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Do We Know How Low Inflation Should Be?

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Abstract

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Keywords: inflation, natural rate of unemployment.

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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 1which shows the centered three-year moving average of German inflation. Under this interpretation of the medium run, the ECB's objective has been achieved in about one year out of three. In Europe, 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.

Figure 1

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]

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.

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

[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.

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. Failure of estimating a Phillips curve does not have to translate into the impossibility of estimating a natural rate of unemployment, and issue taken up again below.

2.3. Grease and Sand: Slopes and Nonlinearities

The standard Phillips curve specification is:

(1) $$p_t = p^e{}_t + a\Delta u_t + au_{t-1} + X_t{}'b + Z_t{}'g + e_t$$

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 *a ¹ 0* and the natural rate is recovered as:

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[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.

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

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

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 postwar 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 p^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*:

(3) $$p^e = i^{LT} - r*$$

[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.

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 p^e are shown in the Appendix (Figure A1).

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 $p_{t-1} - p_t^e$, augmenting (1) as follows:

(4) $$p_t = p^e{}_t + l(p_{t-1} - p_t^e) + a\Delta u_t + au_{t-1} + X_t'b + Z_t'g + e_t$$

which leads to the estimated form:

(5) $$p_t - p_{t-1} = (1 - l)(p_t^e - p_{t-1}) + a\Delta u_t + au_{t-1} + X_t'b + Z_t'g + e_t$$

with $0 < l < 1$. If $l = 0$, the measured expectation term is confirmed by the data while if $l = 1$ 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 $\bar{p}_t$ is defined as the situation where $\bar{p}_t = p_t^e = p_t$ but this definition is not sufficient to derive a time series. In what follows, $\bar{p}_t$ is computed as a centered five-year moving average of expected inflation p_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. $Z_t' = (\bar{p}_t, \bar{p}_t^2, ... \bar{p}_t^n)$. A problem with this procedure is that as $\bar{p}_t$ 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'g* in (5) with $\exp(q\bar{p})Z'g$, with θ<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 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 efficiencies 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

[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.

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

[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.

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 goods and inherited inflation $p_t^m - p_{t-1}$. 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:

(6) $$p_t - p_{t-1} = (1 - l)(p_t^e - p_{t-1}) + a\Delta u_t + a\, u_{t-1} + \exp(q\bar{p}_{t-1})P(\bar{p}_{t-1}) + b\,(p_t^m - p_{t-1}) + g q_{t-1} + e_t$$

where $P(\bar{p})$ is a second or third-order polynomial of long-run inflation and $q \leq 0$. 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 q 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.

Table 1

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):

(7) $$u_t = c + \exp(q \bar{p}_t) P(\bar{p}_t) + g' q_t + e_t^u$$

(8) $$p_t - p_{t-1} = (1 - l)(p_t^e - p_{t-1}) + a \Delta u_t + a e_t^u + b(p_t^m - p_{t-1}) + e_t$$

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 e^u, a measure of the unemployment gap, may well be serially correlated but serial correlation does

[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.

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 polynomial 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.

Table 2

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]

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

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

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.

Figure 3

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 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

[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.

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.

Table 3

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 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.

Figure 4

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

[14] Results for a third-degree polynomial are equally strong.

[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).

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

Table 4

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.

Figure 5

6. Conclusion

Taken at face value, the results presented here imply that a sand 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 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.

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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	
$\pi^{e}_{t} - \pi_{t-1}$	0.25	**	0.41	**	0.41	**	0.23	**
	3.23		6.48		4.01		2.52	
$\pi^{m}_{t} - \pi_{t-1}$	0.07		0.15	**	0.05	**	0.16	**
	1.52		8.83		2.46		3.93	
q_{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	1962-99		1967-99		1962-99		1962-99	
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.

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
$\overline{\pi}_t$	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
$\overline{\pi}_t^2$	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
$\overline{\pi}_t^3$		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.

Table 3. Long-term unemployment
(Panel data)

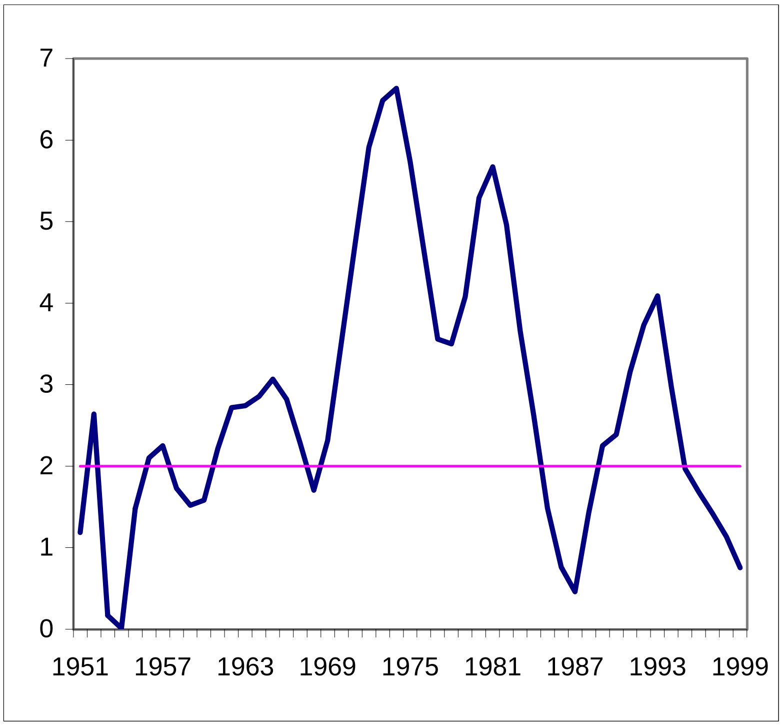
	Germany (1)		France (2)		Netherlands (3)		Switzerland (4)	
Trend	0.24	**	0.36	**	0.25	**	0.08	**
	31.78		48.70		14.55		3.57	
q_t	-1.52	**	-2.79	**	-3.51	**	0.38	
	-5.94		-12.86		-5.91		0.82	
θ					0.5			
Constant					3.86**			
					10.91			
$\overline{\pi}_t$					2.25**			
					12.39			
$\overline{\pi}_t^2$					0.36**			
					4.31			
Adj. R^2					0.97			
SEER					0.88			
DW					0.58			
Sample					1961-99			
N. Obs.					39			

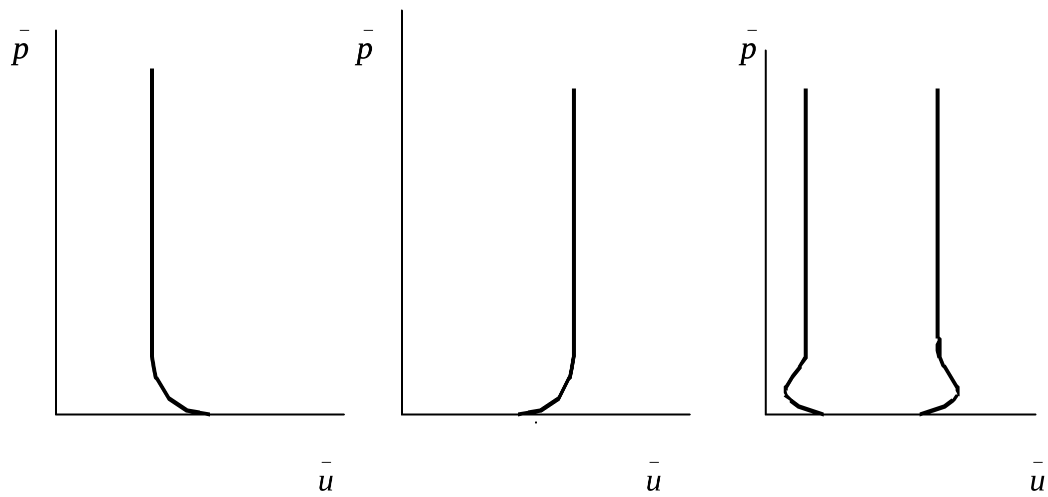
Table 4. Long-term unemployment- Alternative Measure of Expected Inflation

	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
$\overline{\pi}_t$	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
$\overline{\pi}_t^2$	-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
$\overline{\pi}_t^3$	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.

Figure 1. Inflation in Germany

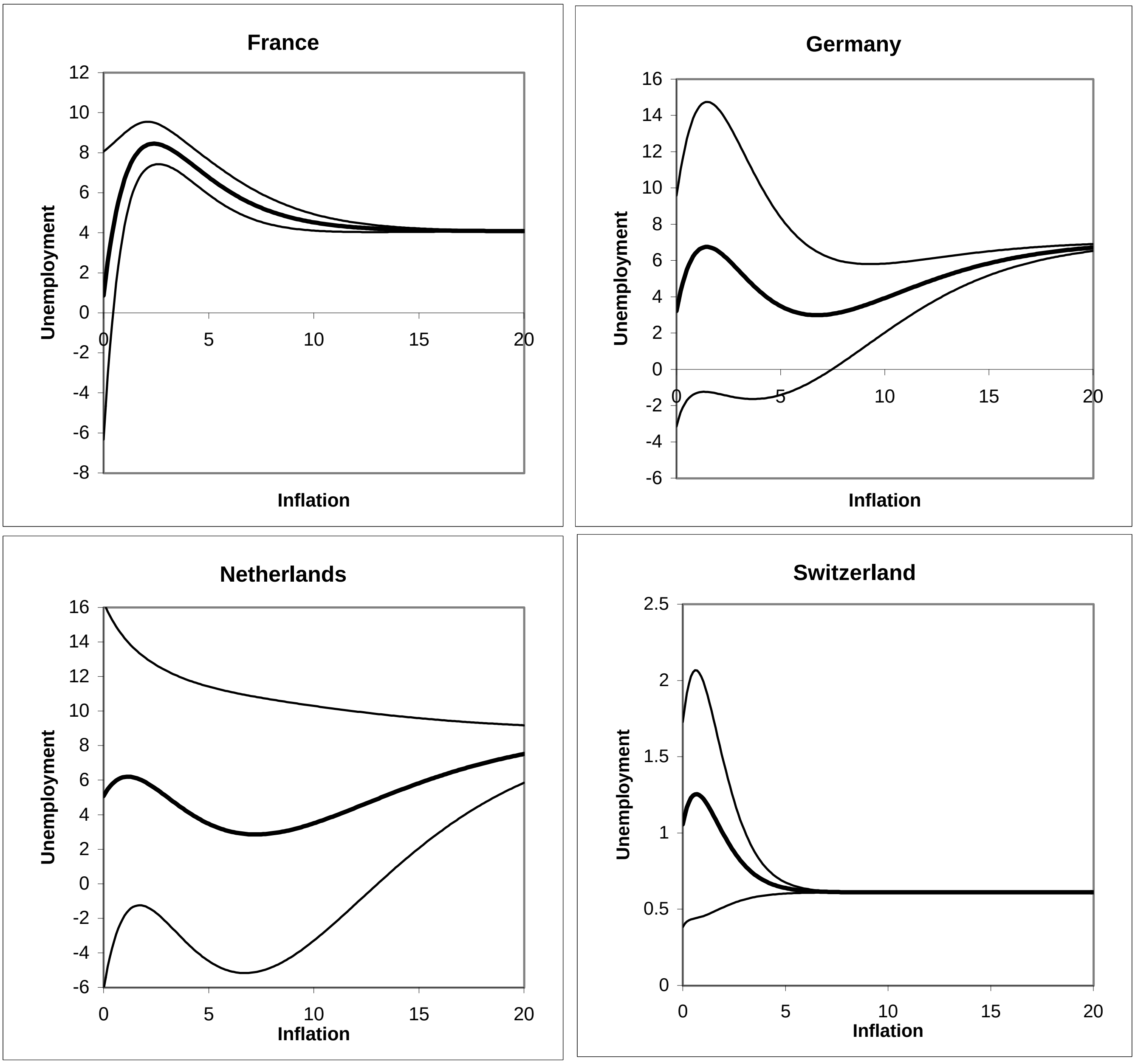




(a) Grease effect (b) Sand effect (c) Grease and sand effects

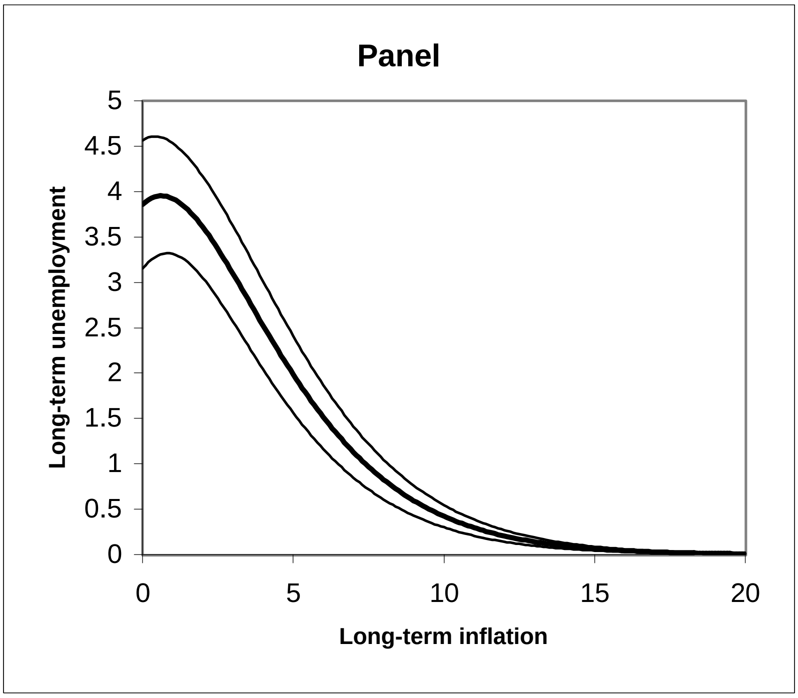
Figure 2. The Long-Run Phillips Curve: Various Hypotheses

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



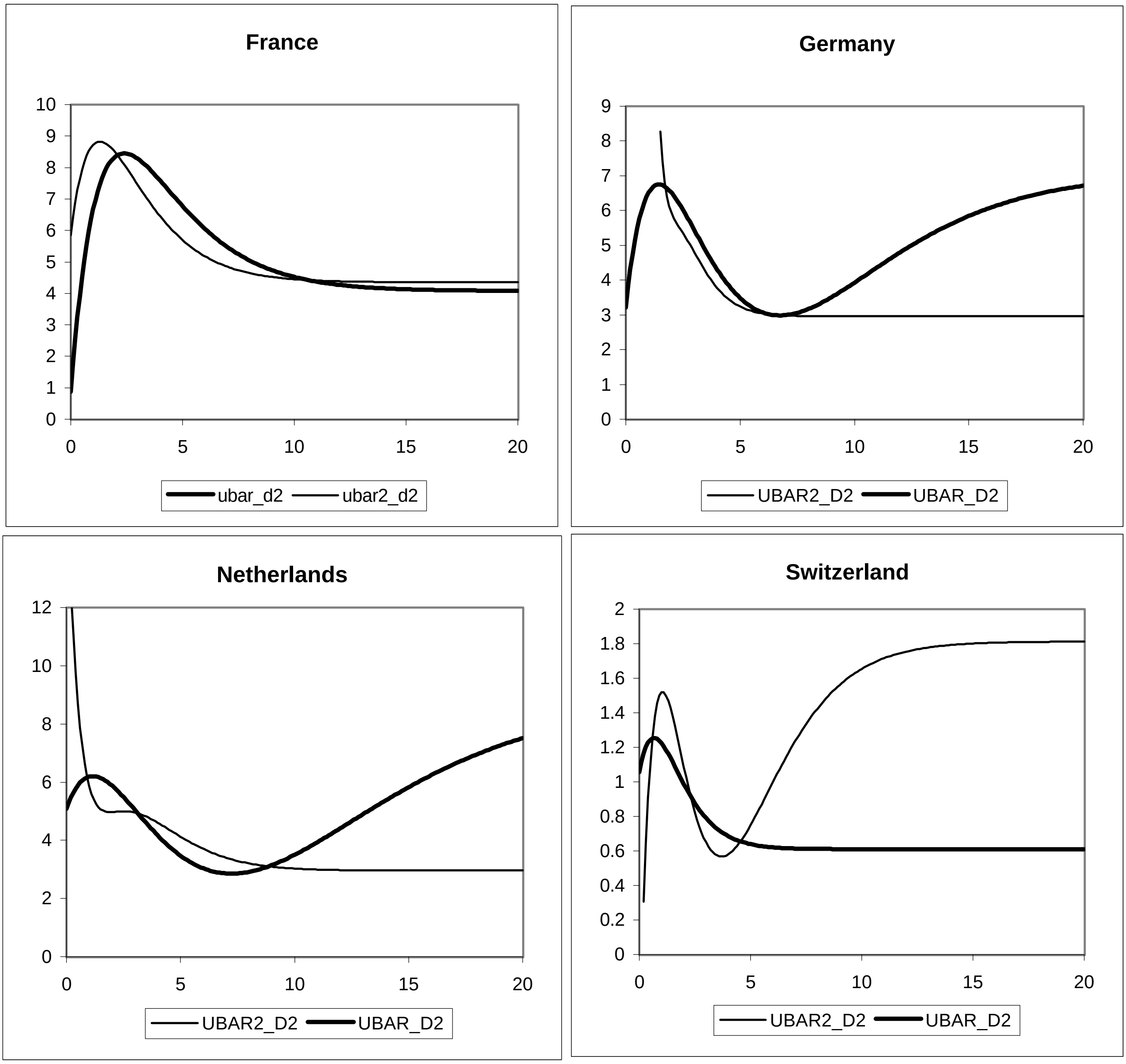
Source: Author's calculations using the second-order polynomial equations in Table 2.

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



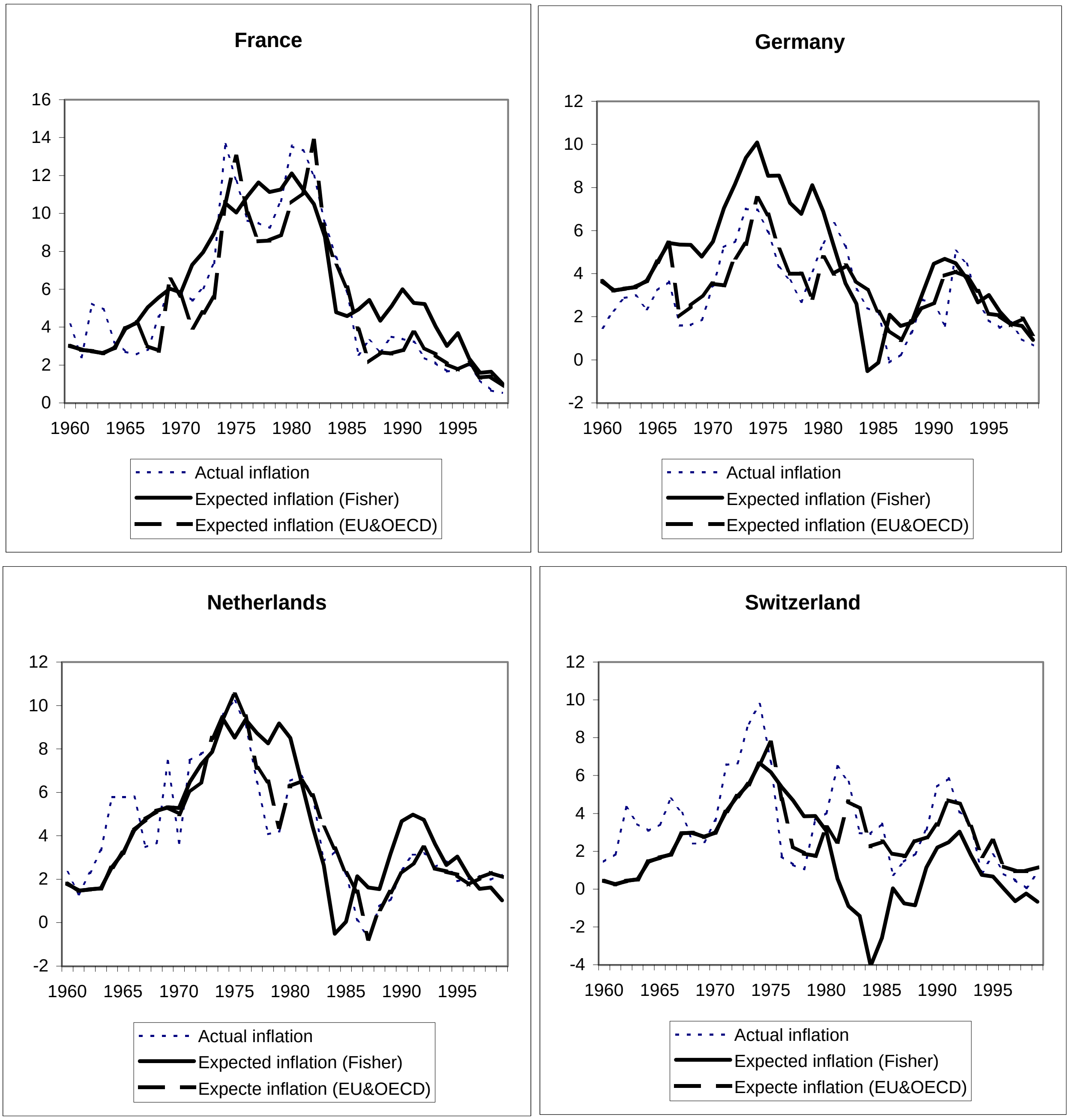
Source: Author's calculations using the estimate in Table 3.

Figure 5. Alternative Measures of Inflation Expectations



Appendix

Figure A1. Actual and Expected Inflation
1960-99



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.