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Do We Know How Low Should Inflation Be?

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Abstract: The paper looks for evidence of grease and sand effects in Europe, in particular the possibility that the natural rate of unemployment is affected in the long run by the inflation rate. Looking at four countries, France, Germany, the Netherlands and Switzerland, the paper reports some preliminary evidence that the long-run rate of unemployment is a nonlinear function of inflation. The particular shape of the empirical relationship supports the view that a moderate level of inflation provides some "grease" to the price and wage setting process. In particular, the long-run rate of unemployment is found to reach a maximum between 0.5% and 1%, and to quickly decline for higher rates of inflation. For the range of inflation rates observed in the sample countries, there is no evidence of sand effects, that uncertainty associated with inflation adversely affect the long-run rate of unemployment.

Keywords: inflation, natural rate of unemployment.

1. Introduction*

When the ECB announced its definition of price stability, "a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%" over the medium run, it signaled a historical shift towards a performance unheard of in the postwar period. This shift is illustrated in Figure 1 which shows the centered three-year moving average of German inflation. Under this interpretation of the medium run,

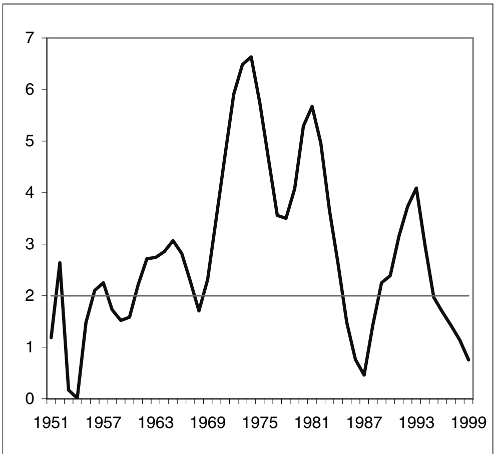

Figure 1. Inflation in Germany

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the ECB's objective has been achieved in about one year out of three. Switzerland's record is better, but still only fits that definition of price stability in 40% of the postwar years. Simply put, inflation below 2% has been the exception, not the rule since the end of World War II.

It is natural to wonder, therefore, how economies perform when inflation is durably maintained at such a low rate. The older literature on the optimum rate of inflation emphasized two aspects: "shoe-leather" costs and public finance. According to the shoe-leather cost view developed by Bailey (1956), the higher is the inflation rate, the more costly it is to hold cash. Because cash yields utility (or raises productivity), a policy that reduces the cost of money is desirable. This reasoning leads to Friedman's rule that the social optimum occurs when the nominal interest rate is zero and the inflation is negative; only then the marginal cost of money borne by users is equal to the marginal cost of producing money, which is negligible.

Running against this logic is the public finance approach developed by Phelps (1973) and others. Inflation is a tax and the principle of optimum taxation is that the marginal costs of all taxes should be equalized. Since all taxes are distortionary, there is an optimal level of distortion for inflation as well. Estimates of the optimal rate of inflation under this heading have been found to be very low.

The literature on optimal inflation has been revived, and made more realistic, in the wake of the debate on rules vs. discretion. Once it is recognized that central bank credibility is a public good, it becomes important that inflation be predictable. Consumers and producers can only accurately plan for the future – and save and invest accordingly – when future relative prices are predictable. While predictability does not necessarily require low inflation, the evidence is that the higher is inflation the less stable are relative prices, and thus the wider is the range of uncertainty that matters for key economic decisions.

This reasoning implicitly assumes that there is no cost to price stability. Akerlof, Dickens and Perry (1996, 2000) challenge this assumption. For various reasons which include efficiency wages, fairness, nominal downward rigidity and information costs, they argue that a moderate level of inflation provides some "grease" to the price and wage setting process. Such a source of real wage flexibility, in turn, durably reduces the natural, or long-run, rate of unemployment. Yet, when inflation rises, the implied money illusion -including information costs- dissipates and the burden of price uncertainty rises. This is when inflation exerts a "sand effect" on the natural rate of unemployment. Groshen and Schweitzer (1997) report evidence based on micro data consistent with the presence of grease effects at low inflation rates, while the sand effect, initial nil, increasingly offsets the grease effect as inflation rises. This finding suggests the existence of an optimal, nonzero rate of inflation which is estimated by Akerlof, Dickens and Perry (2000) to be in the 1.5–4% range. On the other side, Card and Hyslop (1996) report no evidence in favor of a positive rate of inflation (but see Akerlof, Dickens and Pery (1996) who argue that measurement errors and the partial equilibrium nature of the model lead them to underestimate nominal rigidities).

The evidence so far is limited to the US. It is natural to wonder how it plays out in Europe. Given that Europe's labor markets sharply differ from those in the US, there is no presumption that sand and grease effects are the same. European labor markets are known to involve more generous benefits and to rely more on collective bargaining than the US (Nickell, 1997). While such features do not directly affect wage and price setting as emphasized in the grease and sand literature, they do affect workers' incentives in trading-off real wage cuts against employment protection which may put grease effects at a premium in Europe. In addition, in many countries, unilateral nominal wage cuts are explicitly ruled out by existing legislation (Holden, 1994) which implies that very low inflation may result in significantly higher unemployment in the presence of shocks. (Holden, 2000).

The present paper undertakes to seek evidence on the relationship between steady state unemployment and inflation in a selected group of European countries. The chosen countries are the two larger ones (France and Germany) plus one country that has exhibited particularly low rates of inflation over the last decades, Switzerland, and another country with a reasonable good inflation performance, the Netherlands. There is no attempt to track down the channels of grease and sand effects, for example by using micro-data as in the papers mentioned above. The strategy is rather to test directly at the macro-level for any evidence of grease and sand effects. The approach is presented in the next section. Section 3 describes the estimation strategy and the results are presented in Section 4. Section 5 concludes.

2. Investigation Strategy

2.1. Approach

The view that central banks ought to aim at very low inflation because it could affect unemployment is a statement about the steady state. This is made clear in the ECB's presentation of its strategy:

"A monetary policy that maintains price stability in a credible and lasting way will make the best overall contribution to improving economic prospects and raising living standards."

Monthly Bulletin, January 1999, p. 39.

The ECB's statement is justified by appealing to arguments which are similar to those spelled out in the sand-effect literature. One way of testing this view is to test for inflation effects on long-term growth. Results produced by Bruno and Easterly (1996) and Barro (1997) confirm that growth slows down when inflation remains above 20 to 40%. What happens at lower levels is not known.

Another approach is to look at unemployment. The view that low inflation helps achieve low unemployment in the long term can be interpreted as a statement that the long-run Phillips curve is positively sloped. The view that grease and sand effect may partially offset each other to a different degree depending on inflation implies that the long-run Phillips curve is nonlinear. This observation inspires the strategy adopted here, following Akerlof et al. (1996, 2000), who find evidence of nonlinearity, and Groshen and Schweitzer (1997), who find a positively-slopped relationship. Both look only at US data, however.[1]

[1] Fischer (1996) discusses nonlinearities in the Phillips curve at very low rates of inflation.

2.2. *Return of the NAIRU?*

The use of a Phillips curve apparatus to track down nonlinearities assumes the existence of a NAIRU, often referred to as – and confused with – the natural rate of unemployment (two celebrated misnomers). Both the NAIRU and the Phillips curve have repeatedly been pronounced dead but never fail to remerge when needed, i.e. when large and sustained changes in unemployment and/or inflation occur. There is now a large literature on the re-emergence of the Phillips curve as a way of describing aggregate data.[2] The verdict is far from unanimous.

For the US, most researchers find that there exist a relationship between inflation and unemployment, but there is disagreement on the validity of its theoretical underpinnings and on the significance of the results. For example, among those sympathetic to the concept, Clarida and Gali (1999) argue that traditional backward-looking models are misspecified and offer their own forward-looking approach. Gordon (1998) argues that, provided the natural rate is allowed to vary over time, the repeated estimation of the Phillips curve for the US over three decades amounts to an impressively stable stylized fact.[3] Staiger et al. (1997) provide evidence that traditional estimates are robust to specification choices, but they also show that the natural rate is estimated with a great degree of imprecision.

The evidence for Europe is less satisfactory than for the US.[4] The crucial negative effect of unemployment on inflation is not always found with European data.[5] Sometimes, it is the change in the unemployment rate which affects inflation, not the level itself, suggesting the presence of hysteresis. Hysteresis implies that there is no meaningful NAIRU, possibly even that the unemployment rate is nonstationary and, indeed, stationarity is always rejected.

The NAIRU and the natural rate of unemployment are two different concepts. The former relies on the existence of a Phillips curve, the latter is a statement about the nature of equilibrium in the labor market. The NAIRU can be seen as a convenient shortcut -when it works- to estimate the natural rate. Failure to estimate a Phillips curve relationship, or the presence of hysteresis, does not invalidate the concept of a natural rate as famously defined by Friedman as the equilibrium rate of unemployment.

2.3. *Grease and Sand: Slopes and Nonlinearities*

The standard Phillips curve specification is:

$$\pi_t = \pi_t^e + a\,\Delta u_t + \alpha u_{t-1} + X_t'\beta + Z_t'\gamma + \varepsilon_t \tag{1}$$

[2] Representative of this revival is the special issue of the *Journal of Monetary Policy* (1999) and the symposium in the *Journal of Economic Perspectives* (1997).

[3] The point by Galbraith (1997) that the concept of a time varying natural rate is useless unless we can explain and foresee these changes is well taken but not overwhelming. There exist a great many concepts in economics which are problematic and ill-explained but prove to be a useful way of organizing the evidence and theorize about it: the list includes the stock of capital subject of a famed controversy between Solow and Robinson in the 1950s, the definition of the long-run or Tobin's q.

[4] See e.g. Blanchard and Katz (1997).

[5] This is presumably why most researchers work with the output gap instead of the unemployment rate. Given the aim of the present paper – looking at long-run effects – this approach is not feasible.

where X is a vector of variables which may affect inflation temporarily and are therefore I(0), while Z is a vector of variables which may affect the natural rate and are I(1). The unemployment rate appears both in level and first-difference to acknowledge Gordon's (1998) claim, informed by experimentation with US data, that omitting the first difference results in misspecification.

In the absence of hysteresis $\alpha \neq 0$ and the natural rate is recovered as:

$$\bar{u}_t = -\alpha^{-1} Z_t' \hat{\gamma} \tag{2}$$

The grease and sand arguments imply a long-run link between the rate of unemployment and inflation. The long-run rate of unemployment $\bar{u}_t$, possibly time-varying, is taken here to be an estimate of the natural rate. Long run inflation $\bar{\pi}_t$ is defined as the possibly time-varying rate towards which actual inflation is expected to converge in the long run. The grease effect hypothesis is that, starting from perfect price stability, increases in long-run inflation initially reduce the natural rate. As the grease effects dissipate, the natural rate becomes independent of inflation. Thus $\bar{u}_t$ is a function of $\bar{\pi}_t$ which is initially decreasing. The sand effect hypothesis is that $\bar{u}_t$ is increasing with $\bar{\pi}_t$, not necessarily monotonously. The absence of grease and sand effects implies a vertical long-run Phillips curve. Grease and sand effects are not mutually exclusive: at very low inflation grease effects could dominate, with sand effects setting in when inflation becomes more variable. Or, conversely, sand effects might dominate when perfect price stability is being lost but then get overwhelmed by grease effects. These hypotheses are summarized in Figure 2. Testing grease and sand effects, or the combination of both, therefore implies testing for a relationship, possibly but not necessarily nonlinear, between $\bar{u}_t$ and $\bar{\pi}_t$.

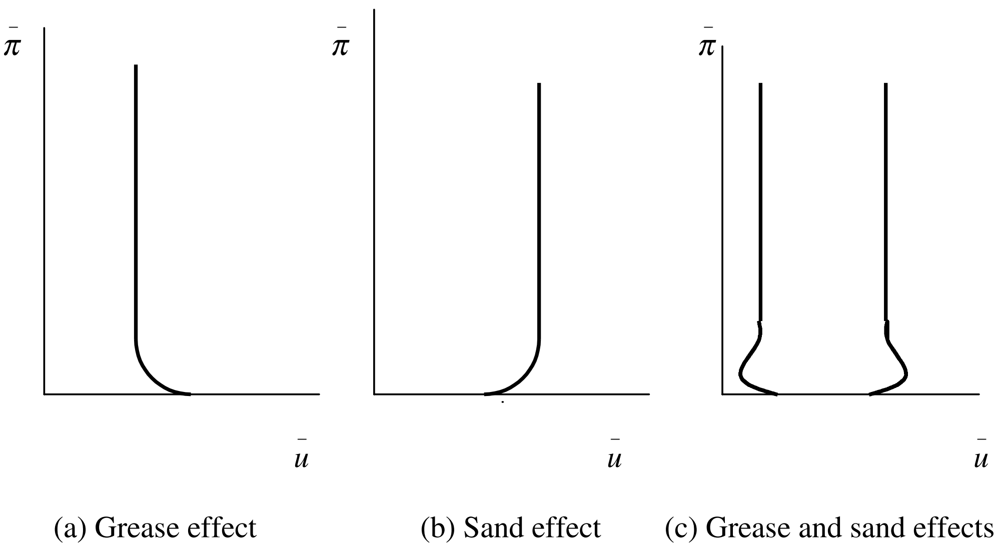

Figure 2. The Long-Run Phillips Curve: Various Hypotheses

3. Estimation Strategy

3.1. Sample and Time Series Properties

The paper looks at the two largest European economies (France and Germany) and at two countries which have experienced periods of low-inflation, the Netherlands and Switzerland. Since the evidence from Akerlof et al. (1996, 2000) is that nonlinearities mostly occur for inflation rates between 0% and 4%, it is essential that the sample period includes as many years as possible when inflation was in this range. This imposes going as far back as possible in the post-war period, certainly before the 1970s. Unfortunately, this requirement severely restricts the availability of variables, especially those which have been found to affect the natural rate. In the end, most data have been collected for the period 1960–1999.

There is some debate (see e.g. Gruen et al., 1999) regarding the desirable frequency at which the data is sampled. In the case of the US, Staiger et al. (1997) show that the results are robust to using quarterly or monthly data. Since the emphasis here is on long run relationships, short run fluctuations are more a nuisance (raising issues of seasonality and serial correlation) than a source of useful information. Gains in degrees of freedom are frequently offset by the need to introduce long lags. For these reasons the chosen frequency is annual.

As the Phillips curve is essentially an empirical relationship, its precise specification must depend on the time series properties of the variable of interests, mainly the rate of inflation and the rate of unemployment. Inflation is measured with the consumer price index (source: *International Financial Statistics*).[6] For all the countries in the sample and all variables, augmented Dickey-Fuller tests indicate that the inflation and unemployment rates are integrated of order one.[7]

3.2. Expected and Long-Term Inflation

A key issue is how to treat expected inflation π^e. A frequent procedure (Gordon 1998, Gruen 1999, Staiger et al. 1996) is to use lagged inflation or ARMA-generated forecasts. Here I start by following Debelle and Vickery (1998) who propose to take the difference between the nominal rate on long-term bonds and a measure of the world real interest rate r^*:

$$\pi^e = i^{LT} - r^* \tag{3}$$

where the world real interest rate is computed as the difference between the long-term US Treasury bond rate and a centered five-year moving average of US CPI inflation (*IFS* data). Debelle and Vickery (1998) report that the results are not sensitive to the precise calculation of the real interest rate. As a check I also use estimates published by the European Commission and the OECD, see further below. The estimates of π^e are shown in the Appendix (Figure A1, page 24).

[6] The preliminary version also looked at the consumption deflator and the GDP deflator.

[7] The conclusion is robust to the use of trends for testing stationarity in levels and of a constant for testing for stationarity in first-differences. Only in very few instances are the results doubtful.

Because the quality of the expectation measure is open to question, and given the popularity of the use of lagged inflation as a measure of expected inflation, I allow for a correction term $\pi_{t-1} - \pi_t^e$, augmenting (1) as follows:

$$\pi_t = \pi_t^e + \lambda(\pi_{t-1} - \pi_t^e) + a\,\Delta u_t + \alpha u_{t-1} + X_t'\beta + Z_t'\gamma + \varepsilon_t \tag{4}$$

which leads to the estimated form:

$$\pi_t - \pi_{t-1} = (1 - \lambda)\,(\pi_t^e - \pi_{t-1}) + a\,\Delta u_t + \alpha u_{t-1} + X_t'\beta + Z_t'\gamma + \varepsilon_t \tag{5}$$

with $0 < \lambda < 1$. If $\lambda = 0$, the measured expectation term is confirmed by the data while if $\lambda = 1$ it is lagged inflation which offers the better description.

We are interested in the impact of long-term inflation on the natural rate. In principle, long-term inflation $\bar{\pi}_t$ is defined as the situation where $\bar{\pi}_t = \pi_t^e = \pi_t$ but this definition is not sufficient to derive a time series. In what follows, $\bar{\pi}_t$ is computed as a centered five-year moving average of expected inflation π_t^e.

3.3. Capturing nonlinearities

The hypothesis that the natural unemployment rate is affected by long-term inflation can be tested by appropriately specifying Z_t. In order to test for the grease and sand effects represented in Figure 2, we need to allow the natural employment rate to be a nonlinear function of long-term inflation. A solution is to use polynomials of inflation, e.g. $Z_t' = (\bar{\pi}_t, \bar{\pi}_t^2, \ldots \bar{\pi}_t^n)$. A problem with this procedure is that as $\bar{\pi}_t$ increases, the implied natural rate goes to infinity in absolute value, an unappealing feature at variance with the behavior postulated in Figure 2 which assumes that the inflation effect dissipates when inflation becomes large so that neutrality prevails at high rates. For this reason I allow for an exponential decay factor, replacing $Z'\gamma$ in (5) with $\exp(\theta\bar{\pi})Z'\gamma$, with $\theta < 0$.

3.4. Time varying natural rate

The view that the natural rate has remained constant over the last four decades is untenable for most OECD countries and indeed most recent estimates of the Phillips curve allow it to vary over time. Sand and grease effects may be the source of such changes but there may be other factors as well. Consequently Z_t should also include all the variables which may affect the natural unemployment rate over and above long-run inflation. Several possibilities are explored.

The best approach is to deal directly with those features of the labor market which are known to affect the natural rate. The literature has produced a list of relevant variables. Recent surveys by Nickell (1997) and Blanchard and Wolfers (1999) identify the generosity of unemployment benefits, collective wage bargaining institutions and union activity, labor taxes and employment protection, as long-lasting sources of changes in the natural rate of unemployment. Unfortunately the corresponding data is only available at best from the mid-1970s.[8] The bias due to omitted variables argues in favor of shortening the sample accordingly but that would imply restricting the sample to the

[8] I am grateful to Olivier Blanchard and Tito Boeri for making their data available, even if, in the end, I have not been able to implement them.

post-1975 period which would eliminate the crucial low-inflation years of the 1960s. Any implication drawn from estimates obtained over a period largely dominated by inflation above 5% would be in the nature of out-of-sample forecasts, therefore highly speculative.

A shortcut is to include symptoms of the kind of market inefficiencies which affect the natural rate. The literature on job search, e.g. Mortensen and Pissarides (1994) provides much of the theoretical underpinning for the concept of a natural rate. This literature argues that the speed of exit from unemployment is a key determinant of long-run unemployment. The exit rate can be approximated (inversely) by the proportion of workers who are long-term unemployed. This variable, however displays cyclical as well as long-run fluctuations. Low frequency movements were computed using a Hodrick-Prescott filter, but failed to enter significantly.[9]

An alternative is to allow for the intercept included in Z_t to be time varying by applying a Kalman filter. This is the approach adopted *inter alia* by Debelle and Vickery (1998), Gordon (1998), Gruen et al. (1999), Staiger et al. (1996). Akerlof et al. (1996, 2000) also allow for a time varying rate of unemployment through recursive estimation. Extensive efforts to obtain plausible estimates for the sample countries have failed and are not reported.

In a series of recent papers, Phelps and co-authors have developed an asset valuation view of the natural rate, see e.g., Phelps and Zoega (2000) for an application to Europe. They view the economy as being driven by low-frequency shifts in productivity expectations, structural booms and slumps. Such shifts, which may last for decades, affect the value of labor to firms and result in lasting changes in the demand for labor. Given the supply of labor, the natural rate of unemployment varies accordingly. They view labor as largely firm-specific, implying that trained labor carries a shadow price which may differ from its direct cost. The shadow price of labor is not observable, but Phelps and Zoega argue that the expected productivity shifts simultaneously affect the shadow price of capital, which can be approximated by Tobin's average q, which is observable. Thus a measure of Tobin's q (the ratio of share values to the investment deflator, normalized to be unity on average over the sample period; source: OECD) is introduced in Z_t.

In the end, all else failing, I allow for a time trend which may capture both demand and supply effects in the labor market.

4. Results

The focus is on testing the hypothesis that the natural rate of unemployment is affected by long-term, or steady-state, inflation. I proceed in two steps. First I estimate standard Phillips curves, adding second and third degree polynomials of long-term inflation with exponential decay. Then, I directly estimate the rate of unemployment on the polynomial with exponential decay, treating the relationship as cointegrating.

In the estimated equation (5), in line with the literature, X_t allows for imported inflation and oil shocks by including the difference between the rate of increase of imported

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[9] The hazard rate could also be affected by long-run inflation, thus giving rise to collinearity. To allow for this possibility I experimented with the residual from the hazard rate's projection on a polynomial of long-term inflation. The variable is never significant either.

goods and inherited inflation $\pi_t^m - \pi_{t-1}$. Importantly, there has not been any "specification search" for lags and other features which can improve the fit. The only exception is the inclusion of dummy variables which account for special events such as price controls or the 1968 social unrest in France (not reported).

4.1. Phillips Curve Estimates

Table 1 reports estimates of (5) modified as follows:

$$\pi_t - \pi_{t-1} = (1-\lambda)(\pi_t^e - \pi_{t-1}) + a\,\Delta u_t + \alpha u_{t-1} + \exp(\theta\bar{\pi}_{t-1})\,P(\bar{\pi}_{t-1}) + \beta(\pi_t^m - \pi_{t-1}) + \gamma q_{t-1} + \varepsilon_t \quad (6)$$

Table 1. The Phillips Curve

	Germany (1)	France (2)	Netherlands (3)	Switzerland (4)
Constant	−77.20**	0.67	−455.51	−0.94
	−3.68	0.86	−0.26	−0.98
$\pi_t^e - \pi_{t-1}$	0.25**	0.41**	0.41**	0.23**
	3.23	6.48	4.01	2.52
$\pi_t^m - \pi_{t-1}$	0.07	0.15**	0.05**	0.16**
	1.52	8.83	2.46	3.93
p_{t-1}	−0.36	−0.21	0.00	0.70
	−0.78	−0.17	0.01	1.58
Δu_{t-1}	0.02	−0.29	0.21	−0.29
	0.14	−0.98	1.64	−0.63
U_{t-1}	−0.43**	0.21	−0.12	−0.50*
	−2.53	0.80	−0.64	−1.92
θ	−0.28	−0.71	−0.20	−1.35**
			−1.04	−3.57
constant	71.20**	−30.03	445.11	0.81
	3.94	−0.75	0.26	0.85
$\bar{\pi}_{t-1}$	33.82**	32.82	107.08	2.41*
	3.26	0.78	0.43	1.87
$\bar{\pi}_{t-1}^2$	−2.12*	−9.86	2.64	1.87**
	−2.06	−0.73	0.13	2.89
$\bar{\pi}_{t-1}^3$	1.00**	0.80	1.54**	0.71**
	3.29	0.55	4.61	3.30
Adj. R^2	0.62	0.78	0.68	0.36
SEER	0.76	0.80	0.93	1.39
DW	2.27	1.23	2.00	1.86
Akaike	2.55	2.64	2.97	3.74
Schwartz	3.06	3.15	3.53	4.26
Sample	1962–1999	1967–1999	1962–1999	1962–1999
N. Obs.	38	33	38	38

A star (two stars) denote significance at the 10% (5%) confidence level.
Dummy variables not reported: 1992 for the German unfication shock, 1968–69 for France. Standard errors and covariances adjusted for heteroskedasticity using the Newey-West procedure.

where $P(\bar{\pi})$ is a second or third-order polynomial of long-run inflation and $\theta \leq 0$. In a number of cases the nonlinear least-squares procedure has been found to produce local maxima of the likelihood function. In these cases the decay parameter θ was estimated using a grid search (steps of 0.01).

The only countries where the effect of lagged unemployment on current inflation is found to be statistically significant are Germany and Switzerland. For France and the Netherlands it is the first difference that seems to matter most, an indication of hysteresis, but the effect is very imprecisely estimated. This barely confirms the difficulties often reported in estimating Phillips curves in Europe.

Nonlinearities are found in all countries except France. The sign pattern is broadly similar, but not indentical across countries. For France and Germany, the pattern suggests that, starting from zero inflation, the natural rate first increases and then decreases, for the Netherlands and Switzerland pure sand effects seem to be present. Still, the coefficient for the unemployment rate remains too imprecisely estimated to allow for computation of the natural rate.

4.2. Direct Estimates of the Unemployment Rate

The difficulty in precisely isolating and measuring an effect of unemployment on inflation challenges the notion of a NAIRU. But it does not invalidate the concept of a natural rate defined as the rate of unemployment which corresponds to the economy's equilibrium and does not depend on the existence of a Phillips curve.

Estimation of the natural rate using requires modeling the labor market. However, as noted above, the labor market variables needed to identify demand and supply are not available over a period long enough to include the low inflation years of the 1960s. For this reason I estimate the reduced form of unemployment (2). Alternatively, what follows can be interpreted as the cointegrating relationship within a Phillips curve now seen as an error-correction model. However, since we are interested in nonlinearities in the effect of long-run inflation, the cointegration interpretation cannot be pushed too far either.[10]

With these caveats in mind, the following specification follows from (6):

$$u_t = c + \exp(\theta\bar{\pi}_t)\, P(\bar{\pi}_t) + \gamma' q_t + \varepsilon_t^u \tag{7}$$

$$\pi_t - \pi_{t-1} = (1-\lambda)\,(\pi_t^e - \pi_{t-1}) + a\,\Delta u_t + \alpha\varepsilon_t^u + \beta(\pi_t^m - \pi_{t-1}) + \varepsilon_t \tag{8}$$

Equation (7) is a minimal description of labor market equilibrium. Given wage rigidity, it is not expected to hold at every point in time. The error term ε^u, a measure of the unemployment gap, may well be serially correlated but serial correlation does not invalidate the estimates if (7) is seen as a cointegration relationship and (8) as the error-correction model version of the Phillips curve.

Table 2 shows estimates of (7) for the four countries in the sample. As before, a grid search is used to estimate the decay parameter when the nonlinear procedure is driven to a local optimum. For each country, the table reports results for second and third order polynomials, including the p-value of the F test that the coefficients of the poly-

[10] A linear approximation including polynomials of long-term inflation cannot be properly considered a cointegration relationship. At least it precludes the use of Johansen's rank procedure which searches for several cointegrating vectors.

Table 2. Long-term unemployment

	France		Germany		Netherlands		Switzerland	
Constant	0.49	−83.42**	4.11	−0.61	8.54**	2.73**	−1.08**	0.52
	1.47	−2.46	1.04	−0.03	2.03	5.93	−2.92	0.78
Trend	0.35**	0.35**	0.22**	0.22	0.23**	0.23**	0.09**	0.09**
	34.95	35.78	29.46	23.16	16.14	15.91	3.72	3.76
q_t	−3.48**	−3.61**	−1.63**	−1.21	−4.88**	−4.99**	2.74**	2.83**
	−7.97	−9.47	−6.44	−5.03	−6.84	−7.60	3.85	4.08
θ	−0.51	−0.18	−0.37**	−0.27	−0.28	−1.88	−1.32	−0.69
			−3.60					
Constant	−3.21	80.42**	−3.78	1.68	−3.79	−320.94*	0.45	−1.19
	−0.89	2.51	−1.19	0.11	−0.68	−1.71	1.33	−1.53
$\bar{\pi}_t$	7.52**	23.56**	4.89	5.39	1.21	679.93*	1.28	0.03
	2.96	2.82	1.47	0.75	0.90	1.78	1.61	0.08
$\bar{\pi}_t^2$	0.01	−0.77**	−1.72**	−1.66	−0.96	−447.56*	0.57	−0.33
	0.01	−3.90	−3.59	−2.96	−1.61	−1.88	1.55	−1.53
$\bar{\pi}_t^3$	0.27**			0.13		108.66**		−0.31
		2.63		0.63		2.30		−1.63
F−Test: p	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.016
Adj. R^2	0.99	0.99	0.97	0.96	0.92	0.92	0.76	0.76
SEER	0.43	0.42	0.53	0.63	0.87	0.86	0.79	0.80
DW	1.09	1.28	0.92	1.02	0.76	0.92	0.74	0.79
Akaike	1.31	1.26	1.74	2.06	2.69	2.69	2.52	2.55
Schwartz	1.57	1.55	2.04	2.35	2.94	2.99	2.77	2.85
Sample	1961–99	1961–99	1960–99	1960–99	1961–99	1961–99	1960–99	1960–99
N. Obs.	39	39	40	40	39	39	40	40

A star (two stars) denote significance at the 10% (5%) confidence level.
Dummy variables not reported: 1992 for the German unfication shock, 1968–69 for France. Standard errors and covariances adjusted for heteroskedasticity using the Newey-West procedure.

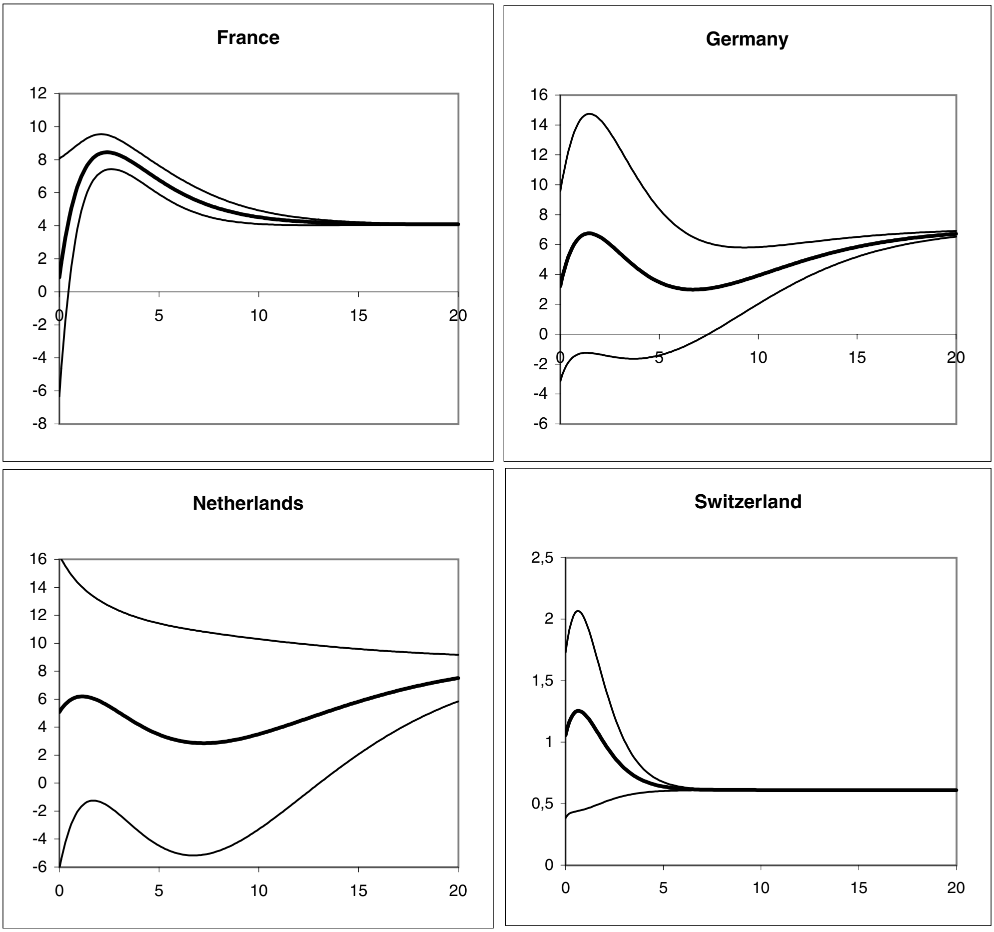
nomial terms are jointly non-significant. The strong rejection of this hypothesis provides support for sand or grease hypotheses. However, the polynomial terms are not precisely estimated in the case of Switzerland, and slightly better in the case of Germany.

Note that in all cases, the time trend is significant, presumably picking up some of the missing labor institution variables not available over the sample period. Note also that the role of Tobin's q is confirmed in all countries, even though the sign is not the expected one in the case of Switzerland.

4.4. Simulations

It is hard to read through the combination of the exponential decay term and polynomials. Figure 3 shows the results of simulations performed using the equations reported in Table 2, setting the terms others than inflation at their sample mean. To that effect, I use the second-order polynomial estimates and allow the inflation rate to vary from 0% to 20%. The figure also shows the 95% confidence interval.[11]

[11] Since (11) is non-linear, the standard errors have been computed by linearizing the equation.



Source: Author’s calculations using the second-order polynomial equations in Table 2.

Figure 3. The Relationship Between Long-Term Unemployment and Long-Term inflation

The pattern is broadly similar across countries. Starting from zero long-run inflation, the natural rate of unemployment rises to reach a maximum when inflation is around 1–2%. The adverse effect then declines smoothly in France and Switzerland (grease effects dissipate), eventually rising in the case of Germany and the Netherlands (sand effects kick in). The width of the confidence interval should be kept in mind in interpreting the results.

The figures suggest the presence of a grease effect at very low inflation rates, except for France when long-run inflation is lowest at zero inflation. Grease effects set in when in inflation is between 1–2% and 5–7%, with long-term unemployment typically rising beyond this range.

5. Robustness Checks

There are many good reasons to be skeptical about the results. To start with, the estimates are far from precise, yet the presence of nonlinearities is strongly

Table 3. Long-term unemployment (Panel data)

	Germany (1)	France (2)	Netherlands (3)	Switzerland (4)
Trend	0.24**	0.36**	0.25**	0.08**
	31.78	48.70	14.55	3.57
q_t	−1.52**	−2.79**	−3.51**	0.38
	−5.94	−12.86	−5.91	0.82
θ			0.5	
Constant			3.86**	
			10.91	
$\bar{\pi}_t$			2.25**	
			12.39	
$\bar{\pi}_t^2$			0.36**	
			4.31	
Adj. R^2			0.97	
SEER			0.88	
DW			0.58	
Sample			1961–1999	
N. Obs.			39	

supported.[12] How sensitive are the results to variants? In this section, I investigate two issues. First, I pool the data across the four countries, second I look at other measures of inflation expectations.

5.1. Panel Data[13]

The sample period used for each country covers about 40 years, many of which were years of inflation significantly higher than the 0–2% range of interest to countries member of the European Monetary Union (during the period 1960–99, annual inflation less than 2% was observed 5 times in France, 13 times in Germany, 7 times in the Netherlands and 14 times in Switzerland). Pooling the four countries together provides a sample of 39 years with less than 2% inflation.

The procedure is as follows: equation (7) is estimated with panel data, allowing for country-specific effects for all the variables – including the constant – but restricting the polynomial terms to be the same. This, of course, assumes that the nonlinearity is the same in all four countries, a plausible assumption in view of Figure 3. The decay term θ is arbitrarily set at −0.50.

The results shown in Table 3 for the second-order polynomial[14] are quite strong. All variables are quite precisely estimated. Figure 4 presents the corresponding pattern. Since all four country-specific curves are parallel, only one curve is shown: it is normalized to reach zero asymptotically, thus depicting the pure effect of long-term inflation on long-term inflation. The figure strongly suggests that zero inflation does not deliver

[12] It bears emphasizing that I have not embarked on specification searches designed to deliver supportive evidence for sand and/or grease effects.
[13] I am indebted to Stefan Gerlach for suggesting this idea.
[14] Results for a third-degree polynomial are equally strong.

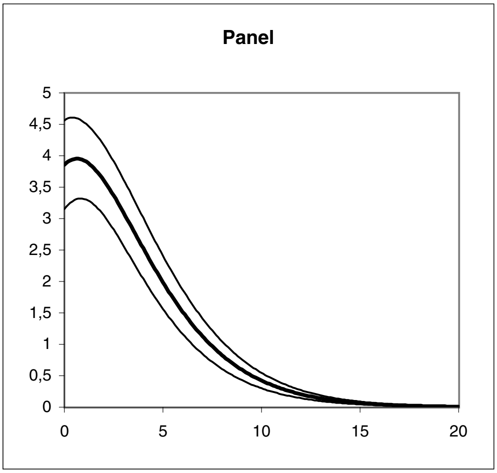


Figure 4. The Relationship Between Long-Term Unemployment and Long-Term Inflation Panel Data

Source:
Author's calculations using the estimate in Table 3.

the lowest long-term inflation rate. Grease effects are present. The long-run unemployment rate is highest when long-run inflation reaches a rate of 0.6%, declining quickly thereafter. The size of the effect is surprisingly – some will say implausibly – large, certainly superior to the estimated margin of error.

5.2. Alternative Measures of Inflation Expectations

The foregoing estimates use a measure of expected inflation derived from long-term interest rate. It may be objected that capital controls and other financial repression measures have long been in place in Europe and that, therefore, the interest rate may be driven by administrative restrictions.[15] How do the results depend on this particular measure? To attempt to answer that question, I have assembled two sets of historical forecasts. The first set consists of the Autumn forecasts produced since the early seventies by the European Commission and presented in detail in Keereman (1999). The second set includes the forecasts published since the mid-seventies by the OECD in the December issue of its *Economic Outlook*. I have built a "consensus forecast" by averaging the Commission's and OECD's forecasts for the years when they are both available. When only the Commission's forecasts are available (typically over 1970–1975) I use only these. In earlier years when none of the forecasts are available, to avoid losing degrees of freedom and throwing out the low inflation years, I revert to the previous expectation measures constructed with the long-term interest rate. Figure A1 presents this measure of expected inflation as well.

Table 4, patterned after Table 2, presents the results of the corresponding estimation. There are a number of significant differences between the two tables. Occasionally, the results based on published forecasts are weaker. This is especially the case

[15] Indeed, a close look at Figure A1 suggests caution, for example the strongly negative rates for Switzerland in 1984. For a general overview of external and internal financial repression in Europe, see Wyplosz (2001).

Table 4. Long-term unemployment – Alternative Measure of Expected Inflation

	France		Germany		Netherlands		Switzerland	
Constant	−3.20	1.62**	30.49	0.56	162.08*	2.10**	−0.75*	0.07
	−1.36	2.17	1.28	0.80	1.89	3.20	−1.86	0.07
Trend	0.31**	0.32**	0.24**	0.22**	0.23**	0.23**	0.09**	0.09**
	13.76	12.75	8.33	10.21	9.41	10.05	4.24	5.74
q_t	−4.41**	−3.75**	−2.50*	−2.34*	−4.26**	−4.28**	2.11**	2.28**
	−4.25	−4.87	−1.96	−1.94	−4.13	−4.08	3.11	3.21
θ	−0.44	−0.66	−0.61	−1.83	−0.24	−0.88	−1.61	−0.70
Constant	−0.23	1.50**	77.01	684.39	−149.99*	13.80	7.38	−2.44
	−0.04	0.16	1.20	1.27	−1.82	1.38	0.73	−0.91
$\bar{\pi}_t$	20.69**	6.95**	−144.69	−743.59	−48.78*	−12.57	−29.65	3.95
	2.41	0.88	−1.18	−1.32	−1.85	−0.91	−0.87	1.39
$\bar{\pi}_t^2$	−5.55**	0.01**	50.08	232.63	0.19	5.76	35.54	−2.10
	−2.13	0.00	1.17	1.52	0.23	1.13	1.16	−1.45
$\bar{\pi}_t^3$	0.78**		−9.92		−1.10*		−10.76	
	2.07		−1.23		−1.80		−1.37	
F−Test: p	0.000	0.000	0.000	0.000	0.000	0.000	0.097	0.209
Adj. R^2	0.97	0.97	0.91	0.93	0.84	0.83	0.73	0.74
SEER	0.69	0.72	0.95	0.88	1.21	1.26	0.84	0.83
DW	0.64	0.56	0.49	0.76	0.51	0.48	0.57	0.56
Akaike	2.27	2.32	2.90	2.75	3.38	3.44	2.64	2.61
Schwartz	2.57	2.58	3.20	3.04	3.68	3.70	2.94	2.87
Sample	1961−99	1961−99	1960−99	1960−99	1961−99	1961−99	1960−99	1960−99
N. Obs.	39	39	40	40	39	39	40	40

A star (two stars) denote significance at the 10% (5%) confidence level.
Dummy variables not reported: 1992 for the German unfication shock, 1968–69 for France.
Standard errors and covariances adjusted for heteroskedasticity using the Newey-West procedure.

for Switzerland where it is impossible to reject the null that the polynomial terms are zero.

What difference do these alternative results make? Figure 5 presents for each country the estimated relationship using the second order polynomials in Tables 2 and 4, respectively labeled UBAR_D2 and UBAR2_D2. The general shape remains unchanged for France. For Switzerland, zero inflation is where long-term unemployment is lowest when using the "consensus forecasts", but this is the country for which we can reject the presence of a polynomial with the alternative dataset. Unemployment is found very large for very low inflation rates in the case of Germany and the Netherlands.

6. Conclusion

Taken at face value, the results presented here imply that a grease effect is present at low inflation rates in Europe, at least in the sample countries. On the basis of this effect, one size fits all EMU member countries, a piece of good news for the ECB. There is dark side to that piece of news, however: the 0–2% inflation target set by the

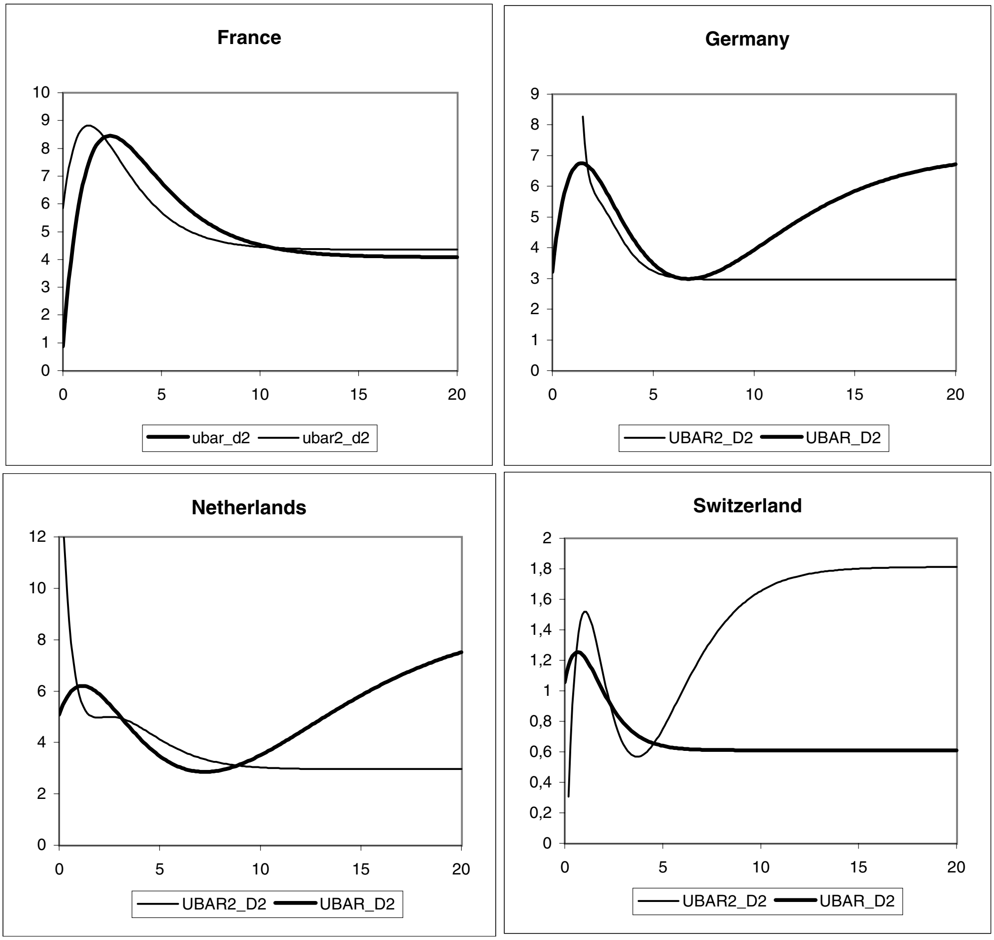


Figure 5. Alternative Measures of Inflation Expectations

ECB corresponds to the range where the grease effect is largest. Based on the panel estimation, the grease effect is found to raise the natural unemployment rate by some 2 to 4 percentage points in about the middle of the ECB's inflation target range. In order to significantly reduce the effect, the ECB ought to aim at an inflation rate of more than 5%, a rate clearly beyond the current range of acceptability. Simply allowing inflation to be, in the long run, around 4% would go a long way towards eliminating the adverse effect.

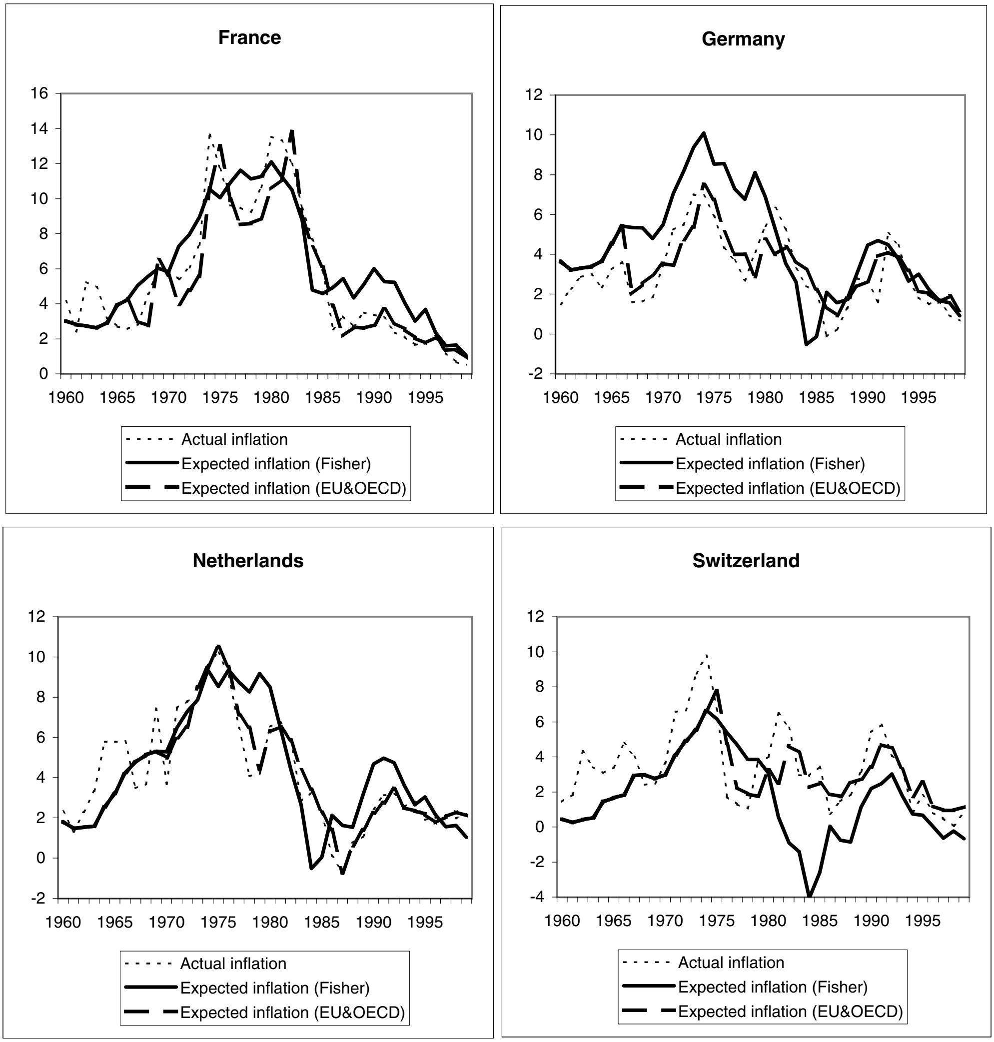
One interesting question is whether maintaining a low rate of inflation for a protracted period of time eventually leads firms and employees to fully internalize the evolution of prices and thus avoid falling victim to the information problems which are presumed to generate sand effects. Detailed country estimates do not strongly support this optimistic assumption. Both Germany and Switzerland, the countries which have had the best track record in terms of low inflation – by no way impeccable – do not appear to behave very differently from the others. The only hint that there might be such a virtuous effect comes from the rejection of nonlinearity with the alternative "consensus forecast" of inflation in the case of Switzerland.

It is essential, however, to keep in mind that this is a preliminary study, calling for more work, possibility the kind of microeconomic studies that has been carried out in the US. For that reason only, the results presented here would be open to considerable caution. In addition, the estimates are admittedly less than overwhelming. The poor performance of Phillips curve estimates for European countries is in line with previous findings. Even in the US where the Phillips curve performs better, Staiger et al. (1997) emphasize the presence of large standard errors in estimates of the natural rate. The fact that the effect of unemployment on inflation is imprecisely estimated casts doubt on the existence of the NAIRU, an empirical construct anyway.

On the other hand, the direct estimates of the natural – here proxied by the long-term – unemployment rate are more satisfactory, theoretically and empirically. The concept of a natural rate of unemployment is better rooted in accepted principles but its estimation requires a fully articulated model of the labor market. Unfortunately, such an approach, pioneered by Layard et al. (1991) and recently surveyed e.g. in Blanchard and Katz (1997), requires variables which are typically not available before the late 1970s. This would eliminate from the sample many of the low inflation years. Since the study is mostly concerned with near-zero inflation, this approach cannot be undertaken with European data, at least not yet. The paper instead relies on a reduced form, with all the drawbacks known to be associated with such an approach. Most worrisome is the fact that a number of variables known to affect the labor market are omitted for lack of availability.

This is clearly an important topic. At this stage, we can only conclude that the ECB's view, that near-zero inflation is good for the economy and hence for the natural rate of unemployment, is not borne out by the evidence presented here. Cautious readers will also conclude that the opposite case, that near-zero inflation is harmful because of the presence of sand effects, is not made either. Indeed, at this stage, the most reasonable conclusion seems that we do not know yet how low inflation should be.

Appendix



Sources: Actual inflation and expected fisher: IFS; expected EU Commission and OECD: average of EU Commission forecasts (Keereman, 1999) and OECD Economic Outlook December forecasts.

Figure A1. Actual and Expected Inflation 1960–1999

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Comment

William T. Dickens

A little inflation may be a good thing in a modern economy. In particular, it may be possible to maintain lower rates of unemployment with low inflation than with zero or very low inflation.[1] In two recent articles, George Akerlof, George Perry and I (1996, 2000) (hereafter, ADP) have presented evidence for two specific mechanisms by which inflation may affect the equilibrium level of unemployment. We modeled those mechanisms, and argued the case that large permanent reductions in unemployment may be obtained by moving from either a high or very low rate of inflation to a moderate rate (2–4% in the United States). The two mechanisms we examined were nominal rigidity in wage setting, and near rationality in the use of inflationary expectations in price and wage setting.

In these papers we estimated Phillips Curve relations from which we deduced the magnitude of the effects of nominal rigidity and near rationality on the long-run relationship between inflation and unemployment. But these empirical exercises do little to verify the *nature* of this relationship because that was simply assumed when we accepted the dictates of our theory in setting up the specification we estimated. In this paper Charles Wyplosz takes a very different approach to roughly the same empirical problem. He estimates models of unemployment in which he allows the NAIRU, or natural rate of unemployment, to vary with the rate of inflation in a very general way. Such an approach has advantages and disadvantages relative to the approach my colleagues at The Brookings Institution and I have taken. Below I discuss Wyplosz's results and present some of my own. Taken together, our results suggest the possibility that very low rates of inflation may cause unemployment to be higher than it would be at moderate rates of inflation in the Euro zone.

Is Very Low Inflation the Best Policy?

Several other papers being presented at this meeting discuss the potential costs of inflation in depth. I would like to call attention to several arguments for choosing low rates of inflation over very low or zero inflation. At least since Keynes there has been concern that the prevalence of nominally denominated debt may make expenditures very sensitive to the level of nominal income, and increase systemic financial risk in times of deflation. Very low or zero inflation may make deflation unavoidable in a contraction – particularly if monetary policy becomes less effective when nominal interest rates approach the floor of zero. In addition, it has been argued that worker resistance to nominal wage cuts prevents real wage adjustments. My colleagues and I demonstrated the potential importance of this last argument in our 1996 *Brookings* paper.

[1] This point is made Tobin (1972, p. 11); Samuelson and Solow (1960, p. 182) and Schultze (1959, p. 134).

Further, in a paper just published this Summer, George Akerlof and George Perry and I (2000) have developed a new argument for moderate inflation. At the center of the case for very low inflation is the belief that the equilibrium level of unemployment either does not change or increases with the rate of inflation. A core assumption of that natural rate model is that economic agents everywhere and always form expectations about future inflation and raise wages and prices in anticipation of it. In our recent paper we present evidence that real world price and wage setters simply do not behave that way – at least not all the time. In particular, we argue that when inflation is low a significant fraction of price and wage setters probably ignore or underweight anticipated inflation in setting future prices. The prices they set will then lag a fixed distance behind what they would be if inflation was fully anticipated and the overall price level will be lower relative to the money supply than it would be at zero inflation. As inflation increases, the cost of such near rational behavior increases and more agents will fully anticipate inflation in wage and price setting as the natural rate model predicts. When they do, prices will rise relative to the money supply. As a result, the real money supply (and therefore real demand) will be larger in times of low inflation than either high inflation or zero inflation. Near rationality at low inflation creates a trade-off between inflation and real activity that central banks can exploit to the advantage of the economy.

If these arguments are right then moderate inflation ought to be better for economies than very low rates of inflation. While there is substantial evidence that very high rates of inflation are related to poor economic performance, there is no persuasive evidence that growth is lower at three percent inflation than at zero or one percent inflation. In fact, the 1960s were a period of high growth and very low unemployment despite average rates of inflation above the levels desired by the European Central Bank and other authorities that have announced inflation targets (see table 1).

While this experience fits the story that moderate inflation is better than low inflation, some have pointed to episodes in which low unemployment and very low inflation have coexisted. The recent experience of the United States, and the past history of Japan are prime examples. There are two things to keep in mind in evaluating these arguments. First, examples from times prior to the institution of modern systems of industrial relations aren't probative. Considerations of nominal rigidity were irrelevant in economies based largely on craft and agricultural production where job tenures tended to be short and self-employment was common. Second, nominal rigidity is not a problem in an economy that is experiencing rapid nominal wage growth *either* because of moderate inflation *or* rapid productivity growth. The recent success of the United States in maintaining both low inflation and unemployment has probably been due in large part to its upturn in productivity growth. High productivity growth probably also helps explain Japan's remarkable labor market prior to the 90s.

Table 1. Inflation and Unemployment in Europe. In the 1960s

	Average Inflation 60–68	Average Unemployment 60–68
United Kingdom	3.4	1.9
France	3.6	1.7
Germany	2.3	1.1

But is there evidence to support the view that moderate inflation would be good for Europe, and if so, what is the rate of inflation that would minimize unemployment for the Euro? These are the questions that Wyplosz poses.

Wyplosz's Approach vs. ADP

Wyplosz takes three very general approaches to estimating the long-run relation between inflation and unemployment. In the first, he estimates a nearly standard accelerationist Phillips Curve. Following Phelps and Zoega (2000) he includes a measure of Tobin's Q in the regression. To allow non-linearities in the long run Phillip's Curve Wyplosz introduces a polynomial in a long centered moving average of expected inflation. Expectations are deduced from the difference between long-term nominal interest rates in a country and the world (US) real long rates. Wyplosz's second approach is to include the polynomial of the long moving average in an equation to predict unemployment directly. The expected value for unemployment in that equation is interpreted as the natural rate. The third approach extends the second by combining data from four countries to estimate the long-run conditional expectation of unemployment given the rate of inflation.

This essentially atheoretic approach to estimating how the equilibrium rate of unemployment might vary with the rate of inflation is complimentary to the approach that my Brookings colleagues and I have taken. Wyplosz's approach has several advantages over our approach. First, to the extent that there are other influences on the shape of the long-run Phillips Curve besides those envisioned in our models, his method could pick them up while they would only lead to problems in estimating our model. A further advantage of his approach is that it could provide a much stronger test of the effects of nominal rigidity and near rationality than what my colleagues and I have done. While we assumed the functional form, his estimates test it. Informally one might inspect his estimated long-run Phillips Curves for the characteristic shape implied by the theory, or one could formally test whether the addition of his polynomials to equations such as those estimated by my colleagues and I significantly improve their fit.

There are also disadvantages to the approach that Wyplosz takes. For one, the long-run Phillips Curve may not be stable. As discussed above, increasing the rate of productivity growth will reduce the rate of inflation at which rigidity effects are felt allowing the attainment of lower rates of inflation for the same rate of unemployment. Wyplosz includes a measure of Tobin's Q in his equations in part to capture such effects. But, a changing value of Tobin's Q would shift the position of the long-run Phillips Curve left or right as his equations are specified, it would not shift it up or down. In contrast, a model of nominal rigidity would predict that declining productivity growth would shift the nearly horizontal section of the long-run Phillips Curve at low inflation up. Examples of this can be seen in my Figures 2–5.[2]

A second drawback to Wyplosz's approach relative to the approach that my colleagues and I have taken is that there may be information in the short-run behavior of inflation and unemployment that would help identify a structural model. That information would be ignored in Wyplosz's approach. For example, near rationality implies that past inflation will be less predictive of future inflation when inflation rates have been

[2] Also, Wyplosz uses a centered moving average for his polynomial term that captures the long-run relationship between inflation and unemployment while most theories would suggest that it is lagged values of inflation that should be relevant for current unemployment.

low than when they have been high. Alternatively, nominal rigidity implies that periods of very low inflation or deflation should affect the economy like a supply shock producing either higher unemployment or a burst of inflation in their wake.

By using a very flexible functional form in the context of a method that ignores some identifying variance Wyplosz's approach necessarily has low power. Our approach is more likely to reject the hypothesis of the natural rate, but will be biased if the true model is not the one we envision. Wyplosz's approach will be less likely to reject the natural rate model if it is false, but will be less vulnerable to most forms of mispecification.

Given the complementary nature of these two approaches it is worthwhile to see what they both have to say about the unemployment-inflation relation in Europe. Of course both methods are subject to the usual problems that bedevil all attempts to estimate Phillip's curves. The Phillip's curve itself is not a structural model though it can be derived from several different models. As such its identification is always an issue. In particular, the assumption that unemployment is effectively exogenous to price setting at the frequency at which the relationship is estimated (typically a quarter or a year) is questionable, and is particularly problematic in open economies subject to external supply shocks. In addition, the question of how to model expectations is vexing. Still, the method is one that is often used to inform monetary policy and is a frequently used device in academic research. Thus I reconsider Wyplosz's analysis and conclusions in the next section, present my own work on applying the ADP model to other countries besides the U.S. in the section after that, and conclude with a discussion of what lessons I think policy makers should take from these two exercises.

Reconsidering Wyplosz's Analysis

Wyplosz approaches the estimation of the effects of inflation on the long-run unemployment rate in three ways. First, he estimates Phillips curves where the natural rate is a non-linear function of the long-term moving averages of the inflation expectations and the q ratio. Second, he estimates for each of his four countries the mean of the unemployment rate conditional on q, a time trend, and his polynomial in the MA of inflationary expectations. Finally, he pools data for all four countries and estimates the conditional mean of unemployment assuming that changes in the rate of inflation have the same effect on unemployment in all countries. I find the results of the last two exercises interesting and important, but the first unconvincing.

Wyplosz presents his Phillips curve results as evidence of non-linearties in the long-run relationship between inflation and unemployment. He notes that the coefficients on the unemployment rate are not very precisely estimated and he therefore eschews computing the implied natural rates. There are other reasons not to perform this exercise as well. In all four countries the implied equilibrium unemployment rates corresponding to at least some inflation rates are negative for most years. In Germany, it is negative for values of inflation less than 0.7% and greater than 3.5% for almost all values of q. In France, the coefficient on unemployment is positive so that the equilibrium unemployment rate is negative for values of inflation above 1%. In the Netherlands the unemployment rate is negative below 1% and above 8.5%. In Switzerland it is negative for inflation rates above 4% in most years.

For France and Germany these results are largely nonsensical, but in Switzerland and the Netherlands most observations fall in the range for which the implied equilibrium unemployment rate is positive. These results illustrate something important about Wyplosz's method. When one fits a polynomial (or for that matter any model), unless the functional form is motivated by a theory there is no reason to believe that the results have any meaning outside the range for which there is data. Even within the range of the data, the shape of the polynomial will be determined to give the best fit where most of the observations are. In both of these countries there are observations in the range in which the implied equilibrium unemployment rate is negative, but only a few. What this probably means is that the gain in fit afforded in the ranges of inflation in which most observations fall from twisting the polynomial this way were greater than the loss of having a few observations fit very poorly.

For the Netherlands and Switzerland Wyplosz notes that the coefficients on inflation in the polynomial are all positive and interprets this as indicating that only sand effects are present in these countries. In my Figure 1, I have plotted the long-run Phillips curves implied by Wyplosz's estimates for these two countries. In both cases the estimated values of θ (the parameter of the exponential decay term multiplying the polynomial) are sufficiently negative to produce significant declines in unemployment with increasing inflation within the range in which most observations fall. In fact, with the exception of the what is going on at extremely low and high rates of inflation in these two countries the results are reminiscent of my colleagues and my findings. However, none of Wyplosz's Phillips curve estimates include controls for many changes going on in these countries labor markets over the sample period and the results for the conditional unemployment rate suggest this may be crucial.

Table 2 and Figures 3 and 5 in Wyplosz's paper present the results for the conditional expected unemployment rate. Note that in all four countries the trend is positive, large and statistically significant. As the author suggests, the most likely explanation for this is that there are important left-out features of the labor markets in these countries that

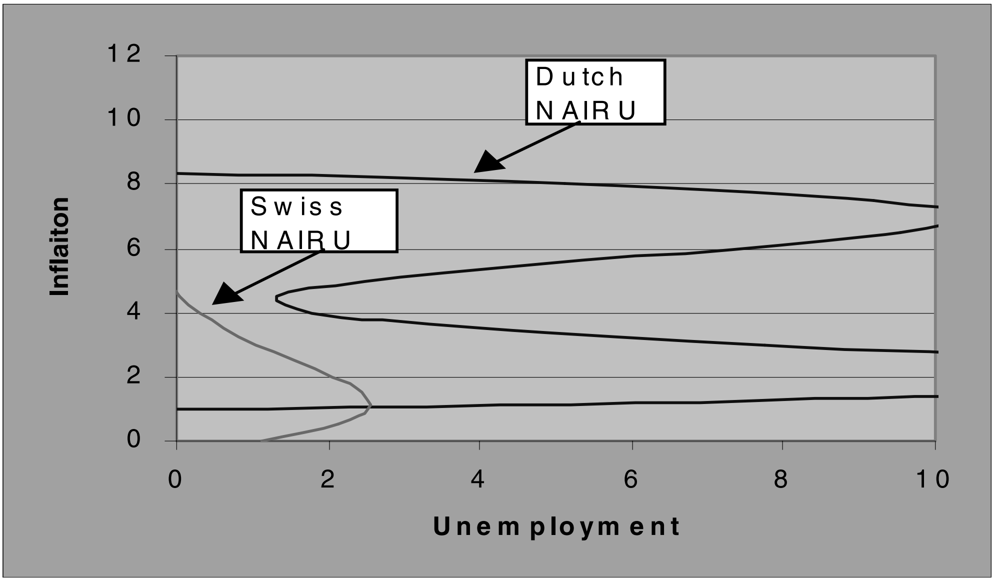

Figure 1. Dutch and Swiss Equilibrium Unemployment

are affecting the unemployment rate. Given that there is no account taken of these in the Phillips curve analysis those results are suspect at best. However, the time trend may be an adequate control, and to the extent it is, there is more reason to take seriously the results of Wyplosz's second and third approaches to the data.

The author draws three conclusions from his results on country-specific conditional expected values. First, for nearly all of the range from 1 to 5% inflation in every country for every specification, unemployment declines with inflation. Second, in nearly every specification there is a small range of inflation rates – mostly below 1% and always below 2% – for which unemployment is increasing with inflation. Finally, while in most specifications a constant expected unemployment rate can be rejected, with the exception of France the confidence intervals for the conditional mean at relevant inflation rates are broad enough so that for all practical purposes a constant rate cannot be ruled out.

The last conclusion nearly negates the first two, and that is why Wyplosz undertakes his third exercise. Since the shapes of relationships are so similar across countries, the loose fit in any one country should not be the last word. Under these circumstances it does make sense to pool the data the way he does and to estimate how the expected unemployment rate will vary with inflation across countries.

The results of this analysis are presented in Table 3 and Figure 4 in Wyplosz's paper. They suggest a strong negative relation between inflation and unemployment over nearly the entire range of post-war inflation rates. Unemployment rates are at a maximum in the range the ECB has chosen as its target for inflation. However, recall my earlier comments about the difficulties of interpreting the results of curve fitting exercises for those parts of the curve at the periphery of the sample. As a quick look at Wyplosz's Figure A1 will confirm, these four countries collectively have not had that much experience with inflation above 6% or below 2%. The curves will thus reflect only what is going on between these two values. Making the polynomial fit well in this range may require it to fit poorly outside the range. I suspect that explains these results.

In particular, I am very suspect of the finding of increasing unemployment with inflation at very low rates of inflation. First, I can think of no theory that would motivate such sharply increasing unemployment rates in the range of 0–1% inflation that would also lead us to expect large decreases as unemployment climbed above that rate. Most stories about how inflation might cause increasing unemployment would imply constant or increasing effects as inflation increased. Second, as Wyplosz's Figures 3 and 4 show, the relationship between inflation and unemployment is very imprecisely estimated in this interval and in no case could one rule out steadily declining unemployment with increasing inflation. In fact, in 2 of the 8 specifications presented in Wyplosz's Figure 5 a declining rate is estimated for this range. This imprecision and sensitivity to specification is to be expected given how few values of expected inflation fall in this range – particularly since nearly all of those that do are during periods of above-normal unemployment. The best conclusion is that we simply can't tell from these data what the long-run relationship between inflation and unemployment is in this range.

Results for the ADP Model Outside the United States

If it is problematic to estimate the relationship between inflation and unemployment at very low rates of inflation using a flexible functional form, can more progress be made using a functional form dictated by theory? If the ADP model was found to fit as well outside the U.S. as it does inside and to suggest an important trade-off between inflation and unemployment at low rates of inflation then one might have some confidence in these findings even if there was little experience with very low rates of inflation. A good model should be able to forecast beyond the range of data on which it is estimated. (The ability of the ADP '96 model to backcast the great depression on the basis of post-war coefficient estimates is exemplary.) With this hope I present some preliminary attempts to fit the ADP model for countries outside the United States.

Table 2 presents estimates of the important parameters of the ADP Phillips curve for Canada, the United Kingdom, France and Germany. Typical results for the United States are also presented. The form of the ADP Phillips curve is

$$\pi_t = a + \Phi(D + E\pi^2_{Lt-1})\,\pi^e_t - bu_{Lt} + gX_t + S_t(\sigma, g_t, \pi_{t-1}, \pi_{t-2}, \ldots) + \varepsilon_t$$

where π is the rate of inflation, Φ is the cumulative standard normal density function, u is unemployment, X is a vector of dummy variables and controls for supply shocks, S is the term we add to account for nominal rigidity (described in ADP 1996) which is a function of the standard deviation of desired wage change (σ), trend productivity growth (g), and past values of inflation. ε is assumed to be an i.i.d. error, the subscript Lx denotes a weighted average of lagged values starting with period x and going back and the superscript e denotes the expected rate (modeled in all of these specifications as a weighted average of past values).

On first examination, it seems that the results for other countries resemble those for the United States. Some aspects look quite promising. Without any time trends or controls for changes in labor market institutions I get a strong negative relationship between the level of unemployment and inflation in every country. If the coefficient on expected inflation is one, as the natural rate hypothesis implies, then the constant term in the cumulative normal multiplying expected inflation should be a large positive number. In all examples presented (except the United States), the value is negative – though small positive values could not be ruled out. Estimated values suggest that the coefficient on expected inflation is considerably less than 1 when inflation is low, as the

Table 2. Parameter Estimates for ADP Phillips Curves for Several Countries

Parameters	United States	Canada	United Kingdom	France	Germany
Constant (a)	0.024 (0.012)	0.025 (0.008)	0.000 (0.018)	–0.009 (0.007)	–0.085 (0.021)
Sum of Coefficients of Unemployment (b)	–0.43 (0.18)	–0.33 (0.10)	–0.35 (0.16)	–0.21 (0.06)	–0.36 (0.05)
Constant in Coefficient on Expectations (D)	0.02 (0.60)	–0.68 (0.59)	–1.36 (1.53)	–0.46 (0.47)	–0.49 (0.38)
Coefficient of π^2 in Coefficient of Expectations (E)	0.117 (0.071)	0.123 (0.048)	0.118 (0.114)	0.116 (0.054)	0.248 (0.118)
Standard Deviation of Desired Wage Change (in Percent) (σ)	2.2 (1.4)	2.7 (1.3)	7.4 (3.1)	7.7 (1.6)	17.6 (2.6)

The general specification and the method of estimation are described in Akerlof, Dickens and Perry (2000). The specific functional forms and the data used are described in the appendix.

theory of near-rationality in price and wage setting suggests. In addition, in every country there is considerable variation in the value of the cumulative normal term over the sample as the coefficient on the weighted average of lagged inflation is large and typically statistically significant.

Besides the U.S., the one country where the coefficient of the square of lagged inflation in the cumulative normal is not statistically significant is the U.K. In many of the specifications that we estimated for the U.S. this parameter was not significantly different from zero when the term for nominal rigidity was included, but significant when that term was excluded. This is the case for this specification for the U.K. as well.

One place where we start to see an important difference between the U.S. and other countries is in the last line of Table 2. The larger the standard deviation of desired wage changes the higher the level of inflation at which nominal rigidity becomes important for unemployment. Were nominal rigidity no problem for an economy, this parameter should be estimated to be zero. Instead we find that in Europe this parameter is estimated to be much larger than in the U.S. or Canada which, taken literally, would mean that nominal rigidity is much more of a problem for Europe. However, the first line of Table 2 shows the constant term to be zero or negative for all the European countries. This implies the impossibility of a negative asymptote for unemployment as inflation rises and calls into question the validity of the exercise.

Figures 2–5 show the implied long-run Phillips curves for Canada, the U.K., France, and Germany. Each figure shows two long-run Phillips curves corresponding to different rates of productivity growth – that which prevailed in the 60s and the average rate since 1980. As noted above, changes in the rate of productivity growth can have substantial effects on the long-run Phillips curve when nominal rigidity is a factor.

The Canadian Phillips curves in Figure 2 look very similar to those we estimated for the United States (ADP 2000). Nominal rigidity causes unemployment to rise substantially at very low rates of inflation. Near rationality allows unemployment to fall notice-

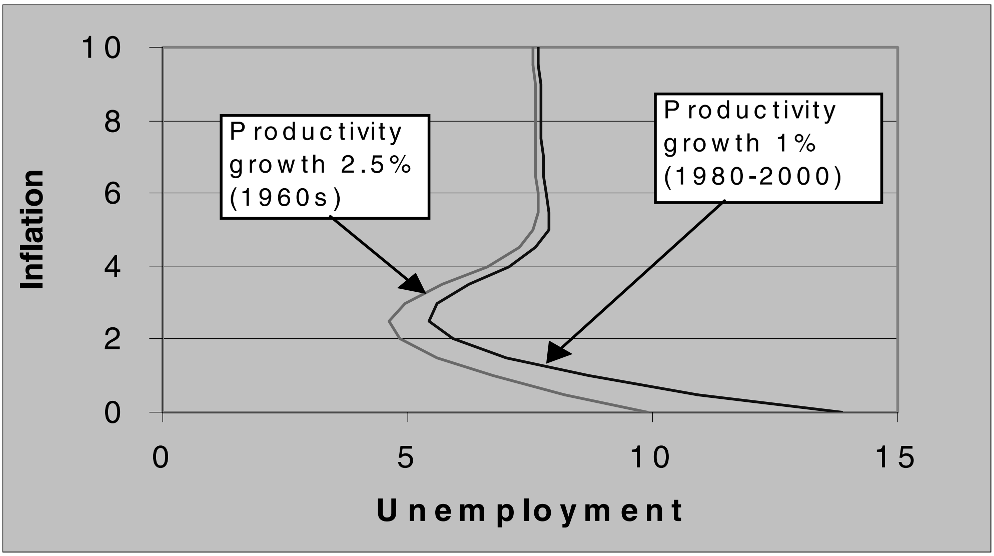

Figure 2. ADP Long-Run Phillips Curve for Canada

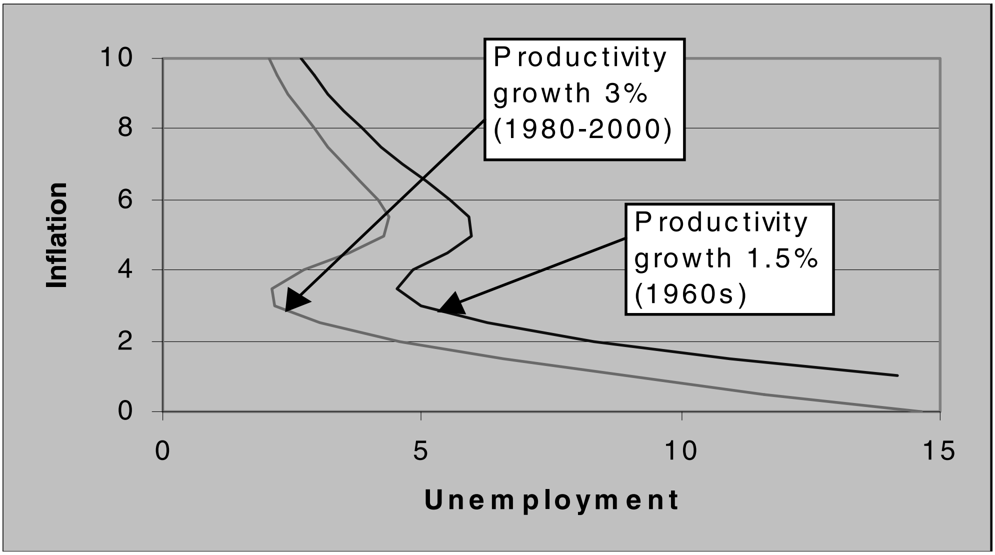

Figure 3. ADP Long-Run Phillips Curve for the U.K.

ably below the natural rate of about 7.5% to a low of about 5.5% at an inflation rate between 2 and 3%. I have not done the exhaustive specification search we did for the United States for any of these countries, but the several specifications we have estimated for Canada all yield qualitatively similar results. The ADP Phillips curves for the U.K. in Figure 3 look somewhat like those for Canada except that unemployment is predicted to fall steadily for inflation rates above 5%. There is a local minimum for the unemployment rate at a rate of inflation between 3 and 4%. The value is higher than for Canada and the United States because the effects of nominal rigidity are estimated to be important at higher rates of inflation due to the greater variability of wage change. Again, limited robustness checks suggest that ADP Phillips curves estimated for the U.K. all have roughly this form. In particular, all have the minimum unemployment rate occurring at very high rates of inflation and most have negative asymptotes.

The French Phillips curves shown in Figure 4 are even more problematic. Only at very high rates of productivity growth do we see the local minimum for unemployment caused by near rationality. As with the U.K., I have run limited robustness checks and find similar results for a range of different specifications. In particular, I have attempted adding a time trend to the French estimates. While the time trend is estimated to be large and statistically significant in any Phillips curve that does not include the term for nominal rigidity, the inclusion of that term causes it to fall to nearly zero and to become statistically insignificant. However, the negative asymptote for unemployment as inflation increases is also characteristic of most specifications we estimated. Two specifications (out of 15) yielded positive asymptotes, but negative values for the minimum unemployment rate for at least some values of trend productivity growth observed during the sample period. Also, the lag structure for unemployment suggests that changes in unemployment are very important for the inflation process in France possibly indicating the existence of insider-outsider problems.

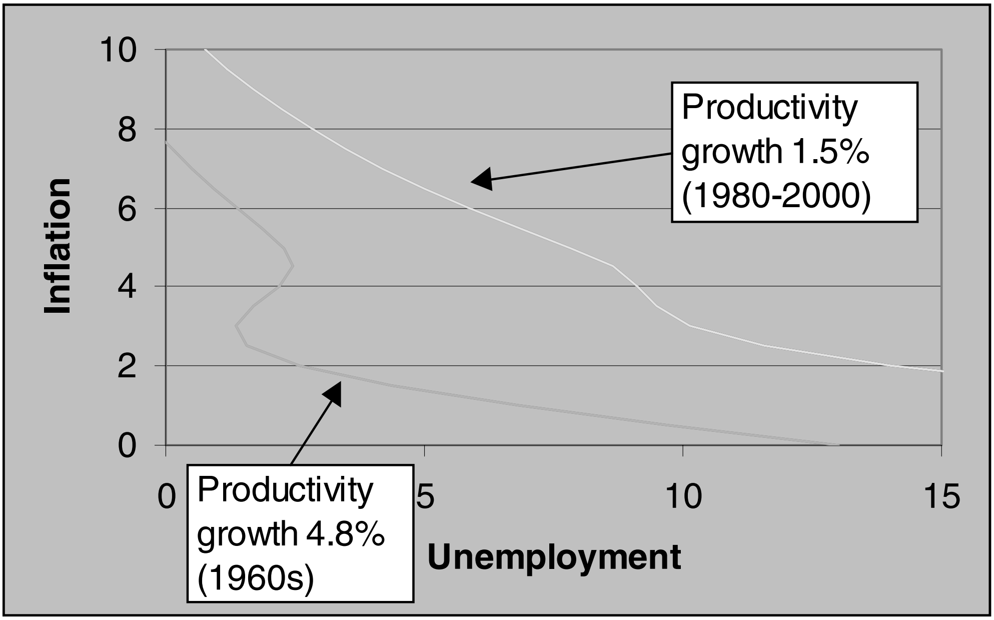

Figure 4. ADP Long-Run Phillips Curve for France

Figure 5 presents typical curves for Germany. The very large value of the standard deviation of wage change estimated for Germany, combined with the negative intercept, results in long-run Phillips curves which are virtually horizontal and that shift up as productivity growth slows. I have only estimated five specifications for Germany, but all have this character.

How seriously should we take these results? With respect to the findings for near rationality, it important to remember that the short-run impact of expectations on the rate of inflation is at least as important for the identification of this effect as is the position of the long-run Phillips curve. Similarly, our approach to estimating the effects of nominal rigidity has implications for the short-run behavior of inflation, though I suspect that most of the identification in these estimates comes from the long-run implications. Thus even though the models estimated for Europe cannot reflect the true long-run relationship between inflation and unemployment, these estimates still provide evidence of the importance of nominal rigidity, and particularly near rationality.

The estimates for the standard deviation of wage change are particularly surprising and suspect. One might expect the corporatist wage setting practices of Germany and France to lead to lower variation in wage change – not higher. However, it has been argued that Europeans are much less mobile than North Americans and this may mean that shocks to local labor markets require larger wage changes to equate labor supply and labor demand. This might help explain an anomaly in the wage curve literature that Blanchflower and Oswald (1994) describe. In Europe there is a negative relationship between wage levels and unemployment in nearly all cross-sectional data sets. In the United States the relationship is only negative with panel data when geographic dummies are included. Otherwise it is usually positive. This suggest that labor moves to

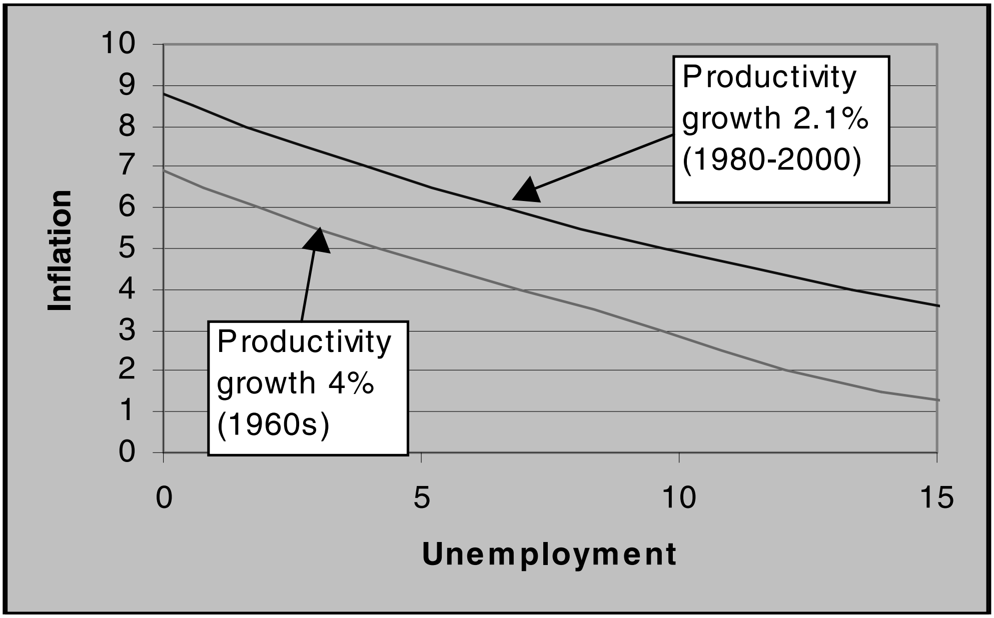

Figure 5. ADP Long-Run Phillips Curve for Germany

equate expected incomes in the medium run in the United States as in the Harris-Todaro model, but not in Europe. It would be useful to examine panel data for these countries to examine the distribution of wage changes directly and to compare the distribution to that in similar U.S. data.

Conclusion

The evidence presented by Charles Wyplosz and the ADP Phillips curves I have estimated for Europe certainly don't make an iron clad case against a target range for inflation of 0–2%, but they should give the ECB reason for concern. Wyplosz's consistent finding that unemployment declines at rates of inflation above 2% combined with the evidence I have presented for the relevance of near rationality, and possibly nominal rigidity, in countries outside the United States suggests that targeting an inflation rate below 2% could be very costly.

Certainly there is more to the European unemployment problem than too low a rate of inflation. Wyplosz's finding of a significant trend in his models of the conditional mean of unemployment, and the inability of the ADP model to tell a coherent story about unemployment at high rates of inflation are suggestive of this. Real wage rigidities as well as other labor market problems could be contributing to the inability of these models to fit European data. It is even possible that these problems cause the models Wyplosz and I have estimated to be mispecified so that the results are meaningless. However, what if near rationality and nominal rigidity are problems in the Euro zone? Targeting too low a rate of inflation could indefinitely delay Europe's full recovery from its high rates of unemployment even if structural reforms are successful in removing other impediments.

Appendix

Functional Forms for ADP Phillips Curves for Several Countries

	Canada	United Kingdom	France	Germany
Number of Lags on Unemployment	11	7	3	11
Lag Structure of Inflationary Expectations (π_e)	Unrestricted	Piecewise Linear	Unrestricted	Unrestricted
Lag Structure for Inflation (π) Coefficient of Inflationary Expectations (π_e)	Piecewise Linear	Geometric Decay	Piecewise Linear	Piecewise Linear

* The specification of each term and the method of estimation are described in Akerlof, Dickens and Perry (2000). For these specifications the only supply shock control was a dummy for the first two quarters in 1973 and the third quarter in 1978 through the third quarter of 1979 as a control for the oil price shocks of those years. Dummies were used instead of a food and fuel price series or import price deflators to accommodate both the price changes and the policy responses to those price changes (such as rationing). The dummies were not significant in Canada and were not used in the specification presented here though they were used in other specifications. Results for all Canadian specifications were substantively similar to results obtained in the U.S.

Data Sources

The Consumer Price Index series used for each country was taken from the International Monetary Fund's "International Financial Statistics" CD-ROM. Unemployment data for France, Canada and the United Kingdom was taken from OECD's *Main Economic Indicators*, and for all years for which an unemployment rate was not published by the OECD, a rate was constructed using the OECD's registered unemployment and total employment series. Unemployment rates for Western Germany are from the German Federal Employment Services Institute for Employment Research. The OECD unemployment rate series for France and Canada were multiplied by a scaling factor, so that the series did not differ significantly from the Bureau of Labor Statistics' "Unemployment Rates: Approximating U.S. Concepts" series in *Comparative Civilian Labor Force Statistics: Ten Countries, 1959–1999*. The productivity trend was constructed by combining sources presented in Table II of Bagnoli (1997).

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Comment*

Lars E.O. Svensson

Charles Wyplosz (2001) has produced a very interesting and challenging paper on a very important topic. It is about the relation between equilibrium unemployment and long-term inflation, whether inflation brings "grease" (lower unemployment) or "sand" (higher unemployment). It is about the slope of the long-run Phillips curve; whether it is vertical or not. This has implications for the choice of the operational definition of price stability and the level of an inflation target.

Charles's approach is to estimate Phillips curves for Germany, France, Italy, the Netherlands and Switzerland, and then to infer a polynomial representation of the long-run Phillips curve. His main results are displayed in his figure 3. He finds that the long-run Phillips curves are nonlinear and not vertical. He, quite surprisingly, finds a sand effect at low levels of inflation. For Germany, he finds a grease effect at a higher inflation, in the range of 4–10% (at an annual rate).

As we know, Charles is a great academic scholar, and he is careful to emphasize, with admirable honesty, a number of caveats and weaknesses of his results. For instance, the confidence intervals are wide, and the estimated long-run Phillips curve is barely significantly different from a traditional vertical long-run Phillips curve. Furthermore, he explicitly shows that the Phillips-curve estimates are very problematic. (Also, the results for the UK that were presented at the conference were highly implausible.) As a consequence, his results displayed in figure 3 must be deemed to be very unreliable. It is much too early to take them seriously and, as often, more research is required before we can give any weight to the findings.

Incidentally, if the results and these curves are taken seriously, it is apparent from the figure that zero inflation is a good inflation target for France and Germany.

One potential source of problems is Charles's main measure of inflation expectations. He takes inflation expectations to be given by the yield curve, more precisely as the difference between a long bond rate and a measure of the world real interest rate. Furthermore, his measure of inflation expectations is quite important for his approach to estimate long-run Phillips curves; indeed, his long-term inflation is defined as a moving average of the measure of inflation expectations.

Obviously, there are other alternatives for estimating inflation expectations. Some sensitivity analysis is warranted, on how the results depend on alternative measures and estimates of inflation expectations. One alternative measure of inflation expectation, based on the European Comission's and the OECD's forecasts, is incorporated in the revised version of the paper. Figure 5 reveals that the results are quite sensitive to the measure of inflation expectations used.

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* A revised version of comments presented to the First ECB Central Banking Conference, *Why Price Stability?*, Frankfurt, November 2–3, 2000.

As another possible alternative, let me mention the approached used in the paper by Stefan Gerlach and myself, (2000). The focus in that paper is on the role of monetary indicators in the Euro area. In examining the role of monetary indicators, we estimate various Phillips curves, using synthetic Euro-area data. With regard to inflation expectations, we assume that they depend on a Euro-area "inflation objective", denoted $\hat{\pi}_t$, and lagged inflation, π_{t-1}. The inflation objective is assumed to reflect the average ERM central-bank commitment to reduce inflation to the German level, and it is assumed to gradually converge to Bundesbank's "inflation target" (what, over time, was called "unavoidable inflation," "normative inflation" and "medium-term price assumption"). With these inflation expectations, our Phillips curves fit very well. This is illustrated in table 1 of Gerlach and Svensson (2001), reproduced below. Column (4) shows a regression of the inflation deviation from the inflation objective, $\pi_{t+1} - \hat{\pi}_{t+1}$, on lagged inflation deviations, $\pi_t - \hat{\pi}_t$, the output gap, $y_t - y_t^*$, and lags of oil-price inflation. We see that the output gap is highly significant, with a sizeable coefficient, and that the adjusted R-squared is substantiable.

Clearly, in this equation, the dependent variable is the output gap, not the unemployment gap, as in Charles's equations. Furthermore, the data is aggregate synthetic Euro-area data, not actual national data. Still, the good fit suggests that it may be a good idea to run Charles's equations for a number of alternative assumptions on expectations formation.

It is, of course, impossible do discuss the issues of unemployment, wage formation, and inflation without reference to the, by now, classic paper by Akerlof, Dickens and Perry (ADP) (1996). The ADP paper provides evidence of downward nominal rigidity and argues that low inflation implies higher unemployment.

Table 1. Inflation, 1981:4–1998:4, Dependent variable: $\pi_{t+1} - \hat{\pi}_{t+1}$

Equation Estimation	(1) OLS	(2) SURE	(3) OLS	(4) OLS	(5) OLS	(6) OLS
$\pi_t - \hat{\pi}_t$	0.354**	0.385**	0.351**	0.437**	0.464**	0.390**
	(0.095)	(0.089)	(0.098)	(0.103)	(0.103)	(0.103)
$\tilde{m}_t - \tilde{m}_t^*$	0.284**	0.281**	0.285**	–	–	–
	(0.057)	(0.054)	(0.092)			
$y_t - y_t^*$	–	–	0.028	0.219**	–	0.188*
			(0.087)	(0.075)		(0.075)
$\Delta_4 m_t - \Delta_4 m_t^*$	–	–	–0.031	–	0.207*	0.162*
			(0.099)		(0.084)	(0.083)
Δq_{t+1}	0.223**	0.242**	0.233**	0.271**	0.246**	0.251**
	(0.066)	(0.062)	(0.067)	(0.072)	(0.075)	(0.072)
Δq_t	0.002	–0.011	0.003	–0.012	–0.016	0.000
	(0.073)	(0.068)	(0.074)	(0.081)	(0.082)	(0.079)
Δq_{t-1}	–0.199**	–0.205**	–0.197**	–0.203**	–0.218**	–0.206**
	(0.068)	(0.064)	(0.069)	(0.075)	(0.077)	(0.074)
Δq_{t-2}	0.283**	0.264**	0.277**	0.232**	0.275**	0.260**
	(0.057)	(0.053)	(0.059)	(0.063)	(0.065)	(0.063)
$\bar{R}^2$	0.71	0.71	0.70	0.65	0.63	0.66
SEE	0.72	0.72	0.73	0.80	0.81	0.78
DW	2.20	2.28	2.19	2.20	2.20	2.20

Given the way the ADP paper is written, many readers interpret it as a warning against inflation targets below 3%, on the ground that lower inflation targets would increase unemployment permanently. However, even if the ADP results are taken at face value, that fact is that they imply that an inflation target of 2% is quite all right, since there is hardly any increase in unemployment at that level of the target (see their figure 3.).

Furthermore, I believe that the ADP results have generally been oversold and should not be taken at face value. Indeed, I think no reader should form an opinion about the ADP paper before reading Gordon's (1996) very sceptic and, in my mind, quite appropriate comment. For instance, the paper relies on data with inflation higher than 2–3%. Furthermore, the ADP analysis disregards that wage-setting behavior may change with a transparent and credible low-inflation policy. Ironically, since the paper was published, US inflation and unemployment have both reached record lows, very much counter to the ADP prediction.

As emphasized in José Viñals paper to this conference (2001), there is evidence that European wage behavior is different from that in the US. Work by Layard, Nickell and Jackman (1991) and Viñals and Jimeno (1998) provide evidence that Europe is characterized by more real-wage rigidity and less nominal rigidity than in the US. An extensive survey by Yates (1998) finds no support for the ADP results for Europe.

Interestingly, the new ADP paper, (2000), is very different. There the authors find grease at low positive inflation. However, as emphasized in the comment by Blinder (2000), this result relies on workers having permanent monetary illusion and a sizeable proportion of the population being indefinitely fooled by a small positive inflation cutting into their real wages. I remain very sceptical about this result. In addition, I believe one objective of a transparent monetary policy is to help people avoid monetary illusion and instead make informed decisions and this way improve the resource allocation.

What levels of inflation targets have some representative central banks in industrialized countries chosen? In New Zealand, the Reserve Bank of New Zealand has a target range of 1–3%, and hence a midpoint target of 1.5%. In the Euro area, we have the embarrassing situation that the announced definition of price stability is somewhat ambiguous and asymmetric (see, for instance, Svensson (1999) and (2000)). The target range is from either 0 or some small positive number to 2%, which leaves the midpoint ambiguous. Working backwards from the construction of the M3 reference value, one gets to a point inflation target of 1.5%, the same level as in New Zealand (which however seems to be higher than the midpoint of the Eurosystem's target range, unless the target range is as narrow as 1–2%). In Switzerland, the Swiss National Bank abandoned monetary targeting in December 1999 and adopted the Eurosystem definition of price stability (although without the much criticized two-pillar strategy; instead relying on an inflation forecast to guide policy). In Canada and Sweden, Bank of Canada and Sveriges Riksbank have a point target of 2% with a tolerance interval of ±1%. In the UK, Bank of England has a point inflation target of 2.5%, and in Australia there is an inflation target over the business cycle that can arguably be interpreted as a 2.5% point target.

Thus, these point targets or midpoints range from 1.5% to 2.5%. I believe that there is no reason to believe that wage formation in Europe would provide difficulties for inflation targets in that range.

First, a bit of productivity growth does wonders. Suppose the inflation target and average inflation is 2%, and suppose that productivity growth is also 2%, not an unrealistic number. This means that average wages can rise at a rate of 4%. But then, one wage can be constant at 0% and another can rise at a rate of 8%, with the average still at a rate of 4%. This means that an inflation target and productivity growth at these levels still allow for substantial relative wage flexibility.

Second, even if there would be downward nominal wage rigidity, a low-inflation environment provides strong incentives to get around this restriction, for the benefit of both workers and firms. For instance, there are strong incentives in favor of flexible bonus and profit-sharing systems. If there is a bonus, which is positive on average but shrinks to zero during bad times, some effective nominal wage flexibility has been introduced.

Third, a credible low-inflation policy means that inflation expectations are anchored on the inflation target. If the inflation target is credible among the labor market parties, this implies that a natural starting point for wage negotiations is the inflation target plus the productivity increase. Here, a symmetric point target has great advantages over a somewhat ambiguous target range. With a symmetric point inflation target, it is natural that this number becomes one of the agreed inputs in the wage negotiations. In contrast, with an ambiguous range or an ambiguous midpoint, the starting point may vary by several tenths of a percent, which is not innocuous since the wage settlements often concern a few tenths of a percent.

A clear and transparent monetary policy should help the labor-market parties understand the rules of the game under a low-inflation monetary policy. It is instructive to see how this is done under inflation-forecast targeting. Suppose that inflation-forecast targeting is implemented so that the central bank's instrument rate is set so that a 2-year-ahead inflation forecast is close to the inflation target. Let the inflation forecast depend on the instrument rate and nominal wage levels, and hold for simplicity other inputs in the forecast constant. If wage negotiations result in increases in nominal wages, everything else equal, this will raise the 2-year-ahead inflation forecast above the inflation target. Consequently, the central bank has to raise the instrument rate so as to contract the economy, reduce employment, and bring the inflation forecast down towards the target.

Since the central bank thus maintains low inflation (and a forecast of low inflation), from the point of view of trade unions, nominal wage increases lead to real wage increases, which lead to higher unemployment. Thus, trade unions are forced to internalize the effect on unemployment of their wage demands, and there are strong incentives to adapt wage demands to the inflation target.

Explaining the above and convincing the trade unions to internalize the effect on unemployment of their wage demands is an important part of a transparent monetary policy. The Swedish experience during the last few years is quite instructive. By a consistent conduct and presentation of its policy, the Riksbank has achieved almost perfect credibility of the 2% inflation target, with inflation expectations a few years ahead anchored almost exactly on 2% (see chart 1 in Lars Heikensten's comment (Heikensten, 2001) on José Viñals paper, 2001). Furthermore, trade-union officials now seem to understand and accept the inflation-targeting regime, and indeed seem to internalize the effect of wage demands on unemployment. Indeed, Lars Heikensten, First Deputy Governor of the Riksbank, can tell you how he has many times during recent years personally met trade-union officials to gather support for new regime and to explain how inflation targeting works and what the new rules of the game are. In full consistency with this, unemployment in Sweden has come down rapidly the last few years, while inflation has remained low.

In conclusion, I find no evidence that wage formation in Europe provides a case against a symmetric point inflation target as low as 2% or even 1.5%.

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General Discussion

Francesco Mongelli referred to the claim in Wyplosz's paper that it was not possible to estimate a Phillips curve for some European countries. Mongelli pointed to a recent paper by D'Amato and Gerlach, where Phillips curves for some European countries, based on backward-looking expectations and using non linear estimation techniques were obtained.

William T. Dickens went back to a comment made by Lars Svensson, namely whether nominal wage rigidity would remain strong during long periods of low inflation. This was indeed crucial for the Akerlof-Dickens-Perry type of models. He pointed to recent evidence on nominal wages rigidities, such as the slight stiffening of nominal wages rigidities in Switzerland over the last decade relative to earlier periods or anecdotal evidence from the US Great Depression on institutional pressure to maintain nominal wage rigidities. Dickens accepted Svensson's point that other institutional arrangements, such as bonuses, may flourish in periods of low inflation and high productivity and profit growth. However, such instruments of wage flexibility would not work the same way in overcoming downward rigidities during downturns.

Frederic Mishkin raised an additional aspect and argued that the optimal inflation rate was not just an issue of "sand and grease" and labour markets but also of financial stability. Mishkin referred to the case of industrialised countries, where contracts are generally long term and denominated in domestic currency, and where changes in the price level can have important effects on the balance sheets, both of the business sector and the financial sector. Miskhin considered this to be a key element of the Great Depression in the U.S. and of the current Japanese situation. From a financial stability point of view, he argued that the optimal inflation rate might need to be slightly above zero in order not to run into periods of deflation, especially if the financial sector is weak. Finally, Mishkin agreed with Svensson that the evidence provided by the labour market literature on the risks of zero inflation is not particularly convincing.

Charles Wyplosz answered to Mishkin with two remarks regarding the relation between inflation and financial stability. The first is that one should acknowledge the possibility of movement around what Lars Svensson called 'the point estimate'. If such movement leads to negative inflation, then we indeed face the problem that Mishkin raised. The second remark goes in the other direction; namely that financial markets are now better equipped to adjust to episodes of negative inflation, through hedging against all sorts of risks.

Philipp Hartmann referred to the title of the session 'Do we know how low inflation should be?' and wondered why the issue of the measurement bias in Consumer Price Indices had not been raised yet.

Lars Svensson answered that there is general agreement that the measurement bias in most countries lies somewhere between a very small positive number and about 1 percent. He noted that, with an inflation target of 2 percent, or even 1.5 percent, the bias is already taken care of.

Diego Rodriguez-Palenzuela drew attention to the large differences in the long-term Phillips curves across countries estimated in Wyplosz's paper and pointed to the need for an explanation of the different grease and sand effects across countries given that institutional settings are not so diverse.

Charles Wyplosz agreed that his results, if taken at face value, would show that the effect of inflation on unemployment is different from country to country but he acknowledged the existence of huge errors in his estimates. Wyplosz noted, however, that, by and large, the sign of the effect of inflation on unemployment is the same at similar rates of inflation, even if the effects may be more dramatic in some countries than in others.

Referring to a comment made by Dickens on the Great Depression, **Bill White** indicated that one of the reasons why wages had not adjusted downward in the early 1930s was that President Hoover had been telling U.S. citizens that wages were income and income was consumption. The consequences of such a policy prescription, keeping nominal wages up and with the consequent increase in real wages, are well known to all. Bill White also referred to the comment made by Frederick Mishkin on deflation and financial institutions. He stressed how often periods of low and stable inflation had been associated with inflation in real estate and other asset prices. In this context, he thought that something like the ECB's monetary policy strategy, i.e. a sort of target for low inflation and also some special role for monetary and credit aggregates may be a better way of avoiding that kind of problem.

William T. Dickens expressed his agreement with White's comment on the Great Depression. However, he considered that institutions, such as the reaction of the trade unions in the U.S. in the 1930s, played an even more important role in supporting nominal wages rigidities than some sort of short-sightedness on the part of politicians or workers or money illusion.

On the second question raised by Bill White, **Charles Wyplosz** noted that increases in asset prices may be more linked to a disinflation process than to low inflation per se. In other words, increases in asset prices may be a temporary consequence of the change in the inflation regime.