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Coordination? Some Evidence from Austria,
Belgium and the Netherlands

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ARE THERE ADVERSE REAL EFFECTS FROM MONETARY POLICY COORDINATION? SOME EVIDENCE FROM AUSTRIA, BELGIUM AND THE NETHERLANDS

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ABSTRACT

A central hypothesis and concern of some skeptics of European monetary union is that monetary policy coordination to secure a peg to the German mark (DM) will tie real economic performance, especially the unemployment rate, to that in Germany. Evidence on this hypothesis can be found in Austria, Belgium and the Netherlands, however, where currencies have been tightly pegged to the mark since 1979, 1986 and 1984, respectively. This paper reviews the theoretical link between a country's real performance and its coordination with foreign economic policy. It uses the three countries' Phillips curves to gauge real economic performance; it tests whether Phillips curve parameters have shifted adversely following the introduction of the DM-peg and whether any such shift is related to German unemployment rate movements. The article concludes that coordination does not have adverse economic effects on real economic performance.

KEYWORDS: Exchange rate regimes, monetary policy, policy coordination

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Are There Adverse Real Effects From Monetary Policy
Coordination? Some Evidence from Austria, Belgium and
the Netherlands

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Since 1979 Austrian monetary policy has been coordinated unilaterally with German monetary policy by an exchange rate policy that maintains a very tight peg of the Schilling to the Deutsche mark. Similarly, Dutch and Belgian policy were tied to the mark through the exchange rate mechanism beginning in 1979, but Dutch monetary policy has maintained such a tighter peg to the mark since 1984 and the Belgian franc-mark exchange rate stabilized in 1986. During the 1980s, the West German unemployment rate rose sharply to historically high-levels and other European unemployment rates rose as well.² This paper

¹An earlier version of this paper was presented at the Second Annual Workshop on Economic Policy Coordination, Amsterdam, November 4-6, 1992 and at the Seventh Annual Meeting of the Canadian Macroeconomics Study Group, University of Victoria, Victoria, British Columbia, November 5-6, 1993.

²There are several reasons for the rise in the German unemployment rate that have been discussed in the literature. We discuss the link between German unemployment and money growth below, but the source of German developments is not central to this paper. Soltwedel (1988) provides an excellent review of alternative explanations, however. It would be useful

addresses whether these unemployment rates have been adversely affected by Austrian-style coordination policy.

The potential influence of coordinated monetary policy on a country's unemployment rate is not an issue limited to these three countries. Indeed, the development of sustained fixed exchange rate targets in the European Monetary System (EMS) and the prospects for hard, irrevocable fixed rates in the European Monetary System (EMS) make the issue of central importance to European policymakers generally. Since the mid-1980s, the experience in several European countries, like the Netherlands and Belgium and, later France, raise the same issue of "importing" German unemployment. Unfortunately, the experience for EMS countries is more limited and, hence, provides more limited evidence on the issue. Thus, while the Austrian evidence is relatively unique, and that in Belgium and the Netherlands more limited, the implications of their evidence have broad relevance.³

and complementary to our efforts to examine whether the factors discussed by Soltwedel for Germany are also relevant for Austria. See also Blanchard et al (1985), Blanchard and Summers (1987a) and (1987b) and Giersch (1983).

³The relevance of this experience to EMU is not beyond question, however. Decisions about the conduct of EMU monetary policy have not been taken. To the extent that it is the same as German policy or resembles policy in Germany, both with respect to achieving

Economic theory indicates that a country that pegs its currency to that of another country ties its nominal economic measures to those abroad; real economic activity can also be affected, however. For example, Gluck, Proske and Tatom (1992) have shown that Austria's attempt to coordinate its monetary policy with that in Germany was successful in tying Austria's nominal developments, especially inflation and interest rates, to those in Germany. They also provide evidence which indicates that Austria's real output movements were systematically related to Germany's before the introduction of the exchange rate peg as well as after its introduction. Thus, Austria's unemployment could be related to German unemployment, independently of the coordination of monetary policies.⁴ On the other hand, coordinated monetary policy could buffer some of the adverse effects of real developments in Germany on Austria.

The potential influence of coordination on employment is examined below by examining the issue in the context of the analysis of the Phillips Curve (PC). The next section examines whether policy

similar inflation objectives with similar credibility and predictability, the issue of adverse national unemployment consequences could remain.

⁴In this paper, monetary policy coordination in the three countries and a DM-peg are referred to interchangeably.

coordination could be expected to affect a country's Phillips curve. The second section explains how one could test for adverse movements in the unemployment rate using PC analysis. The third section examines whether there is statistical evidence that the PC in Austria has been adversely affected by German unemployment developments since coordination began. The fourth section looks at such evidence for Belgium and the Netherlands. The article concludes that coordination has not had an influence on the unemployment experience in these three countries.

I. SHOULD POLICY COORDINATION HAVE ADVERSE REAL CONSEQUENCES?

Tying domestic monetary policy to developments in an anchor country is not likely to be undertaken if adverse effects are expected, unless clearly-defined benefits are expected to offset these effects. In the case of pegging the exchange rate to an anchor currency, the principal benefit is expected to be the importation of the anchor country's lower domestic inflation rate. Are there trade-offs in such a decision?

Consider the simple rational expectations paradigm for monetary policy. In this view, the expected rate of monetary growth determines the inflation rate, while unexpected movements in money

growth have real consequences. In this case, the effects of pegging the exchange rate depend on a comparison of the expected pace of money growth and inflation and the variance of money growth in the anchor country with those domestically in the absence of the peg. A peg to the anchor country requires that the inflation consequences of expected money growth in the anchor country are lower than the domestic authorities could do without a peg. A tradeoff arises if the variance of money growth or of unanticipated money growth in the anchor country is larger; then a more cyclical real economy could result from tying monetary policy. Feldstein (1992) restates related objections to an exchange rate peg. He argues that a peg raises cyclical instability by eliminating the independent use of countercyclical policy. Of course this view assumes that the independent use of monetary policy has, or would, lower cyclical variations in floating countries.

An alternative view of discretionary monetary policy hypothesizes that activist monetary policies aimed at pursuing a relatively low unemployment rate involve both more procyclical policy movements and higher mean money and price growth than would otherwise occur. If this hypothesis is correct, policy is expected to be more predictable and less

variable if a long-term pursuit of price stability is the focus of policy. In this case, potential anchor countries also are expected to exhibit less cyclical variability.

In this paper, adverse real consequences refer to increases in cyclical or natural unemployment. Economic growth is another central aspect of real economic performance, however. If economic growth is influenced by monetary policy regimes, it is most likely to be boosted by a low inflationary environment with smaller cyclical variations. The former raises expected return to capital and the latter reduces the riskiness of returns to capital. Thus, the capital-labor ratio and income per person are unambiguously raised by a regime that lowers inflation and dampens cyclical variations.

If an anchor country only achieves lower inflation by pursuing policies that are more variable and restrictive, then a trade-off could arise in coordinating policy. In this case, expected improvements in inflation could come at the expense of greater risk, greater cyclical variation, and a higher unemployment rate.

II. THE PHILLIPS CURVE AND ITS POTENTIAL SHIFTS

The potential effects of changing monetary arrangements on a country's unemployment rate can be identified from a conventional Phillips curve. While the PC analysis is a model of inflation, it provides a convenient and useful model for assessing whether Austrian exchange rate policy had real consequences. If unemployment is shifted by policy coordination, then it must shift relative to inflation and inflationary expectations--the two other variables in the Phillips curve analysis--or it shifts along with them along an existing PC.⁵

Suppose that the relationship between the unemployment rate and the inflation rate is initially that shown in figure 1. The picture is a stereotypical one based on an expectations-augmented view of the PC derived from the rational-expectations and natural rate hypotheses. In the short run, there is a trade-off between inflation and the unemployment indicted by the SR curve; its position is conditioned

⁵Algoskoufis and Smith (1991) examine the effects of the exchange rate regime on the coefficients of the Phillips Curve. Salemi (1992) attempts to test and quantify the effects of several factors influencing the U.S. natural rate using a method similar to that below. Such efforts require the existence of a short-run PC. According to several of the studies in Brunner and Meltzer (1976), including Lucas (1976), this is generally doubtful. Such an existence problem is not apparent for the three countries studied here.

by the expected rate of inflation, which in figure 1 is assumed to be $\dot{P}_0^e$. In the long run, there is no trade-off, as any level of equilibrium inflation (determined by factors other than the unemployment rate) is consistent with the natural rate of unemployment. The level of the unemployment rate, where $\dot{P} = \dot{P}^e$ is usually referred to as the natural rate of unemployment, or, in some other models, the NAIRU or non-accelerating-inflation-rate of unemployment.

The natural rate is determined by institutional factors like laws, regulations, tradition and economic factors like firm's and workers information costs and moving, training and employment-adjustment costs. Under the natural rate hypothesis, labor markets adjust real wages to balance the supply and demand for labor at some minimum level of the unemployment rate, given full information on, and the presence of, an equality of expected and actual resource and product prices. The natural rate could be a function of the inflation rate if the informational content of market prices declines with the inflation rate, but this additional feature is not drawn in figure 1.

Several potential effects of monetary policy coordination on a country's unemployment rate can be identified using figure 1. The first is that a

country could lower its inflation rate which in the short-run could raise the level of the unemployment rate moving along the short-run PC. This effect is transitory, however, since market participants would eventually learn about the lower inflation and adjust their expectations downward so that in equilibrium no effect on $U(U=U_N)$ could be observed. More importantly, such an effect would only occur once, when the policy regime changed.⁶

A related movement in the unemployment rate arises if a shift in policy raises the expected inflation rate. An increase in inflationary expectations shifts the short-run PC to the right in figure 1. If the actual inflation rate is unchanged initially, the unemployment rate would rise. Since inflation would eventually adjust to its higher expected pace and unemployment would fall as a result, such a source of a higher unemployment rate also is not likely to be permanent. A permanently higher unemployment rate only can be associated with a shift to a higher inflation rate when the higher inflation rate raises the natural rate of unemployment. A shift to a pegged exchange rate regime, is unlikely to

⁶For an analysis that focuses on the coordination problems arising from permanent short-run trade-offs between inflation and unemployment where countries' PCs differ on their objectives differ, see Kahn (1987).

result in a higher inflation rate, however, since, as discussed below, pegging is generally undertaken to tie domestic inflation to a lower rate abroad.

The source of permanent shifts in the unemployment rate in the PC model, are due to shifts in the long-run PC. For example, policy coordination could make the countries natural rate more closely related to the country (or countries) it coordinates with (the "anchor" country). This is especially likely if the institutional framework influencing its labor market is brought more closely in line with that in the anchor country, either directly by the importation of the laws or regulations of the anchor country, or indirectly, as a result of having more closely-related nominal shocks and, therefore, more closely-related cyclical experience.

If the natural rate of unemployment is affected by coordination, then the Phillips curve would shift; a given level of inflation would be associated, with a higher (or lower) level of the unemployment rate, given the expected rate of inflation, or vice versa for the unemployment rate. This could be depicted in a leftward or rightward shift in the pair of curves (SR and LR) and their intersection at P_0 (at differing levels of U_N). An adverse effect occurs if

coordination raises the actual and expected rate of inflation.

A second source of a potentially permanent effect is that the PC can become flatter (or steeper). If the slope of the PC becomes flatter, the level of unemployment associated with any given level of inflation and inflationary expectations becomes larger. Consider the linear empirical model of the PC shown in figure 7:

$$(1) \quad \dot{P}_t = \beta_0 + \beta_1 U_t + \beta_2 \dot{P}_t^e + \epsilon$$

where ϵ is a normally distributed random variable with zero mean and constant variance, σ_t^2 . In the conventional model β_2 equals one and β_1 is negative. When actual and expected inflation are equal, the unemployment rate tends to equal $(-\beta_0/\beta_1)$ if β_2 equals one, or $[-\beta_0 + (1 - \beta_2) \dot{P}_t]/\beta_1$, if β_2 does not equal one. Note that if β_2 is less than one, the unemployment rate where actual and anticipated inflation are equal is a decreasing function of inflation. In figure 1, the long-run PC is negatively-sloped in this case.

The parameter β_1 measures the slope of the PC. If it declines in absolute value, the level of unemployment associated with a given $(\dot{P}, \dot{P}^e)$ is

higher. This can be ascertained by rewriting equation 1 to obtain:

$$(2) \quad U_t = \frac{1}{\beta_1} [\dot{P}_t - \beta_0 - \beta_2 P_t^e - \epsilon_t]$$

A fall in absolute value of β_1 will raise U if the unemployment is constrained to be positive; note that this also raises the natural rate of unemployment ($-\beta_0/\beta_1$). The parameter β_1 measures the sensitivity of the inflation rate to a change in the domestic unemployment rate. This parameter would become smaller in a PC analysis if shifts in aggregate demand confront a flatter aggregate supply curve. When a small country ties its monetary policy to maintain a given exchange rate, shocks to aggregate demand (or aggregate supply) might have little or no effect on domestic inflation, so that more pressure is put on domestic wages and, in the short-run for adverse demand shocks, on the unemployment rate. In this case, domestic inflation becomes largely or completely determined abroad, so that the PC becomes flatter or, in the limit, completely flat.

Equation 2 summarizes the channels of influence discussed above. Adverse unemployment rate movements can arise if the inflation rate falls or if the expected inflation rate rises, but these are transitory influences. Since exchange rate regimes do

not change often, even a permanent effect on the average level of $\dot{P}$ or $\dot{P}^e$ are not likely to have an observable effect on U .

There is one exception, however, and this occurs if the natural rate of unemployment is a negative (positive) function of inflation and if inflation is permanently changed by the change in the exchange rate regime. Then a fall (rise) in inflation permanently raises the unemployment rate. In this case, the parameter β_2 is different from 1 so that the long-run PC is a positive function of the natural rate ($\beta_2 > 1$) or a negative function of the natural rate ($\beta_2 < 1$). Then a rise (fall) in inflation raises (lowers) the natural rate of unemployment, if β_2 is greater than one and the reverse holds if β_2 is less than one. In addition, if β_2 is not equal to unity, a rise in β_2 will raise the natural rate of unemployment.⁷ Thus, an increase in the short-run response of actual inflation to expected inflation will raise unemployment. In the analysis below tests for such a rise in β_2 and whether it depends on German unemployment rate movements are conducted.

Changes in the two other parameters in equation 2 can also raise the unemployment rate. As

⁷The partial derivative of the natural rate, U_N , with respect to β_2 , assuming $\dot{P} = \dot{P}^e$, is $-\dot{P}_t/\beta_1$, which is positive for positive values of inflation.

discussed above, a fall in β_1 or a rise in β_0 can raise the unemployment rate. Thus, an adverse effect of coordination can be tested by examining whether β_1 fell in absolute value, or and whether β_0 or β_2 rose, systematically or statistically significantly during the period of coordination. A more direct test of an adverse influence arising from the unemployment experience in the anchor country is to test whether the positive movement in β_0 or β_2 is a positive function of the anchor countries unemployment rate and whether the absolute size of β_1 is a positive function of the unemployment rate in the anchor country. Thus, testing for shifts in PC parameters and their links to unemployment movements in the anchor country provide a framework for assessing whether there are perverse real effects of policy coordination.

III. THE EVIDENCE FROM PHILLIPS CURVE ESTIMATES

To test whether coordination has had real consequences, a benchmark PC is estimated over the period before the exchange rate peg. Chart 1 shows indexes of the quarterly average Mark exchange rate (1986 = 100) for Austria, Belgium and the Netherlands from I/1960 to II/1993. Since the Schilling has the most closely pegged rate and for the longest period, the discussion here focuses first on the Austrian

experience. The chart shows a relatively large devaluation of the Schilling relative to the Mark in 1969, the two appreciations associated with each oil price shock and more moderate depreciations in 1971-73 and in 1975-79. Since mid-1981, however, the Schilling has been essentially fixed, averaging 7.03287 Schilling per mark with a standard deviation equal to less than one-tenth of one percent of this mean.

Based on chart 1, the Austrian coordination period was chosen as beginning in III/1981, although the peg to the Mark began in most respects in 1979, except for the oil-related appreciation which occurred over about a two-year interval.⁸ The peg period for the Netherlands is chosen to begin in I/1984 and that for Belgium is set at II/1986. The choice in the Belgian case is more problematical, however, as the index fluctuated within a narrow band of about ± 2.5 percent of its 1986 value from early 1984 to mid-1990.

Charts 2A to 2C show the combination of the annual inflation and unemployment rate for Austria, Belgium and the Netherlands, respectively, and for

⁸Gluck, Proske and Tatom (1992) test for shifts in nominal and real Granger-casual relationships between Austria and Germany using III/1979 as the break-point. The choice there was based on the shift in policy procedures. This two-year shift should not affect the results in either study, however.

Germany from 1971 to 1992 to illustrate the issue.⁹ The dates on the points are labeled periodically for comparison. Chart 2A shows that German unemployment rose sharply from 1973 to 1975, which was not the case in Austria. Both countries show similar movements in inflation and unemployment from 1975 to 1978, when inflation reaches a new low in both countries. From 1980 to 1983 both countries had relatively large increases in unemployment, especially Germany. It is this period when one could visually see the strongest relationship between unemployment movements in both countries and this corresponds to the beginning of the pegging period. Subsequently, Austrian unemployment continued to rise, except for declines in 1988-89. German unemployment changed little from 1983 to 1987, then fell sharply until 1992. The evidence in the chart is suggestive, at least, of a relationship between developments in both countries and supports the validity of concern over the direction of changes in the unemployment rate in Austria (and in Germany).

Charts 2B and 2C show similar patterns for the Netherlands and Belgium. Both show larger increases in the unemployment rate than in Austria or Germany

⁹The unemployment data in chart 2A are from the OECD and are the national series for the unemployment rate in each country. The unemployment rates used in Charts 2B and 2C for Belgium and the Netherlands are the OECD's measures of the standardized unemployment rate.

from 1974 to 1983. Beginning with the peg period in 1984 for the Netherlands and in 1986 for Belgium, the PC points appear to be more closely tied together than previously, although this could simply reflect the smaller range of inflation and unemployment rate experience in the three countries than previously.

Table 1 provides comparative data for the unemployment rate and the inflation rate for the three countries; in each country, equally long periods are used for the pre-peg period and the period of the peg identified in figure 1. Growth rates are measured on an annualized continuous basis ($400 \Delta \ln$). The table shows that the mean unemployment rate rose sharply in Austria and in Germany following Austrian coordination, although the rise in Austria is less than half that in Germany. The table also shows that inflation fell sharply in both Austria and Germany and by about the same amount (1.86 and 1.63 percentage points, respectively).

In the Netherlands, the unemployment rate also rose following the peg but, again, by less than the unemployment rate rose in Germany. Also, as in Austria, Dutch and Belgian inflation fell following the peg and by more than it had in Germany. In Belgium, however, the unemployment rate fell following the peg, despite a rise in Germany. In this case, at

least, the simple observation of post-peg experience is not consistent with the hypothesis.

Formal Tests for Shifts in the Austrian Phillips Curve

More systematic evidence is obtained by estimating the Austrian PC and testing whether 1) its parameters have shifted adversely during the coordination period and 2) whether any shifts are systematically related to German unemployment rate movements. Of course it is possible that the Austrian PC parameters depended upon German unemployment developments before the peg too, so this is examined first.

In order to conduct the tests, a benchmark Austrian PC curve for the period before the peg (I/1962 to II/1981) is estimated and tested. The first task is to construct the expected inflation rate measure, however. This is no small problem, but to avoid economic controversy and, yet, capture all available statistical information from the series itself, the best time-series model for the rate of increase in the CPI ($\dot{P} = 400 \Delta \ln P$) was estimated for the period.¹⁰ This model is a third-order autoregressive model with a first-order moving average error.

¹⁰The quarterly consumer price index data used here are seasonally adjusted using a Census X-11 program.

Table 2 provides benchmark estimates of the Austrian PC for the period before the peg (I/1961 to II/1981), along with the PC estimates and tests. The basic PC estimate in the first row of PC estimates is consistent with the PC model; there is a statistically significant negative relationship between Austrian inflation and unemployment, and the expected rate of inflation measure has a positive and statistically significant coefficient. The latter coefficient is less than one, although not significantly so ($t = 1.34$).¹¹

The tests reported in table 2 examine whether any of the parameter ($\beta_0, \beta_1, \beta_2$) depend on the German unemployment rate. These tests are conducted and reported since this is one of the hypotheses for the coordination period. If there are significant effects of the German unemployment rate on the Austrian PC after pegging, it would be inappropriate to interpret these effects as being the result of policy

¹¹Pagan (1984) indicates that a generated regressor problem arises from including the expected rate of inflation in the Phillips curve estimate. All of the tests for shifts reported below were estimated replacing the expected rate of inflation with its lagged determinants indicated in the first-stage regression for the time series model of inflation. Only one of the results differs from those reported below using this procedure. This case is discussed in the text. This procedure corrects the residual variance estimate for the second-stage estimate according to Pagan.

coordination, if, in fact, similar effects were present before coordination.

The tests of whether the intercept or response coefficients (β_0 , β_1 , β_2) are influenced by movements in the German unemployment rate are all rejected at a conventional 95 percent confidence level. No individual shift term is significant, nor is any of the four possible combinations of shifts statistically significant. Hence, potential shifts in the PC parameters related to German unemployment can be conducted without allowance for such effects before 1981.¹²

Table 3 presents the results when the coordination period is added to the sample. The best time series model for inflation, which again is used to estimate the expected rate of inflation is found to have the same structure as before, a third-order autoregressive process with an MA1 error. The reported F-statistic is for a Chow test for structural change; its statistical insignificance indicates that the time series model for Austrian inflation did not shift after II/1981.

¹²Comparable tests for Belgium and the Netherlands were conducted with the same results, i.e. there is no significant effect of German unemployment on the Phillips curve parameters for these countries before the peg period. These results are not surprising and to save space they are omitted. The result for the whole period in these countries are reported below.

In the basic PC estimate in the first row for the PC estimates, both the unemployment rate and expected inflation rate have the expected sign and are statistically significant.¹³ The expected-inflation coefficient is less than one, as in table 2, but, again, not statistically significantly so ($t = 1.48$). The F-statistic for a Chow test for structural change after II/1981 is $F_{3,122} = 1.90$, which is not statistically significant at a 95 percent confidence level (critical value = 2.68).

The PC estimates in table 3 test whether the parameters of the Austrian PC curve ($\beta_0, \beta_1, \beta_2$) shifted after the peg began. None of the coefficients for a shift are statistically significant, although that for a shift in the response to Austrian unemployment is nearly so ($t = 1.91$). It is marginally significant at a 5.8 percent significance level (two-tail test) and suggests that β_1 fell in absolute value, which would imply that the natural rate of unemployment had risen in Austria. This result is consistent with the presence of an adverse

¹³The residuals from the basic PC equations for all three countries were tested for cointegration using the Engel-Granger Dickey-Fuller test. The augmented test was unnecessary because no lagged dependent variables were statistically significant. The test statistics were -10.96 for Austria, -9.24 for Belgium, and -7.95 for the Netherlands for the equations estimated over the period ending in IV/1992. The 5 percent critical value, according to Engel and Granger, is -3.37.

effect and, while not significant in a two-tail test, it is statistically significant using a one-tail criterion (the critical value of the t-statistic is 1.66). Evaluated at a sample mean of 3.2 percent inflation over the period (III/1981-IV/1992) the natural rate estimate rises from 2.9 percent to 4.8 percent, according to this PC estimate.¹⁴ Table 3 also reports the results for combinations of shifts in the parameters. In two of these four cases, one of the shift components (that for the unemployment rate slope) is statistically significant, but the reported F-statistics that the β^* terms are all zero fail to reject that they are; none of the F-statistics are statistically significant.

Since the Austrian PC appears to have shifted during the coordination period, it is possible that it became more sensitive to movements in German unemployment. Thus, it is important to test whether the source of the shift was, in fact, due to the Austrian PC becoming more sensitive to movements in German unemployment. In particular, the relation of

¹⁴When three lagged values of the dependent variable are used in place of the expected rate of inflation, the same term $D813_t UA_t$ is again the only statistically significant shift term ($t = 2.26$). For this estimate, the Austrian unemployment rate coefficient shifts from -1.908 to -1.117 and the implicit natural rate at the mean inflation rate of 3.2 percent rises from 2.9 percent to 5 percent.

$\beta_0, \beta_1, \beta_2$ to the German unemployment rate after II/1981 was tested using the hypothesized relationship:

$$(3) \quad \beta_i = \beta_i^0 + \beta_i^* D813 + \beta_i^{**} D813 UG_t; i = 0, 1, 2$$

where β_i has the same interpretation in equation 1, but its components include a pre-coordination value (β_i^0) and a shift that is a function of the German unemployment rate (UG_t) ($\beta_i^* + \beta_i^{**} UG_t$). Table 4 reports the estimates of the (β_i^*, β_i^{**}) coefficients for the three β 's, including the estimates when the β_i^* term, alone, is constrained to zero. Most of these effects are statistically insignificant, but there is again some evidence that the short-run response of inflation to changes in the unemployment rose, but the increase did not occur because this coefficient became a positive function of German unemployment. This is consistent with a rise in the Austrian natural rate in proportion to the unemployment rate in Germany. Note that β_i^{**} is not statistically significant, however, when considered alone or jointly.

The evidence here rejects the hypothesis that the adoption of the fixed exchange rate peg to an anchor currency like the Mark has had adverse real economic consequences. Evidence is found that suggests that Austrian inflation became less sensitive

to movements in the unemployment rate and that the natural unemployment rate was higher during the post-peg period. However, no significant shift, including this one, could be found which was related to movements in the German unemployment rate. Thus, it is not clear that Austria's unsatisfactory unemployment experience since the early 1980s has been related to the German developments.

There is one remaining possibility raised above, however. It is the case that Austria's inflation rate has been lower since the peg; inflation averaged only 3.24 percent (standard deviation = 1.90) from III/1981 to IV/1992, well below its 4.94 percent pace (standard deviation = 2.988) from I/1961 to II/1981. Along the short-run PC given in table 3 (with no shift terms), this reduction should raise the unemployment rate by 3.9 percentage points, given the expected rate of inflation. But the expected inflation rate is not a constant. The relevant change in the Austrian unemployment rate is estimated assuming actual and expected inflation are the same, that is, the change in the natural rate of unemployment. On this basis, again using the table 3 estimate, the associated rise in the unemployment rate is only one percentage point. Neither estimate of the change in the unemployment

rate is statistically significant, according to the shift measures, however.

IV. EVIDENCE FOR SHIFTS IN THE BELGIAN AND DUTCH PHILLIPS CURVE

As Chart 1 indicates, the Belgian franc and Dutch guilder became more closely tied to the Deutsche mark in the mid-1980s. For the purposes of testing for shifts in the Phillips curve, I/1984 and II/1986 were identified as the beginning of the peg period for the Netherlands and Belgium, respectively. Chart 3 shows the unemployment rates for the four countries: Austria, Belgium, Germany and the Netherlands. While all four rates appear to converge in the 1990s, it is not so apparent that the pegging countries (Austria, Belgium and the Netherlands) have raised their unemployment rates by pegging to the mark.

Austria's unemployment rate did rise after 1981 and moved closer to the rate in Germany, as the adverse-consequences hypothesis suggests that it should. The unemployment rates in Belgium and the Netherlands also move closer to the German level after the respective pegs, but their excess over the German unemployment rate actually fell following the adoption of pegging. Indeed, the excess of the German rate over the Austrian rate actually widened after II/1981 until 1990. Only since I/1990 has the Austrian rate

both been as close to the German unemployment rate as it was before III/1981, and continued to rise relative to it. Moreover, the rise in Austrian unemployment relative to the German rate did not actually begin until late 1985, well after the beginning of the peg. Chart 3 suggests that the "adverse consequences" hypothesis is not easily supported by the facts, especially in Belgium and the Netherlands where the unemployment rate fell after the peg began.

Tables 5 and 6 provide tests for peg-related shifts in the Dutch and Belgian Phillips curves. The time series model used for inflationary expectations shows no evidence of a structural break in either country; in Holland, this model contains a fourth lag of inflation and MA(4) and MA(6) error terms, while in Belgium three lags of inflation are included. In Belgium, the Phillips curve tests include a statistically significant first-order moving average error process. In Holland, the PC includes significant MA(2) and MA(4) terms. In both Holland and Belgium, the basic Phillips curve contains statistically significant coefficients with the expected signs for the unemployment rate and for the expected rate of inflation. With one exception in Belgium, the evidence in the tables rejects the hypothesis that there were statistically significant

shifts in the Phillips curve parameters following pegging the mark exchange rate.

The one exception occurs in Belgium where there is evidence that the coefficient on the price expectations term fell significantly after early 1986. Recall that the implication of a decline in the inflation expectations coefficient is to lower the natural rate associated with any positive level of expected and actual inflation, but to leave the natural rate associated with zero inflation unchanged. This result has the wrong sign for the "adverse consequences hypothesis". Before the peg, the coefficient on price expectations in Belgium was not significantly different from one; in the basic equation without shifts, the t-statistic for this hypothesis is not statistically significant, and when the shift is included the t-statistic for whether the early-period inflationary expectations coefficient equals one remains insignificant ($t = 1.75$). A test of this hypothesis for the period following the shift indicates that the new expectations coefficient (0.5192) is significantly less than one ($t = 2.20$).

It should also be noted that in the equation with the significant shift in the inflationary expectations coefficient, the implicit natural rate at zero inflation is 16.6 percent, which is implausibly

high relative to the history of the series. Even in the basic equation without shifts, the implicit rate is 10.2 percent, well above the actual unemployment in every year except 1981 through 1986. The Dutch estimate suffers from the same shortcoming; its implicit natural rate is 8.29 percent, a level only exceeded from mid-1981 to 1989. Thus, the only significant evidence of a PC shift in Belgium is counter to the adverse consequences hypothesis, but the estimated test equations appear to be poorly conditioned for such a test.

V. CONCLUSION

Austria's unemployment rate rose following coordination to German monetary policy and a rise in German unemployment. Some analysts infer from this simple observation that the rise in German unemployment caused Austria's increase as a result of Austrian policy coordination. It is also tempting to infer that adverse unemployment rate movements in both countries were the result of policies that successfully reduced inflation. The generally higher levels of the unemployment rate in other European countries, like Belgium and the Netherlands who also pegged to the mark somewhat later, has also been attributed to such adverse consequences of a peg.

This article explains how these hypotheses can be tested using a Phillips Curve framework. In Austria's case there is evidence of a statistically significant shift in the slope of the short-run Phillips Curve, but this shift is not related to German unemployment developments. Thus, the evidence for Austria presented here casts doubt on the hypothesis that monetary policy coordination in Austria has raised the unemployment rate there. The evidence for Belgium and the Netherlands is more decisive, however. In these two countries there is no evidence that their PC changed in any manner that would raise their unemployment rate following the peg to the mark.

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Table 1
Inflation and Unemployment Rates
Before and After Coordination

	$\dot{P}$ (Standard Deviation)		U (Standard Deviation)		$\Delta \dot{P}$	ΔU
Austria peg: III/1981-IV/1992 pre-peg: I/1970-II/1981	3.24 6.06	(1.904) (2.523)	4.97 1.95	(0.828) (0.272)	-2.82	3.02
Germany peg pre-peg	2.54 5.03	(1.918) (1.576)	8.08 3.04	(1.131) (1.645)	-2.49	5.04
Belgium peg: II/1986-IV/1992 pre-peg: III/1979-I/1986	2.26 6.28	(1.365) (2.014)	8.85 10.83	(1.681) (1.677)	-4.02	-1.98
Germany peg pre-peg	2.15 4.01	(1.882) (2.024)	7.79 6.93	(1.065) (2.378)	-1.86	0.86
Netherlands peg: I/1984-IV/1992 pre-peg: I/1975-IV/1983	1.81 5.69	(2.647) (3.105)	8.97 7.19	(1.679) (2.661)	-3.88	1.78
Germany peg pre-peg	2.10 4.37	(1.730) (7.529)	8.10 5.38	(1.110) (1.81)	-2.27	2.72

Table 2
The Austrian Phillips Curve: Pre-Coordination

(I/1961 to II/1981)								
Expected Inflation ($\dot{P}^e$): $\dot{P}_t = 0.999 + 0.608 \dot{P}_{t-1} - 0.165 \dot{P}_{t-2} + 0.269 \dot{P}_{t-3} - 0.467 \epsilon_{t-1} + \epsilon_t$ (0.72) (2.74) (-0.56) (2.53) (-2.02)								
$\bar{R}^2 = 0.150$ S.E. = 2.755 D.W. = 1.96 Q(8) = 11.93								
(I/1962 to II/1981)								
Phillips Curve: $\dot{P}_t = \beta_0 + \beta_1 UA_t + \beta_2 \dot{P}_t^e + \beta_0^* UG_t - \beta_1^* (UG_t UA_t) + \beta_2^* (UG_t \dot{P}_t^e)$								
β_0	β_1	β_2	β_0^*	β_1^*	β_2^*	$\bar{R}^2$	S.E.	D.W.
6.756 (2.19)	-2.171 (-2.52)	0.612 (2.11)	---	---	---	0.255	2.6280	2.05
7.007 (2.22)	-2.275 (-2.54)	0.654 (2.14)	-0.103 (-0.47)			0.247	2.6418	2.07
6.810 (2.19)	-2.190 (-2.52)	0.650 (2.13)	---	-0.043 (-0.43)	---	0.247	2.6425	2.07
6.696 (2.15)	-2.200 (-2.51)	0.659 (1.86)	---	---	-0.009 (-0.23)	0.246	2.6447	2.06
7.762 (1.82)	-2.602 (-1.70)	0.653 (2.13)	-0.507 (-0.33)	0.190 (0.26)	---	0.238	2.6585	2.08
$F_{2,73} (\beta^* = 0) = 0.14$								
7.681 (2.25)	-2.006 (-2.18)	0.384 (0.74)	---	-0.266 (-0.73)	0.089 (0.63)	0.241	2.6532	2.07
$F_{2,73} (\beta^* = 0) = 0.29$								
10.776 (2.25)	-2.722 (-2.75)	0.103 (0.17)	-1.130 (-1.12)	---	0.188 (1.04)	0.248	2.6401	2.10
$F_{2,73} (\beta^* = 0) = 0.66$								
12.491 (2.07)	-3.359 (-2.01)	0.052 (0.08)	-1.961 (-0.97)	0.347 (0.47)	0.205 (1.11)	0.240	2.6543	2.12
$F_{3,72} (\beta^* = 0) = 0.51$								

Table 3
Tests For Shifts in the Austrian Phillips Curve

(I/1961 to II/1993)								
Expected Inflation ($\dot{P}^e$): $\dot{P}_t = 0.616 + 0.684 \dot{P}_{t-1} - 0.054 \dot{P}_{t-2} + 0.231 \dot{P}_{t-3} - 0.506 \epsilon_{t-1} + \epsilon_t$ (0.73) (4.21) (-0.59) (2.74) (-3.05)								
$\bar{R}^2 = 0.218$ S.E. = 2.4306 D.W. = 1.96 Q(8) = 13.46								
F-test for structural break after II/1981: $F_{5,120} = 0.92$								
(I/1961 to IV/1992)								
Phillips Curve: $\dot{P}_t = \beta_0 + \beta_1 UA_t + \beta_2 \dot{P}_t^e + \beta_0^* D813_t + \beta_1^* (D813_t UA_t) + \beta_2^* (D813_t \dot{P}_t^e)$								
β_0	β_1	β_2	β_0^*	β_1^*	β_2^*	$\bar{R}^2$	S.E.	D.W.
2.565 (2.14)	-0.436 (-2.50)	0.735 (4.10)	---	---	---	0.267	2.3673	1.96
3.916 (2.22)	-0.858 (-1.95)	0.638 (3.16)	1.216 (1.05)	---	---	0.268	2.3664	1.94
6.231 (2.76)	-1.642 (-2.51)	0.516 (2.45)	---	0.668 (1.91)	---	0.282	2.3426	1.95
2.861 (1.80)	-0.511 (-1.63)	0.705 (3.38)	---	---	0.057 (0.29)	0.262	2.3760	1.95
7.603 (3.11)	-2.162 (-2.90)	0.483 (2.29)	-3.638 (-1.44)	1.654 (2.15)	---	0.289	2.3327	1.99
$F_{2,123} (\beta^* = 0) = 2.87$								
4.134 (2.34)	-1.076 (-2.28)	0.698 (3.37)	3.686 (1.59)	---	-0.490 (-1.23)	0.271	2.3614	1.96
$F_{2,123} (\beta^* = 0) = 1.31$								
7.709 (2.86)	-2.186 (-2.77)	0.472 (1.95)	-4.044 (-0.81)	1.711 (1.74)	0.047 (0.05)	0.283	2.3421	1.99
$F_{3,122} (\beta^* = 0) = 1.90$								
6.529 (2.88)	-1.859 (-2.74)	0.564 (2.63)	---	1.005 (2.23)	-0.301 (-1.18)	0.285	2.3388	1.97
$F_{2,123} (\beta^* = 0) = 2.53$								

Table 4					
Tests of the Relation of Austrian PC Parameter Shifts to the German Unemployment Rate					
β_0^*	β_{0}^{**}	β_1^*	β_{1}^{**}	β_2^*	β_{2}^{**}
4.928 (1.67)	-0.430 (-1.35)	1.706 (2.52)	-0.109 (-1.05)	0.755 (1.20)	-0.090 (-1.18)
$F_{2,119} = 1.50$		$F_{2,119} = 3.50$		$F_{2,119} = 0.73$	
---	0.058 (0.46)	---	0.026 (0.79)	---	-0.004 (-0.15)

Table 5
Phillips Curve Evidence for the Netherlands

(III/1961 to II/1993)

$$\text{Inflation Expectations: } \dot{P}_t = 0.919 + 0.802 \dot{P}_{t-4} - 0.463 \epsilon_{t-4} + 0.289 \epsilon_{t-6} + \epsilon_t$$

(2.13) (10.29) (-4.90) (3.70)

$$\bar{R}^2 = 0.497 \quad \text{S.E.} = 3.052 \quad \text{D.W.} = 1.63 \quad Q(9) = 14.96$$

$$\text{Chow test for break in I/1984: } F_{3,123} = 2.34$$

(I/1970 to I/1993)

Phillips Curve:

$$\dot{P}_t = \beta_0 + \beta_1 UN_t + \beta_2 \dot{P}_t^e + \beta_0^* D841_t + \beta_1^* D841_t UN_t + \beta_2^* D841_t \dot{P}_t^e + \beta_3 \epsilon_{t-2} + \beta_4 \epsilon_{t-4} + \epsilon_t$$

β_0	β_1	β_2	β_0^*	β_1^*	β_2^*	β_3	β_4	$\bar{R}^2$	S.E.	D.W.
4.118 (4.71)	-0.396 (-5.06)	0.742 (6.63)	-0.844 (-1.28)	---	---	0.527 (6.92)	0.477 (6.38)	0.700	2.0808	1.90
4.006 (4.73)	-0.383 (-4.67)	0.748 (6.79)	---	-0.096 (-1.30)	---	0.534 (7.02)	0.478 (6.40)	0.700	2.0801	1.90
3.710 (4.69)	-0.411 (-5.43)	0.816 (9.10)	---	---	-0.169 (-1.13)	0.534 (7.12)	0.479 (6.49)	0.701	2.0793	1.89
4.025 (4.51)	-0.385 (-4.56)	0.750 (6.66)	-0.196 (-0.097)	-0.075 (-0.33)	---	0.536 (7.04)	0.480 (6.45)	0.697	2.0922	1.90
$\beta_0^* = \beta_1^* = 0: F_{2,86} = 0.83$										
4.045 (4.14)	-0.396 (-5.04)	0.755 (5.72)	-0.683 (-0.63)	---	-0.045 (-0.18)	0.528 (6.90)	0.478 (6.36)	0.697	2.0928	1.90
$\beta_0^* = \beta_2^* = 0: F_{2,86} = 0.82$										
3.960 (4.43)	-0.385 (-4.65)	0.758 (6.20)	---	-0.079 (-0.73)	-0.048 (-0.22)	0.533 (6.98)	0.479 (6.38)	0.697	2.0923	1.90
$\beta_1^* = \beta_2^* = 0: F_{2,86} = 0.86$										
3.928 (3.93)	-0.385 (-4.53)	0.766 (5.76)	0.063 (0.03)	-0.084 (-0.37)	-0.051 (-0.21)	0.538 (7.04)	0.481 (6.45)	0.693	2.1043	1.90
$\beta_0^* = \beta_1^* = \beta_2^* = 0: F_{3,85} = 0.56$										

Table 6
Evidence from Belgium

(I/1961 to II/1993)									
Inflation Expectations: $\dot{P}_t = 0.652 + 0.513 \dot{P}_{t-1} + 0.079 \dot{P}_{t-2} + 0.271 \dot{P}_{t-3} + \epsilon_t$									
(2.01) (6.03) (0.83) (3.23)									
$\bar{R}^2 = 0.626$ S.E. = 1.9733 D.W. = 1.90 Q(9) = 16.80									
Chow test for break in II/1986: $F_{4,122} = 0.65$									
(I/1970 to II/1993)									
Phillips Curve:									
$\dot{P}_t = \beta_0 + \beta_1 UB_t + \beta_2 \dot{P}_t^e + \beta_0^* D862_t + \beta_1^* D862_t UB_t + \beta_2^* D862_t \dot{P}_t^e + \beta_3 \epsilon_{t-1} + \epsilon_t$									
β_0	β_1	β_2	β_0^*	β_1^*	β_2^*	β_3	$\bar{R}^2$	S.E.	D.W.
1.244 (1.98)	-0.122 (-2.26)	0.950 (13.75)	---	---	---	0.325 (3.12)	0.739	1.7019	1.93
1.929 (2.52)	-0.113 (-2.10)	0.855 (9.32)	-0.810 (-1.57)	---	---	0.347 (3.29)	0.741	1.6972	1.92
1.852 (2.44)	-0.108 (-1.99)	0.859 (9.18)	---	-0.085 (-1.43)	---	0.345 (3.27)	0.740	1.6994	1.92
2.020 (2.77)	-0.122 (-2.28)	0.855 (10.34)	---	---	-0.336 (-2.09)	0.351 (3.32)	0.744	1.6880	1.92
1.914 (2.49)	-0.117 (-2.08)	0.862 (9.19)	-1.253 (-0.67)	0.053 (0.25)	---	0.344 (3.27)	0.738	1.7064	1.92
$\beta_0^* = \beta_1^* = 0: F_{2,88} = 1.24$									
1.836 (2.40)	-0.131 (-2.37)	0.890 (9.50)	0.882 (0.74)	---	-0.580 (-1.55)	0.346 (3.25)	0.741	1.6965	1.92
$\beta_0^* = \beta_2^* = 0: F_{2,88} = 2.37$									
1.956 (2.57)	-0.126 (-2.26)	0.868 (9.28)	---	0.027 (0.29)	-0.391 (-1.55)	0.349 (3.28)	0.741	1.6975	1.92
$\beta_1^* = \beta_2^* = 0: F_{2,88} = 2.18$									
1.800 (2.34)	-0.119 (-2.14)	0.883 (9.41)	6.503 (1.36)	-0.465 (-1.25)	-1.184 (-1.82)	0.346 (3.22)	0.741	1.6976	1.93
$\beta_0^* = \beta_1^* = \beta_2^* = 0: F_{3,87} = 1.95$									

Figure 1
The Phillips Curve

Chart 1
Indexes of the Mark Exchange Rate
(1986 equals 100)

— IAEXG ---- IBEXG -.- INEXG

Chart 2A

Phillips Curves for Germany and Austria (1971 to 1992)

% Inflation

Chart 2B

Phillips Curves for Germany and Netherlands (1971 to 1992)

Chart 2C

Phillips Curves for Germany and Belgium (1971 to 1992)

% Inflation

% Unemployment

Chart 3
Unemployment Rates in Four Countries
(Percent of total labor force)

National rates for Austria and Germany; standardized rates for Belgium and Holland.