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A Case of the Phillips Curve in the Formation of a Monetary Union

A Glimpse at High Inflation Countries of the European
Monetary Union

A Research Honors Project

By
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Abstract

The European Monetary Union was established in 1992 as part of an effort to bring economic integration to new levels by creating a common currency area for Europe – a monetary union that would abolish transaction costs of converting one European currency to another, and eliminating exchange rate variability and uncertainty among traders and investors. Since the formation of the European Monetary System in 1979, lowering inflation had become the main monetary policy priority. My research centers on the Phillips Curve, which implies that decreasing inflation rates would always be coupled with increasing unemployment rates. This study uses the trends of inflation and unemployment in these countries to test the validity of the Phillips Curve. Regression analysis found that inflation had a significant inverse relationship with unemployment. Further analysis found that the institutional effort towards disinflation during the implementation of the European Monetary System was a major cause of increasing unemployment in the 1980s –1990s.

I. INTRODUCTION

The Maastricht Treaty went into effect in November 1993 with eleven European Countries joining forces to form the European Monetary Union (EMU). Recently in June 2000, Greece joined the EMU. The EMU was a drastic new initiative to bring economic integration one step further by creating a common currency for Europe – a monetary union that would abolish the transaction costs of converting one EC currency to another, as well as eliminating exchange rate variability and uncertainty among traders and investors.

The eleven member states were required to meet several convergence criteria prescribed in the Maastricht Treaty relating to inflation, interest rates, government debt, and exchange rate volatility. High inflation countries such as Italy and Ireland are working hard to force down their inflation close to that of the three best performing member states, such as Germany (Grauwe, 1994).

This paper examines how disinflation in high inflation economies affects unemployment levels. According to Keynesian macroeconomic theories, a decrease in inflation will cause an increase in unemployment in the short run. Due to high inflation over the years among countries like Italy and Ireland, their expected inflation rate is significantly high (Grauwe, 1994). As a result, when the government starts a process of disinflation through restrictive fiscal and monetary policies, economic activity declines, and a significant short run increase in unemployment follows (Mankiw, 1997).

In opposition to the Keynesian theories, contemporary rational expectations theory states that a country's commitment and its announcement to join the Monetary Union could create an effect that will lower the citizens' expectations of inflation levels (Grauwe, 1994). If the monetary authority is known for its reputation and credibility of

policy commitment, then inflation levels could be reduced without the cost of significant unemployment (Blanchard, 1997).

The implication of possible increases in short-term unemployment is crucial. High inflation countries may have to bear the heavy cost of unemployment in order to meet the convergence criteria. The decision to join the EMU might change if there exist a significant increase in unemployment, resulting in a severe impact on the economy. High unemployment leading to recession could subsequently cause failure of the European Monetary Union.

Section II offers a historical background of the EMU, Section III examines the Theory of Optimum Currency Areas and the Phillips Curve that relates inflation to unemployment. Section IV provides an empirical model that looks at unemployment in the economies of the EMU states. Section V presents and interprets the regression results. Section VI gives the implications of the results on European Economies and offers policy implications and Section VII concludes this paper.

II. HISTORICAL BACKGROUND

In line with the European Union's objective to create an economically integrated region that will have common trade regulations, the European Monetary System was established in 1979. A subset of countries established an adjustable pegged exchange rate system through the Exchange Rate Mechanism (ERM) (Ungerer, 1997). These countries were required to maintain their actual exchange rate within an allowed fluctuation band of plus/minus 2.25 percent. When some countries were unable to keep their exchange rates within the stated ERM band, it was revised and realigned to a larger range that was easier for some member states to maintain (Krugman, Obstfeld, 1997). By the 1990s,

several countries such as Italy, Spain, Britain, and Portugal joined the ERM with bands of 6 percent (Ungerer, 1997).

This brings us to the theory of Purchasing Power Parity that states that the exchange rate between two countries is equal to the ratio of the countries' price levels. In floating exchange rate systems, the exchange rate would naturally move to purchasing power parity (Krugman, Obstfeld, 1997), but since the EMU has fixed exchange rates, it is changes in price levels that will have to adjust for the disparities. Germany was considered as the lead in the system due to the size of its economy and the reputation of its central bank. Therefore, countries became disciplined by the fixed exchange rates to lower their inflation similar to that of Germany. (Pugel, Lindert, 2000)

Europe continued to strive for a more integrated economy by dismantling barriers to trade and removing capital controls by 1990. These increased movements of trade and capital flows called for even more integration in terms of inflation rates and interest rates in order to avoid speculative capital flight (Hughes, 1999). Speculative capital flight occurs because of differences in interest rates between two countries where the country with a higher interest rate will attract capital from the country with a lower interest rate. Because of the high degree of capital mobility between the EMU states, capital moves across borders very quickly in the presence of interest rate disparities.

The Maastricht Treaty was drafted in 1991 and became effective in November 1993, which called for the establishment of the European Monetary Union where countries will use a single union-wide currency. Countries intending to join the Union must meet five criteria, called the convergence criteria. They were (Pugel, Lindert, 2000):

- a. The inflation rate must be no higher than 1.5 percentage points above the average of the 3 lowest inflation countries;

- b. The exchange rate must be within the ERM bands without realignment for 2 years prior to joining the Union;
- c. Interest rates on government bonds must be no higher than 2 percentage points above the average of the 3 lowest inflation countries;
- d. The budget deficit must be no larger than 3 percent of its GDP, and
- e. The gross government debt must be no larger than 60 percent of its GDP.

As mentioned earlier, this paper will focus on the first criterion – restriction of inflation rates. The idea of convergence of inflation rates contained in the Maastricht Treaty really began in the 1980s when the European Monetary System first started as an effort to create a common economic area. By the time the Maastricht Treaty came about in 1992, low inflation was already the top priority and the first intention for convergence. The following section will detail why the contractionary policies to decrease inflation may create a problem for the economy.

III. THEORETICAL FRAMEWORK

The Theory of Optimum Currency Areas helps in explaining the rationale behind economic integration. However, before getting into that, we need to understand why disinflation causes unemployment. The Phillips Curve is a theory that best illustrates that phenomenon.

Phillips Curve

The Phillips Curve was developed in 1958 from a theory of aggregate supply taken by a British economist named A. W. Phillips. Phillips examined the relationship between unemployment and the rate of inflation in Britain, and found that there was an inverse relationship (Phillips, 1958). Authors Paul Samuelson and Robert Solow

replicated Phillips's model two years later for the United States and the relationship held true even for US data. This inverse relationship came to be known as the Phillips Curve (Samuelson, Solow, 1960). The modern Phillips curve posits that the inflation rate is dependent on expected inflation (π^e), cyclical unemployment ($u - u^n$) and supply shocks (ε). The equation takes the following form (Mankiw, 1997):

$$\pi = \pi_e - \beta(u - u^n) + \varepsilon$$

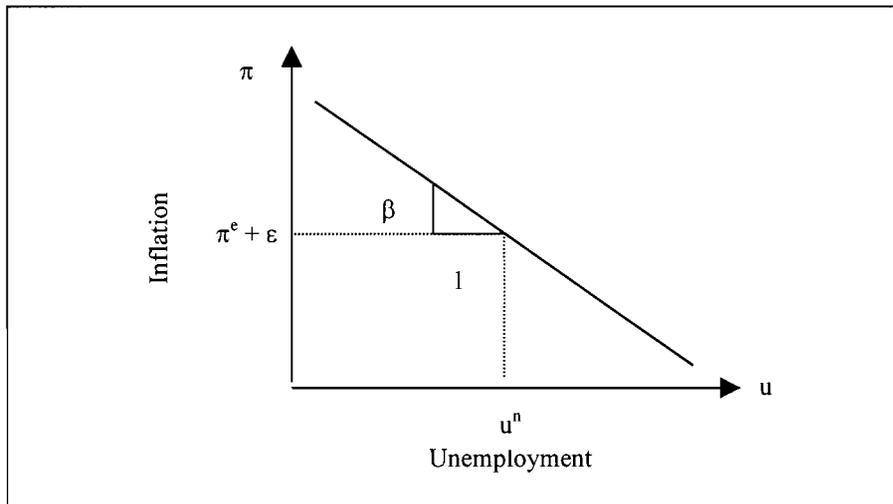
Based on the assumption of adaptive expectations, people form their expectations of inflation from past or recently observed inflation. Therefore, π_e can be written as the previous year's inflation level, π_{t-1} . In fact, π_e can even be written as π_{t-2} or π_{t-3} because people's expectation on inflation can be based on last year's level or even the level for the year before. This method of predicting expected inflation is based on the adaptive expectation concept. People's expectations are based on what happened in the past. Therefore, if they have been adapted to a consistent level of inflation over the past two, three or even four years, then their expectations will be a function of past inflation.

In an economy with adaptive expectations, if price levels have been rising quickly, then they will be expected to continue rising provided that the economy is at the level of natural unemployment. This is because past inflation has influenced people's expectations on future inflation. This implies that inflation is inertial and price levels will continue to rise at the prevailing inflation rate until some exogenous event such as a recession (which increases unemployment above natural unemployment) or a supply shock, which abruptly modifies inflation expectations occurs (Mankiw, 1997).

The second element of the equation captures cyclical unemployment, which implies the deviation of unemployment from the natural rate. An increase in unemployment other than the natural rate causes cyclical unemployment to increase and

as a result, the inflation rate is pulled downwards. The term β determines the responsiveness of the inflation level to the change in cyclical unemployment. Figure A shows the relationship between inflation and unemployment in terms of the Phillips curve (Mankiw, 1997).

Figure A: Relationship Between Inflation and Unemployment



Therefore, in order to influence inflation levels, the government can increase or decrease aggregate demand (which will in turn result in changes in the level of unemployment) through fiscal and monetary policies. In the Maastricht treaty, high inflation EU states were required to bring their inflation levels down to that of the three best performing EU states. This means that the government will have to impose some kind of restrictive fiscal or monetary policy to fight the inertial inflation. When that happens, aggregate demand falls and as a result, the economy is faced with a recession in the short run, which means that the economy will experience falling output and rising unemployment. In terms of Figure A, the restrictive fiscal or monetary policy will cause

an increase in unemployment, which in turn, will cause a decrease in the current inflation rate.

Theory of Optimum Currency Areas

The Phillips Curve tells us why inflation and unemployment are inversely related, implying that the convergence criteria could be very costly in the short run for some EU countries. Now we need to reevaluate whether the countries in the European Union will function well as a common currency area where exchange rates are fixed to the area's currency. In deciding the costs and benefits of joining a fixed exchange rate system, the Theory of Optimum Currency Areas predicts that fixed exchange rates are most appropriate for areas that are closely integrated in terms of international trade and factor movements (Krugman, Obstfeld, 1997).

Developed by Robert Mundell in the 1960s, this theory suggests that a high degree of economic integration among countries will lead to higher monetary efficiency gains when these countries fix their exchange rates against the area's currency (Krugman, Obstfeld, 1997). The key impediments to a successful common currency area are the large difference between countries in terms of such things as different rates of inflation and different citizen's inflationary expectations. To illustrate, Mundell uses a simple model of two economically opposite entities that are initially at full employment and balance of payments equilibrium. This model illustrates that structural differences between countries attempting to create a common currency area can have adverse effects on the economy of the individual countries. Mundell's argument lies on two assumptions: 1) money wages and prices cannot be reduced in the short run without causing unemployment (as predicted by the Phillips Curve), and 2) monetary authorities act to prevent inflation. In the original document written by Mundell in the *American*

Economic Review, he names the two entities A and B and illustrates the effect of a shift in demand from the goods of entity B to entity A:

Suppose first that the entities are countries with national currencies. The shift of demand from B to A causes unemployment in B and inflationary pressure in A. To the extent that prices are allowed to rise in A the change in terms of trade will relieve B of some of the burden of adjustment. But if A tightens credit restrictions to prevent prices from rising all the burden of adjustment is thrust onto country B; what is needed is a reduction in B's real income and if this cannot be effected by a change in the terms of trade—because B cannot lower, and A will not raise, prices—it must be accomplished by a decline in B's output and employment. The policy of surplus countries in restraining prices therefore imparts a recessive tendency to the world economy on fixed exchange rates or (more generally) to a currency area with many separate currencies. (Mundell, 1961)

Mundell then adds more assumptions into this model by claiming that the entities now have a closed economy within the region with a common currency and the national government of each country now pursue a full employment policy. He shows that the same shift in demand from B to A causes not only unemployment in country B and inflation in country A, but also a surplus in A's balance of payments. Since the priority now is to maintain full employment, the central bank might increase the money supply to correct the unemployment in B, but that will only aggravate A's inflationary pressure. Therefore Mundell concludes that forming a common currency area cannot prevent both unemployment and inflation at the same time among its members if they are not highly economically integrated (Mundell, 1961).

A different representation of Mundell's model by Grauwe (1994) takes on the same assumptions but this time using Germany and France as examples. Like Mundell, Grauwe demonstrates that the shift in demand causes unemployment in France and inflationary pressure in Germany. But Grauwe argues that there are two mechanisms that

will bring back equilibrium in the two countries. The two mechanisms are wage flexibility and mobility of labor. If there is sufficiently free movement of labor between European countries, then an increase in unemployment in France will cause the unemployed workers to look for jobs in Germany, thus balancing out the disequilibrium, as long as wages are flexible (Grauwe, 1994).

While the Phillips Curve suggests that disinflation can be obtained only at the cost of higher unemployment, the unemployed population can actually obtain jobs from other member states if labor is mobile across borders with few restrictions. If this is true, then the unemployment is likely to be little affected by policies that decrease inflation rates. In this case, we would be contemplating a downward shift in the Phillips Curve rather than a rightward movement along the Phillips Curve. Also, if labor is mobile, the estimated unemployment impact from disinflation is likely to be small. But, there are several reasons to believe that labor is not very mobile between EU countries.

Perhaps the most apparent barrier to mobility of labor among EU countries is the barrier of language and culture. An econometric study by Barry Eichengreen (1990) of the University of California at Berkeley found that regional unemployment rates are more similar in the United States than the national unemployment rates among EU members. This implies that there is some magnitude of difference in the demand for labor and wages among these EU states. (Krugman, Obstfeld, 1997).

Another barrier to the mobility of labor is caused by government regulation. As in many countries, the government typically requires potential employees to obtain residency status before he or she is allowed to work in the country. Therefore it becomes harder for unemployed workers in say, France, to look for employment in Germany (Krugman, Obstfeld, 1997).

IV. EMPIRICAL MODEL

The empirical model utilizes the Phillips curve to construct a regression model to test its validity in four high inflation countries in the EMU. Based on the Phillips Curve, it can be hypothesized that inflation and unemployment are inversely related. Note that the Phillips Curve takes the following form:

$$\pi = \pi_e - \beta(u - u^n) + \varepsilon \quad (1)$$

Assuming no supply shocks, this equation implies that actual inflation will equal expected inflation if unemployment equals natural unemployment. This means that inflation is 100% inertial and if all else equal, people's expectations on inflation, which are based on last year's inflation, will be a perfect predictor of actual inflation. This is obviously not completely accurate. Expectations are merely assumptions based on factors such as past experiences that might not be a perfect indicator of actual inflation levels.

We will return to remedy this problem in later paragraphs.

Several methods can be used to create a proxy for expected inflation. Since we are assuming that expected inflation is based on past experiences, the simplest way to model adaptive expectations is by lagging actual inflation by one period for the variable π_e . The simplicity of this variable ignores the fact that people may look back beyond one year in terms of expecting what the inflation level would be for the current year. Therefore, the variable for expected inflation in this model is a weighted average of the inflation levels for the past three years. In addition, it is assumed that the inflation rate at period t-1 is weighted more heavily than inflation at time t-2 and inflation at time t-2 is weighted more heavily than inflation at time t-3. It is a logical and reasonable argument to assume that although past year inflation rates do matter, people view the most recent inflation rate to be more important than the inflation rates in earlier years. The weights assigned are 1.5

(50%) for inflation at t-1, 1.0 (33%) for inflation at t-2 and 0.5 (17%) for inflation at t-3.

For example, assume that the inflation rates for the years 1997-1999 are as follows:

1997 - 4.2%
1998 - 3.0%
1999 - 4.0%

Expected inflation for the year 2000, then, would be $(4.0 \times 0.5 + 3.0 \times 0.33 + 4.2 \times 0.17 = 3.7)$. This means that the estimated expected inflation for 2000 is 50% of inflation rate in 1999, 33% of inflation rate in 1998 and 17% of inflation rate in 1997.

Although the weights assigned are merely arbitrary weights, they provide a way to give different importance to inflation rates of different years. Most importantly, these weights allow the model to give less importance to inflation rates of earlier years.

As mentioned earlier, equation (1) assumes that inflation is 100% inertial, which might not be true. In formulating the empirical model, inflation is assumed inertial but not 100% inertial. This is achieved by assigning a coefficient, θ , to π_e as follows:

$$\pi = \theta\pi_e - \beta(u - u^n) + \varepsilon \quad (2)$$

In his explanation of the Phillips Curve, Mankiw posits that $\theta = 1$, implying that actual inflation is 100% inertial. This means that prices are sticky and people's expectation on this year's inflation is heavily dependent on the level of previous year's inflation. Therefore if θ is equal to or close to one, there is little flexibility in prices and consequently wages. On the other hand, the modified Phillips curve model in equation 2 allows for θ to be any value and not restraining it to the value of one. This value is unknown and will be estimated in the regression analysis.

By manipulating the terms in equation 2, the following equation was obtained (The details of this transformation can be found in Appendix 1):

$$u = u^n + 1/\beta(\theta\pi_e - \pi) + \varepsilon/\beta \quad (3)$$

where u = unemployment

u^n = natural unemployment

π_e = expected inflation

π = inflation

ε = error term

Based on the relationship between unemployment and inflation observed in equation 3, and applying the assumption that natural unemployment level is fixed, a partially complete regression model was formulated with unemployment as the dependent variable. What is done here is merely changing the terms in equation 3 into a form that can be easily recognized as a regression model:

$$\text{UNEMP} = \alpha + \alpha_1 \text{WEIGHT3} + \alpha_2 \text{INFLAT} + e \quad (4)$$

Where UNEMP = u

WEIGHT3 = π_e

INFLAT = π

α = u^n

α_1 = θ/β

α_2 = $1/\beta$

e = ε/β

Note that WEIGHT3 is the weighted average of the past 3 years' inflation average and INFLAT is the current inflation rate.

Two research hypothesis are suggested by this equation:

1. Expected inflation (WEIGHT3) is positively related to this year's unemployment, that is, α_1 is expected to carry a positive sign. The presence of nominal rigidities supports this hypothesis. Nominal rigidity is defined as the "slow adjustment of nominal wages and prices to changes in economic activity" (Blanchard, 1997). In modern economies, wages and prices are set in nominal terms for some time. The existence of contracts and tenure, for example, fix wages for a period of several years under a binding contract. Wages in these contracts typically reflect expectations of inflation for the next two to three years that the contract is in effect. The rationale behind the positive relationship between expected inflation and unemployment is that when business people expect high inflation in the near future, they are likely to lower costs through either lower wages or hiring less labor. This directly causes higher unemployment.
2. Inflation (INFLAT) is negatively related to unemployment, that is, α_2 is expected to carry a negative sign. When the government tries to lower inflation through contractionary fiscal policies, aggregate demand decreases. The resulting decreased income level makes businesses poorer and they end up hiring fewer workers.

This regression was run for data from four countries with the highest average inflation rate during the years studied: Finland, Italy, Portugal, and Spain. Annual data was used, which spanned 35 years: beginning from the year 1964 to 1998.

Since this regression required the use of cross sectional and time series data, three dummy variables representing Finland, Italy and Portugal were added into the regression. Spain was the omitted variable.

$$\text{UNEMP} = \alpha + \alpha_1 \text{WEIGHT3} + \alpha_2 \text{INFLAT} + \alpha_3 \text{FINLAND} + \alpha_4 \text{ITALY} + \alpha_5 \text{PORTUGAL} + e$$

MODEL 1

These dummy country variables are shift parameters that are meant to pick up the effect of country specific characteristics on unemployment. Since Spain is the omitted variable, the constant represents the predicted level of natural unemployment for Spain. The coefficients attached to the individual dummy variables represent that particular country's natural rate of unemployment with respect to Spain's level of natural unemployment.

As explained above, EMS began in 1979 and plans for economic convergence began to take place at that time. By the 2nd phase of the EMS, which began in 1982, lowering inflation had become the main monetary policy priority, and the Deutsche mark had emerged as the anchor currency for the system. By 1992, low inflation became a requirement for joining the EMU (Ungerer, 1997). The government's announcement to join the economic union may have resulted in a change in the population's expectations on inflation. This suggests the hypothesis that there may be a structural change within the economy that might cause inflation levels to have a different effect on unemployment from the year 1979 onwards. MODEL 2 attempts to look at this factor. Although Spain and Portugal did not join the European Community until 1986, Model 2 looks at not only the effect of the EMS in 1979, but also the institutional changes *after* 1979. The addition of the two variables in model 2 will look specifically at a later time period, therefore eliminating the "distraction" of supply shocks during the 60s and 70s but still taking into account both Spain's and Portugal's transition into the European Community.

For this regression, two new variables were created and added into MODEL 1. The first variable, D79, is a dummy variable that equals 1 for data from the years 1979 to

1998, and 0 for data from the years before 1979. The second variable, called INFL_D79 is an interaction variable between D79 and INFLAT. The coefficient for INFL_D79 plus the coefficient to INFLAT represents the effect of inflation on unemployment on and after the year 1979. The addition of these two variables indicates the responses to institutional changes within the economy; D79 allows a shift to take place and INFL_D79 changes the slope of the regression line. These two variables in addition to the variables from MODEL 1 make up the second regression model:

$$\text{UNEMP} = \alpha + \alpha_1\text{WEIGHT3} + \alpha_2\text{INFLAT} + \alpha_3\text{FINLAND} + \alpha_4\text{ITALY} + \alpha_5\text{PORTUGAL} + \alpha_6\text{D79} + \alpha_7\text{INFL_D79} + e$$

MODEL 2

By adding D79 and INFL_79, the model is controlling for a change in the effect of inflation on unemployment for the years after 1978.

V. DATA

The data was obtained from the Organization for Economic Cooperative Development Employment outlook database for four countries with the highest average inflation rates during the years studied: Finland, Italy, Portugal and Spain. The years studied were from 1964 to 1998. Two variables were extracted from this database: consumer price indices and unemployment rates. The CPI values are converted into inflation levels by calculating its percentage increase from the previous year.

In order to detect the general trend in inflation and unemployment that will support the hypothesis that inflation and unemployment is negatively related, the mean of inflation and unemployment were compared for 2 periods: pre-EMS (1960-1978) and

post-EMS (1979-1998). Consistent with institutional changes to lower inflation within the countries of the European Community, the means of inflation should fall between those two periods, while the means of unemployment should increase, if the Phillips Curve held true. Figures 1 through 4 show the movement of inflation and unemployment between the years 1960 to 1998. One can see that these two variables clearly move in opposite direction most of the time.

Table 1 shows the comparison of mean inflation and mean unemployment during these two periods (1960-78 and 1979-98) for all four countries. Three of the four countries reported small decreases in average inflation rates while average unemployment rates soared. Results for Finland showed a 40.38% decrease in average inflation between the pre-EMS period and during the EMS period, while average unemployment grew by 212.38%. Average inflation rates in Italy fell by 6.77% during the EMS period, while average unemployment was 124.25% greater during the EMS period. Results for Spain showed similar patterns. While the average inflation rate during the EMS period was 27.77% less than the average inflation rate during the pre-EMS period, average unemployment went the opposite way and was 457.91% greater than the average unemployment during pre-EMS. From Table 1, only results for Portugal showed increases in both average inflation (31.13%) and average unemployment (32.53%) between those two periods.

In 1974, there was heavy worker emigration from Portugal and a military draft, partly due to the 1974 Revolution. In 1974 and 1975, violence broke out between Portuguese people of differing political views (Country Studies, 2001). As a result of the heavy emigration, the working population of continental Portugal shrank from more than 3.1 million in 1960 to just 2.9 million in 1973 (Country Studies, 2001). Though the

reformation promised a better future, it was causing economic instability. During this political turmoil, the economy continued to suffer high unemployment. Decreasing labor productivity created high inflation rates averaged at nearly 18% annually in the 1980s compared to a modest 4% a year before the revolution (Country Studies, 2001). The economy was in stagflation. In 1985, the economy finally got back on its feet, with the Social Democratic Party taking control of the government and bringing political stability to the country. Finally, in 1986, Portugal gained membership into the European Community. Inflation levels, as shown in Figure 3, rapidly declined and the economy was again under control. The remarkable thing about Portugal is that, unlike the other three countries, the unemployment rate does not seem to respond to rather dramatic episodes of increasing or decreasing rates of inflation. Indeed, the unemployment rate was fairly stable throughout the entire period, including the period of disinflation from 1984 through 1998.

VI. REGRESSION RESULTS

MODEL1

Results of regression from Model 1 are presented in Table 1. The coefficient *WEIGHT3* was significant to the 0.01 level. *INFLAT* was significant to the 0.001 level. Both these coefficients have the expected sign. With this, we can infer that inflation and unemployment is indeed inversely related. Inserting the coefficients into the regression model, the following equation was obtained:

$$UNEMP = 12.361 + 0.308WEIGHT3 - 0.369INFLAT - 6.091FINLAND - 4.681ITALY - 5.090PORTUGAL + e \quad (5)$$

Comparing this to equation 4, the values for θ/β and $1/\beta$ were determined to be 0.308 and 0.369. Subsequently, θ can be calculated by dividing θ/β by $1/\beta$ ($0.308/0.369$), giving a value of 0.835. A summary of the values obtained for $1/\beta$, θ/β , θ and β is presented in Table 3.

The values obtained for $1/\beta$ and θ were then replaced into equation 3:

$$u = u^n + 0.369(0.835\pi_e - \pi) + \varepsilon/\beta$$

Bringing natural unemployment, u^n , over to the left hand side, the following equation was obtained:

$$u - u^n = 0.369(0.835\pi_e - \pi) + \varepsilon/\beta \quad (6)$$

This simple equation reveals a lot about the effect of a fall in inflation on unemployment. Contrary to the generalized Phillips Curve that Mankiw had presented, this equation says that $\theta \neq 1$. In the estimated equation, $\theta = 0.83$. This suggests that past inflation is an important determinant of unemployment, but that the system is not totally inertial. Assuming no supply shocks (therefore $\varepsilon = 0$), equation 6 calculates the deviation of unemployment from its natural level (cyclical unemployment) based on the deviation of inflation from the expected level.

From the equation above, the results from MODEL 1 were used to calculate the predicted level of unemployment for individual countries. Table 4 lists the predicted unemployment levels for Spain based on different deviation of actual inflation from expected inflation. Expected inflation is assigned a hypothetical value of 20%, and it is assumed that there are no supply shocks.

Notice that the larger the difference between expected inflation and actual inflation, the larger the predicted level of unemployment. A small deviation of 1% causes 11.14% unemployment. On the other hand, a large deviation of actual inflation from expected inflation causes a high level of unemployment. For example, a difference of 11% results in predicted unemployment of 15.20%. This implies that if the country was experiencing a process of drastic disinflation that was not expected by the citizens, then unemployment is predicted to be high. This is because expectations on high inflation keep labor costs and other production costs from falling as fast as the general price level thus causing businesses to lower costs by cutting wages or laying off workers. This is especially true for long-term contracts whereby the employer is bounded by law to maintain a fixed level of salary for its workers for a fixed amount of time, typically over a period of one to three years. At the same time, contractionary fiscal policies by the government decreases aggregate demand, which in turn lower total revenue. These two factors together make it even more essential that businesses cut costs by hiring less workers, thus causing a period of recession.

The results of Model 1 provide significant support for the hypothesis developed from the Phillips Curve in the empirical section. Inflation was found to be negatively related to unemployment. Monetary policy aimed at lowering inflation by lowering money growth led to high unemployment in Europe (Blanchard, 1997). At the same time, historically high inflation levels create high expected inflation. Inflation would already be built into existing wage agreements signed before or around 1979 based on expectations prior to the change in policy. Therefore, both effects combined, rapid disinflation caused even higher unemployment.

MODEL 2

The coefficients and significance of each variable for Model 2 are presented in Table 2. All variables were highly significant except WEIGHT3 and INFLAT. Both these variables lost their significance in this model. Although the variable INFLAT became insignificant, note that the coefficient itself is extremely low. The reason for the loss in significance could be that unemployment levels were fairly steady and might be unresponsive to changes in inflation before 1979.

What may be happening is that before the European Monetary System, countries were experiencing a steady level of unemployment year after year. Changes in inflation may not cause large shifts in unemployment due to the fact that the population has been expecting the high inflation levels and steady increase in inflation year after year. The 1970s period was a tumultuous time characterized by high inflation levels due to drastic fluctuations in oil prices as a result of multiple occurrences of oil shocks. But after the plan for the European Monetary System became effective, the governments of high inflation countries began forcing down inflation levels and this might have tightened the economy and put cost pressures on businesses. This, according to the Phillips Curve, would result in an increase in unemployment.

Because INFLAT was insignificant in MODEL 2, one might think that MODEL 2 invalidates the Phillips Curve assumption that inflation is related to unemployment. However, a plausible explanation to this is that, prior to 1979, there were a number of supply shocks due to fluctuations in oil prices that could not be controlled for in the model. A supply shock would cause simultaneous increase in unemployment and inflation. Thus, the normal Phillips Curve relation could not be captured during these years. Increase in oil prices due to sudden restrictions in supply of oil increases non-labor

costs and thus forces firms to increase prices, which will in turn lower demand and output. This will result in an increase in the natural rate of unemployment and inflation at the same time (Blanchard, 1997). Because of this phenomenon in the 1970s, the general relationship between inflation and unemployment over the period studied (1964-1998) became unclear and insignificant after controlling for the formation of the EMS in 1979.

On and after the year 1979, the economy went through a process of disinflation due to the contractionary fiscal policies applied by the government. This squeezed aggregate demand and income levels, which consequently lead to lower inflation levels.

The coefficient of INFL_D79 represents the effect of inflation on unemployment from 1979 onwards. This variable has a negative coefficient of -0.316 and is significant to the 0.002 level. This means that after the introduction of the European Monetary System in 1979, the model predicts that unemployment levels became very responsive to changes in inflation. Again, this may be because of the squeeze on aggregate demand. From this, it is predicted that a kink occurred in 1979 where unemployment became more responsive to changes in inflation compared to the years before 1979.

VII. POLICY IMPLICATIONS / CONCLUDING REMARKS

This study found significant evidence of the possible unemployment cost of lowering inflation for the sake of inflation convergence required for economic integration. One of the major conclusions of this paper is that disinflation will inevitably create higher unemployment levels. In addition, as seen in the results of MODEL 2, the larger the deviation of actual inflation from expected inflation, the larger the predicted unemployment would be. The presence of nominal rigidities in wage contracts at times of disinflation can result in even higher unemployment. Therefore, in order to avoid the high

unemployment levels, the government can plan on a gradual decrease in inflation, rather than a rapid decrease. If steps were taken to create a gradual disinflation process, people's expectations on inflation would also decrease over time. Higher unemployment levels are certainly inevitable, but it will be relatively lower than if the government tries to force down inflation drastically in a very short time.

In evaluating the results of this study, it is important to remember that the convergence criteria also consist of four other factors relating to exchange rates, interest rates, budget deficit, and government debt. The convergence of inflation that is covered in this study may mean that the process of gaining eligibility into the union comes with a cost in the form of unemployment, but the other criteria in the Maastricht Treaty might offset the negative effects of disinflation. Future research would be to include the effects of other convergence criteria such as the restriction on the level of budget deficit and interest rates. Considering these factors will make this study more realistic and might even better predict unemployment levels.

Also, future research should include controls for labor mobility and wage flexibility as mentioned in the theory section. It is likely that the more integrated the region, the more likely that labor will travel across borders with little difficulty. This implies that the unemployment costs of future disinflation by EU countries may be somewhat less than today.

However, this study has important implications for high-inflation countries that may be considering joining the EMU. The unemployment cost of disinflation may be very costly.

APPENDIX 1

From the Phillips Curve equation,

$$\pi = \theta\pi_e - \beta(u - u^n) + \varepsilon$$

the terms can be moved around as illustrated:

$$\beta(u - u^n) = \theta\pi_e - \pi + \varepsilon$$

$$u - u^n = 1/\beta (\theta\pi_e - \pi + \varepsilon)$$

$$u = u^n + 1/\beta(\theta\pi_e - \pi) + \varepsilon/\beta$$

1. Natural unemployment, u^n , will be assumed as fixed and will therefore be the constant in the regression.
2. θ/β will be the coefficient for π_e
3. $1/\beta$ will be the coefficient for π
4. ε/β will be the error term in the regression

Figure 1: Inflation and Unemployment in Finland

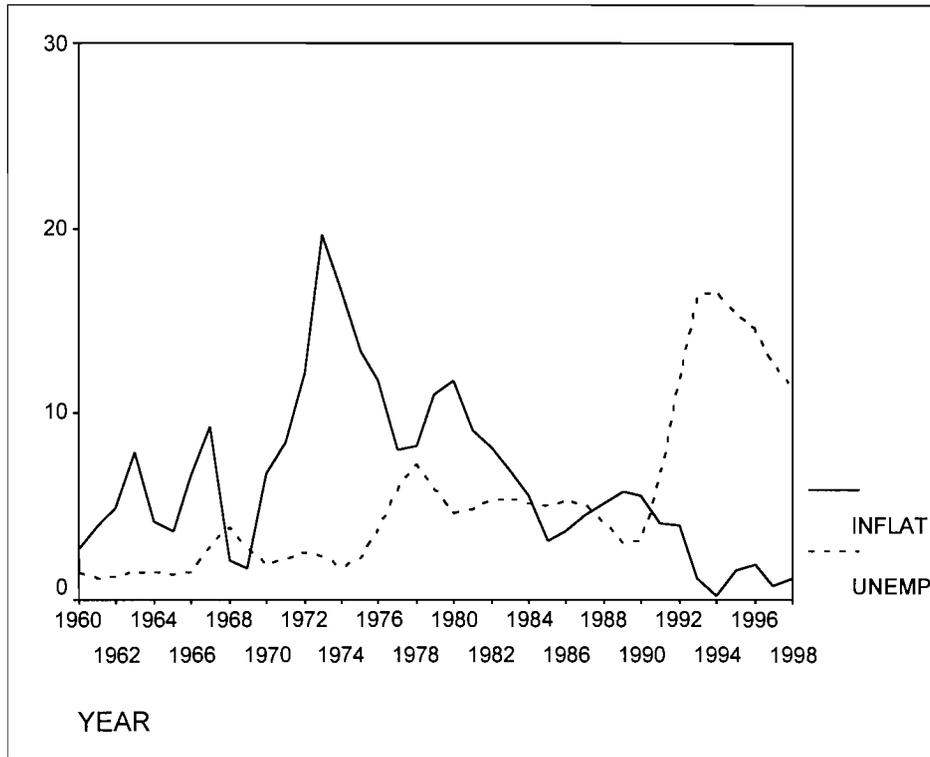


Figure 2: Inflation and Unemployment in Italy

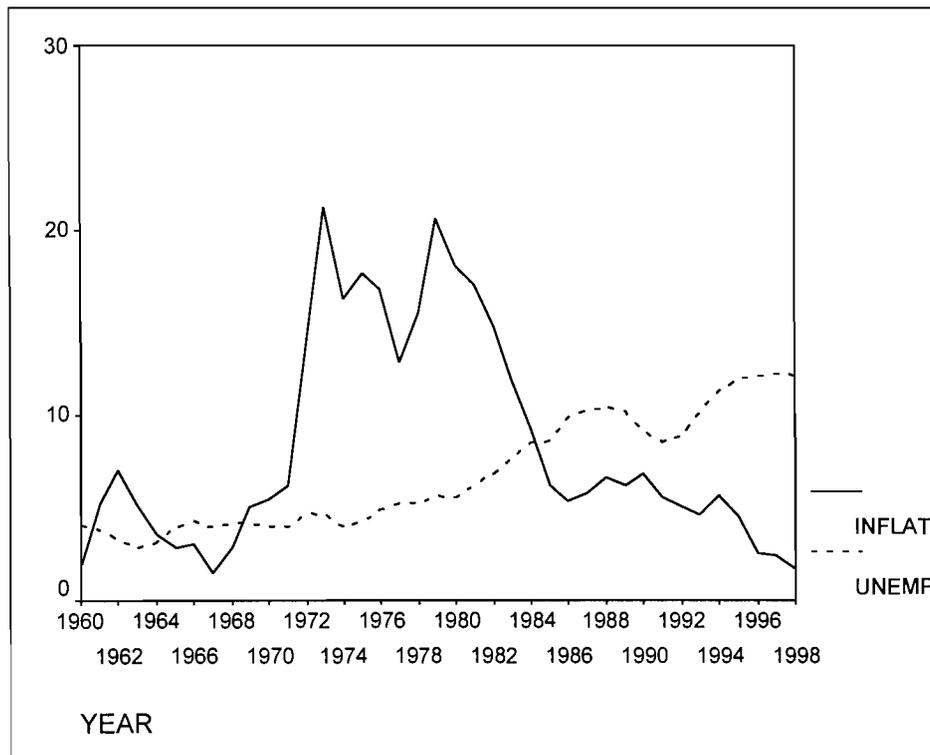


Figure 3: Inflation and Unemployment in Portugal

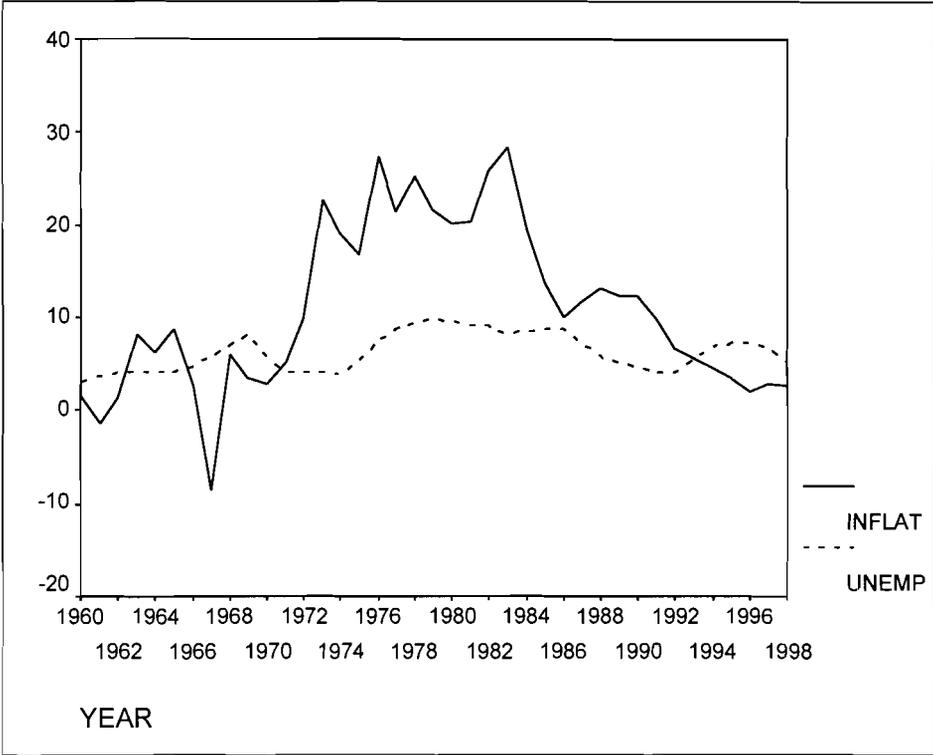


Figure 4: Inflation and Unemployment in Spain

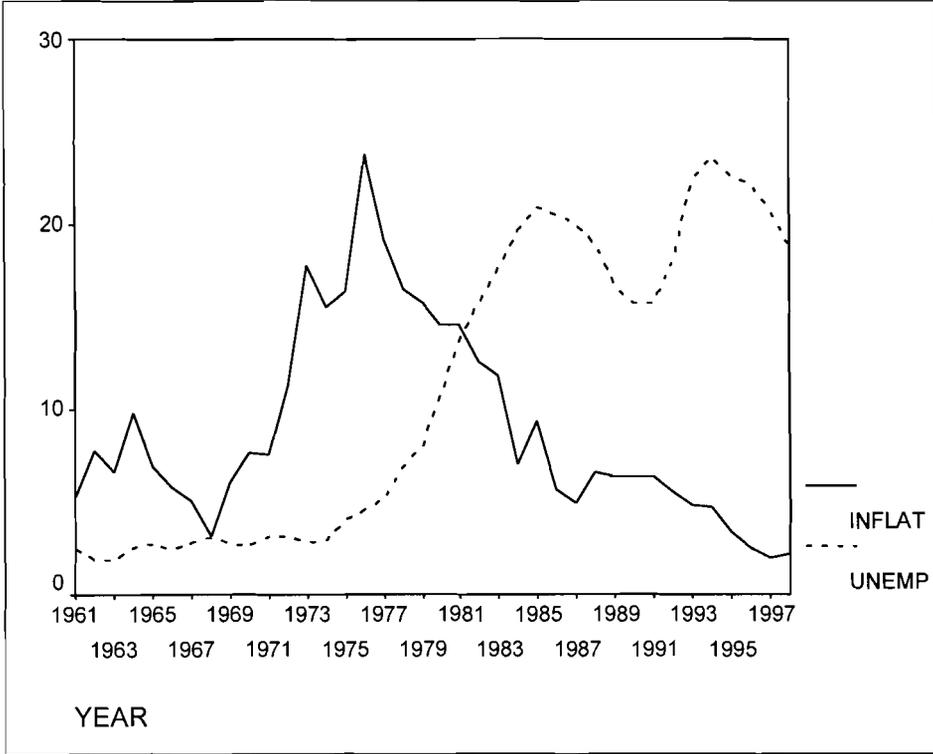


TABLE 1: CHANGES IN MEAN OF INFLATION AND MEAN UNEMPLOYMENT BETWEEN THE PERIODS 1960-1978 AND 1979-1998

Countries		1960-1978	1979-1998	% Change
Finland	Mean Inflation	8.0141	4.7775	-40.386
	Mean Unemployment	2.6045	8.1361	212.386
Italy	Mean Inflation	8.6376	8.0526	-6.773
	Mean Unemployment	4.1615	9.3321	124.248
Portugal	Mean Inflation	9.3871	12.3091	31.128
	Mean Unemployment	5.3279	7.0613	32.534
Spain	Mean Inflation	10.2255	7.3859	-27.770
	Mean Unemployment	3.2506	18.1355	457.912

TABLE2: REGRESSION RESULTS FOR MODEL 1
Adjusted R² = 0.228

Variable	Expected Sign	Coefficient (t-statistics)	Significance
CONSTANT		12.361 (11.862)	.000
WEIGHT3	+	.308 (2.669)	.009
INFLAT	-	-0.369 (-3.445)	.001
FINLAND	?	-6.091 (-5.291)	.000
ITALY	?	-4.681 (-4.117)	.000
PORTUGAL	?	-5.090 (-4.423)	.000

TABLE 3: REGRESSION RESULTS FOR MODEL 2
Adjusted R² = 0.575

Variable	Expected Sign	Coefficient (t-statistics)	Significance
CONSTANT		7.399 (7.408)	.000
WEIGHT3	+	8.777E-02 (0.921)	.359
INFLAT	-	-1.649E-02 (-0.187)	.852
FINLAND	?	-6.296 (-7.371)	.000
ITALY	?	-4.515 (-5.340)	.000
PORTUGAL	?	-4.554 (-5.248)	.000
D79	+	9.168 (8.656)	.002
INFL_D79	-	-0.316 (-3.217)	.000

TABLE 4: SUMMARY OF VALUES FOR $1/\beta$, θ/β , θ AND β DERIVED FROM MODEL 1

VALUE		
θ/β	0.308	α_1
$1/\beta$	0.369	α_2
θ	0.835	0.450 / 0.940
β	2.710	1 / 0.940

TABLE 5: PREDICTED UNEMPLOYMENT FOR SPAIN BASED DIFFERENT DEVIATIONS OF ACTUAL INFLATION FROM EXPECTED INFLATION

WEIGHT3	INFLAT	%change	Predicted
(π_e)	(π)	$((\pi_e - \pi) / \pi_e) * 100$	unemployment*
			(u)
20	20	0	11.1433
20	19	-5	11.5123
20	18	-10	11.8813
20	17	-15	12.2503
20	16	-20	12.6193
20	15	-25	12.9883
20	14	-30	13.3573
20	13	-35	13.7263
20	12	-40	14.0953
20	11	-45	14.4643
20	10	-50	14.8333
20	9	-55	15.2023
20	8	-60	15.5713
20	7	-65	15.9403
20	6	-70	16.3093
20	5	-75	16.6783
20	4	-80	17.0473
20	3	-85	17.4163
20	2	-90	17.7853
20	1	-95	18.1543
20	0	-100	18.5233

* for Spain, the predicted level of natural unemployment is 12.361, based on the results of MODEL1. Therefore, in order to calculate unemployment for Spain, we add cyclical unemployment ($u - u^n = 1/\beta(\theta\pi_e - \pi)$) values to the level of natural unemployment.

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