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Consequences for the Phillips Curve and the NAIRU

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Changes in the balance of power between the wage and price setters and the Central Bank: Consequences for the Phillips curve and the NAIRU.*

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Abstract

In this paper we introduce and test the hypothesis that the relation between inflation and unemployment has been in many countries subject to a significant change in the early 1990's after the disinflation period. That period began between 1975 and 1980 after the first (or the second) oil price shock in autumn 1973. During the disinflation period, inflation and unemployment were the result of the struggle between the wage and price setters trying to influence the distribution of income to their favour and the Central Bank fighting against inflation. Since the wage and price setters did not fully believe in an "unconditional" pursuit of the anti-inflationary policy, the result was a gradual decline of the inflation rate rendered possible by a rising rate of unemployment.

Our hypothesis was inspired by the observation that the statistical Phillips curves are now rather flat in many countries. If such horizontal Phillips curves will also result when they are estimated taking into account the most important other factors influencing the inflation rate (mainly supply shocks) they may be explained by the hypothesis that during the 1990's, wage and price setters finally accepted the new rigour of the monetary policy and tried no more (nor had the market power – due to increasing globalisation and international competition) to pursue a policy which raises the inflation rate significantly above the target inflation rate of the Central Bank. In that case a "break" in the parameters of the Phillips- Curve should be observed.

We use econometric methods to test whether the presumed "break" in the relation between inflation and unemployment can be shown to exist. We restrict our study to the four largest countries of the Euro area (Germany, France, Italy and Spain), the UK and the USA. The result are very different for the countries; therefore we intend in a further step to detect the reasons for there divergences.

JEL: E10, E50, C22, C32.

Keywords: Phillips curve, unemployment, inflation, wage and price setting, Central Bank, structural break.

Contents

In a first section, statistical Phillips curves for the six countries are considered and a brief history of the Phillips curve is given along these charts. In a second section, we look at the actual discussion and report that the literature on the Phillips curve, on the natural rate of unemployment (NRU) and on its empirical counterpart (the NAIRU) took account of the developments up to the early 1990s by progressing from the unique to a time-varying NAIRU and underlines the difficulties to measure the NAIRU. Conseqently, some authors returned to the theory of a long-run downward sloping Phillips curve.

In Section 3 we develop our hypothesis about the slope of the Phillips curve during the last 13 to 15 years which implies that in the last decade the idea of a Nairu has lost its meaning since the rate of inflation now is determined (at least over the cycle) by the Central Banks irrespectively of the rate of unemployment.

As these statistical Phillips curves do not consider other variables which might influence the relation between inflation and unemployment, we test econometrically to what extent the picture remains unchanged when other influences (esp. supply shocks) are taken into account. This is the object of Section 4.

In Section 5 we discuss three recent contributions to various topics.

In Section 6 the paper concludes with final remarks.

1 A short history of the changing relation between inflation and unemployment

Beginning with the years following the second oil price in autumn 1979 the statistical Phillips curves of most countries are marked by a negative relation between the rates of unemployment and of inflation. Chart 1 shows this for the four great countries of the Euro Area, for the UK and for the United States. Their Phillips curves start about 1975/1980 with low rates of unemployment (except in Italy and in Spain) and they finish all with distinctively lower rates of inflation. We measure the inflation rate by the GDP deflator which has the advantage to exclude that part of the inflation which results from the pass-through of higher import prices to the prices of the commodities produced within the country (Phillips curves measured by other price indicators are given in annex A.3 on p. 35 – they are not fundamentally different except for the years

of large import price movements).

The inflation rates in 1975/80 are strongly influenced by the first oil price shock in autumn 1973 which brought to an end the phase of near full employment and of the corresponding vertical long term Phillips curve (natural rate à la Friedman). During that time, this "natural" rate was considered to be stable even if Friedman had explicitly stated that it must not be constant but may change for structural reasons.

After the second (in some countries after the first) oil price shock, inflation decreased and unemployment increased - mainly as the result of the struggle between the wage and price setters trying to influence the distribution of income to their favour and the Central Bank fighting against inflation. Since the wage and price setters did not fully believe in an "unconditional" pursuit of the anti-inflationary policy, the result was a gradual decline of the inflation rate rendered possible by a rising rate of unemployment. This kind of explanation based on the behaviour of (collective) wage setters and (individual) price setters is often called "Keynesian".

The period of declining inflation rates ends in the early 1990s. Afterwards, i.e. during the last 13 to 15 years, Chart 1 shows more or less constant inflation rates without a marked trend (Germany excepted). This change in the relation between inflation and unemployment is clearly to distinguish.

Chart 1: Phillips curves for Germany, France and Italy, quarterly data from 1970/1980 to 2006

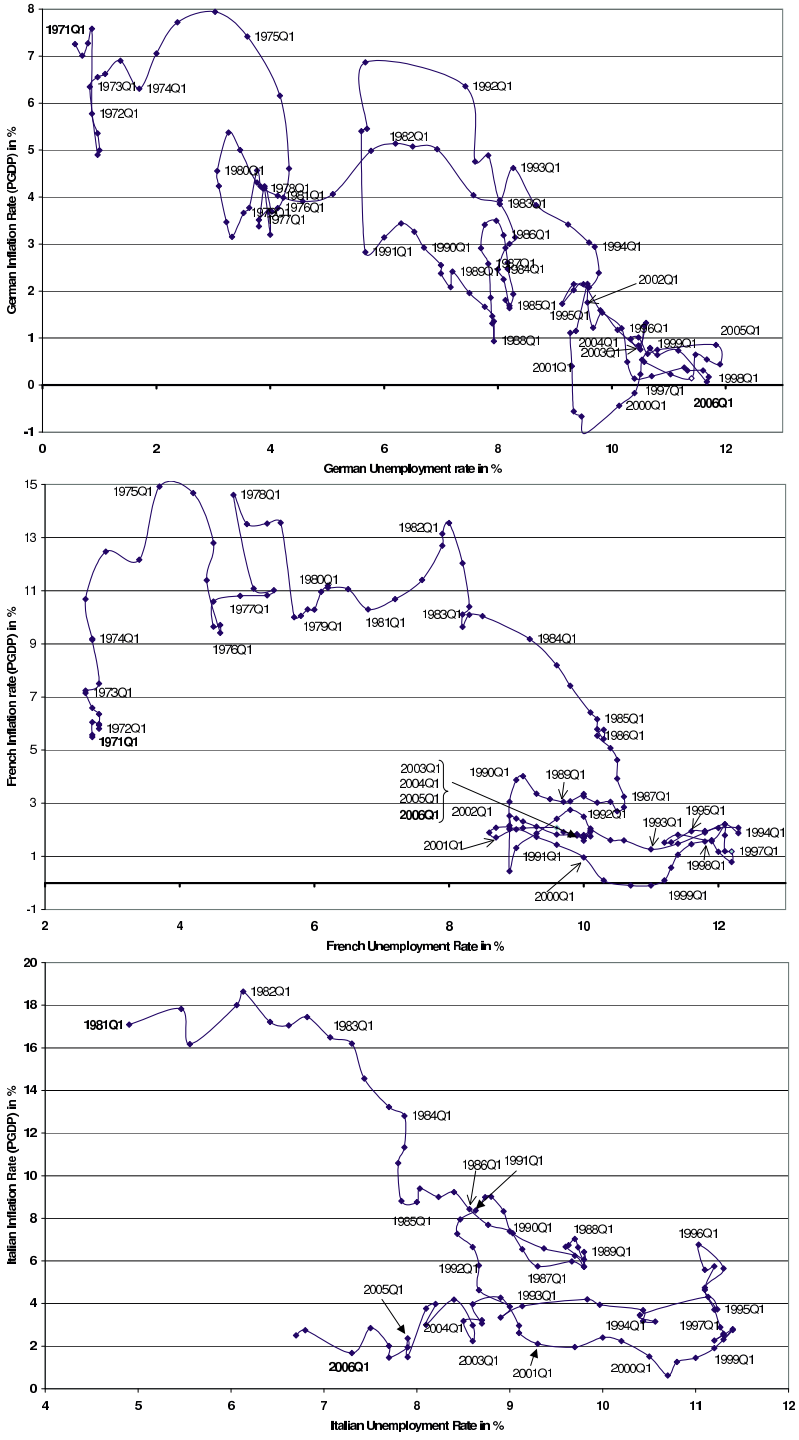
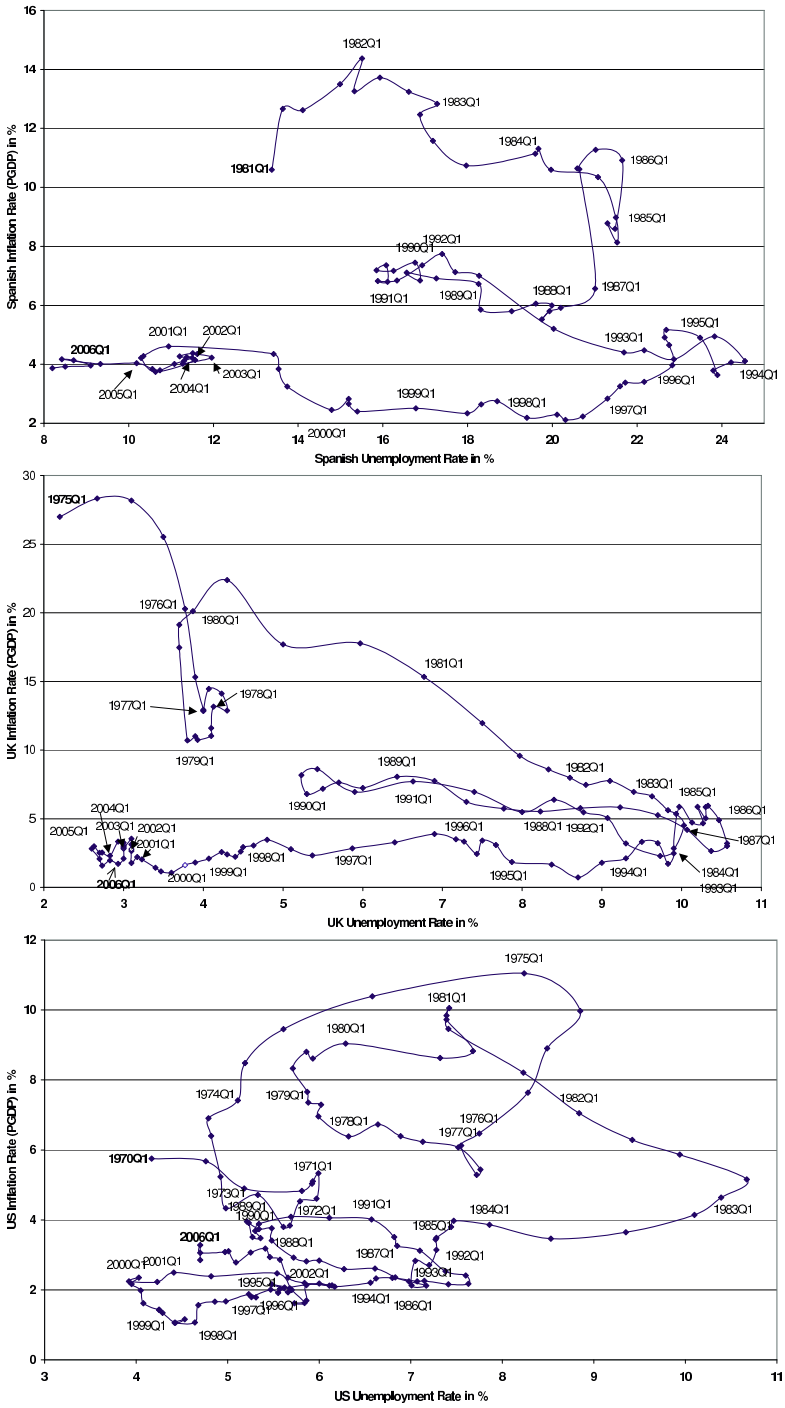


Chart 1 (*continued*): Phillips curves for Spain, the UK and the USA, quarterly data from 1960/1980 to 2006



Sources: OECD (EcoWin), own calculations. Inflation is measured in terms of the GDP Deflator.

2 The fate of the NAIRU and its implications for the Phillips curve

The concept of the NAIRU claims that there exists a certain rate of unemployment (the NAIRU) where the rate of inflation does not change. When the actual unemployment rate lies beneath or above the NAIRU an accelerating or decelerating rate of inflation will result. However, for the acceleration case the theoretical arguments are much more convincing and empirical examples are easier to find than for the opposite case. A continuous accelerating decline in the rate of inflation is rarely observed and it would be difficult to reconcile it with all theories supporting the downward rigidity of prices and wages. Therefore it is more prudent to define the NAIRU as the minimum rate of unemployment at which the rate of inflation does not rise.

In the high days of the natural rate of unemployment (NRU) hypothesis it was supposed that the NAIRU – considered as its empirical counterpart – was determined by the structural features of the economies studied and hence considered as constant. But at the end of the 1990's it had become evident that the NAIRU is not time-invariant and is therefore difficult to estimate. All articles published in the "Journal of Economic Perspectives"-Symposium in 1997 share this view:

1. Gordon (1997) states the time-varying nature of the NAIRU in its title and he mentions the difficulties to measure it. Nevertheless he writes (p. 28) "Uncertainty about the value of the NAIRU is not so large as to render the NAIRU concept useless".

2. Staiger, Stock & Watson (1997) underline that the NAIRU has changed and is difficult to measure: "the most striking feature of these estimates is the lack of precision" (p. 34). Therefore the authors find that although unemployment is a useful indicator of inflation over the next year, other leading indicators of inflation are better. "The recent debate over whether the NAIRU is currently by 6 percent or 5.5 percent does little to inform monetary policy". (loc. cit. p. 34)

3. Blanchard & Katz (1997) already know that it is varying over time and ask what are the reasons for these changes. They see many candidates but to their opinion "the magnitude of the increase, the diversity of labor market institutions and of policies should have helped to identify culprits. Yet, while many suspects have been identified, none has been convicted". (p. 52)

4. Stiglitz (1997) emphasizes the interaction between actual unemployment and the NAIRU. One of his conclusions is: "high unemployment is even worse than we thought because it raises the NAIRU, and lower unemployment is better than we thought, because it lowers the NAIRU". (p. 8)

5. Only one out of these articles concluded that it is "time to ditch the NAIRU" (Galbraith 1997).

Some years later Laubach (2001, p. 220) states that "in general, the results of his empirical analysis [...] confirm those of Staiger et al. (1997) for the United States [...] that the measured uncertainty around the NAIRU estimates is large" and he raises doubts what these estimates measure: "The finding that information from unemployment data greatly improves the precision of the NAIRU estimates raises the question whether these estimates are in fact linked to inflation, or just smoothed unemployment series."

Most adherents to the view that the NAIRU is determined by structural features of the economy tried to identify structural changes which augmented the NAIRU (often called the equilibrium rate of unemployment). Most prominent in this area of research is the OECD (1994) Jobs Study and its "OECD Jobs Strategy". The 10 commandments of this strategy (see OECD 2006, p. 24) concern mainly changes in the labour market and social institutions supplemented by enhanced product market competition, a better framework for the creation and diffusion of technological knowledge and by an anti-inflationary macroeconomic policy (this point had nothing to do with a macroeconomic policy in the Keynesian sense, aiming at an expansion of the demand for commodities).

Since the efforts to identify structural changes were often not successfull because the regulations considered became mostly less rigid, i.e. changed in the wrong direction, some authors – esp. from the USA – saw the main source for a change in unemployment on the demand side. For example Ball (1997) analyses the disinflation period from 1980 to 1990 in the OECD-countries and states: "The main cause of rising unemployment was the tight monetary policy that most OECD countries pursued to reduce inflation" (p. 168). As Stiglitz (1997), he argues that the disinflation resulting from this policy causes via hysteresis a rise in the NAIRU.

The argumentation based on structural changes became still more difficult when, beginning with 1992-93, the rate of unemployment began to decline in the USA and UK without an increase of the rate of inflation (some years later this also happened in the

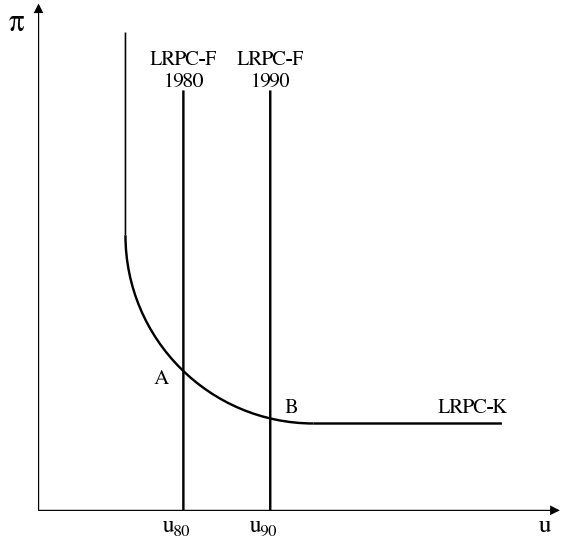
countries of "old Europe") and it became necessary to explain a decrease of the NAIRU. Adherents to the NRU-hypothesis tried this again and added hitherto unmentioned structural changes. A prominent example is given by Katz & Krueger (1999), who propose four factors to explain the recent decline in the rate of unemployment below the estimated NAIRU combined with reduced wage pressure and low inflation for the US labor market, namely:

- Favorable demographic trends
- Improved efficiency in matching workers with jobs
- Greater anxiety about job security
- Increase in the prison population

The last item is specific to the US but the first three could be relevant also for the European countries. The first is analysed in section 5.

What does the coincidence of declining inflation rates and rising rates of unemployment imply for the Phillips curve? It does not imply a shift in the Phillips curve. This can be seen by looking at a stylised representation of the disinflation period considered by Ball (1997). In Chart 2 we observe at its beginning the point A and at its end the point B. Two shapes of the Phillips curve may lay behind it:

Chart 2: Long-run Phillips curves (LRPC)



According to the NRU hypothesis the vertical long-run Phillips curve (LRPC-F) and the NAIRU should have shifted to the right: In 1980 it corresponded to the level u_{80}, in 1990 to the level u_{90}. According to the Keynesian theory of the Phillips curve, the downward-sloping LRPC-K remained unchanged. A and B are two points on the same LRPC (F stands for Friedman and K for Keynes).

Contrary to the dominating structural change argumentation, Akerlof, Dickens & Perry (1996) returned to the non-linear LRPC which is rather flat at high rates of unemployment but remains in the domain of positive values of the rate of inflation. Essential for their model and their empirical analysis is the downward rigidity of wages, whose role becomes smaller when the inflation rate is higher. In 2000, these three authors added a new argument pretending that at low rates of inflation, their impact is too small to be taken into consideration. They call this a "near-rational wage and price setting behaviour". Astonishingly they did not repeat their argumentation of 1996 and invented a very special shape of the non-linear LRPC.

Another - and more convincing - explanation of the price-setting behaviour at low rates of inflation can be found in Taylor (2000, p. 1389), who argues that "the decline in pass-through or pricing power is due to the low inflation environment that has recently been achieved in many countries" (p. 1389). This explanation has the advantage not to lead to the very special LRPC derived in Akerlof, Dickens & Perry (2000).

The existence of the downward-sloping LRPC is supported by Karanassou, Sala & Snower (2003) (KSS 2003) for Europe. KSS (2003) use data for the years 1970 to 1998 and reach the conclusion "that the EU faces a long-run inflation-unemployment trade-off".

For Germany, Franz (2005) reaches the conforming conclusion for the period 1972 to 2002 that "the coefficient associated with the sum of lagged inflation rates is well below unity in all estimated Phillips curves... It means that strictly speaking there exists no such thing as a vertical Phillips curve" (p. 146).

To explain their results, KSS (2003) propose a new theoretical formulation for the long-run downward sloping Phillips curve instead of its traditional Keynesian interpretation, which is expressed by KSS (2003) in its simplest form as:

$$\pi_t = a\pi_{t-1} - bu_t + c + \varepsilon_t \tag{1}$$

KSS (2003, p. 96) argue that this interpretation has received "no proper microfoundations". From a methodological point of view, it may be asked: Why needs a curve to be founded on microeconomic maximizing behaviour which produces the results of collected bargaining agreements concluded between collective bodies on both sides of the labour market? Whatever the answer may be it is useful to present the microfoundation chosen by KSS (2003) and to discuss whether their implications contradict the considerations based on the "traditional" Keynesian interpretation of the Phillips curve[1].

KSS (2003) provide their model with a "rigorous microfoundation" based on price and wage sluggishness with respect to changes in the money growth rate. The "price sluggishness parameter" $a < 1$ is called the "only substantive ad hoc simplification" of the model. Thanks to these lagged reactions a change in the money growth rate has permanent real effects.

We leave aside the question in what sense the assumption of sluggish reactions may be seen as "rigorous microfoundation", esp. since the individual price setting behaviour is not analysed, but described with the help of an ad hoc simplification. We restrain ourselves to consider the implications for the Phillips curve. The two most interesting implications are: The long-run Phillips curve is flatter

– the greater is the price sluggishness parameter a

– the greater is the wage sluggishness parameter b

We shall return to these implications in the next section.

[1]This "traditional" interpretation is not based on money illusion. When Phelps (1967) and Friedman (1968) developed the expectation-augmented Phillips curve, they introduced – without attracting attention to it – a very severe restriction in setting the parameter a in equation (1) to unity. This implies that workers and entrepreneurs always have the market power to pass-through price increases to nominal wages and wage increases to prices respectively. In this special case the "accelerationist hypothesis" necessarily always holds, because with $a = 1$ equation (1) becomes the following first order difference equation $\Delta\pi_t = c - bu_t + \varepsilon_t$. Therefore if $a = 1$ there exists only one unique value of the unemployment rate u where the inflation rate does not change, namely $u^* = c/b$.

3 A flat Phillips curve after the disinflation period?

The return of Akerlof et al. (1996 and 2000), KSS (2003) and Franz (2005) to the downward-sloping LRPC is an important step in explaining the disinflation period up to the nineties. In the literature, allusion is made to a flattening of the Phillips curve. But is this sufficient to explain the years of relatively constant rates of inflation following thereafter? In the KSS (2003) paper the flattening of the Phillips curve implies that the sluggishness parameters became very large: Wages and prices lag indefinitely behind changes in the money growth; instead they are set in such a way that the inflation rate remains constant.

Also Staiger, Stock & Watson (2001) address the question, what happened to the slope of the Phillips curve, after having observed that the statistical Phillips curve for the USA remains flat from 1993 to 1998. Their answer is, that "the evidence suggests that the price Phillips curve has shifted in, not flattened out" (p. 5). This result is questionable because the authors substitute the rate of unemployment by the unemployment gap, defined as the "deviation of the actual rate of unemployment from an (unexplainable) univariate (stochastic) trend rate of unemployment". If the trend is well measured, any flattening of the Phillips curve tends to disappear. Moreover they have to admit that "our regressions using the state data fail to isolate any economic or demographic determinants of the trend unemployment rate" (p. 6).

We want to go one step further and to discuss the hypothesis that there has been a break in the wage and price setting behaviour in the early 1990's. This break may be due to a strengthened position of the Central Banks, whose new vigour in the pursuit of their inflation target is now taken very seriously by the wage and price setters, and by a reduced market power of the wage and price setters, due mainly to the globalization of goods and labour markets; See Section 5.3.

4 Econometric analysis

The traditional Phillips curve with adaptive expectations is estimated in this part. An overview of the empirical literature is first made, then the modelling and testing strategy is presented and at least the results are presented on a concentrated way.

4.1 Econometric strategy

4.1.1 Overview of single-equation-Phillips curves in the literature

There are several competing forms of the (single-equation-)Phillips curve: Gordon's triangle model is the most "consensual" for the traditional Phillips curve i.e. with adaptive expectations (Gordon 1981, Gordon 1997, Eller & Gordon 2003):

$$\pi_t = \alpha(L)\pi_{t-1} + \beta(L)(u_t - u_t^*) + \delta(L)Z_t + \varepsilon_t \tag{2}$$

where the Z-Variables are de-meaned and de-trended supply-shock variables (oil & food; exchange rate; price control, tax and minimum-wage effects;...). The NAIRU is modelled as a constant or a random walk (within a ML-estimation). In Gordon (1981) the level of unemployment and its first difference are included, instead of the unemployment gap. Most estimations of such a Phillips curve (Gordon included) imposes the restriction $\alpha(1) = 1$, what is equivalent to estimate the equation in terms of the first difference of inflation ($\Delta\pi_t$ is then the endogenous variable) and to rule out a long-run non-vertical Phillips curve. This is the most used specification and the one used by international organisations like the OECD, the ECB and the European Commission (Richardson, Boone, Giorno, Meacci, Rae & Turner 2000, Fabiani & Mestre 2001, McMorrow & Röger 2002).

Another specification, also quite consensual, can be taken from Staiger et al. (2001)):

$$\begin{aligned} \Delta\pi_{t+1} &= c_0 + \alpha(L)\Delta\pi_t - \beta(L)(\Delta w_t - \Delta prod_{t-1}^* - \pi_{t-1}) \\ &\quad +\gamma_0 X_t + \gamma(L)\Delta X_t + \delta(L)Z_{t-1} + \varepsilon_{t+1} \end{aligned} \tag{3}$$

The most important departure from the first specification with the restriction $\alpha(1) = 1$ lies in the presence of the cointegration term $(\Delta w_t - \Delta prod_{t-1}^* - \pi_{t-1})$ coming from a wage equation not reported here. Note here that the cointegration is expressed in terms of the differenced variables; Staiger et al. argue that the levels do not seem to be cointegrated in their data set. X is the unemployment gap or output gap (from a univariate filter method). The Z are, as in Gordon, some de-meaned and de-trended supply-shocks variables.

The idea of introducing a cointegrating term comes from Blanchard & Katz (1997, p. 62) and from Sargan (1964):

$$\Delta w_t = c_0 + \Delta\pi_{t-1} - \lambda(w_{t-1} - prod_{t-1} - p_{t-1}) - \beta u_t \ (+\delta Z_t) + \varepsilon_t \tag{4}$$

Here the cointegration term is expressed in levels. They interpret its significance as evidence for labour market theories other than the neo-classical one (efficiency wages, hysteresis with insider/outsider features) where the reservation wage is influenced by productivity.

A "new" strand in the estimation of the Phillips curve, and alternative to the "traditional" Phillips curve presented above, is proposed along the New-Keynesian theories: $\pi_t = \beta\pi^e_{t+1} + \alpha X_t + \varepsilon_t$. X_t is – depending on the authors – the output gap, the unemployment gap or the de-trended real unit labour costs. But the Phillips curve derived from them is far from beeing satisfactory (even when supply shocks are added as in Roberts 1995). Whereas the microfoundations are well derived, the implications of the models theoretically as well as empirically are problematic. Mankiw & Reis (2002) listed the main arguments against such Phillips curves:

1. A credible and long announced disinflation would produce an economic boom against the admitted stylized facts (Ball 1994).
2. The persistency of inflation is not explained through theses models. Only the addition of some backward-looking terms reconcile them with the data (Fuhrer & Moore 1995).
3. The models cannot reproduce the lagged and spread impact of monetary shocks on the economy, what is also admitted as a stylized fact (Mankiw 2001).

Moreover one can find quite strong evidence against the hypothesis of rationality for survey data on household and expert inflation expectations; See Nielsen (2003) for European data and Grant & Thomas (1999) for US data.

All these objections let us discard this kind of specifications and prefer the "traditional" Phillips curve.

4.1.2 Our single-equation specifications

Following the literature we estimate two types of "traditional" Phillips curves for each country that take the forms:

$$\begin{aligned}\pi_t &= a_0 + \sum_{i=1}^{8} \alpha_i \pi_{t-i} + \beta_0 u_t + \sum_{i=1}^{8} \beta_i \Delta(u_{t-i}) + \delta_0 \pi_t^{oil} + \sum_{i=1}^{8} \delta_i \Delta \pi_{t-i}^{oil} \\ &\quad + \theta_0 \pi_t^{prod} + \sum_{i=1}^{8} \theta_i \Delta \pi_{t-i}^{prod} + \varepsilon_t \qquad (5) \\ \Delta\pi_t &= a_0 - \lambda[\pi_{t-1} - \beta_0 u_{t-1} - \theta_0 \pi_{t-1}^{prod} - b_0 trend] \\ &\quad + \sum_{i=1}^{8} \alpha_i \Delta \pi_{t-i} + \sum_{i=1}^{8} \beta_i \Delta u_{t-i} + \sum_{i=0}^{8} \delta_i \Delta \pi_{t-i}^{oil} + \sum_{i=1}^{8} \theta_i \Delta \pi_{t-i}^{prod} + \varepsilon_t \qquad (6)\end{aligned}$$

These two types differ from each other as follows:

1. In the first specification (equation 5) we estimate the Phillips curve in levels, on the contrary to most of the existing literature, because we explicitly do not want to rule out a priori the possibility of a downward-sloping long-run Phillips curve. The long-run slope is then equal to $\beta_0/(1 - \sum_i \alpha_i)$. Therefore these two coefficients β_0 and $\sum_i \alpha_i$ are of special interest here. If the first is zero then the long-run Phillips curve is flat, if the second is equal to one then it is vertical. If the first is negative and the second below one, then the long-run Phillips curve is downward-sloping. The long-run elasticity of the inflation rate w.r.t. the productivity growth is equal to $\theta_0/(1 - \sum_i \alpha_i)$. Most authors would expect a zero-coefficient, or if any a negative one. But as the Philips curve is a reduced form from a wage-setting and a price-setting equations, the sign is not given a priori[2]. We do not expect the change of the oil price to have a permanent effect on inflation ($\delta_0/(1 - \sum_i \alpha_i)$) and thus expect an insignificant coefficient for δ_0.

2. The second specification – albeit not very far from the second in spirit – is closer in its formulation to the standard model as it is expressed in first difference of the inflation rate. We follow the way of Blanchard & Katz (1997) in including an error correction term. This is superior to the standard specification (equation 2

[2]A positive coefficient means that the wage-setters pass a greater amount of productivity growth in their wages than the price setter in their prices. A negative coefficient the opposite. A zero coefficient means that the proportion of productivity passed in the wages and the prices resp. is equal.

with $\alpha(1) = 1$) because it takes into account that the main variables (the inflation rate, the unemployment rate and perhaps the productivity growth) are I(1) and may be cointegrated. On the second hand it allows not to rule out a priori the possibility of a non-vertical Phillips curve; Indeed two coefficients are of interest here. The loading coefficient $-\lambda$ measures strictly speaking the adjustment speed to past deviations from equilibrium (encompassed by the cointegration relation) (Johansen 1995). If this coefficient is significant, it tells us two things; first that the cointegration exists (or at least between two of the variables) and second that it influences the inflation developments (i.e. the inflation rate is not weakly exogenous). The second coefficient of interest is the long-run elasticity of the inflation rate w.r.t. the unemployment rate (β_0). It tells us if it is significant negative (and provided that the loading coefficient is significant) that the long-run Phillips curve is downward-sloping. If it is zero, there is no long-run Phillips-curve. Then only the degree of integration can tell whether the Phillips curve is flat (inflation I(0) and unemployment rate I(1)) or vertical (inflation I(1) and unemployment rate I(0)) or just not existing at all (both being I(1) or I(0))[3].

Here an alternative step is performed: the cointegration relationship is estimated in level and the residuals are tested for unit roots. This gives a rapid and first insight of the possible breaks and which coefficient they likely may hit. [4]

4.1.3 The data and their statistical properties.

We choose to express the inflation rate in terms of the GDP deflator because it turns off the imported inflation (provided the higher prices are past over to the customers). Almost all authors we have cited before estimate at least one specification in terms of the GDP deflator for the same reason.

The unemployment rate is based on the national definition rather than on the ILO definition because of two reasons. First, the national definition is more precise because it is based on an exhaustive statistic of the unemployed (the ILO series are based generally

[3] In all countries, the inflation rate and the unemployment rate are found I(1) for the maximal sample.

[4] After the method of Engle & Granger (1987); the cointegration exists if the resulting estimated residuals are I(0). Special t-critical values should then be used for the ADF-test. As then OLS is super-consistent, the estimated elasticities can be interpreted as usual and do not suffer from simultaneous-equation bias for large samples. However as for the error-correction single-equation, OLS is inefficient and the usual t-stats should not be used.

on a yearly poll that is choked on the national definition and revised when new figures are known) and this unemployment rate is much more commented through the press than the ILO one. One can fairly say that a larger part of the population in each country knows the level of the survey-based unemployment rate than the level of the ILO rate. Second, most of the ILO times series are not available for long samples (see annex A.1 for a detailed report of the sample availability). Some authors consider specific unemployment rates to account for demographic shifts (only for certain categories like middle-aged men or "Perry-weighted" rate that hold the demographic structure of the labour force constant). The demographic effects for the countries we consider are explorated in the Section 5.1 and it can be seen there that these effects are negligible for all countries. Therefore we restrain ourselves to the genuine unemployment rates.

For the choice of the exogenous supply-shock variables we leaned ourselves on the existing literature and the common admitted stylised fact that the slowdown of the productivity growth in the Western countries and the oil shocks (1974, 1979, 1990, 1999, 2003-...) are the major economic supply shocks since 1970. We include therefore these two shocks in the Phillips curve.

More technically, the data we focus on are seasonally adjusted quarterly data; yearly data are available on a quite large sample but they may yield – from an estimation point of view – a more evident simultaneous bias. Even if quarterly data do not rule out a priori this problem, the induced bias may be smaller. Monthly data are available only for half of the data of interest (unemployment rate and oil prices). The GDP-deflator and the productivity series are not available on a monthly basis and it is in our view preferable to estimate the Phillips curve in controlling for labour productivity changes and in terms of the GDP-deflator. Therefore we are obliged to estimate on a quarterly basis. Our variables are defined as follows:

- π: The inflation rate is measured as the yoy-percentage growth rate of the GDP deflator (DPGDP). Source: Eurostat.
- u: The unemployment rate (UR) is the survey-based or national definition unemployment rate. Source: OECD (EcoWin-Reuters).
- π^{oil}: The yoy-change in the price of oil in national currency (DOIL). Source: IMF-IFS (EcoWin-Reuters).
- π^{prod}: Labour productivity yoy-growth rate (DPROD, real GDP per person in

employment). Source: OECD (EcoWin-Reuters), Eurostat.

The data covers all countries for the period 1980q1-2006q3. In some of them the covered period is but longer (USA and UK: 1960q1/2-2006q3; France and Germany: 1970q1-2006q3).[5]

The inflation rates for all six countries considered and all periods (see Table 4 in the annex, p. 35) are I(1), as well as the unemployment rates. The changes in the price of oil are I(0). For the growth rate of labour productivity, the figures are not clear-cut. Precise definitions, sources and details on the statistical properties are in the annex (A.1 on p. 32ff).

Granger causality tests within bivariate VARs (with a constant, a deterministic trend and if necessary impulse dummies for outliers in the inflation equation, different lag-lengths) were conducted between all variables and the inflation rate. Especially interesting are the results for the unemployment rate[6]. We look at two samples: the 1980-2006 sample and the 1995-2006 sample. The results can be summarized as follows:

- 1980-2006: In all countries the causal direction from the unemployment rate to the inflation rate cannot be rejected at the 10%-level (USA: all lag-lengths and even at the 1%-level; UK: all lag-lengths and even 5%-level; Germany: all lag-lengths; Spain: only at some lag-lengths), with exception of France – where only the inclusion of the 70's permits such an affirmation – and of Italy[7].
- 1995-2006: The evidence is weaker and mostly disappears completely (USA: only for a lag-length of 7 and with significance level 5%; UK: no evidence at 10% but for lag-length 8; Germany: no evidence at 5% but for lag-length 8; France: no evidence at 10% but for lag-length 5; Italy: no evidence at the 5%-level, but at the 10%-level for some lags; Spain: no evidence at the 10%-level).

From the Granger-tests it seems already that something happens to the Phillips

[5]The statistical break due to the German Reunification is solved as follows: fictive whole German levels are calculated backward from the first level of reunified German figure (1991q1) and the growth rate of the original West-German figures.

[6]Results for the other variables are available on request.

[7]Depending if the sample begins in the early 80's or the late 80's, and which lag-length is chosen, the figures are not clar-cut.

curve in all countries between the 80's and 90's and in the way we postulated it: the relation becomes weaker if it not disappeared.

We estimate each country separately for two reasons; the first one is that we do not think that all countries have exactly the same breakpoint dates, as can be suggested from the charts on p. 6, and in general have common coefficients. Indeed even though the convergence due to the European integration is certainly observed it is not completed yet. It began for Italy and Spain in 1993, for France perhaps sooner in the 80's. Since the UK still has another cyclical development, it cannot really be spoken of European convergence. Germany faces the big statistical and economic break of the Reunification that did not hit the other European countries in the same strength. Thus it seemed not advisable to us to estimate a common Phillips curve for the "old European" countries in a panel estimation. Second, data were available in different lengths (UK, Germany and France from at least the 70's; Italy and Spain only from 1980 onward; USA from even 1960 onward) that renders a panel estimation quite difficult if one does not wish to forego data.

4.1.4 Stability tests used for detecting possible breakpoints

For the determination of the eventual presence of structural breaks, we follow the usual literature (Hansen 2001), in performing F-tests like the Chow- and Quandt-tests, RSS-tests, CUSUM and CUSUM^2 and looking at the recursive and rolling estimates of coefficients of interest.

The tests used are constructed as follows:

Chow- or Quandt-test: The sample is parted in two subsamples, whereas the parting time date or breakpoint goes from a time point t_1 to another t_2. Following Hansen (1997) these two time points are chosen as to imply a 15% symmetric trimming. For t going from t_1 to t_2, a Chow-test is performed and the respective Wald-statistics and F-statistics are stored, as our models are linear they will not differ except for a constant factor term. Three possible Quandt-statistics are possible as in Andrews (1993) and Andrews & Ploberger (1994): the maximal F-statistic, the exponential average of all F-statistics and the simple average of the F-statistics. For all a p-value can be derived from Hansen (1997). We look however only at the first one. The data where the statistics are maximal give then the possible break-point(s). These statistics are now computed

in the version 6 of EViews and were used here. This test assumes homoskedastic errors in the whole sample. This is why we perform also the next test.

RSS-Test: The same splitting method as above is used and for both subsamples a regression is performed and the estimated residual sum of squares (RSS) are stored and added together (Hansen 2001, p. 121f). A plot of the overall RSS give insight for possible breakdate(s) (local and global minima). Here the assumption of homoskedasticity is released and provide an alternative if the homoskedasticity tests do fail.

CUSUM and CUSUM^2: Using ever larger subsets of the sample data, the equation is estimated at each step and the estimated coefficients used to perform a one-step-forecast. Both tests are based on the obtained series of one-step-ahead and standardized forecasts errors, precisely on their cumulative sum. They are provided standardly in any statistical packages. Here the plots performed by EViews are used and the statistics are computed after Brown, Durbin & Evans (1975). When the statistics are outside the confidence bounds, there is an indication for instability; The CUSUM testing for overall parameter stability whereas the CUSUM^2 for variance stability.

Recursive coefficient estimates: are provided by EViews also. The equation is estimated repeatedly, using ever larger subsets of the sample data. For each estimations the estimate of the coefficient(s) of interest is stored and pictured with the 95% confidence bounds. According to EViews, "If the coefficient displays significant variation as more data is added to the estimating equation, it is a strong indication of instability."

Rolling coefficient estimates: The equation are estimated over a window of 10 years or 40 observations, starting from the soonest possible to the latest. All coefficients with their respective p-values are stored and the short-run (β_0) as well as the long-run ($\beta_0/(1-\sum \alpha_i)$ or β_0^c) elasticities w.r.t. unemployment are commented.

As in some countries obvious outliers could be identified the estimations are performed including a dummy variable correction for these outliers.

4.2 Single-equation estimations: results

In a first table (Table 1), the results from the stability tests described above are summarized (a more detailed description can be obtained from the authors). From these

results it can be seen that for each country a breakpoint in the first half of the 90's can be found. From this evidence the two sepcifications were re-estimated for the two sub-samples – before and after the detected breakpoint. The results of this second step are presented in Table 2.

Table 1: Results of the stability tests: Dating the breakpoints

	Germany	**France**	**Italy**	**Spain**	**UK**	**USA**
Unit-root tests (ADF)	*for the maximal samples u and π are I(1).*					
Granger-tests	*show all a diminishing evidence for the Granger-causality from unemployment to inflation in the 90's.*					
Quandt (Max-Chow)[a]	1992 (1.0%) ; 1994 (3.5%)	1982 (0.0%) ; 1982 (0.0%)	2001 (0.1%) ; 2000 (0.3%)	1995 (0.0%) ; 1997 (5.5%)	1975 (0.0%) ; 1975 (0.0%)	1981 (0.0%) ; 1973 (0.3%)
RSS: Local Min[b]	– ; –	1990 (2.8%) ; 1990 (3.7%)	1997 (0.9%) ; 1996 (0.8%)	– ; 1995 (>10%)	1987 (0.0%) ; 1987 (0.0%)	1991 (0.3%) ; 1981 (2.7%) 1991 (4.6%)
Rolling estimates	$\sum \alpha_i$ is stable around 0.8, β_0 is not stable but always negative and more imprecisely estimated in the 90's ; Cointegration seems stable.	$\sum \alpha_i$ moves around 0.9 and becomes very unprecisely estimated in the 90's, β_0 is not stable but in the 90's around -0.1 and significant ; The cointegration is really strong, the unemployment-l.t.e. turned negative in the 90's.	$\sum \alpha_i$ is unstable but decreased in the 90's, β_0 becomes significant negative 90's ; Cointegration exists only in the 90's but unemployment-l.t.e. approaches zero throughout the 90's.	$\sum \alpha_i$ decreased sharply below one in the 90's, β_0 is always negative and instable ; Cointegration does not exist.	$\sum \alpha_i$ is significantly below one in the 80's and 90's, β_0 is not significant and turns positive in the 90's ; Cointegration exists only in the 90's but then unemployment l.t.e.-turns positive.	$\sum \alpha_i$ moves around one in the whole sample but in the 90's where is is significantly below one. Then β_0 but turns positive ; Cointegration does not exist.

Tests for the first specification are followed by those for the second specification. They are separated with a semi-colon.

[a] The probability reported is the one from the Chow-test.

[b] The probability reported is the one from the corresponding Chow-test.

Table 2: Results of some equations

Country and time period	Equation 5 *H0: =1* $\sum_i \alpha_i$	Equation 5 *H0: =0* β_0	Equation 5 *H0: =0* l-t e.	Equation 6 *H0: =0* $-\lambda$	Equation 6 *H0: =0#* β_0
Germany					
1971q1-1989q4	0.822***	-0.086***	-0.487***	-0.093	-0.506
1994q1-2006q3	0.837***	-0.074*	-0.451**	-0.182***	0.117
Breakpoints:	1992-93 + 2000			1993-94	
France					
1971q1-1989q4	0.921***	-0.118***	-1.498***	-0.112**	-2.963**
1991q1-2006q3	0.803***	-0.100***	-0.508***	-0.218**	-0.628***
Breakpoints:	1979-83 + 1990			1982-83 + 1990	
Italy					
1981q1-1994q4	0.838***	-0.172**	-1.059***	-0.166***	-6.110***
1996q1-2006q3	0.751***	-0.004	-0.014	-4.338***	-2.523***
Breakpoints:	1995-97 + 2001-03			1995-96 + 2000	
Spain					
1981q1-1994q4	0.845***	-0.221***	-1.427***	-0.321***	0.071
1996q1-2006q3	0.729***	-0.033***	-0.120***	-0.344***	-0.322***
Breakpoints:	1995			1997	
UK					
1961q2-1973q4	1.021	0.470**	-22.693	>0	–
1976q1-1987q4	0.784***	-0.220**	-1.019***	-0.137	-0.594***
1990q1-2006q3	0.758***	0.080**	0.331***	-0.327***	-0.216
Breakpoints:	mid 70's + 1980 + 1986			mid 70's + 1981 + 1987	
USA					
1960q1-1974q4	1.157***	0.161***	-1.022***	-0.041	2.42
1977q1-1989q4	1.072***	-0.329***	4.579***	-0.101	-2.160***
1991q1-2006q3	0.857***	0.054*	0.376**	-0.037	-0.113
Breakpoints:	1976-77 + 1981 + 1990-91			1975 + 1981 + 1986	

l-t e.	Long-term elasticity ($\beta_0/(1-\sum_i \alpha_i)$)
*/**/***	Reject H0 at the 10% / 5% / 1% level.
no star	Not significant (do not reject H0)
#	The distribution are non-standard and unknown.
	Here the $\mathcal{N}$-distribution is used and thus subject to caution.

4.3 Summary of results

Compared to the statistical Phillips curves which are flat in 5 of our 6 chosen countries during the last ten to thirteen years, the results of our econometric analysis are partly disappointing. We start with three positive aspects of our results:

1. The stability tests (Table 1) confirm the existence of the expected break in the Phillips curve in all six countries during the 1990's. Only in the UK the latest break is found for 1986. The year(s) of the break in the 1990's are estimated by equation (5) as follows: USA and France: 1990; Germany: 1993/94; Spain: 1995-1997; Italy: 1995-2001. The break points resulting from equation (6) differ slightly, but they are less reliable because in three countries no cointegration is found, for all or a part of the periods considered.

2. The results summarized in Table 2 show that - with the exception of the USA before 1990 - there does not exist any vertical Phillips curve after the beginning of the disinflation period. The relevant parameter is significantly below unity for that period (except the USA) and for the actual period.

3. In three countries of romance languages, namely France, Italy and Spain, equation (5) indicates a flattening of the estimated Phillips curve; in Italy it is flat since 1996. The results of equation (6) confirm these results except for Spain where β_0 is not significantly different from zero.

The less successful results of our econometric analysis are:

4. In Germany there is not much change in the slope of the Phillip curve. In the UK we obtain a flattening of this curve between the disinflation period and the later period. But since 1990 the Phillip curve is sloping slightly upward what we are not yet able to explain.

5. For the USA the results are rather strange what confirms the results of other empirical studies (Beyer & Farmer 2002, for example).

6. Equation (6) which includes an error correction term offers no great help, since esp. in the countries without the expected results too often no cointegration is found. This might be due to the relative small sample size (40 to 50 quarters).

5 On three recent contributions to specific topics

5.1 Demography and NAIRU; a 30-years-assessment

Some authors claim that the NAIRU could have changed just because of demographic shifts in the active population (Stiglitz 1997, Ball & Mankiw 2002, Wall & Zoëga 2004)[8]; groups with different unemployment rate (esp. along gender and age) could have experienced shifting weights. Along gender and age two contradictory effects can be supposed: As the women participation to the labour force gets larger and their relative unemployment rate is in general higher than for men, it could induce a statistical increase of the unemployment rate. On the other hand, as the population is getting older in Europe and especially in Germany (2004 was the first year of decreasing overall population!), the share of younger workers, with generally higher unemployment rate[9], in the labour force gets smaller and induce therefore a statistical decrease on the unemployment rate. This is why some Phillips curves estimations are done with at least two types of unemployment rates: the official figures and one corrected for demographic effects. Staiger et al. (1997) take for example the unemployment rate for young men only, Ball & Mankiw (2002) a "Perry-weighted" unemployment rate.

It is open to discussion whether it is admissible to use this kind of argument since it implies that the overall rate of unemployment is the weighted result of the different subgroup rates. On the contrary the average of these rates may be determined by the overall rate of unemployment. Nevertheless we try to gauge this effect for Germany, France, Italy, Spain and the UK. For that we follow the method of Ball & Mankiw (2002), named "Perry-weighted", which divides the labour force in subgroups (gender/age) and let their respective shares fictively fixed over the period considered whereas their unemployment rates are the original ones. The induced fictive new unemployment rate gives therefore the possible effects of the gender/age-shifts effects on the unemployment rate and give thus an idea of their possible effects on the NAIRU. Here it assumed implicitely that

[8]Stiglitz (1997) measures this effect for the USA with 1/3 of the decline of the NAIRU, the latest being accounted with 1.5 %-points between the early 1980's and 1995. To the same modest effect come Ball & Mankiw (2002) for the period 1960-2000 and for the USA. Wall & Zoëga (2004, p. 30) measures the effect of demographic changes on the US NAIRU between 1982 and 2000 with 0.7%-points in 2000.

[9]Here the specificities of Germany should be mentioned. On the contrary to other continental European countries and to the UK and USA, the unemployment rate of younger workers in Germany as the one of women is not significantly higher than the average rate of unemployment in Germany. The specific dual education system is often put forward to explain this positive feature.

these structural effects were not corrected by overall reaction of the unemployment rate (e.g. if the total unemployment rate depends on total demand for goods).

For Germany 10 age groups (15-19; 20-24; 25-29 ;30-34; 35-49; 40-44; 45-49; 50-54; 55-59; 60-65) and the two gender are considered, so that the labour force is divided in 20 groups. Data are only available for a longer period from the Mikrozensus (after 1975) and thus differ from the official figures of the German Labour Agency, as the definition for being unemployed is much more in line with the one of the ILO than the administrative one. The different pictures are shown in Chart 3. The maximal difference for the 1975-2005 period is as high as +0.5 percentage points (2005) and -0.3%-points (1987). Even more than for the USA, the gender/age structural shifts of the labour force can thus be considered as negligible.

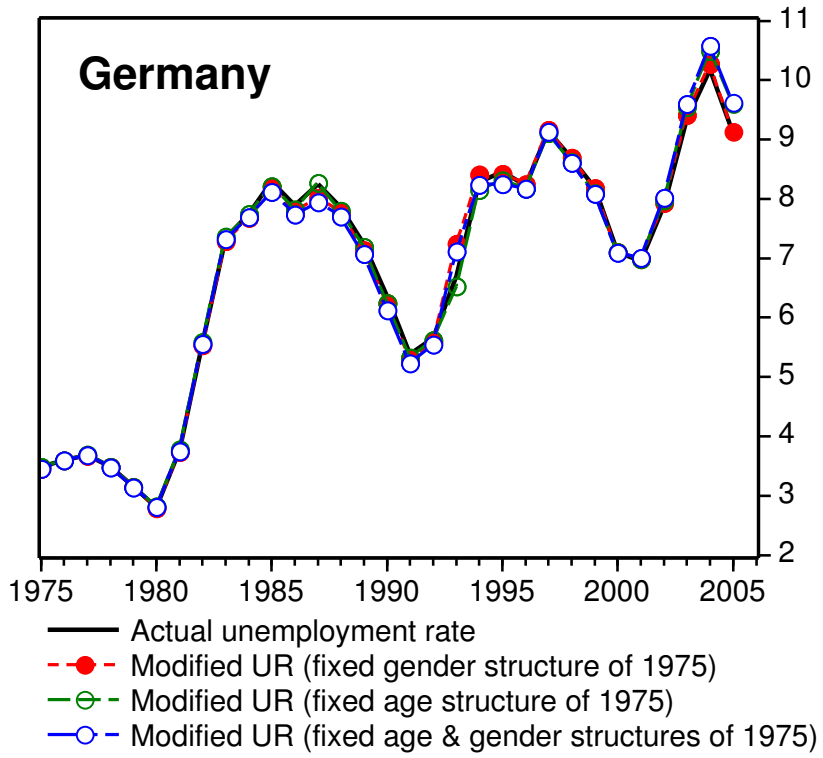
For the other European countries, data from the Eurostat-Labour Force Surveys between 1983 and 2006 are considered. Five age groups (15-24; 25-39; 40-49; 50-59 and 60+) and the two genders parted the labour force. The different pictures are shown in Chart 4. The maximal positive effect (increase of the NAIRU) lies between 0 and 0.6 %-points and at the beginning of the sample (1984-91). The maximal negative effect (decrease of the NAIRU) is much higher for all countries and lies between -0.5 and -1.5 %-points and is achived at the end of the sample (2005-06, for France also 1997). The demographic effects on the NAIRU are somehow more important for the other European countries than for Germany but are still relatively modest if one compares these ranges with the maximal fall in their resp. unemployment rates (5.5 to 15.7 %-points).

5.2 Role of institutions: the OECD-Employment Outlook 2006

In its Employment Outlook 2006, the OECD staff once again tries to prove the importance of institutional changes for the evolution of the unemployment rate. Therefore, the changes of the latter from 1982 to 2003 are explained by five structural factors and by the output-gap with the results that the output-gap contributes much less to the changes in unemployment than the structural factors (OECD 2006, Chart 7.3 on p. 214).

This may suggest that structural factors contribute more than the macroeconomic

Chart 3: Demographic effects on the German unemployment rate (in %)

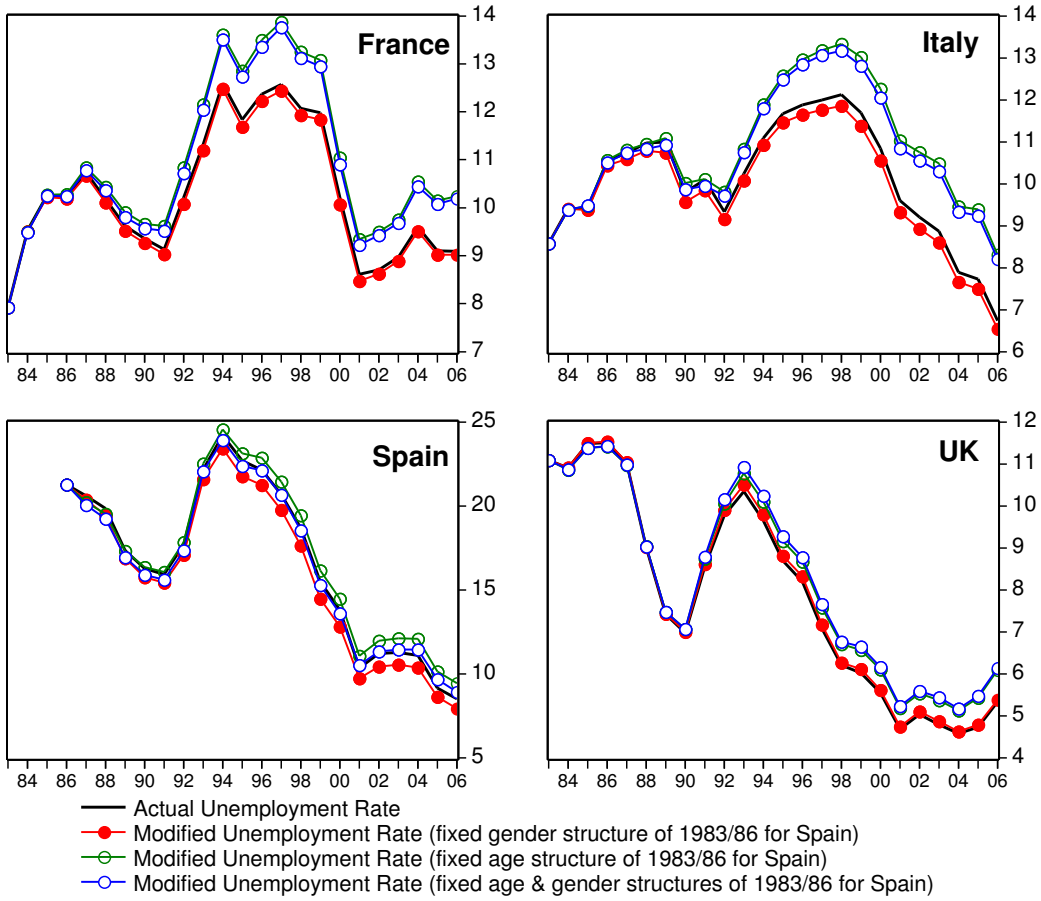


Note: 20 different unemployment rates are calculated (10 age groups and the 2 gender groups). The age/gender-structure of the first available year (1975) is held constant for the different dotted and marked lines whereas the actual structure is unchanged for the bold line. 1975-1990: West-Germany, 1991-2005: Reunified Germany. Sources: Mikrozensus, own calculations.

environment to the explanation of the changes in unemployment. But this is not the case, since only the output gap (i.e. the deviation from trend output) and not the output itself is included as an explanatory variable. Therefore the influence of the growth performance of a country is not taken into account. The importance of this omission can be demonstrated for the most extreme case, Ireland, where the unemployment rate diminished by almost 8%-points. This change in the OECD-calculations is attributed to almost 90% to structural factors, only the small rest to the output gap. The well-known extraordinary growth performance in Ireland has no chance to show its influence on the rate of unemployment. We suppose it would be overwhelming.

With respect to the single structural factors it is shown that in the OECD-average higher average replacement rates, higher tax wedges and lower product market competi-

Chart 4: Demographic effects on the unemployment rate (in %) for 4 European countries.



Note: the unemployment rate is considered separately for 5 different age categories and for men and women. Thus 10 different unemployment rates are calculated. Sources: Eurostat-LFS and own calculations.

tion significantly raise unemployment. Employment protection and union density have a very small and non-significant effect. On the contrary, active labour market policies (ALMP) tend to lower unemployment.

5.3 Globalization and inflation

Several studies look at the role of globalization (i.e. growing importance of international trade) for the Phillips curve. In a recent cross-countries comparative study from the International Monetary Funds (IMF 2006, chap. 3) the flattening of the Phillips curves in

the 90's is confirmed for all industrialized countries. To measure whether this change can solely be attributed to a better conduct of the monetary policy or also to globalization the IMF develop an original strategy.

The IMF (2006, chap. 3) finds that the persistency of inflation diminished from 1983 to 2004. The estimated Phillips curve for the G8-countries between 1960-2004 takes the form:

$$\begin{aligned} \pi &= c_0(credibility) + \alpha(credibility)\pi_{t-1} \\ &\quad +\beta(credibility, d^{\circ}openess, Wage - Coord, PastInfla)Gap^{Dom} \\ &\quad +\delta X^{supply} + \epsilon \end{aligned} \tag{7}$$

The overall α and β coefficients have decreased over the sample. The credibility variable has a negative sign and is significant for the constant and the α-coefficient. To account for the decrease of the β coefficient, only the degree of openess is significant. This means that both – improved monetary policy and globalization – have contributed to the flattening of the Phillips curve. The IMF quantifies the improved monetary policy (credibility) to have contributed to half of the declined sensivity of prices to domestic product, the increased openess of the economies accounting for the rest.

To summarize the findings, we join Bean (2006) – the Executive Director and Chief Economist of the Bank of England – which states in his LSE-speech, that globalization seem to have supported the trend of declining inflation but cannot be seen as the major driving force behind it.

6 Conclusions

Impressed by the development of the statistical Phillips curve of the USA, the UK and the four great countries of the Euro Area, we formulated the hypothesis that during the early 1990's the wage and price setters finally accepted the new rigour of the monetary authorities and tried no more (nor had the market power) to pursue a policy which raises the inflation rate significantly above the target inflation rate of the Central Banks. As a consequence the long-run Phillips curves not only flattend a bit but are flat now.

Our econometric analysis which takes account of the most important factors which

influence also the inflation rate (esp. supply shocks like productivity growth and oil price hikes) confirms that (except for the USA before 1990) there does not exist any vertical Phillips curve after the beginning of the disinflation period. Further more, a "break" in the Phillips curve is confirmed for all countries during the early or middle 1990s (only in the UK it occurs already in 1986). The late apperance of the break in Italy and Spain may be related to the strong efforts of these countries to fulfill the Maastricht criteria for entrance in the EMU.

With respect to the slopes of the Phillips curves, it is shown that the clear-cut picture given by the statistical Phillips curve in Chart 1 does not survive the inclusion of other explanatory variables: the influence of the unemployment rate on the rate of inflation does only disappear in Italy: The Phillips curve is flat in that country since 1996. In the other countries it becomes flatter.

The next steps of our reserach will be designed to explain the differences between the countries considered to determine the reasons for the observed behaviour. It would especially be useful for the monetary authorities to know whether the factors which led to the flattening of the Phillips curve are rather permanent or only transitory.

A Annex

A.1 Description of the data

The data are quarterly data. The abbreviations are as follows:

Table 3: Description of the data.

Variable Name	Description
PGDP	Deflator of the Gross Domestic Product. Eurostat (national Account statistics); seasonally adjusted quarterly series. The inflation rate from this series is built as the yoy-growth rate in %.
HUR	Harmonised Unemployment Rate in %. Eurostat; seasonally adjusted monthly series.
SUR	Standardised Unemployment Rate in %. OECD, seasonally adjusted quarterly series.
UR	Unemployment Rate in %. (used for the estimations) OECD, seasonally adjusted quarterly series.
NEER	Nominal Effective Exchange Rate. From the IMF-IFS-Database; 1957q1-2006q3; 2000=100. The growth rate for this series is built as the yoy-growth rate in %.
LProd	Labor productivity (real GDP per person in employment), index (2000=100), seasonally adjusted.
OIL_USD	Oil Price in USD (average of crude). IMF-IFS; 1957q1 2006q4.

- Germany

  PGDP: Destatis (1970-2006). 1970-1990: West-Germany, linked with qoq-growth rates. 2000=100.

  HUR, SUR, UR: UR: national definition and from 1969q1 to 2006q4. SUR: from 1978q1 to 2006q3. HUR: from 1992q2 to 2006q4.

  LProd: Destatis (1970-2006). 1970-1990: West-Germany, linked with qoq-growth rates. 2000=100.

- France

PGDP: Eurostat (1978 onward) and IMF-IFS (1970-1977). From 1970q1 to 2006q3.

HUR, SUR, UR: (Insee and Dares for last points) UR: national definition and from 1967q1 to 2006q4. SUR: from 1982q1 to 2006q4. HUR (=SUR): from 1983q2 to 2006q4.

LProd: Eurostat, OECD and IMF. From 1970q1 to 2006q3.

- Italy

  PGDP: From 1980q1 to 2006q3.

  HUR, SUR, UR: UR: national definition and from 1960q1 to 2006q3; but break in the definition from 1992q4 onward (UR=SUR). SUR: from 1982q1 to 2006q2. HUR (=SUR): from 1983q1 to 2006q3. The break wa suppressed from the UR-series in re-linking its level after 1993 with its changes before (the evolution is the same but at a lower level).

  LProd: OECD-Economic Outlook. From 1970q1 to 2006q3.

- Spain

  PGDP: From 1980q1 to 2006q3.

  HUR, SUR, UR: UR: national definition and from 1964q2 to 2006q3. SUR: from 1982q1 to 2006q3. HUR(=SUR): from 1983q1 to 2006q4.

  LProd: OECD-Economic Outlook. From 1970q1 to 2006q3.

- UK

  PGDP: From 1955q1 to 2006q3.

  HUR, SUR, UR: UR: national definition and from 1960q1 to 2006q3. SUR: from 1982q1 to 2006q3. HUR(=SUR): from 1983q1 to 2006q4.

  LProd: Eurostat and OECD-Economic Outlook. From 1960q2 to 2006q3.

- USA

  PGDP: From 1947q1 to 2006q3.

  HUR, SUR, UR: UR=SUR=HUR: from 1960q1 to 2006q4.

  LProd: Eurostat and BLS. From 1948q1 to 2006q3.

A.2 Unit root tests

The unit root tests were performed on the levels and first difference of the data. The test used is the Augmented Dickey-Fuller (ADF) test. A constant was always included and a variant with a trend also was performed. All tests are performed routinely by EViews. The results are summarized in the table below; Details as well as the ERS-tests can be obtained from the authors on request.

Table 4: ADF-tests

Variable name	Country	level	difference	Remarks
Variable name	Country	level	difference	
π^{PGDP}	DEU	***	**	With SIC-lag selection: ***/-
	FRA	***	*	
	ITA	*	*	Trend-stationary
	ESP	***	-	Trend is necessary
	UK	***	-	
	USA	***	-	
UR	DEU	***	-	
	FRA	***	-	
	ITA	***	-	
	ESP	***	***	
	UK	***	-	
	USA	***	-	
NEER	DEU	***	-	
	FRA	***	-	
	ITA	***	***	
	ESP	***	-	
	UK	***	-	
	USA	**	-	a trend is necessary
π^{NEER}	DEU	*	-	
	FRA	-	-	
	ITA	***	-	
	ESP	-	-	
	UK	*	-	
	USA	*	-	

—*continued next page*—

Table 4: ADF-tests

Variable name	Country	level	difference	Remarks
OIL_USD		***	-	
π^{OIL}		-	-	
LabourProd	DEU	***	-	
	FRA	* to ***	-	
	ITA	***	-	
	ESP	*** to '-	- to ***	depending if trend or not...
	UK	***	-	
	USA	***	-	
$\pi^{LabourProd}$	DEU	***	-	
	FRA	* to '-	-	
	ITA	*	-	
	ESP	**	-	
	UK	-	-	
	USA	** to '-	-	
-	Reject H0 at 1%: I(0)			
*	Do not reject H0 at 1%			
**	Do not reject H0 at 5%			
***	Do not reject H0 at 10%: I(1)			

From this table it is clear that the inflation rates for all country and all indicators are non-stationary (I(1)), as well as the unemployment rate. The changes in the price of oil are stationary (I(0)). For the growth rate of labour productivity and of the nominal effective exchange rate, the figures are not clear-cut.

A.3 Phillips curves: different price indices

The Phillips curves that arise from these data are pictured in the following charts. It is obvious from the charts that the USA behaves much more conform to the "traditional" theory than the (main) European countries.

Chart 5: Phillips curve: Germany.

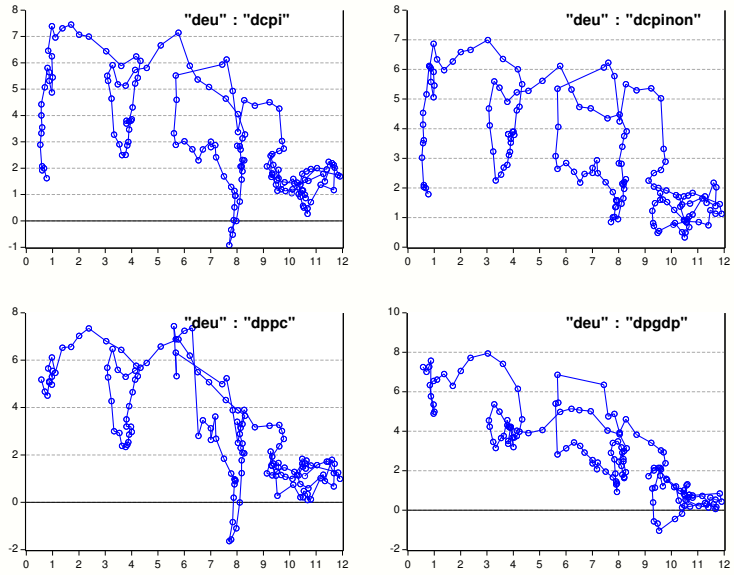


Chart 6: Phillips curve: France.

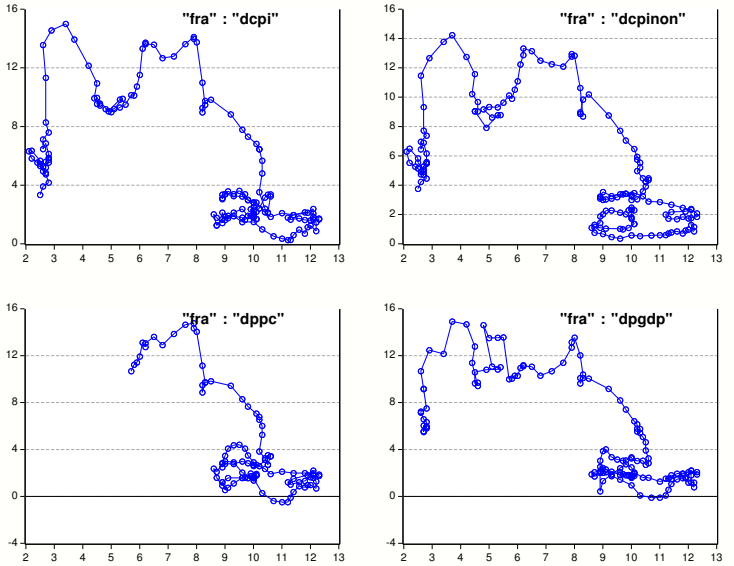


Chart 7: Phillips curve: Italy.

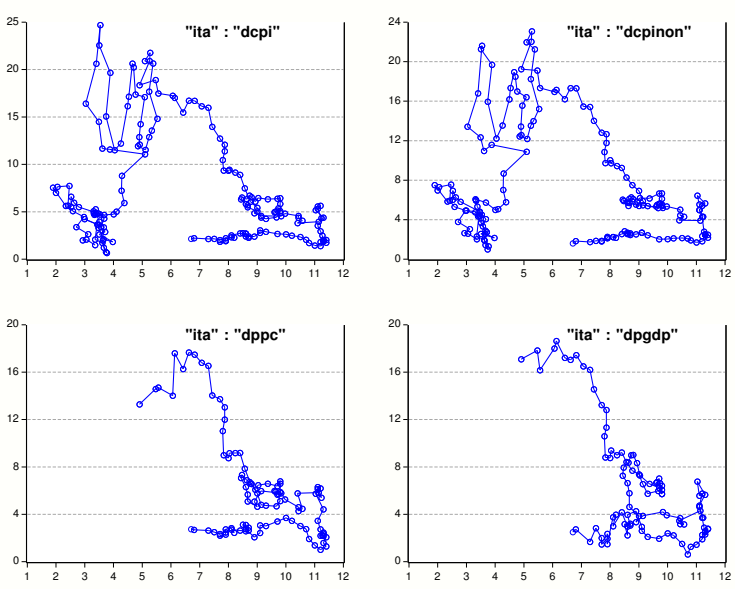


Chart 8: Phillips curve: Spain.

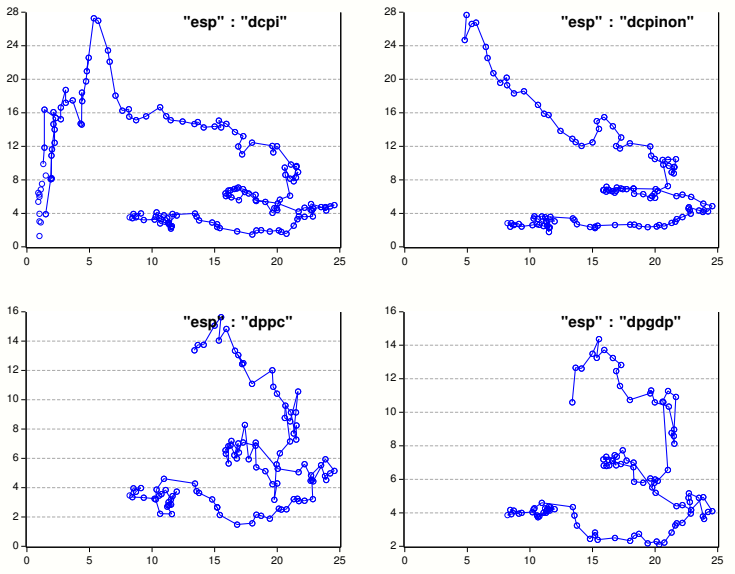


Chart 9: Phillips curve: UK.

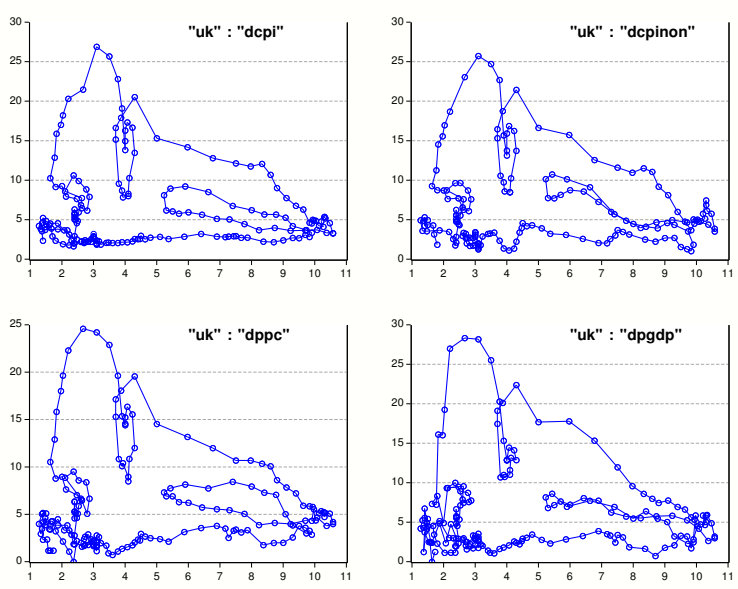
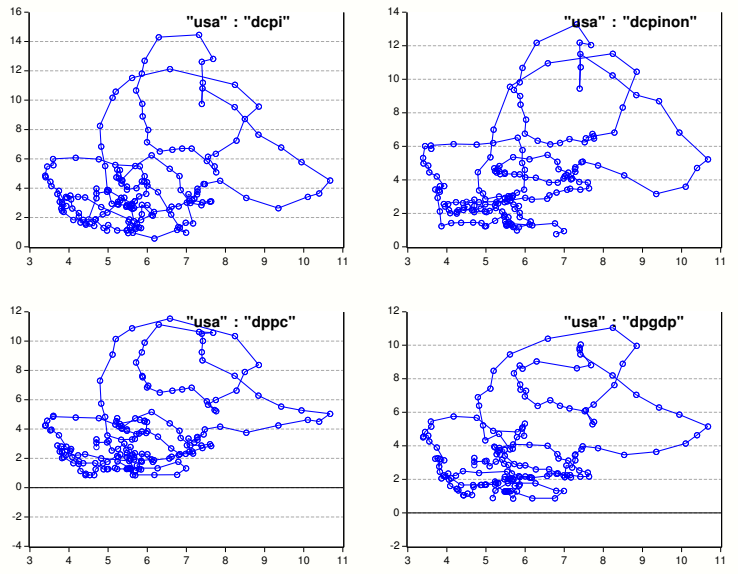


Chart 10: Phillips curve: USA.



References

Akerlof, G. A., Dickens, W. T. & Perry, G. L. (1996). The macroeconomics of low inflation, *Brookings Papers on Economic Activity* **1996**: 1–59.

Akerlof, G. A., Dickens, W. T. & Perry, G. L. (2000). Near-rational wage and price setting and the long-run Phillips curve, *Brookings Papers on Economic Activity* **1**: 1–60.

Andrews, D. W. K. (1993). Tests for parameter instability and structural change with unknown change point, *Econometrica* **61**(4): 821–856.

Andrews, D. W. K. & Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative, *Econometrica* **62**(6): 1383–1414.

Ball, L. (1994). Credible disinflation with staggered price-setting, *The American Economic Review* **84**(1): 282–289.

Ball, L. (1997). Disinflation and the NAIRU, *in* C. Romer & D. Romer (eds), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago, chapter 4, pp. 167–185.

Ball, L. & Mankiw, N. G. (2002). The NAIRU in theory and practice, *Journal of Economic Perspectives* **16**(4): 115–136.

Bean, C. (2006). Globalisation and inflation, *Speech*, LSE Economics Society. Tuesday 24^{th} October.

Beyer, A. & Farmer, R. E. A. (2002). Natural Rate doubts, *Working Paper 121*, ECB.

Blanchard, O. J. & Katz, L. F. (1997). What we know and what we do not know about the Natural Rate of unemployment, *Journal of Economic Perspectives* **11**(1): 51–72.

Eller, J. W. & Gordon, R. J. (2003). Nesting the New Keynesian Phillips curve within the mainstream model of U.S. inflation dynamics, *Konferenzbeitrag*, CEPR Conference "'The Phillips Curve revisited" in Berlin, 5.-7. Juni 2003.

Engle, R. F. & Granger, C. W. (1987). Co-integration and error correction: Representation, estimation, and testing, *Econometrica* **55**(2): 251–276.

Fabiani, S. & Mestre, R. (2001). A system approach for measuring the Euro Area NAIRU, *Working Paper 65*, ECB.

Franz, W. (2005). Will the (German) NAIRU please stand up?, *German Economic Review* **6**(2): 131–153.

Friedman, M. (1968). The role of monetary policy, *American Economic Review* **68**: 1–17.

Fuhrer, J. C. & Moore, G. R. (1995). Inflation persistence, *Quaterly Journal of Economics* **110**(1): 127–159.

Galbraith, J. K. (1997). Time to ditch the NAIRU, *Journal of Economic Perspectives* **11**(1): 93–108.

Gordon, R. J. (1981). Inflation, flexible exchange rates, and the Natural Rate of unemployment, *Working Paper 708*, NBER.

Gordon, R. J. (1997). The time-varying NAIRU and its implications for economic policy, *Journal of Economic Perspectives* **11**: 11–32.

Grant, A. P. & Thomas, L. B. (1999). Inflationary expectations and rationality revisited, *Economic Letters* **62**(3): 331–338.

Hansen, B. E. (1997). Approximate asymptotic p-values for structural-change tests, *Journal of Business & Economic Statistics* **15**(1): 60–67.

Hansen, B. E. (2001). The new econometrics of structural change: Dating breaks in U.S. labor productivity, *The Journal of Economic Perspectives* **15**(4): 117–128.

IMF (2006). *World Economic Outlook: Globalization and Inflation*, Vol. April, IMF, Washington D.C.

Johansen, S. (1995). *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Karanassou, M., Sala, H. & Snower, D. J. (2003). Unemployment in the European Union: A dynamic reappraisal, *Economic Modelling* **20**(2): 237–273.

Katz, L. F. & Krueger, A. B. (1999). The high-pressure U.S. labor market of the 1990s, *Working Paper 1999-05*, Princeton University, Dpt. of Economics.

Laubach, T. (2001). Measuring the NAIRU: Evidence from seven economies, *The Review of Economics and Statistics* **83**(2): 218–231.

Mankiw, N. G. (2001). The inexorable and mysterious tradeoff between inflation and unemployment, *The Economic Journal* **111**(471): C45–C61.

Mankiw, N. G. & Reis, R. (2002). Sticky information versus sticky prices: A proposal to replace the new keynesian phillips curve, *The Quarterly Journal of Economics* **117**(4): 1295–1328.

McMorrow, K. & Röger, W. (2002). Technical specification of the model used for the estimates, *Internal note to economic trends*, European Commission.

Nielsen, H. S. (2003). *Essays on expectations*, Shaker, Aachen.

OECD (1994). *The OECD Jobs Study: Facts, Analysis, Strategies*, OECD, Paris.

OECD (2006). *Employment Outlook*, OECD, Paris.

Phelps, E. E. (1967). Phillips curve, expectations of inflation and optimal unemployment over time, *Economia* **34**: 254–281.

Richardson, P., Boone, L., Giorno, C., Meacci, M., Rae, D. & Turner, D. (2000). The concept, policy use and measurement of structural unemployment: Estimating a time varying NAIRU across 21 OECD countries, *Working Paper 250*, OECD.

Roberts, J. M. (1995). New Keynesian economics and the Phillips curves, *Journal of Money, Credit and Banking* **27**(4): 975–984.

Sargan, J. D. (1964). Wages and prices in the UK: A study in econometric methodology, *in* G. M. P.E. Hart & J. Whitaker (eds), *Econometric analysis for national economic planning*, Butterworths, London.

Staiger, D., Stock, J. H. & Watson, M. W. (1997). The NAIRU, unemployment and monetary policy, *Journal of Economic Perspectives* **11**: 33–49.

Staiger, D., Stock, J. H. & Watson, M. W. (2001). Prices, wages and the U.S. NAIRU in the 1990s, *Working Papers 8320*, NBER.

Stiglitz, J. (1997). Reflections on the Natural Rate hypothesis, *Journal of Economic Perspectives* **11**: 3–10.

Taylor, J. B. (2000). Low inflation, pass-through, and the pricing power of firms, *European Economic Review* **44**(7): 1389–1408.

Wall, H. J. & Zoëga, G. (2004). U.S. regional business cycles and the Natural Rate of unemployment, *Review of the Federal reserve Bank of St. Louis* **86**(1): 23–32.