The Euro and Inflation Divergence in Europe

Margarida Duarte

In January 1999, eleven European countries abandoned their respective national currencies and monetary independence to adopt a common currency, the Euro.[1] This event, in which several industrialized countries formed a currency union, stands out in modern monetary history by its uniqueness, and in due time, it will allow for a better understanding of the implications of different monetary arrangements among countries. Already, with four years of data available, we can begin to learn from Europe's natural experiment.

In a flexible exchange rate regime, the equilibrium adjustment in the relative price across countries associated with a given country-specific shock results both from movements in nominal prices and from movements in the relative price of the countries' currencies, i.e., the nominal exchange rate. In a currency union, movements in the nominal exchange rate are, by definition, no longer possible, and equilibrium adjustments in the relative price across countries result only from movements in nominal prices.[2] In addition, countries in a currency union can no longer use monetary policy in response to such a shock. The equilibrium adjustment of nominal prices associated with a given country-specific shock reflects, among other factors, not only the degree of asymmetry of the shock but also the degree of integration of the different regions (namely, the mobility of factors of production or the ability

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[1] These countries were Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. Greece adopted the Euro in January 2001. Monetary policy in the Euro area has been conducted by the European Central Bank (ECB) since 1999.

The remaining three members of the European Union (Denmark, Sweden, and the United Kingdom) have, so far, decided to maintain their own currencies and monetary independence.

[2] For example, as will be seen later, in response to faster productivity growth in its traded-goods sector (than in the other sectors), a country will experience a real exchange rate appreciation (an increase in its relative price), which in a currency union translates into higher inflation.

to automatically transfer resources across regions). The more asymmetric the shock or the less integrated the different regions in a currency union, the bigger the equilibrium adjustment associated with a given shock. Hence, inflation differentials can be seen as an indicator of regional asymmetries within a currency union.[3]

In this article I document the behavior of inflation dispersion and inflation differentials in Euro-area countries before and after the introduction of the Euro. This documentation supports the main message of the article: that inflation dispersion and inflation differentials (with respect to German inflation) within the Euro area have *increased* after the adoption of the common currency. Moreover, inflation dispersion in the Euro area has been higher than that observed in the United States. Assessing the sources of inflation divergence in the Euro area after 1999 suggests that countries with higher inflation rates tend to have also had higher GDP growth rates and a lower price level when the Euro was adopted. Finally, the variability of the inflation differential with respect to German inflation has tended to increase for most countries after the Euro was adopted.

This article is organized as follows. In Section 1 I briefly review the process leading to the implementation of the European Monetary Union (EMU). In Section 2 I provide a general discussion about currency unions, and in Section 3 I document the behavior of inflation before and after the Euro was adopted using twelve-month core CPI inflation data from the eleven countries that adopted the common currency in January 1999. In the final section I state my conclusions.

1. A BRIEF REVIEW OF THE ROAD TO THE EMU

The process of European integration started shortly after World War II, stimulated by the idea that a unified Europe would help ensure peace. In 1950 Robert Schuman, France's foreign minister, proposed that the coal and steel industries of France and Germany (then West Germany) be coordinated under a single supranational authority. This initiative lead to the European Steel and Coal Community, formed in 1952 together with Belgium, Italy, Luxembourg, and the Netherlands. Building on the success of this organization, the European Economic Community and the European Atomic Energy Community were established in 1957 by the Treaty of Rome. These three organizations were later consolidated in 1967 to form the European Community (EC), known as European Union (EU) since the ratification of the Maastricht Treaty in 1992.

[3] This discussion is closely related to that of optimal currency areas. The theory of optimal currency areas dates back to Mundell (1961), but it gained renewed interest in the last decade with the European project for a currency union. This theory stresses the relative importance of internal factor mobility and external factor immobility in defining the appropriate domain for a currency area.

As the Bretton Woods system became less stable during the 1960s, the European Council decided in December 1969 to pursue the goal of establishing an economic and monetary union in Europe by 1980.[4] A three-phase plan designed by Pierre Werner (then prime minister of Luxembourg) to achieve economic and monetary union within ten years was approved in March 1971, and the first stage, involving the narrowing of currency fluctuation margins, was launched. However, the instability in foreign exchange markets in 1971 and the subsequent collapse of the Bretton Woods system effectively brought the EMU project to a stop until the end of the decade.

In a new effort to establish an area of monetary stability, the European Monetary System (EMS) was created in March 1979.[5] The EMS allowed (initially) for currency fluctuations in a $\pm$ 2.25 percent range around fixed bilateral rates, and it effectively reduced exchange rate volatility among the participating currencies. It wasn't until 1988, however, that a new effort to establish a monetary union was made when the Hanover European Council commissioned a report to Jacques Delors (then president of the European Commission) on the implementation of a monetary union. The resulting Delors Report laid out a three-stage plan for the implementation of a monetary union, culminating with the creation of a single currency. The first stage of this process began in July 1990 and was marked by the dismantling of internal barriers to the free movement of capital.

In February 1992 the European Council signed the Maastricht Treaty, formally establishing the blueprint for economic and monetary integration in Europe. It defined the precise time line for the three stages leading to monetary union and set out the convergence criteria that member states had to pass in order to be eligible to adopt the common currency (the EMU's final stage).

The first stage of the EMU project, already in place, ended in December 1993. The second stage then began with the establishment of the European Monetary Institute (which would later become the European Central Bank—ECB). Its role was to strengthen the coordination of monetary policies among member states and to make the preparations required for a single monetary policy and currency.

The Maastricht Treaty laid out five convergence criteria that member states had to meet in order to enter into the EMU's final stage. These criteria were (1) public budget deficit below 3 percent of GDP; (2) public debt less than 60 percent of GDP; (3) inflation rate within 1.5 percent of the three EU countries with the lowest rates; (4) long-term interest rates within 2 percent of the three

[4] The European Council is composed primarily of the president of the European Commission (the executive body of the EU) and the heads of government of the member states and their foreign ministers.

[5] The participating countries in the EMS were the six countries that formed the EC since its inception, plus Denmark and Ireland (which joined the EC in 1973). The United Kingdom also joined the EC at this date but opted not to participate in the EMS.

lowest interest rates in the EU; and (5) no nominal exchange rate movements outside the EMS's margins for two years. These convergence criteria, which imposed strict fiscal rules and required inflation and nominal interest rates to converge across Europe, conditioned the conduct of both monetary and fiscal policy in the EU countries before the actual adoption of the common currency.

In the spring of 1998 the European Council announced the eleven countries that would enter the EMU's third stage as well as the irrevocable conversion rates between the Euro and each participating currency.[6] The third stage started in January 1999 with the introduction of the Euro as a medium of account. Euro banknotes and coins were put in circulation in 2002.

With the start of the EMU's third stage, member countries abandoned their monetary independence, and monetary policy came under the control of the ECB. Its goal is to maintain medium-term price stability in the Euro area, defined as a year-on-year increase in the harmonized index of consumer prices (HICP) below 2 percent.[7] With the start of the third stage, member countries also committed to the fiscal rules set by the Stability and Growth Pact. This pact establishes a limit of 3 percent of GDP for budget deficits, and it commits member countries to aim in the medium term for budgets that are close to balance or in surplus.[8]

Several countries may join the EMU in the next few years. In one group are the three EU member states still pending political approval in their countries to join the EMU: Denmark, Sweden, and the United Kingdom. Another group includes the countries that are candidates to join the EU in 2004 and are required to meet the Maastricht convergence criteria. These countries are the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia.

2. CURRENCY UNIONS AND INFLATION DIFFERENTIALS

Monetary and Fiscal Policies in a Currency Union

In a currency union, different countries or regions share a common currency. The issuance of the common currency and the conduct of monetary policy is the

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[6] Of the remaining four EU member countries not entering the Euro zone in 1999, Denmark, Sweden, and the United Kingdom chose not to participate, while Greece was viewed, at this stage, as not having fulfilled the necessary conditions for the adoption of the Euro.

[7] The HICP is the weighted arithmetic average of the consumer price indices for the Euro-area countries. The weight of each country is its share of private domestic consumption expenditure in the Euro area.

See Svensson (2002) for a critical evaluation of European monetary-policy strategy.

[8] The Stability and Growth Pact also defines the exceptional conditions under which breaching the 3 percent budget deficit limit can be accepted and establishes how and when fines can be levied against countries that display excessive deficits.

responsibility of a central monetary authority.[9] This institutional arrangement characterizes, for example, the states that form the United States and the countries that form the EMU; the authorities responsible for monetary policy are the Federal Reserve System and the ECB, respectively.

The central bank of a currency union holds assets which may include interest-bearing instruments issued by the governments of the different regions (or countries) or by the federal government, and its liabilities consist of the monetary base for the whole area. The monetary authority adjusts the money supply through the purchase and sale of interest-bearing assets. Note that since the member countries share a common currency, interest-rate parity implies that the nominal interest rate (on assets with similar characteristics) is the same across countries in a currency union. The joint central bank earns seigniorage revenue from issuing the common currency, and this revenue can be freely allocated across countries.[10]

In contrast to monetary policy (which is decided at the central level), fiscal policy is under the control of a member state or country in a currency union. That is, member states or countries maintain a fiscal authority, responsible for the conduct of fiscal policy in their region. This fact does not preclude the existence of a central fiscal authority as well. This is the case, for example, in the United States, where fiscal policy at the federal level involves a large amount of resources. In Europe, the resources involved in fiscal policy at the central level are very small.

Costs and Benefits of a Currency Union

By adopting a common currency, countries eliminate exchange rate risk and the costs of currency conversion.[11] Under floating exchange rate regimes, nominal exchange rates typically exhibit very high variability, with standard deviations in the order of 7 or 8 percent for quarterly data.[12] Obstfeld and Rogoff (2002) compute the welfare cost of exchange rate variability in an explicitly stochastic version of the "new open-economy macroeconomics" framework.[13] In this context, they consider a monetary regime change that eliminates exchange rate variability (by pegging the exchange rate) while maintaining the variance of

[9] I am restricting attention to arrangements in which a group of countries (or regions) shares a common currency and monetary policy is decided by a joint central bank. I am, therefore, abstracting from arrangements in which a country (typically small) adopts the currency of a large anchor country.

[10] Sibert (1994) considers the problem of allocating seigniorage in a currency union.

[11] The European Commission estimated that costs of currency conversion in the European Union amount to 0.4 percent of the area's GDP.

[12] See, for example, the data presented in Chari, Kehoe, and McGrattan (2002).

[13] The "new open-economy macroeconomics" framework was set forth by Obstfeld and Rogoff (1995), and it represents an important workhorse model in international economics. This model introduces nominal rigidities into a two-country general equilibrium model.

world monetary growth constant. For their parameterization, which assumes a low degree of risk aversion, the cost of exchange rate variability is about 1 percent of GDP. This calculation suggests that the welfare losses due to exchange rate movements generated by monetary shocks alone could be large. Furthermore, it reflects only the benefits of eliminating exchange rate risk, that is, of fixing the exchange rate. Adopting a common currency, however, is understood to have other implications, such as deeper market integration, which may entail additional benefits that are beyond the scope of the model in Obstfeld and Rogoff (2002).

An increase in trade volume is typically stressed as an important implication of reduced costs of currency conversion and the absence of nominal exchange rate risk. Several recent empirical studies have investigated the relationship between currency unions and trade. These studies offer a wide range of estimates of the effect of the currency union on trade and suggest that belonging to a currency union/board may lead to an increase in trade with other members by as much as a factor of three. Among these studies, Rose and van Wincoop (2001) estimate that the Euro may lead to an increase in trade in the Euro area of about 50 percent.[14]

By joining a currency area, however, a country forgoes the ability to use monetary policy to respond to region-specific macroeconomic disturbances. The inability to use monetary policy in response to asymmetric shocks can be an important cost of joining a currency union, particularly if asymmetric shocks represent an important source of output fluctuations and if adjustment mechanisms across regions to these shocks are absent. One such margin of adjustment across regions is provided by factor mobility, which allows factors of production to be easily reallocated in response to regional shocks. Another margin of adjustment to idiosyncratic shocks across regions is the automatic stabilization provided by sizeable transfer programs administered at the union level. The federal income tax and unemployment insurance, which automatically transfer resources from booming regions to those in recession, are examples of such programs administered at the federal level in the United States. Europe differs considerably from the United States along these two dimensions: despite the elimination of barriers to the movement of factors, labor mobility within Europe is still lower than in the United States, and unlike the United States, Europe lacks a sizeable system of transfers among states. Finally, countries in a currency union may also incur strategic and political costs in determining the allocation of seigniorage and the conduct of monetary policy.

[14] See Rose (2002) for a review of this literature and for a complete list of references. This paper, in particular, uses meta-analysis for evaluating and combining the disparate estimates from different studies. He finds that the combined estimate implies that a currency union approximately doubles trade.

Price Level Divergence in a Currency Union

Countries in a monetary union share the same currency but need not have the same price level: different regions within the union may have different price levels and experience different inflation rates.[15] The United States, a long-established currency union, provides a benchmark for the magnitude of price differentials in a currency union. Cecchetti, Mark, and Sonora (2002) use consumer price data for nineteen U.S. cities from 1918 to 1995 and find that price level divergences across U.S. cities are large and persistent: annual inflation rates measured over ten-year periods can differ by as much as 1.55 percentage points. Parsley and Wei (1996) use commodity level price data for forty-eight U.S. cities from 1975 to 1992 and find persistent deviations from the law of one price for both traded and nontraded goods.[16] They also find that convergence rates for traded categories are higher than those of nontraded goods or those found in cross-country data.

Deviations in the price level across regions within a currency union can arise from two sources. The first source is deviations from the law of one price for traded goods across regions. The second source is deviations in the relative price of nontraded goods across regions.

Let us consider a currency union with two regions, A and B, and assume that the price index in each region is given by a geometric weighted average of traded- and nontraded-goods prices:

$$p_{i,t} = \alpha p_{i,t}^{N} + (1-\alpha)\, p_{i,t}^{T}, i = A, B,$$

where $p_{i,t}$ is the log of the price index, $p_{i,t}^{T}$ $\left(p_{i,t}^{N}\right)$ is the log of the traded- (nontraded-) goods price index, and α is the share of nontraded goods in the price index.[17] Clearly, asymmetric shocks within a currency union, with distinct effects on the price index of traded or nontraded goods (p^T or p^N) across regions, will generate a differential in the price level across countries and an inflation differential.[18]

One such asymmetric shock is the following. If a country experiences faster productivity growth in the sectors producing traded goods (relative to

[15] Much of the existing literature on monetary unions associates a common currency with a common price level. See, for example, Canzoneri and Rogers (1990) or Bergin (2000). In contrast, Bergin (2002) and Duarte and Wolman (2002) model currency unions allowing consumer price levels to differ across regions.

[16] The law of one price states that, absent trade barriers, a commodity should sell for the same price (when expressed in the same currency) everywhere.

[17] Of course, if the weight α differs across regions, then the price level will also differ across regions due to the difference in composition of the indices (even if p^N and p^T are identical across regions).

[18] Denoting the inflation rate in period t, the percentage change in the price level from $t-1$ to t, as π_t, it follows that the inflation differential can be approximated by a weighted average of the inflation differential in traded- and nontraded-goods indices:

$$\pi_{A,t} - \pi_{B,t} \simeq \alpha\left(\pi_{A,t}^{N} - \pi_{B,t}^{N}\right) + (1-\alpha)\left(\pi_{A,t}^{T} - \pi_{B,t}^{T}\right).$$

the sectors producing nontraded goods) than the other countries in the currency union, then this country will experience higher inflation than the other countries. To see this, note that a positive shock to productivity in the traded-goods sector leads to a higher real wage in the country (since labor is assumed to be perfectly mobile across sectors). In the nontraded-goods sector, the higher real wage drives up the relative price of nontraded goods, since productivity in this sector has not risen. Assuming that the law of one price holds for traded goods, a higher relative price of nontraded goods in this country raises this country's price level relative to that abroad. The inflation differential associated with the shock to productivity in the traded-goods sector is an equilibrium phenomenon and will persist while productivity differentials persist across countries. An inflation differential generated in this way is known as the Balassa-Samuelson effect.[19]

At the inception of a currency union, another source of inflation differentials is price level convergence. If price levels differ initially across countries, then adopting a common currency will lead prices to converge (at least to some extent), generating temporary inflation differentials across countries. Price level convergence can occur for both traded and nontraded goods.

For traded goods, increased market integration and price transparency associated with the adoption of a common currency reduces the scope for deviations from the law of one price, leading to temporary inflation differentials for traded-goods price indices.[20] As for the price of nontraded goods, the Balassa-Samuelson hypothesis also suggests that adopting a common currency narrows deviations in the price for these goods across countries. To see this, note that in a currency union, economic integration creates pressure for convergence in productivity levels. Since tradable goods tend to be more capital intensive than nontraded goods, the scope for productivity differentials across countries in the nontraded-goods sector tends to be limited relative to that in the traded-goods sector. Therefore, countries with initially low productivity levels (which tend to be poorer and have lower price levels) tend to experience higher productivity growth in the tradable-goods sector as a result of convergence in productivity. As we have seen before, prices of nontraded goods in the countries with lower price levels tend to increase, converging to the higher price level of wealthier countries.[21]

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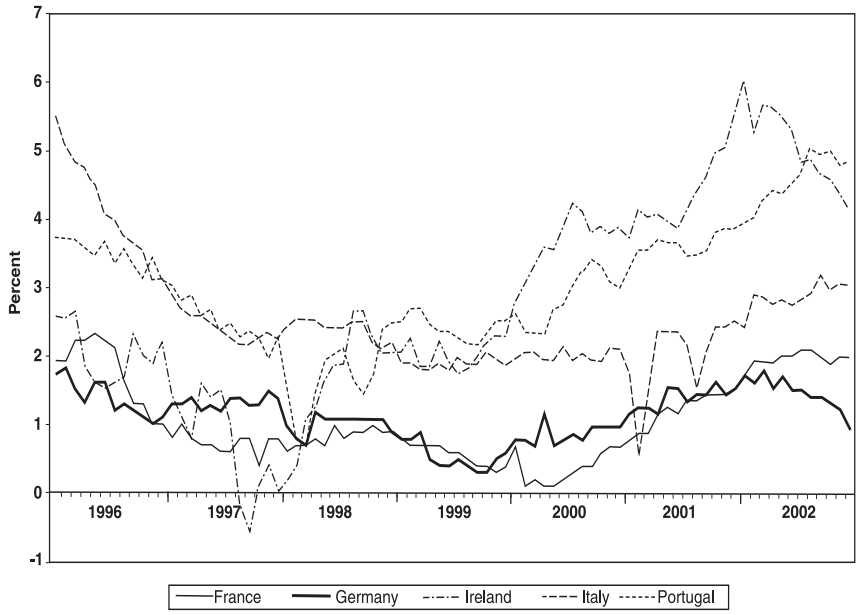
[19] See, for example, Chapter 4 in Obstfeld and Rogoff (1996) on the Balassa-Samuelson effect.

[20] The ECB *Monthly Bulletin* (October 1999), for example, provides strong evidence for the convergence of car prices across Euro-area countries.

[21] Natalucci and Ravenna (2002) analyze the choice of the exchange rate regime for accession countries to the EMU when these countries need to meet both inflation and nominal exchange rate criteria but are experiencing a real exchange rate appreciation due to increased productivity in the tradable-goods sector (the Balassa-Samuelson effect).

Figure 1 Monthly Core CPI Inflation



3. THE ADOPTION OF THE EURO AND THE BEHAVIOR OF INFLATION

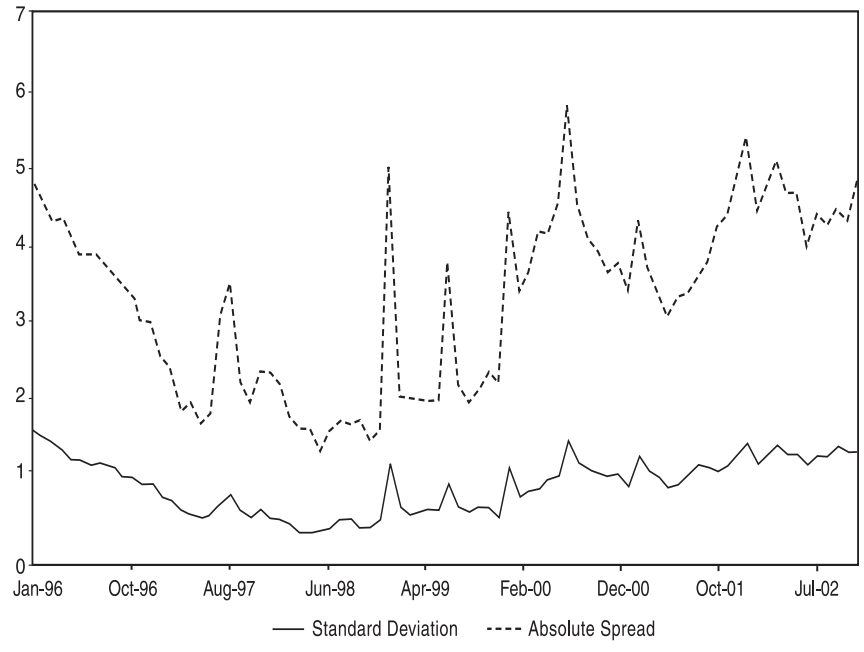
In this section I document the recent behavior of inflation in Euro-area countries. The measure of inflation I use is the twelve-month percentage change of the core consumer price index (CPI) for each of the eleven countries that adopted the Euro in 1999, at a monthly frequency.[22] That is, inflation in month t in country j is measured by $\pi_t^j = \frac{CPI_t^j}{CPI_{t-12}^j} - 1$.

Figure 1 depicts the monthly core consumer price inflation for a subset of Euro-area countries. Consumer price inflation declined steadily during the second half of the 1990s but has recently started to rise throughout the Euro zone. In the beginning of 1999, the twelve-month inflation rate in most countries was below the ECB's medium-term price stability target of 2 percent; this rate was above this level only in Portugal and Spain (2.5 percent). By mid-2002, the overall picture was quite different. Except for Germany and France,

[22] Core consumer price indices exclude food and energy prices, which are considered the most erratic components of price indices. The data are taken from Eurostat.

I have not included data for Greece, which adopted the Euro in January 2001.

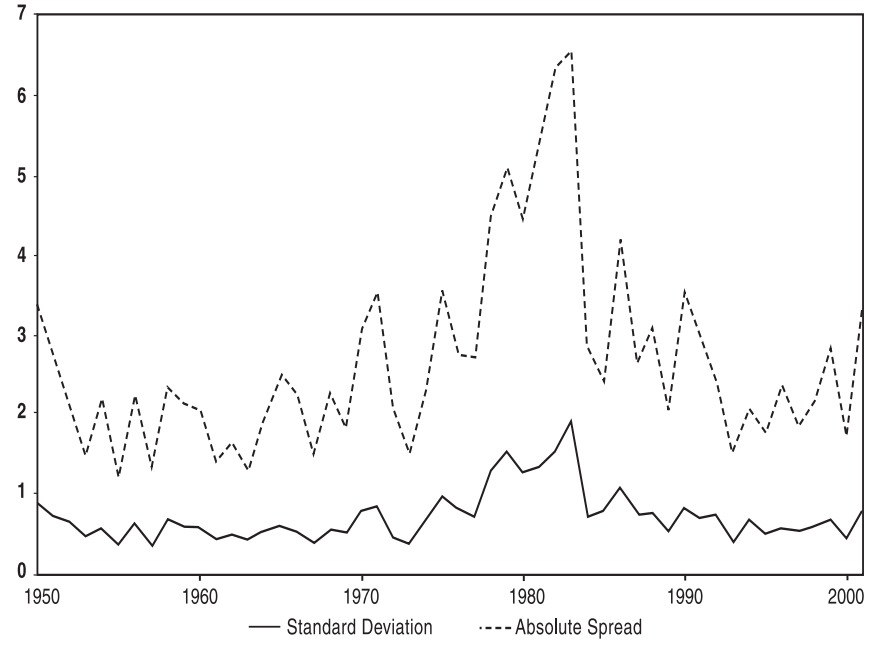
Figure 2 Euro-Area Inflation Dispersion: Absolute Spread and Standard Deviation



all Euro-zone countries were above the 2 percent target. The twelve-month core CPI inflation rate in June 2002 was 5.3 percent in Ireland, 4.5 percent in Portugal, and 3.9 percent in the Netherlands and Spain, for example.

I now turn to the behavior of inflation dispersion in the Euro area in this period. Figure 2 plots two summary statistics for the dispersion of inflation: the absolute difference between the highest and lowest inflation rates and the (unweighted) standard deviation of inflation rates across the Euro area from 1996:1 to 2002:12. The absolute spread decreased sharply during the second half of the 1990s, from about 4 percentage points to about 2 percentage points by the end of the decade, as the EU member countries aimed at fulfilling the convergence criteria defined by the Maastricht Treaty. The absolute spread has increased since then to nearly its level at the beginning of the sample (the average absolute spread in 2002 was 3.8 percentage points). The graph also shows a decrease in the standard deviation of inflation rates across the Euro area before the common currency was adopted followed by a subsequent increase. In 2002, the standard deviation averaged 1.2 percent, while in 1998 it averaged 0.6 percent.

Figure 3 U.S. Inflation Dispersion: Absolute Spread and Standard Deviation

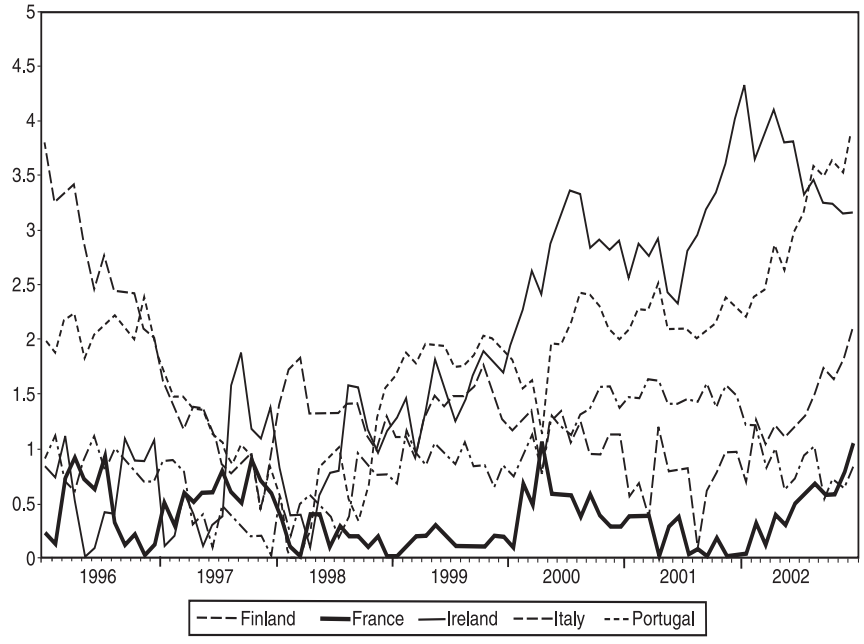


The United States constitutes a long-established currency union, and data on U.S. inflation dispersion provide a natural benchmark against which to compare the recent increase in inflation dispersion in Europe depicted in Figure 2. There is, however, relatively little data on U.S. subnational inflation rates. In order to compare inflation dispersion in the Euro area with that in the United States, I use annual data on consumer price levels in nineteen U.S. cities from the Bureau of Labor Statistics.

Figure 3 plots the two measures of inflation dispersion for the United States from 1950 to 2001. The average absolute spread was 2.8 percentage points in the entire sample and 2.2 percentage points in the last decade. The average standard deviation was 0.8 and 0.6 in these two periods, respectively.[23] Comparing the dispersion of inflation rates in the Euro area with that observed among U.S. cities indicates that the former resembled the latter in the late 1990s. Notwithstanding the existence of some episodes of high

[23] Cecchetti, Mark, and Sonora (2002) study the dynamics of these price indices for U.S. cities. They estimate that price index divergences across U.S. cities are temporary but surprisingly persistent, with a half-life of nearly nine years.

Figure 4 Absolute Inflation Differentials Relative to Germany



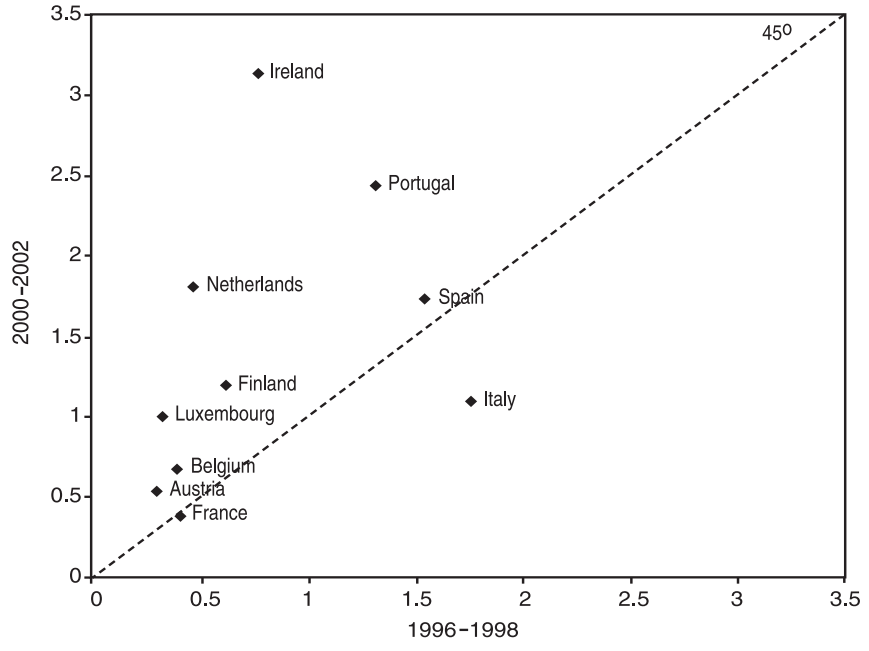
inflation dispersion in the United States, the two measures of Euro-area inflation dispersion are currently higher than the corresponding U.S. sample averages.[24]

I now turn from these two summary statistics of inflation dispersion to the distribution of inflation differentials with respect to the German inflation rate across the Euro area. The choice of Germany as the reference country reflects the fact that, prior to the adoption of the Euro, the German monetary authority had a strong reputation for advocating low inflation and that its inflation rate has been relatively flat throughout the period considered (Figure 1). Focusing on the distribution of inflation differentials allows some insight into the nature of these differentials.

Figure 4 plots the inflation differential with respect to German inflation for a subset of Euro-zone countries, and Figure 5 plots the average inflation differential with respect to German inflation for each Euro-area member country before and after the adoption of the Euro. The former period averages inflation data from 1996 through 1998, and the latter period averages inflation data from 2000 onwards. I have not included the twelve data points for 1999 since

[24] In comparing Figures 2 and 3, the distinct time samples as well as the distinct frequency of the data should be noted. Using annual (instead of monthly) frequency data for the EMU countries leads to the same conclusion.

Figure 5 Average Inflation Differentials (percentage points)



the twelve-month percentage change of consumer price indices for these data points effectively cover both the period before and after the Euro was adopted.

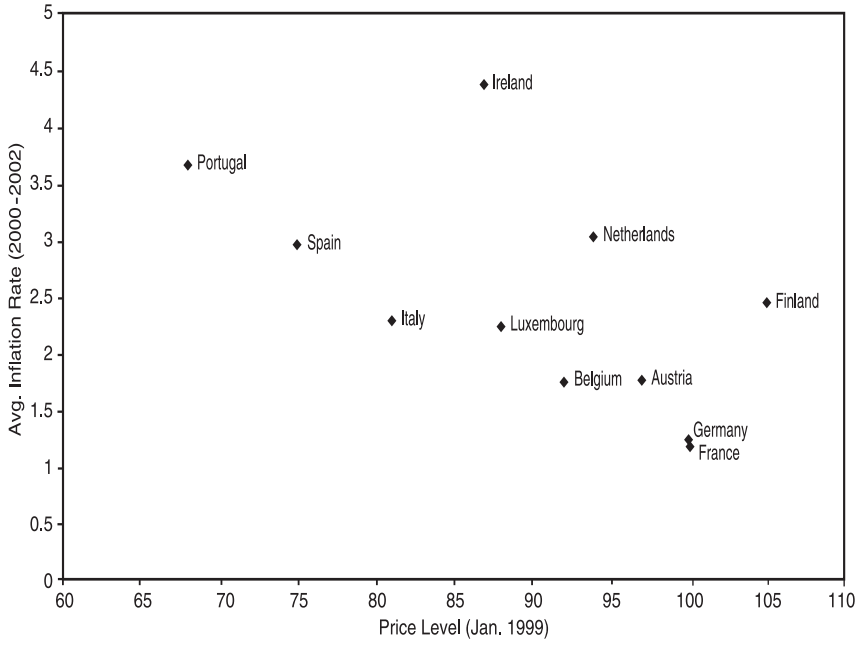
It is apparent from these two figures that inflation differentials within the Euro area have increased after the adoption of the common currency for most countries, reinforcing the message from Figure 2. Over the period before the Euro was adopted (1996 to 1998), average inflation differentials ranged from 0.3 (Austria) to 1.7 (Italy) percentage points. Inflation differentials have increased steadily across the Euro since after 1999, and over the period from 2000 to 2002 they ranged from 0.4 (France) to more than 3 (Ireland) percentage points.

Assessing the sources of the inflation differentials observed in the Euro area after 1999 is a complicated task. Drawing upon the discussion in the previous section, I briefly look at the joint behavior of inflation with the growth rate of output and initial price levels.

As I pointed out in the previous section, price level convergence can be a source of inflation differentials when different countries with initial distinct price levels adopt a common currency.[25] This argument suggests that countries

[25] The ECB has emphasized price level convergence as an important source of inflation differentials in the Euro area. See, for example, the ECB *Monthly Bulletin* (October 1999).

Figure 6 Initial Price Levels and Average Inflation Rate



with lower price levels would exhibit higher inflation rates than countries with higher price levels. I use the comparative price levels from the OECD for January 1999 as a measure of the initial differences in price levels among the countries in the Euro zone. Figure 6 plots the average inflation rate after 2000 against the comparative price level in 1999 for each country in the Euro area. The plot shows a negative relationship between the price level and subsequent inflation rates (the correlation coefficient is -0.6).[26] This evidence suggests that price level convergence may be a partial explanation for the different behavior of inflation across Euro-zone countries. The process of price level convergence, however, is a temporary one, and it has been under way in Europe throughout the 1990s.[27] This fact suggests a reduced scope for future price level convergence in Europe.

[26] Comparative price levels, a measure of the differences in price levels between countries, are from the OECD Main Economic Indicators.

[27] See Rogers (2001) for evidence on price level convergence in Europe during the 1990s. He concludes that while price level convergence contributed to observed inflation differentials within the Euro area in 2000, other forces explain most of those cross-country differences in inflation.

Figure 7 Average Inflation Rates and GDP Growth Rates After 1999

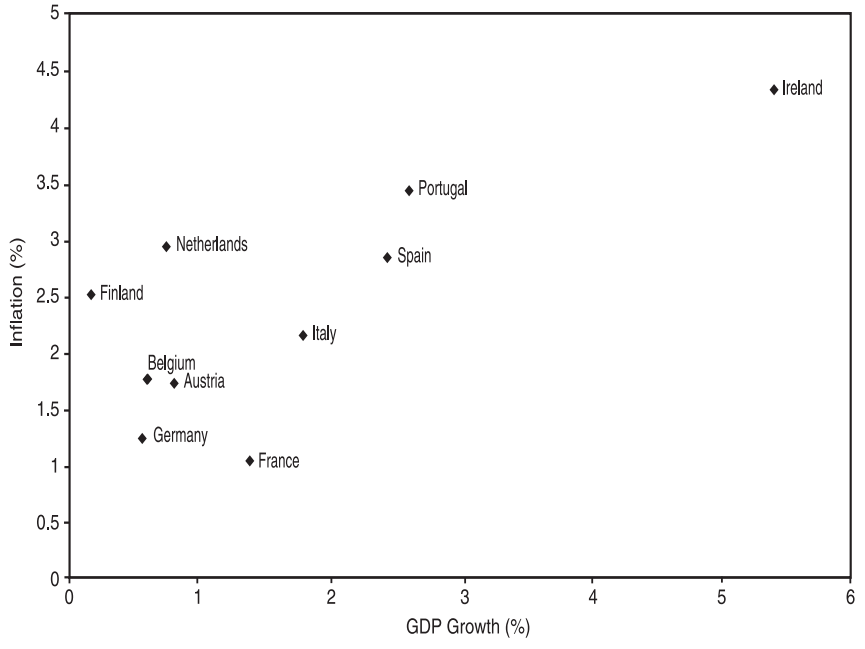
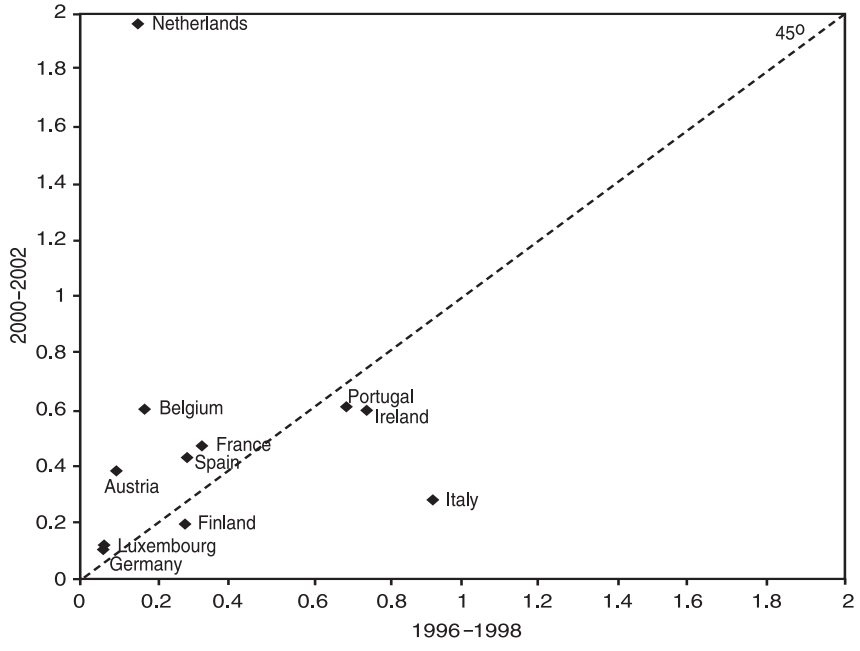


Figure 7 plots the average inflation rate after the Euro was adopted in each Euro-zone country against its average growth rate of GDP in the same period. This figure clearly suggests a positive relationship between the average growth rate of output and average inflation after the common currency was adopted. This figure suggests that, reflecting the Balassa-Samuelson hypothesis, the observed inflation differentials could be indicative of a process of the convergence of productivity levels (driving income convergence) across countries as well as asymmetric shocks across countries (and desynchronized business cycles).

Finally, in Figure 8, I plot the variance of twelve-month inflation in the periods before and after the adoption of the Euro, as defined before. This figure shows a tendency for increased inflation variability after the adoption of the Euro relative to the previous period. The variance of inflation increased in the later period for seven out of the eleven countries considered. The most significant exception is Italy, where the variance of inflation was substantially smaller after the Euro was adopted.

The Maastricht criteria forced the potential entrants in the EMU to attain inflation convergence by 1998, a requirement that conditioned these countries' use of monetary and fiscal policy throughout the 1990s. With the start of the

Figure 8 Variance of Inflation



EMU, the restriction on inflation convergence was eliminated and the ECB took control of monetary policy in the Euro area. The figures above suggest that the inability to use monetary policy in response to country-specific shocks after the requirement that countries attain inflation convergence was eliminated is associated with an increase of inflation dispersion and volatility.

In the new European institutional framework, regional fiscal policy is the only instrument available to the regional authorities to affect regional inflation. Should a regional fiscal authority decide to use fiscal policy to affect its inflation rate, it raises the question of the effectiveness and implications of such policy.[28]

4. CONCLUSION

In this article I document the behavior of inflation dispersion and inflation differentials in Euro-area countries before and after the Euro was introduced. Inflation dispersion and inflation differentials (with respect to German inflation)

[28] See Duarte and Wolman (2003) for an analysis of the implications of using fiscal policy to affect regional inflation in a currency union.

within the Euro area have increased since countries lost monetary independence and were no longer required to attain inflation convergence. Inflation dispersion in the Euro area after the common currency was adopted has been higher than that observed in the United States. Additionally, the variability of the inflation differential with respect to German inflation has tended to increase for most countries since the Euro was adopted.

These observed inflation differentials reflect both a temporary process of price level convergence as well as the adjustment to asymmetric country-specific shocks. To the extent that the process of price level convergence is temporary, these differentials, if continued or widened, are bound to start generating considerable attention, prompting the debate over the criteria to be met by Euro-area countries and the design and goals of regional policies. These differentials naturally raise the question of the adequacy of a common monetary policy for an area composed of heterogeneous constituent countries and, since fiscal policy is the only tool available to regional authorities to affect inflation, the question of the ability and desirability of using regional fiscal policy to affect regional price differentials.

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