The range of values we get under the bounds we defined above lies within these two extremes.

The results are presented in three steps. In section 4 we use a simple reduced form VAR which allows an analysis of the dynamic relationship between the two variables of interest, without prejudging of their exogeneity. The long term cross impacts give a measure of the influence of each variable on the other, and the Granger causality tests assess whether one variable is predetermined compared to the other. We then describe the scope of sacrifice ratios which are consistent with the estimated reduced forms. This gives a measure of the potential costs of the disinflationary policies, that we can compare across European countries. It allows a first assessment of structural similarities between the E4 labour markets. In section 5, we test for the robustness and stability of the results. We argue that reforms in the European labour markets may have induced a structural change in the inflation-unemployment dynamic relationships. Hence, we proceed to sub-sample analysis, to get an assessment of the convergence of monetary policy transmission in the E4.

4. MONETARY POLICY TRANSMISSION IN EUROPEAN LABOUR MARKETS : A FIRST ANALYSIS

4.1. Causality tests

To implement causality tests we need to estimate the reduced form VAR (6-7). The lag length is determined by a simple likelihood ratio test (Sims, 1980). We start from a maximum of twelve lags and test sequentially whether the last lag is significant. This procedure is preferred to Akaike, Hannan and Shwartz criteria which obtain different optimal lag length. The likelihood ratio test gives as optimal 8 lags for Italy and France, 9 for Germany and 12 for the UK.

From the estimation we get the long-run coefficients (a(1), b(1), c(1) and d(1)) : they represent the long-run impact of one variable's fluctuations onto the other's. For instance, b(1) measures the persistence of the effect of a change in inflation on unemployment. Hence, the hypothesis of no impact of the fluctuations in inflation on the fluctuations in unemployment in the long-run corresponds to b(1)=0. Similarly, testing for the exogeneity of inflation with respect to unemployment is testing for the hypothesis that b(L) = 0. Given the interpretation of the system in section 3, we expect the b coefficients to be positive and the d coefficients to be negative.

Table A1 in Appendix B gathers the estimated long-run cross impacts and the causality tests[9]. Results vary greatly across countries. Inflation fluctuations Granger cause unemployment fluctuations only in the UK, while unemployment variations Granger cause inflation variations (tests on d(L)=0) everywhere except in France.

As in King and Watson (1994), the coefficient that measures the long run impact of the fluctuations of inflation on unemployment b(1) is not significantly different from zero in all countries (although the result could be subject to uncertainty in the German case). Hence, for the four countries we cannot reject the hypothesis that the variations in inflation have no persistent impact on unemployment.

On the other hand, the long run impact of unemployment fluctuations on inflation movements (d(1)) is significantly negative in every country, but Italy where it also has the expected negative sign but does not appear significant (as all Italian long-run coefficients). Hence, the direction of the inflation-unemployment relationship is in favour of unemployment fluctuations being an indicator of demand tensions.

4.2. Long run derivatives

The simple estimation of the reduced forms allows to assess the persistence of a demand shock on unemployment (the long-run derivative (10)) as a function of λ . This is presented in figure 1 below.

[9] A variable is said to Granger-cause another one if the residuals from the estimated VARs with and without this variable are significantly different.

Figure 1 : long term derivative as a function of λ

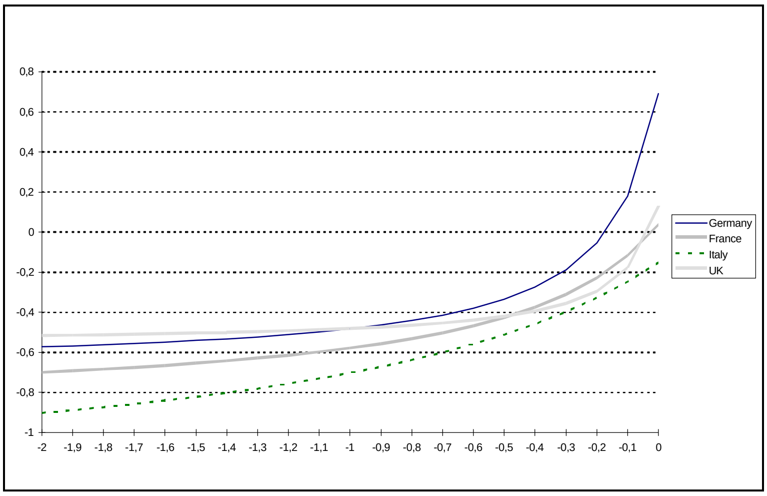
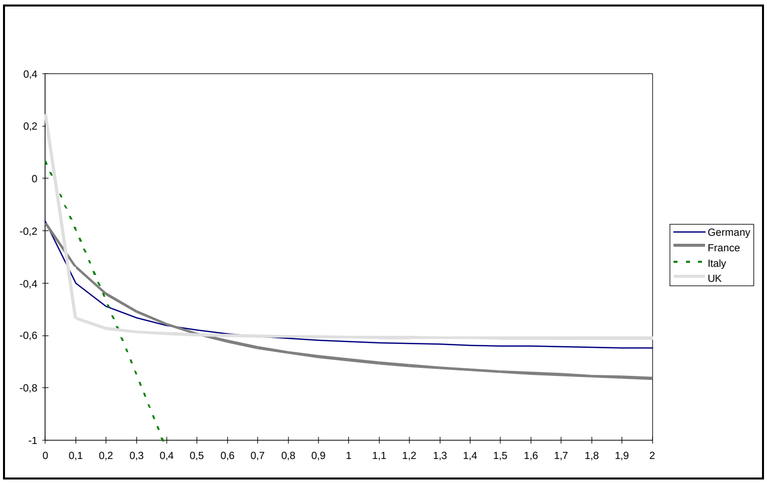


Figure 1 shows that for a given value of the elasticity λ, the long run derivatives look very similar across European countries. This points towards a similarity of structure, as represented by the link between the persistence effect and the contemporaneous correlation of inflation and unemployment variations.

Figure 2 represents the range of long term derivatives linked to the range of values that δ might take.

Figure 2 : long term derivatives as a function of δ



Apart from Italy, for a given δ, there is also indication of symmetry in the structure of the transmission of monetary policy.

These first results would support the idea of symmetric labour market structures in Europe, conditional on the similarities of the two short run elasticities (λ and δ) across countries.

4.3. Sacrifice ratios

Let us now turn towards the cost of disinflationary policies, as measured by the sacrifice ratios. We use the upper limit for the short run elasticities, λ or δ, as defined above to compute these ratios.

Results are presented below, together with the corresponding values for the long term derivatives and the sacrifice ratios in each country of the E4.

Table 3 results on sacrifice ratios should be read as follows : a demand shock inducing a permanent 1 % decrease in the inflation rate leads to a rise of 1,6 % in the German unemployment rate after 5 years. However, in the very long term, this shock does not induce fluctuations in the unemployment rate that are higher than a quarter of percentage point as shown by the LTD.

Table 3. Upper limits of sacrifice ratios with respect to the instantaneous elasticities λ and δ.

	Germany	**France**	**Italy**	**UK**
δ	2.76	4.16	2.43	5.93
λ	-0.36	-0.24	-0.41	-0.17
LTD	-0.25	-0.26	-0.27	-0.34
Sacrifice ratio (5 years)	1.61 (0.81)	1.53 (0.48)	1.42 (0.29)	1.38 (0.52)

Note : LTD stands for long term derivative (equation 13).The sacrifice ratio is the cumulated increase over 5 years in unemployment that followed a demand shock lowering permanently inflation by 1%. Standard errors come from Monte Carlo simulations.

Table 3 also provides striking evidence about the similarity of long term derivatives in the four countries of Europe. Furthermore, the maximum estimated values of sacrifice ratios is also very much alike across countries : they are about 1.5 for the four European countries, and all significant. This is very encouraging in terms of homogeneity of the inflation unemployment relationship across likely EMU participants. However, one should bear in mind that there is no particular reason to consider that the instantaneous elasticity of unemployment fluctuations with respect to inflation, λ, should be the same in all European countries (see Appendix C). Finally, the upper limits on δ differs across countries. This reflects the fact that inflation is relatively more variable than unemployment in the UK and in France, than in Italy and in Germany, over the sample period.

5. SUB-SAMPLE ANALYSIS

This section analyses the robustness of the previous results, on the basis of parameters stability. This provides us with some information on the inflation-unemployment relationship per sub-period. This is particularly important under EMU, as it helps assessing the evolution of existing asymmetries in this relationship across European countries over the last years.

5.1. Tests for structural breaks

Two tests for structural breaks are undertaken[10]. We first run recursive residual tests over the whole period of estimation in each country in order to point out possible break points. These tests do not reveal any significant break in the UK nor in Germany. In France, the inflation equation shows a break occurring between 1982 and 1989. In Italy, both the inflation and the unemployment equations are found unstable over a large part of the period.

Then we test the stability of the estimates for each sub-sample. This requires the selection of dates for structural breaks, as the tests above either give no break points, or break points that are too vague to pinpoint a precise date. The dates of the regime change were chosen as follows. They correspond to strong switch(es) in the monetary policy of each country (cf. Clarida, Gali and Gertler 1997, or Weber 1994), sometimes accompanied by reforms of the labour market. The idea is that a change of monetary policy may correspond to a change in the relative weights of the coefficients of the objective variables in the loss function of the monetary authorities. This is a change of regime that may affect the relationship between unemployment and inflation.

The hypotheses of structural changes we tested are the following :

- France, 1983:2, which is the time when France switched from its ‘Keynesian inspired macroeconomic policy’ (mostly resulting in periodic devaluation of the Franc) to adopt the « Franc Fort » policy. It is also the time at which the indexation of wages was suppressed. Thereafter, France dedicated monetary policy to inflation control within the EMS. Furthermore, we also tested the first quarter of 1987 as a second structural break as it is the last realignment of the Franc in the EMS.

- Germany, 1983:1. According to Juselius (1996), this is a date when the Bundesbank started according a even higher priority to inflation in its objective function. Using a battery of tests, she shows that there is a clear change of monetary policy at this time.

- The United Kingdom implemented a disinflationary policy following the second oil price shock with the arrival of Mrs Thatcher at Downing street. The impact on inflation of the ‘newly oriented monetary policy’ started to look efficient in the first quarter of 1983, hence we tested for structural change at this date.

[10] For simplicity of exposition, the stability tests results are not displayed here, but they are available upon request from the authors.

- Finally, we choose for Italy the same structural breaks as for France (1983 and 1987) because the timing of the disinflation for the two countries is quite similar. The mid-eighties have seen the first attempts to liberalise the Italian labour market, but these reforms do not seem to have been effective until the early 1990's and the end of the *Scala Mobile* (Christofides, 1996). This reform of the Scala Mobile, which started in 1990 and was fully implemented in 1992, must have affected the inflation-unemployment trade-off, but that is too recent to be tested with our time series approach.

We use again the likelihood ratio tests built up by Sims (1980) to test for the stability of the coefficient. Sub-samples being short, we choose to estimate the models with four lags only on each sub-sample[11]. Surprisingly, the hypothesis of stable coefficients is not rejected by the data in every country, for the whole sample and for most sub-samples. Only France and the UK display evidence of instability in the coefficients after 1983.

5.2. Sub-sample analysis

In this section, we analyse the sacrifice ratios per sub-period in the four countries in order to assess the evolution of asymmetries in the European labour markets. Results are presented in table A2 of Appendix A. We obtain stable long-run coefficients measuring the long run cross impacts and Granger causality tests in Germany and the UK, which confirms the results of the likelihood ratio tests. On the contrary, France and Italy differ from one period to the other. In France, the recent period is characterised by a negative and significant impact of unemployment on inflation and vice versa. It is exactly the opposite picture in Italy which exhibits such long run cross impacts in the first part of the sample, i.e. before the mid eighties, but not in the recent period.

The long-run derivatives and the sacrifice ratios are much higher for the four countries, as can be shown in the upper limits for these measures, presented in table 5 below.

Table 5 : Upper limits of sacrifice ratios with respect to the instantaneous elasticities l and d.

	Germany	**France**	**Italy**	**UK**
δ	3.28	2.64	1.01	3.96
λ	-0.30	-0.38	-1.00	-0.25
LTD	-0.74	-0.74	-0.47	-0.59
Sacrifice ratio (standard dev.)	2.26 (1.0)	3.24 (1.89)	2.28 (0.74)	2.34 (1.02)

Note : second sub-period only; France (1987-96), U.K (1983-96), Germany (1983-96), Italy (1987-96)

In all countries of the E4, the upper limit of the sacrifice ratios has increased, and the most important rise took place in France. This corresponds to a rise in the long term derivative that might indicate a more persistent impact of the fluctuations of inflation on

[11] Again, the stability tests results are not displayed here, but they are available upon request from the authors.

unemployment. Once again, the upper limits of the sacrifice ratios are very much alike for all the E4 except France which has now a relatively high upper bound (that is not surprising considering that it is the only country where there seems to be a persistent long-run relationship between the fluctuations of the two variables, as indicated by a significant b(1) coefficient in the second sub-period). This is confirmed (Appendix C, tables C3 and C4) when λ takes other values, previously used in the literature.

As for the whole period of estimation, there is however no reason to believe that the observed contemporaneous elasticities should be the same in the four countries. Indeed, history of the structure of the four labour markets would rather favour the hypothesis of different estimates. In both the UK and France, the reforms implemented on labour markets took place from the early eighties onwards. In Germany, such reforms are more recent and sector-oriented : they focus on hours rather than wages and therefore are not very likely to have a direct impact on the inflation unemployment relationship. In Italy, strong changes in the labour markets have not been effective before the early nineties, when the *Scala Mobile* was withdrawn. Hence, we could not capture this through our estimations.

In both France and the UK (though to a different extent), hiring and firing procedures are less rigid, which means that a demand shock leads to a higher variability of unemployment. On the other hand, wage flexibility has also increased which should counterbalance the variability of the number of unemployed that is required for an equivalent adjustment on inflation. Our results suggest a greater flexibility in terms of number of unemployed rather than in terms of wages.

CONCLUSION

This paper takes its roots in the King and Watson’s methodology (1994) to investigate the inflation-unemployment correlation in the E4 with a time series approach. A first approach is to compute the correlation between the cyclical components of inflation and unemployment to check for an arbitrage between the two series at the business cycle horizon. This does not yield a robust result: we obtain that the correlation between the cyclical component of inflation and the cyclical component of unemployment varies with the trend-cycle decomposition methodology used. Yet, this correlation is often negative which calls for a deeper empirical investigation on the short run Phillips trade-off in Europe.

A second approach is to analyze the dynamic of the two time series, inflation and unemployment fluctuations, in a bi-variate VAR model. This allows the unemployment cost of disinflationary policies to be assessed. The results are twofold.

First, the sacrifice ratios appear similar from one country to another under the assumption that the short run impacts of inflation on unemployment are similar across countries. Yet, this is another empirical issue that the VAR cannot help answering, and there is no particular reason why this should be true. This hilights the limits of under-identified VAR models with which one can only compute a range of sacrifice ratios but can not compute a precise value. Altogether, the monetary policy transmission through the labour market can very well be contrasted across the E4.

Second, sacrifice ratios are much higher in the second sub-period (starting around the mid-eighties), when European countries went through disinflation processes. Furthermore, the range of sacrifice ratios in France now appears much higher than in the other countries which would suggest some kind of departure of France from the other three countries in terms of wage adjustment. Now that the Euro and the ESCB are in place, this might be quite worrying.

The scope for further research is quite large. First it seems essential to identify the origin of the demand shocks we analyse in this paper. This would help us assessing more accurately asymmetries in the transmission of monetary policy in Europe. Secondly, the theoretical foundations of this study should be deepened, with a structural model allowing for an extended form of the Phillips curve and a more complete supply side.

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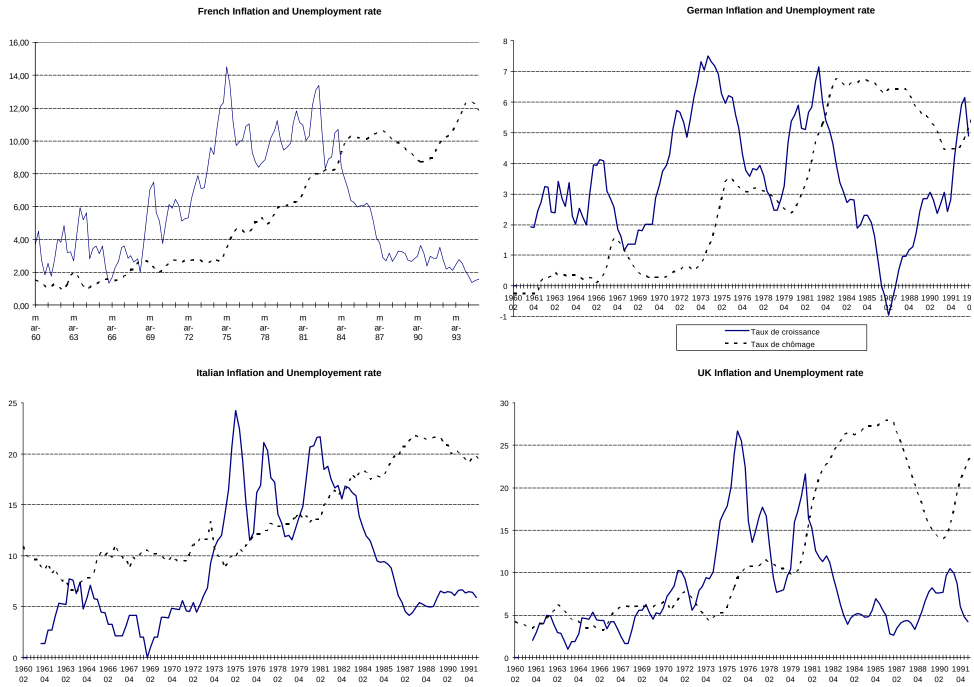
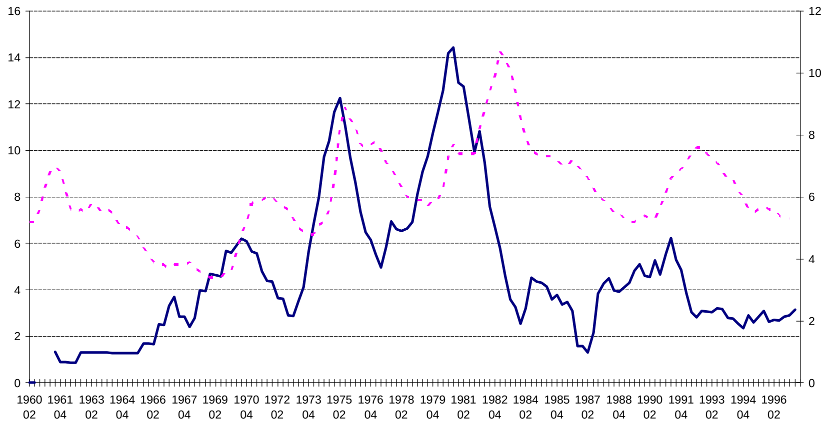
APPENDIX A : FIGURES

Figure 1. Inflation and Unemployment rate in the E4 and in the US

(Inflation is in plain line, and unemployment in dotted line)



US Inflation and Unemployment rate



APPENDIX B - RESULTS TABLES

Table B1. Bivariate estimation and causality tests for the whole sample

FRANCE	**62:2 to 96:4**	
	long run coefficients	*Student*
b(1) d(1)	0.013 -0.69	0.38 -1.62
	F.Stat	*P.Values*
b(L) = 0 d(L) = 0	1.556 0.382	0.145 0.928
ITALY	**62:2 to 96:4**	
	long run coefficients	*Student*
b(1) d(1)	-0.10 -0.58	-1.38 -0.82
	F.Stat	*P.Values*
b(L) = 0 0.d(L) = 0	1.09 1.69	0.370 0.107
GERMANY	**63:2 to 96:4**	
	long run coefficients	*Student*
b(1) d(1)	0.12 -1.08	1.52 -3.80
	F.Stat	*P.Values*
b(L) = 0 d(L) = 0	1.44 2.37	0.178 0.017
U.K	**62:2 to 96:4**	
	long run coefficients	*Student*
b(1) d(1)	0.03 -1.62	0.62 -2.77
	F.Stat	*P.Values*
b(L) = 0 d(L) = 0	2.06 2.41	0.026 0.008

Note : The P-values stand for the probability that the variable x Granger causes the variable y. The coefficients are denoted in the same way as the lags polynamial of equations (6) and (7).

Table B2. Bivariate estimation and causality tests for the sub samples

FRANCE (4 lags)	62:2 to 86:4		87:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	0.024 -0.42	1.06 -0.82	-0.38 -0.65	-2.05 -2.66
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	0.69 1.51	0.599 0.206	1.52 4.08	0.22 0.01
FRANCE (4 lags)	62:2 to 82:4		83:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	0.031 -0.325	1.16 -0.53	-0.07 -0.54	-0.92 -1.76
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	1.40 1.10	0.24 0.36	0.17 0.57	0.83 0.56
ITALY (4 lags)	62:2 to 86:4		87:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	-0.07 -2.15	-1.72 -2.90	0.02 -0.07	0.06 -0.25
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	1.68 2.46	0.16 0.05	0.44 0.56	0.77 0.68
ITALY (4 lags)	62:2 to 82:4		83:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	-0.07 -2.34	-1.66 -2.81	-0.10 -0.12	-0.67 -0.43
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	1.54 2.24	0.20 0.07	0.39 0.57	0.81 0.68

GERMANY (4 lags)	63:2 to 82:4		83:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	0.054 -0.56	0.88 -2.33	-0.03 -0.92	-0.47 -2.22
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	2.24 1.47	0.07 0.21	0.65 2.24	0.62 0.08

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…/…

U.K (4 lags)	62:2 to 82:4		83:1 to 96:4	
	long run coefficients	*Student*	*long run coefficients*	*Student*
b(1) d(1)	0.04 -1.97	1.93 -2.59	0.19 -1.91	2.74 -5.3
	F.Stat	*P.Values*	*F.Stat*	*P.Values*
b(L) = 0 d(L) = 0	2.02 2.13	0.10 0.08	2.84 5.36	0.03 0.00

Note : The P-values stand for the probability that the variable x Granger causes the variable y. The coefficients are denoted in the same way as the lags polynamial of equations 1 and 2. The likelihood ratio tests(Sims, 1980) implemented concluded in favour of 12 lags everywhere but in France (8).

APPENDIX C :
USING THE KING AND WATSON APPROACH TO COMPUTE SACRIFICE RATIOS

In this section we present the restrictions used in the previous literature (King & Watson 1994, Dolado et al. 1996) and the empirical results they imply. We show that more consideration should be given to the values of the estimated elasticities as some models may indeed be invalidated by abnormal estimators.

Let's re-write the SVAR in its MA form :

$$\begin{pmatrix} \Delta u \\ \Delta \pi \end{pmatrix} = \begin{pmatrix} d_{11}(L) & d_{12}(L) \\ d_{21}(L) & d_{22}(L) \end{pmatrix} \begin{pmatrix} \varepsilon_S \\ \varepsilon_D \end{pmatrix} \tag{10}$$

and the reduced form VAR in its MA form :

$$\begin{pmatrix} \Delta u \\ \Delta \pi \end{pmatrix} = \begin{pmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{pmatrix} \begin{pmatrix} e_u \\ e_\pi \end{pmatrix} \tag{11}$$

where $d_{ij}(1)$ is the long-run multiplier of shock j on variable i, and the other variables and parameters are defined as above.

Real Business Cycle Approach

Under the RBC assumptions, real variables such as the unemployment rate are not affected by nominal shocks, neither in the short-run, nor in the long-run, but they are perfectly correlated with aggregate supply shocks. Hence, the coefficient $\lambda = 0$ and ϕ_{12} (L) = 0. Therefore both the short and long run inflation-output trade-offs are vertical.

Rational Expectations Monetarist Approach

Within this framework, supply shocks may only have a temporary impact on the level of inflation because inflation is a purely monetary phenomenon in the long run. Yet, there may be some impact of supply shocks on the level of inflation, before full adjustment. Within this framework, King and Watson (1994) use the λ coefficient estimated by Sargent (1976) in a large classical macroeconometric model, which is -0.07[12]. Dolado et al. (1996) estimate a parameter λ that is specific to each country, with a common identification strategy. There the REM approach implies that $d_{21}(1) = 0$, that is $\delta = -\phi_{12}(1)/\phi_{11}(L)$, which together with the orthogonality conditions defines a corresponding value for λ. We choose the Dolado et al. approach for our estimations.

[12] Barro and Rusch (1980) also estimated a range of values for λ in the US that lies between -0.17 and -0.07.

Traditional Keynesian approaches

In these specifications, demand shocks should dominate short run unemployment fluctuations because of price rigidities. In the long run, supply and demand shocks are allowed to affect unemployment in a permanent way. King and Watson (1994) use the estimate of Gordon (1970) that is λ = -1.56 (with a standard deviation of 1.61). Dolado et al. (1996) propose to compute a value of λ that maximises the short-run demand effects on unemployment so that :

$$\lambda = \arg\max \frac{\lambda}{1-\lambda\delta} \qquad (12)$$

with δ defined from the orthogonality condition. This approach will be called TK1 in the following.

We also propose an alternative identification restriction to represent this approach (denoted TK2) which rests on the belief that prices are rigid in the short run, so that δ is simply fixed to zero.

Results

Table C.1 summarises the results on the persistence of the impact of a demand shock on unemployment relative to inflation for each model in each country (except for RBC model where both λ and the sacrifice ratio are null).

In most cases, we note that the persistent effect is of the same order of magnitude as that provided in the previous literature; the corresponding estimated λ also falls within the range of values chosen by King and Watson (1994) and Dolado et al. (1996) for the monetarist hypothesis (-0.07). Under the first Keynesian assumption, our estimated λs are around twice as big as the one found by Dolado et al (-0.25) in Spain with the same method, but smaller than the value fixed by King and Watson to -1.56.

Table C.1 : Sacrifice ratios over the whole sample (1962-1996)

	RBC	REM	TK1	TK2
		France		
SR	**-0.019**	**0.87**	2.33	**0.25**
(stand. dev.)	**(0.40)**	**(0.40)**	(0.62)	**(0.25)**
LRD	**0**	**-0.13**	-0.41	**0.04**
l	**0**	**-0.12**	-0.47	**0**
d	**0**	**2.04**	8.1	**0**
		Germany		
SR	-2.87	2.66	3.20	-9.15
(stand. dev.)	(1.83)	(0.76)	(0.86)	(3.59)
LRD	0	-0.52	-0.63	1.70
l	0	-1.24	-5.11	0.07
d	0.54	5.98	10.50	0
		Italy		
SR	**0.375**	**0.48**	2.29	**0.25**
(stand. dev.)	**(0.24)**	**(0.22)**	(0.41)	**(0.23)**
LRD	**0**	**-0.1**	-0.43	**-0.053**
l	**0**	**-0.03**	-0.90	**0.041**
d	**0.24**	**0.43**	4.57	**0**
		UK		
SR	-0.86	1.76	2.63	-1.25
(stand. dev.)	(0.75)	(0.58)	(0.68)	(0.90)
LRD	0	-0.37	-0.55	0.18
l	0	-0.24	-0.70	0.01
d	0.23	8.18	21.29	0

Note : standard errors are between brackets. 'Reasonable' representations are in bold characters. Models whose λ and δ fall within the range defined in the main text are in bold charcacters.

The main feature of table C.1 is the diversity of results across countries and models. The TK1 model, inspired from Dolado et al. (1996) exhibits unreasonable values for δ for all countries[13]. Yet, the magnitude of the sacrifice ratios computed under this hypothesis is very close to the ones exhibited in the previous literature (Dolado et al., Weber and King and Watson).

France and Italy seem to be the only countries where the REM and TK2 models are comply by our restrictions. However, in the TK2 framework, the values of the instantaneous elasticities look very much like the ones implied by the RBC hypothesis which implies very small sacrifice ratios. At the same time, the REM model implies a value for δ, and subsequently for the sacrifice ratio, that we may call 'reasonable' in both countries. No model fits the UK nor the German data : either the elasticity measured by d takes implausible values or the sacrifice ratio appears to be negative.

[13] However, we cannot compare our results with Dolado et al. (1996) since they do not provide any estimates of δ.

This appendix shows that using arbitrary identification hypotheses might lead to misleading results for the sacrifice ratios, or at least results that rest on too strong assumptions to be used for policy analysis. This was confirmed by the work we did on sub-samples, presented below.

Using the same criteria, the models found to be 'reasonable' differ only slightly from what we got for the whole period. The UK is still characterised by the rejection of all models. Germany exhibits a 'reasonable' monetarist model before 1983. Italy seems either monetarist before 1986 or TK2 in either sub periods, but this second model delivers null sacrifice ratios. Finally, French data still show that either the REM or the TK2 model can not be rejected for all sub-periods. Again, the TK1 assumption usually fails the 'sensibility tests'.

Table C.2. Sub-samples sacrifice ratios under the monetarist hypothesis

	1962-82	**1983-96**	**1962-86**	**1987-96**
France	-0.15 (0.25)	2.67 (1.09)	0.13 (0.21)	7.21 (4.21)
Germany	2.72 (1.14)	2.70 (0.91)		
Italy	0.81 (0.21)	0.72 (0.56)	0.79 (0.20)	0.31 (0.89)
UK	0.83 (0.29)	3.33 (1.16)		

Note : standard errors are between brackets

Table C3. Responses of unemployment and inflation to a demand shock which lowers inflation permanently by 1% and associated Sacrifice ratios, 1962 to 1996

RBC Model

UK				**France**			
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0.00	-1.12	0.00	1	0.00	-0.63	0.00
4	-0.11	-2.22	-0.04	4	0.06	-1.39	0.03
8	-0.35	-0.99	-0.31	8	0.00	-1.20	0.05
12	-0.30	-0.62	-0.66	12	-0.03	-1.07	0.05
16	-0.13	-0.28	-0.85	16	-0.03	-1.04	0.01
20	0.06	-1.00	-0.86	20	-0.03	-1.00	-0.02
Associated Standard Deviation				Associated Standard Deviation			
4	0.05	0.21	0.02	4	0.04	0.14	0.02
12	0.21	0.46	0.28	12	0.12	0.34	0.18
20	0.27	0.47	0.76	20	0.12	0.30	0.40
Germany				**Italy**			
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0.00	-1.53	0.00	1	0.00	-0.74	0.00
4	0.03	-2.13	0.04	4	0.10	-1.59	0.06
8	-0.61	-1.71	-0.32	8	0.11	-0.89	0.16
12	-0.88	-1.28	-1.18	12	0.06	-0.94	0.24
16	-0.86	-0.97	-2.03	16	0.06	-0.89	0.30
20	-0.83	-1.00	-2.87	20	0.08	-1.00	0.37
Associated Standard Deviation				Associated Standard Deviation			
4	0.16	0.31	0.08	4	0.04	0.14	0.02
12	0.51	0.59	0.80	12	0.07	0.29	0.14
20	0.58	0.70	1.83	20	0.05	0.21	0.24

Monetarist model

UK				**France**			
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0.10	-0.42	0.10	1	0.06	-0.49	0.06
4	0.27	-1.31	0.19	4	0.24	-1.10	0.16
8	0.31	-0.96	0.49	8	0.18	-1.10	0.35
12	0.41	-0.94	0.86	12	0.17	-1.08	0.53
16	0.45	-0.90	1.30	16	0.17	-1.05	0.70
20	0.47	-1.00	1.76	20	0.16	-1.00	0.87
Associated Standard Deviation				Associated Standard Deviation			
4	0.04	0.16	0.02	4	0.04	0.13	0.02
12	0.16	0.33	0.21	12	0.11	0.33	0.18
20	0.22	0.36	0.59	20	0.12	0.31	0.40
Germany				**Italy**			
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0.19	-0.16	0.19	1	0.03	-0.75	0.03
4	0.59	-0.48	0.41	4	0.13	-1.64	0.08
8	0.66	-0.87	1.07	8	0.13	-0.89	0.21
12	0.56	-1.01	1.66	12	0.08	-0.94	0.32
16	0.50	-1.03	2.19	16	0.08	-0.87	0.39
20	0.46	-1.00	2.66	20	0.09	-1.00	0.48
Associated Standard Deviation				Associated Standard Deviation			
4	0.06	0.11	0.03	4	0.04	0.15	0.02
12	0.21	0.23	0.31	12	0.07	0.28	0.13
20	0.27	0.35	0.76	20	0.05	0.19	0.22

Neokeynesian model

UK

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.02	-0.99	0.02
4	-0.02	-2.07	0.01
8	-0.22	-1.01	-0.14
12	-0.16	-0.71	-0.34
16	-0.02	-0.42	-0.42
20	0.14	-1.00	-0.34
Associated Standard Deviation			
4	0.05	0.24	0.02
12	0.19	0.52	0.26
20	0.27	0.40	0.71

France

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.01	-0.59	0.01
4	0.10	-1.30	0.06
8	0.04	-1.16	0.11
12	0.02	-1.06	0.15
16	0.02	-1.03	0.16
20	0.01	-1.00	0.18
Associated Standard Deviation			
4	0.05	0.14	0.02
12	0.10	0.34	0.17
20	0.09	0.30	0.34

Germany

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.12	-0.71	0.12
4	0.39	-1.14	0.27
8	0.18	-1.21	0.56
12	0.01	-1.11	0.59
16	-0.02	-1.01	0.59
20	-0.04	-1.00	0.56
Associated Standard Deviation			
4	0.09	0.16	0.04
12	0.28	0.29	0.43
20	0.36	0.40	1.04

Italy

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	-0.10	-0.80	-0.10
4	0.00	-1.57	-0.04
8	0.03	-0.95	-0.02
12	-0.01	-0.96	-0.01
16	-0.01	-0.91	-0.02
20	0.00	-1.00	-0.03
Associated Standard Deviation			
4	0.04	0.18	0.02
12	0.07	0.28	0.13
20	0.05	0.20	0.24

Keynesian model (Dolado)

UK

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.13	-0.19	0.13
4	0.39	-0.98	0.27
8	0.53	-0.89	0.75
12	0.65	-1.02	1.36
16	0.65	-1.08	2.01
20	0.60	-1.00	2.63
Associated Standard Deviation			
4	0.04	0.17	0.02
12	0.17	0.35	0.23
20	0.29	0.43	0.68

France

Horizon	unempl.	Inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.16	-0.34	0.16
4	0.56	-0.85	0.39
8	0.46	-1.03	0.89
12	0.48	-1.11	1.35
16	0.49	-1.03	1.84
20	0.49	-1.00	2.33
Associated Standard Deviation			
4	0.06	0.16	0.03
12	0.17	0.37	0.26
20	0.21	0.38	0.62

Germany

Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.21	-0.04	0.21
4	0.64	-0.33	0.45
8	0.79	-0.80	1.20
12	0.71	-1.01	1.94
16	0.63	-1.05	2.60
20	0.58	-1.00	3.20
Associated Standard Deviation			
4	0.06	0.11	0.03
12	0.23	0.22	0.32
20	0.33	0.38	0.86

Italy

Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock			
1	0.47	-0.52	0.47
4	0.56	-1.71	0.50
8	0.49	-0.70	1.00
12	0.42	-0.92	1.44
16	0.43	-0.73	1.85
20	0.44	-1.00	2.30
Associated Standard Deviation			
4	0.07	0.27	0.04
12	0.12	0.47	0.23
20	0.09	0.35	0.41

Table C4. Responses of unemployment and inflation to a demand shock which lowers inflation permanently by 1% and associated sacrifice ratios, monetarist model over sub-periods

UK		**1962**	**1982**	**France**		**1962**	**1983**
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0,08	-0,61	0,08	1	0,02	-0,71	0,02
4	0,19	-1,26	0,15	4	0,07	-1,42	0,05
8	0,16	-0,97	0,32	8	-0,11	-0,94	0
12	0,16	-0,98	0,48	12	-0,03	-0,98	-0,06
16	0,17	-1,02	0,65	16	-0,05	-1,02	-0,1
20	0,17	-1	0,83	20	-0,05	-1	-0,15
Associated Standard Deviation				Associated Standard Deviation			
4	0,03	0,21	0,02	4	0,05	0,19	0,02
12	0,08	0,17	0,14	12	0,07	0,29	0,14
20	0,08	0,17	0,29	20	0,06	0,27	0,25

Germany		**1962**	**1982**	**Italy**		**1962**	**1982**
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0,17	-0,59	0,17	1	0,12	-0,87	0,12
4	0,68	-1	0,44	4	0,22	-1,63	0,16
8	0,64	-1,16	1,13	8	0,15	-0,8	0,35
12	0,52	-1,05	1,69	12	0,15	-1,07	0,48
16	0,5	-0,98	2,19	16	0,17	-1,06	0,65
20	0,55	-1	2,72	20	0,15	-1	0,81
Associated Standard Deviation				Associated Standard Deviation			
4	0,1	0,2	0,05	4	0,04	0,18	0,02
12	0,36	0,34	0,54	12	0,04	0,16	0,12
20	0,29	0,27	1,14	20	0,05	0,21	0,21

UK		**1983**	**1996**	**France**		**1983**	**1996**
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0,1	0,02	0,1	1	0,14	-0,56	0,14
4	0,38	-0,27	0,23	4	0,47	-0,93	0,33
8	0,69	-0,75	0,83	8	0,59	-0,88	0,89
12	0,81	-0,9	1,6	12	0,57	-1	1,47
16	0,86	-0,97	2,45	16	0,61	-0,96	2,06
20	0,9	-1	3,33	20	0,62	-1	2,67
Associated Standard Deviation				Associated Standard Deviation			
4	0,05	0,11	0,02	4	0,11	0,17	0,05
12	0,28	0,3	0,36	12	0,28	0,3	0,47
20	0,54	0,55	1,16	20	0,34	0,35	1,09

Germany		**1983**	**1996**	**Italy**		**1983**	**1996**
Horizon	unempl.	inflation	sacrifice ratio	Horizon	unempl.	inflation	sacrifice ratio
Responses to a disinflationary demand shock				Responses to a disinflationary demand shock			
1	0,18	-0,39	0,18	1	0,04	-0,48	0,04
4	0,46	-0,59	0,34	4	0,1	-1,13	0,07
8	0,56	-0,92	0,87	8	0,18	-0,97	0,23
12	0,6	-0,94	1,45	12	0,15	-0,96	0,39
16	0,62	-0,98	2,07	16	0,16	-1	0,55
20	0,64	-1	2,71	20	0,16	-1	0,72
Associated Standard Deviation				Associated Standard Deviation			
4	0,09	0,19	0,04	4	0,09	0,19	0,05
12	0,23	0,28	0,37	12	0,13	0,35	0,28
20	0,3	0,36	0,91	20	0,15	0,38	0,56

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