DIVERGENT INFLATION RATES IN EMU[*]

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Abstract

We analyze the sources of divergent national inflation rates among EMU member countries. At one level, we review the Irish 'outlier' experience; at another, we estimate panel regressions for the 1999-2001 period. We highlight the role played by differential exposure to euro exchange rate movements in explaining inflation divergence. In addition, we find evidence that output gaps and a "price level convergence" effect have also been important. We draw some policy conclusions for the accession countries that are hoping to join EMU.

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1. Introduction

It has always been well understood that regional asymmetries would represent a major challenge to the success of the euro. Absent the option to adjust the nominal exchange rate, bilateral real exchange rate movements between members of the euro zone are coterminous with relative inflation differentials: real appreciation is generated by above-average inflation; a large real depreciation may involve actual deflation. An extensive *ex ante* literature discussed these issues. This paper looks at what has happened *ex post* in the first years of the single currency.

Three main factors were not fully known to the authors of *ex ante* studies. First, the scale and nature of asymmetric shocks; second, the evolution and potential convergence of monetary transmission mechanisms (Angeloni et al., 2002); third, how conflicting interests would be resolved in the decisionmaking of the European Central Bank (cf. Dixit and Jensen, 2002). Although the evolving situation regarding the other two will remain important over the longer term, the first effect is likely to be by far the most significant in interpreting the experience of the first few years against expectations and it is the focus of our paper.

Although the ECB has done relatively well in achieving its target of medium-term price stability for the eurozone aggregate, regional inflation differentials since the beginning of 1999 have been quite marked. Most notably, Ireland and the other peripheral nations have been persistently at the top of the inflation league table. In contrast, German inflation has been below the eurozone average. An expanded EMU with the entry of the accession countries will surely lead to even greater inflation differentials in the future.

Understanding the sources of these inflation differentials is important to ensure public acceptance of the EMU monetary regime and in facilitating smooth adjustment. Local inflation rates carry many of the standard "costs of inflation" by affecting those on fixed nominal incomes, real returns on savings and investments and private and public wage negotiations. To what extent was the divergence caused by asymmetric nominal shocks? To what extent was it a reflection of equilibrium real exchange rate

adjustment, or did it reflect economies being out-of-equilibrium? Would inflation rates have been more stable and differentials lower in the absence of EMU? Gathering initial evidence on these issues can help guide structural and fiscal policy responses not only in member states, but also in future potential joiners.

The structure of the paper is as follows. In section 2, we review some theoretical considerations about relative inflation and real exchange rate movements among members of a currency union. Section 3 studies in detail the Irish experience, which has special significance since Ireland has been at the top of the inflation table since the launch of the single currency. We turn to the factors driving inflation differentials across the broader eurozone in section 4. Section 5 addresses the counterfactual of what might have happened under independent national monetary policies. Section 6 assesses the policy implications for prospective new members of the eurozone. Finally, concluding comments are offered in section 7.

2. Why understanding differential inflation matters

If average eurozone inflation is being kept at an optimal level, why might one worry about differences emerging as between countries? After all, regions within nations do not have identical inflation rates, nor do states within other currency unions. Moreover, it is generally accepted that that the European Central Bank can only attempt to control the area-wide aggregate inflation rate, with no tools at its disposal to address variation in inflation across member countries.

Indeed, some sources of inflation rate differences within the EMU are entirely innocuous, or even benign:

- Where countries begin with different price levels, convergence towards a common price level necessarily entails a deviation in inflation rates. In this case also, differing measured inflation rates can be regarded as benign in that they betoken a convergence towards long-run equilibrium. A variant of this case is when the long-run relative price level across countries is a function of relative incomes, relative wealth levels or relative productivities: in this case, a faster-growing country may naturally have temporarily higher inflation in the

transition to its new long-run equilibrium relative price level (this is a loose statement of the widely-invoked Balassa-Samuelson hypothesis).

– The basket of goods may differ from country to country so that even if all individual prices are the same, the basket average is different. For the small price movements that have occurred since EMU began, this is unlikely to have been a serious problem and we will not return to it.

Nevertheless, not all inflation differentials are of this harmless variety. There seem to be two main dimensions to possible concerns about differentials: the fear of sustained inflation differentials and the fear of weak adjustment mechanisms that lead to boom-bust cycles.

First, the *fear of sustained inflation* in some regions. Underlying the adoption of EMU was a policy model in which centralized monetary policy would be sufficient to keep long-run inflation under control throughout the union. If diverging inflation rates in the early years of the system are extrapolated to the prospect of long-run sustained inflation differentials, this can naturally give rise to a concern that something might be wrong with the model. In that event, national governments that are concerned about the welfare of their residents – for whom it is local inflation rates that are relevant – will be faced with the political imperative of reducing excessive inflation, but now without having recourse to monetary instruments. [1][2][3]

To be sure, welfare analysis does not ascribe very large aggregate welfare losses to inflation rates in the range recently experienced by eurozone members, but some estimates are still far from zero (cf. Lucas, 2000). Moreover, there are distributional effects, with a novel feature for the currency union, in that (with the nominal interest

[1] As is well understood from a vast range of empirical studies, trade is not perfectly frictionless even within currency unions. Moreover, nontradables (especially housing costs) loom large in the overall cost of living. As such, residents of any given member state cannot perfectly insulate themselves from an increase in the domestic price level relative to price levels elsewhere in euroland.
[2] Especially if the population is largely immobile (today's resident is tomorrow's voter) as compared with economies with higher rates of inter-regional mobility (today's resident may be a voter elsewhere tomorrow). Given the short life of the euro, euroland voters are more likely to hold national governments responsible for addressing inflation concerns, whereas citizens in a currency union of long-standing may view inflation differentials as outside the scope of local government.
[3] National fiscal policies are also constrained by balanced budget rules and restrictions on the ability to vary indirect taxation.

rate fixed at the union level) above-average inflation implies a low or even negative real interest rate: at the very least, this may imply significant wealth transfers (e.g. from creditors to debtors) and may also push up local asset prices (e.g. housing).

An exaggerated national response to a perception of persistent excessive inflation – or deflation – could spill over to the rest of the union. A country that is experiencing sustained deflation might opt to unleash a large fiscal expansion, violating the rules of the Stability and Growth Pact and potentially disrupting eurozone financial markets.[4]

The second, and more plausible, main concern relates to *weaker adjustment mechanisms* implying more frequent and prolonged relative price misalignments, or alternating overheating and recession. Even if long-run inflation rates do indeed converge throughout the union, temporary asymmetric shocks to relative prices can be expected from a variety of sources.

For instance, if there are short-run supply rigidities, an aggregate demand disturbance will feed into domestic inflation and a real exchange rate change. Such inflation may be purely transitory but is potentially dangerous especially if it triggers persistence mechanisms that continue to operate even when the original shock has disappeared or supply responses have kicked in (cf. EEAG, 2002, chapter 4).

Overshooting may happen via price-wage dynamics if current inflation feeds into the path for future wage growth; it may also occur through balance sheets, if the low average real interest rate associated with high inflation inside a currency union leads to excessive debt accumulation on the parts of households or affected businesses; and, in related fashion, it may also happen via the housing/property markets, by virtue of a run-up in local asset prices. Imperfections in factor and credit markets may mean the unwinding of such overhangs can involve a painful adjustment process. In addition, it may be the case that even a temporary increase in domestic relative prices (i.e. a loss in competitiveness) can lead to a permanent loss in international market share or inward foreign direct investment, if hysteresis effects are important.

[4] In a worst case scenario, an over-reacting sovereign nation, dissatisfied with the inflation consequences of EMU membership, could even decide to leave the currency union: this would be destabilizing for the entire union, especially since the current statutes do not specify how such a departure could be implemented.

'Imported' inflation remains a threat even for a currency union, if member countries have different exposures to extra-union trade. Most directly, a member country that consumes imports from a non-member country will experience different inflationary pressures if the euro exchange rate depreciates as compared to a member country that conducts all its trade with other member countries. There are also indirect effects: the within-EMU competitiveness of a firm could be adversely affected if it relied on imported materials from a non-EMU country when its competitors were sourcing from within the EMU. Unless the contractual and technical conditions were such that the firm could quickly and fully switch its source of material supplies, the firm's profitability could be badly damaged perhaps resulting in layoffs or even bankruptcy. The sharp movements in exchange rates between the euro and the US dollar make this a point of empirical relevance in the present context.

Indeed, inflation differentials in the eurozone could turn out to be larger and more persistent than in some other currency unions. Relative to the United States, inter-regional smoothing mechanisms are absent: migration is weaker and there is no strong federal fiscal system. Domestic fiscal policy is also unlikely to be an effective counterweight. As is increasingly well appreciated, the effectiveness of discretionary fiscal policy is weak and uncertain.[5] Moreover, even if fiscal policy could be usefully deployed as a stabilization device, its flexibility is constrained by the Growth and Stability Fact and long-term sustainability concerns in several member countries.

An in-built adjustment problem for a currency union is the pro-cyclical interplay between regional inflation and real interest rates. Since any intra-union real exchange rate shift has to be accomplished via inflation differentials, a booming economy that displays relatively high inflation will also have a correspondingly low real interest rate, adding fuel to overheating tendencies. As a result, the coolant effect of real appreciation through a loss of competitiveness is likely only to operate at a more gradual pace. This persistence mechanism is reinforced if the wage-setting process is not perfectly flexible, such that current rather than prospective inflation influences wage determination.

[5] See Perotti (2003) and the references therein. However see EEAG (2003) for proposals that could improve the capability of discretionary fiscal policy to act as stabilizing force.

Along another dimension, we note also that from a theoretical perspective regional inflation differentials may also potentially affect the optimal policy for the ECB. As pointed out by Benigno (2000) and others, regional asymmetries when combined with variation in the severity of nominal rigidities across the eurozone require that the ECB optimally target the inflation rate of the regions with the highest degrees of price/wage stickiness, in order facilitate relative price adjustment at the lowest welfare cost. It has also been suggested the existence of significant inflation differentials should prompt the ECB to raise its inflation target in order to allow those countries that require real depreciation to avoid absolute deflation (Sinn and Reutter, 2001).

The dangers, real and perceived, of inflation differentials are thus not insignificant. They certainly confirm the importance of understanding the behaviour of inflation differentials among eurozone member countries. Moreover, the prospective enlargement of the eurozone with the entry of accession countries means that inflation asymmetries are likely to be even stronger in the future. It is therefore timely and appropriate to address this question.

3. The 'Outlier': Ireland's Inflation Surge in EMU: External or Internal Causes?

Ireland's experience calls for special attention: Irish inflation, below 5 per cent for almost fifteen years and averaging just under 2 per cent per annum in the five years prior to EMU membership, suddenly accelerated in late 1999 and has since then been persistently at the top of the EMU inflation league. CPI inflation touched an annual rate of 7 per cent in the twelve months to November 2000, before retreating to the 4-5 per cent range (Figure 3.1).

What went wrong for Ireland and is it a harbinger of the likely prospects for the accession countries? We argue that, in addition to domestic factors, EMU itself has contributed to the surge in Irish inflation. EMU did remove a potentially effective instrument of policy restraint (nominal exchange rate adjustment). Furthermore, by lowering nominal and real interest rates, EMU added an important demand fillip, especially manifested in soaring house prices. And the inflationary impulse, exceptionally strong for Ireland, that was generated by euro weakness in the early

years of the system might well have been offset by an appreciation of the Irish pound within the wide EMS band that was in effect from 1993-1998.[6]

Nevertheless, external factors are only part of the story of Irish inflation. These positive shocks were all superimposed on an economy running close to capacity, with effectively full employment and substantial net immigration. A sharp upward shift in the trend of real wages had already got under way by 1998. The sizable relaxation of fiscal policy after 2000 also added to domestic demand. Against this background, it is unsurprising that external shocks should have had such a striking effect.

Productivity

It is important to recognize that little if any of this inflation deviation is a reflection of the Balassa-Samuelson effect. Ireland's boom has been largely one of employment growth, and not exceptional productivity gains. Much of the very high apparent productivity growth in Irish manufacturing over the past several decades is an artifact of transfer pricing, and Ireland is already close to the EMU-average of per capita GNP (Honohan and Walsh 2002).

Exchange rate

From late 1996 to 2000, Ireland's nominal effective exchange rate depreciated by some 17 per cent (Figure 3.3). This was much more than in other EMU members, essentially because Ireland has by far the smallest share of its trade with euro-area participants (31 per cent, compared to 54 per cent for the others). Furthermore, the extreme openness of the Irish economy means that almost a third of aggregate demand (over 55 per cent of GDP) is met by non-euro area imports. Although much of that trade has something of the character of an entrepôt business, nevertheless, the sharp fall in the value of the currency against the US dollar and sterling from 1997 on has implied a much larger cost push factor than experienced by other members. Assuming a lag of several quarters in the pass-through of exchange rate to domestic

[6] In recognition of upward pressure on the real exchange rate, Ireland undertook a 3 percent nominal appreciation against its EMU partners in April 1998. A larger nominal appreciation at that time could have forestalled some of the inflationary pressure that was experienced after the formation of EMU.

CPI, Figure 3.3 points to a simple mechanism, namely that much of Ireland's inflation of 2000-2002 can be interpreted as a pass-through effect from the depreciation.[7]

Had it not been for adherence to the common currency, historical experience suggests that a surge in the value of the US dollar and sterling would have resulted in appreciation of the Irish pound against the DM.[8] To that extent, some of this imported inflation has been due to EMU accession.

Interest rates and house prices

Given the very high interest rates previously experienced, whether measured in nominal, exchange-rate corrected, or real terms (Figure 3.4), it was always clear that EMU accession would lead to a sizable step reduction in interest rates and a reduction in their volatility.[9] In the event, since EMU began, Irish real interest rates have been the lowest in the union at an average of *minus* 1 percent (reflecting the higher inflation rate).

This represents a sizable change in intertemporal prices facing resident households (as well as locally exposed firms *on average*), and this may be expected to alter local asset prices, such as that of housing. The Irish property boom since the late 1990s has pushed real house prices to well over 250 percent of the levels of the early 1970s and mid-1980s. Demographic pressures and real income growth have obviously contributed, and there may have been a non-fundamental (bubble) component but there will also have been an important contribution of capitalization effects of the

[7] The speed of pass-through seems to have slowed in recent years; cf. FitzGerald (2001) and FitzGerald and Shortall (1998) who point to a switch from sterling-based to euro-based pricing by the large UK groups which dominate Irish retailing.

[8] For example a typical log-linear regression of the Irish pound/deutsche mark rate on the bilateral rates vis-à-vis the US dollar of the pound sterling and deutsche mark on quarterly data for the wide-band period 93Q2-97Q3 produces:

$$e_{DM/IEP} = 2.76 + 0.52\, e_{\$/£} + 0.62\, e_{DM/\$} \quad \rho=0.64$$
$$(2.9) \quad (2.2) \qquad (6.2) \qquad (2.6) \quad R^2=0.896;\ DW=1.71$$

[9] The decade from 1983-93, during the narrow-band EMS period, saw real interest rates averaging 7.44 per cent per annum; excess returns on Irish money market instruments were more that 250 basis points relative to Germany during that period. In the wide-bank EMS period real interest rates fell to an average of 3.86 percent, but, with monetary policy holding money market rates as tight as possible it was not in the last couple of months of 1998 that nominal short interest rates (including floating mortgage rates) converged to the EMU average. Most mortgages in Ireland are still at floating rates, but in the run-up to EMU there was a big shift to mortgages interest rates fixed typically for three-to-five years. By early 1999, these accounted for 38 per cent of total mortgages; since then, most new mortgages have reverted to the floating model.

interest rate change (or the impact of interest rate decline on what market participants call "affordability"). [10] [11] [12] Just how big this capitalization effect is depends very sensitively on how large is the fall in the market's expectation of the likely average of real interest rates in coming years – at the extreme, a fall from 7 per cent real to close to zero real (close to the actual shift between pre-1993 and post 1999) could warrant a price doubling.

In principle, the capitalization effect need not require a change in the flow of credit, though in practice, recourse to bank credit to finance purchases of housing at the new higher prices is to be expected.[13] In practice, the decline in real interest rates by early 1999 was accompanied by a surge in (private sector) credit growth. However, the peak in house price inflation preceded the surge in credit just as it preceded the fall in interest rates. Credit expansion pushed from the supply-side could also have boosted the price of non-traded goods other than housing. [14] However, it is not possible to identify a close econometric link between the 1999 surge in credit demand and the upturn in CPI inflation, and subsequently credit growth generally moderated even as CPI inflation accelerated.

Internal factors: Wage behaviour

Real wage rates were remarkably slow to increase during most of the 1990s, despite the rapid growth in employment and a tightening labour market. This is partly because employers could still attract workers (from abroad and via an increasing

[10] There has been strong immigration since the early 1990s – a reversal of historical experience – as well a rapid aggregate income growth reflecting the growth in employment and decline in unemployment. Shifting tax considerations have also been quite influential in this context (Bacon, McCabe and Murphy, 1999). After a sharp but brief interruption in 2001, the resumption of rapid house-price growth thereafter was widely attributed to the re-introduction of tax incentives.

[11] Econometric analysis of the price of housing in Ireland 1979-98 (Roche, 1999) suggested that rising real incomes and falling interest rates could explain much of the rise in prices to end-1998, though he found prices to be about 12% above their fundamental values at that date (recall that there has been a further 40 per cent increase in real house prices since then).

[12] Note, though, that the peak of the house-price inflation was in the Spring of 1998, hence before the main decline in interest rates. Nevertheless, house buyers were already being urged by estate agents to discount the likely decline in mortgage servicing costs which by then were virtually certain (and which had indeed already been somewhat priced into those mortgage products that offered initial periods of fixed interest).

[13] Especially in an economy with an open capital market and easy access to foreign lending through the banking system. Retail credit institutions in Ireland increased their *net* position vis-à-vis Irish residents by 10 per cent of their total balance sheet in the first two years of EMU.

[14] New foreign entrants into the mortgage market have narrowed spreads and perhaps reduced non-price (creditworthiness appraisal) criteria for lending.

participation rate) and a series of multi-year neo-corporatist national wage agreements also contributed to wage restraint. These agreements were facilitated by reductions in income tax rates that allowed take-home pay of production workers to increase far more rapidly than wage costs to employers. This wage restraint was one of the main keys to the employment boom of the 1990s (Honohan and Walsh 2002).

From 1997, a less restrictive wage agreement and an increasing tendency for local wage rate increases above nationally-agreed levels saw real wages in manufacturing start to increase steadily, so that by late 2001 they had reached 14 percent above their 1996 average level (Figure 3.2).[15]

To some extent the recent increase in real wages reflects a catch-up relative to a period of artificial wage-repression (centralized wage agreements), restoring equilibrium between real product wages and marginal productivity. In addition, however, it also reflects a tightening labour market, as the traditional pool of expatriates dried up, and as the demand price of others (especially those more sensitive to house prices) increased. Finally there may also be exercise of market power by trade-unions in the tighter market. The affordability of these wage increases even by marginal exporters to non-euro countries was, of course, enhanced by the currency depreciation that began about the same time and, as such, part of the real wage increase can be attributed to currency movements.

Employers in non-traded sectors certainly attempted to pass on rising wage costs and this can be regarded as an additional twist to consumer price inflation in 2001-2002 when the direct effect of exchange rate depreciation was beginning to wear off. However, we view the source of this wage-driven inflation as primarily reflecting an improvement in the bargaining power of labour, rather than as evidence in favour of the Balassa-Samuelson hypothesis.[16]

[15] Historical data on other sectors is remarkably deficient, but the new series covering services employment also shows similar increases from 1998.
[16] Recall that the Balassa-Samuelson hypothesis assumes full employment and competitive factor and product markets.

Internal factors: Fiscal policy

Fiscal policy has certainly helped sustain high inflation in the last few years, especially with the rapid shift from high and rising surplus (before 2001) to deficit today. Even in the earlier years when revenue buoyancy kept the budget in growing surplus, fiscal policy was not withdrawing demand to the extent that the improved fiscal accounts reflected falling external debt service (as the external debt to GDP ratio declined), and increasing tax payments by foreign firms (exploiting the low tax regime). After 2000, the budget surplus declined rapidly with a turnaround of almost 6 per cent of GDP in just two years, mainly due to autonomous tax reductions and spending policy increases.

Summary on Ireland

Exchange rate depreciation from 1997 has been a major driver of inflation acceleration in Ireland after 1999. Not only did it raise import prices directly but it improved wage competitiveness, thereby facilitating a sizable increase in real wages. The fall in interest rates as Ireland joined EMU fuelled a house-price boom whose other causes were likely more important. That CPI inflation persisted after the currency stopped falling reflects domestic factors (the continued rise in real wages and the sharp relaxation in the budgetary position), in addition to delayed pass-through. Ireland's persistently higher inflation does not, therefore, cast doubt on the long-run convergence of inflation rates in the union. But to what extent wage and house-price inflation embody overshooting dynamics that may require painful adjustment in the future remains hard to establish with confidence.

4. Divergent Inflation Experience in Practice: Aggregate Data

In this section, we widen the focus to the whole eurozone. The close, albeit lagged, correlation between the hump-shaped time series of EMU inflation and movements in the USD/EUR exchange rate is documented: the correlation is observed across the zone, but has also been associated with a widening of the dispersion of inflation rates since EMU began. However, we show that this has been matched by a *convergence* of absolute price levels, a convergence which has been a unnoticed but invariable characteristic of episodes of dollar strength for several decades.

The initial decline in nominal interest rates – a once-off asymmetric shock – does seem to have been associated with differential effects on property price levels. And, contrary to a simplistic view of the price process in a currency union, national output gaps continue to have a significant impact on national inflation rates, although government deficits have no separate effect (apart from their indirect effect on output gaps).

The section concludes with a formal modeling of how these factors have interacted jointly to determine national inflation rates.

Converging inflation rates to EMU…and then diverging!

After a long period of decline, reflecting the convergence demanded by the Maastricht Treaty, mean and median inflation in the EMU area bottomed out (somewhat ironically perhaps), in the first months of the new currency, namely during the quarter to March 1999: see Figure 4.1. Since then, the rebound has, however, only been a modest one from about 1.25 per cent to between 2 and 2.5 per cent.[17] By 2002, inflation rates were slowing again in the EMU, giving a generally hump-shape (inverted U-shape) to the plot of inflation rates since 1999 (Greece apart): see Figure 4.2. [18]

Dispersion of inflation rates between member countries, whether measured by the overall spread between maximum and minimum, by standard deviation, or by the coefficient of variation, has also widened since 1999, though it remains well below the figures recorded before 1997 (Figure 4.1). Indeed, the increase of 0.2 percentage points in standard deviation (from the 1999 quarterly average of 0.8 per cent to 1.0 per cent in 2001-2002) is much less than the increase in mean and median of more than 1.0 percentage points.

The major outliers in the years before EMU began were Greece and Portugal. Since the start of EMU the clustering of countries has remained quite tight (Figure 4.2). In only one country (Ireland) has 1999-2002 inflation differed from the EMU-wide mean

[17] Nevertheless, the rebound in dispersion is striking relative to the sustained and almost complete convergence in bill and bond yields (cf. Adjaouté and Danthine, 2002).
[18] Of course, Greece was not a member of EMU until 2001. Much of the empirical work below excludes Greece.

by more than one standard deviation. Ireland's mean annual inflation in this period was 4.1 per cent, compared with an EMU average of 2.5. The next highest countries were Greece, Netherlands, Portugal and Spain with between 3.1 and 3.2 per cent.

Comparing Inflation Dispersion in EMU to the United States

Though the dispersion of inflation rates took some observers by surprise, Table 4.1, reporting summary statistics on the distribution of national/regional inflation rates in the eurozone and the US over 1999-2001, shows that the dispersion, as measured for example by the coefficient of variation (CV) was not dramatically wider in the eurozone during these years. Indeed, the range for inflation is bigger for US regions in each of the years 1999-2001. This table indicates that, at least over this period, the degree of inflation dispersion in the eurozone is not out of line with that occurring in the other major advanced country currency union.

Moreover, if national/regional price levels have a common long-run trend, inflation differentials should diminish over time. Although we do not have a long time series for the eurozone, Table 4.2 offers some relevant comparisons. For the 'Euro Core' countries, the range in average annual inflation rates (measured in a common currency) was only 0.2 percentage points over 1972-1998. Indeed, this is lower than the ranges calculated for US regions over various time intervals, as is shown in columns (2) and (3). These data suggest that there is a substantial non-permanent component to inflation differentials. That said, the existing evidence is that inflation differentials are only eliminated slowly: Cecchetti et al (2002) estimate the half-life of convergence for US regions to be nine years.

This comparison with the United States experience is instructive: inflation differentials in the eurozone do not appear to be extraordinary; moreover, differentials should be reversed over time. However, even if the distribution of relative inflation rates turns out to continue to be similar between the eurozone and the United States, inflation asymmetries may be more troublesome for the eurozone than for the United States, for the reasons we argued in section 2.

Exchange rates a major factor in explaining inflation divergence

Section 2 above already flagged differential import price movements as a possible source of inflation differentials. Shifts in exchange rates are an important source of such movements. Even though the exchange rate movements are the same for all EMU members, the widely differing trade patterns means that the impact on prices can be quite different.[19]

We show this in regression A in Table 4.3. A pooled regression of quarterly changes in national nominal effective exchange rate indices on the euro-dollar exchange rate 1998.4-2002.2 produces an R^2 of 0.85 fixed effects are not significant. The coefficients on the dollar rate, estimated quite precisely, vary widely from 0.07 in Luxembourg and 0.11 for Austria to 0.24 for Finland and 0.35 for Ireland. Thus the impact, during the EMU period, of the change in the euro-dollar rate for the Irish effective exchange rate index was five times that for Luxembourg, taking into account the correlated changes in other exchange rates.

So far as the time-path of euro-zone inflation during EMU is concerned, the first thing to note is that the hump-shaped pattern already noted of average four-quarter price level movements in EMU (Figures 4.1 and 4.2) is rather strikingly paralleled by a hump-shaped pattern of four-quarter exchange rate changes (euro against the dollar) (Figure 4.3). Actually, the same pattern is observed for most of the countries. For Germany the link can be traced further back to the previous exchange rate cycle 1997-98, though the timing of the link is somewhat different (Figure 4.4).[20] In fact, the average lag for Germany in the EMU period appears to be about 6 months, apparently increasing as time goes on, whereas it appears to be about one year for the average.[21]

[19] Even if trade patterns were identical, variation in rates of pass through could still lead to inflation divergence in response to an exchange rate shock. This has some relevance: a large (albeit declining) share of Irish consumer imports has traditionally been invoiced in Sterling, whereas the same goods imported into Germany or France might be invoiced in euro, due to different distribution networks. The determinants of exchange rate pass through are the subject of much current theoretical and empirical work in international macroeconomics. At a broad level, we may expect the introduction of the euro to increase the proportion of imported goods that are priced in euro rather than in foreign currency, which will act to insulate eurozone prices from temporary exchange rate shocks.

[20] This could possibly be because of a less accommodating monetary policy since EMU began, or to the extent that the causality may have been from a price surge in Germany in 1997-1998 to exchange rate movements, whereas whereas it was undoubtedly the other way in 2000-2001.

[21] The amplitude of Ireland's hump-shape is the highest, but then, as already noted, its trade exposure to non-EMU partners is also the largest. The correlation across countries between average inflation and the ratio of non-EMU trade to GDP is significantly positive, but mainly because of the Irish data point. This question can also be examined at the level of national trade-weighted exchange rate indexes.

As a preliminary bivariate verification and quantification of the relation between exchange rates and price levels, we estimated a panel regression on quarterly data linking national CPI changes to previous exchange rate movements (results of estimating a more fully-specified model on annual data are presented later). We include an error correction term to capture the long-run relation between exchange rate and price level trends: we allow the long-run coefficient a_{4i} to vary across countries, to take into account variation in exposure to extra-eurozone trade. The model estimated was:

$$\Delta p_{it} = a_1 + a_{2i}\Delta e_{t-1} + a_3[p_{it-1} - a_{4i}e_{t-2}] + \varepsilon_{it} \quad (1)$$

The results of this regression are shown in Table 4.3 (Regressions B, C, D,E) and display a convincingly close fit, whether it is the dollar-euro exchange rate or the nominal effective index that is used. Moreover, the largest coefficients a_{4i} are for the outlying countries for inflation as a whole (Ireland, Greece, Netherlands and Portugal).

Price Level Convergence

Despite the existence of the common currency, it is not correct to interpret inflation differentials between members as implying a deviation from PPP in first differences. For there is the rest of the world to take into account, and to the extent that trading partners differ, then it may be that some of the raw inflation differentials between EMU members have had the effect of reducing deviations from PPP measured on a trade-weighted basis. Moreover, if initial price levels differ, inflation differentials are required for convergence to PPP. This subsection examines the convergence of PPP-adjusted exchange rates (a measure of absolute price convergence).

Figure 4.5 shows the relation between productivity growth and real exchange rate appreciation for post-EMU and a representative pre-EMU period for a set of European countries.[22, 23] The positive correlation implied by a crude version Balassa-Samuelson

[22] We include non-EMU members here since long-run real exchange rate dynamics should be in force regardless of the exchange rate regime.

[23] See Alesina et al (2001) for a simplified rendition of this explanation. See Obstfeld and Rogoff (1996) for a more comprehensive textbook treatment. Devereux (2000) makes the point that productivity growth may be more important

hypothesis is not present in this short period. Indeed, there is actually a strong negative correlation between productivity growth and real exchange rate appreciation during 1998-2001 (thanks largely to Ireland and Greece, and also the UK). As a matter of theory, this is not too surprising: Benigno and Thoenissen (2002) and FitzGerald (2002) have recently emphasized that fast productivity growth can lead to real depreciation. One factor is that it may generate a terms of trade deterioration; another is that productivity growth in the nontraded sector should be associated with real depreciation.

Nevertheless, a positive *cross-sectional* relationship between PPP/exchange rate and the level of GDP per capita has existed consistently for several decades among the EMU members.[24,25] And the gradual convergence in living standards as between different countries has contributed to some long-term convergence of price *levels* across countries.[26] For example, the coefficient of variation of PPP/exchange rate (which we will call the index of price level dispersion) declined from an average of 19 per cent in the early 1970s to 14 per cent in 2001. But there have been wide fluctuations over the period, with the index going as high as 24 per cent in 1978.

Interestingly, movements in the index have been correlated, not only with the dispersion of per capita income, but strikingly with the DM/dollar market exchange rate (Figure 4.6).[27] When the US dollar is strong, prices in Europe converge. Although the empirical relationship has been quite tight, this point does not appear to have been noticed in the literature over the years; whatever forces underlay it in the

[24] The positive relation between output per capita and price levels may reflect the Balassa-Samuelson mechanism but also non-homotheticity in tastes and the importance of quasi-fixed factors (e.g. land) in the nontraded sector.

[25] The slope of this line appears to have flattened, however, presumably reflecting closer good market integration. (Figure 4.7). (Detailed regression results not reported).

[26] See also Rogers (2002) who uses a different measure for the price level (from the EIU) and finds that the greatest reduction in price dispersion took place in the early 1990s, rather than being associated with the advent of the single currency. Beck and Weber (2001), Chen (2002) and Imbs et al (2002) study price dispersion across European regions but the focus is on (possibly nonlinear) speeds of convergence rather than the determinants of the price gaps.

[27] The cross-sectional standard deviation of per capita GDP enters with a negative "wrong" sign if included in this regression on its own on annual data 1970-2001, but this is due to a data discontinuity in 1991 after the unification of Germany enters the statistics. Accounting for this with a slope dummy restores the "right" sign. The fit of the resulting equation is quite good. It implies that a 10% per cent movement in the dollar/DM rate narrows the index by about 0.75 per cent .The regression is:

$$Coeffvar_t = -0.14 + 1.69\, Gdppc_t - 0.54\, Uni{*}Gdppc_t + 0.075\, \$/DM_t$$
$$(1.4)\quad (2.9)\qquad (7.0)\qquad (5.3)$$
$$R^2=0.811 \quad DW= 1.61$$

past are likely to have been the drivers once again of the price level convergence during the first three years of EMU. [28]

Other policy factors: fiscal policy and interest rates

In addition to the roles played by effective exchange rate movements and price level convergence, what policy-related factors have contributed to inflation differentials within the eurozone? In the case of interest rate and fiscal deficit policy, a common rule structure was nominally in effect (much weaker in the case of fiscal policy). But once again, as with the exchange rate, the actual impact of the evolution of interest rate and fiscal variables on inflation rates was, if anything, to contribute to divergence.

In the presence of nominal price or wage stickiness, aggregate demand factors play a role in driving inflation and real exchange rates in the short run and can push output above its long-run potential level. The pairwise correlation between output gaps and inflation rates was 0.50 over 1999-2001.[29]

One factor driving aggregate demand in some countries during this period was a sharp decline in real interest rates. The convergence of both nominal and real interest rates in the different member countries was sharp as the start date for EMU approached. But, while nominal rates remained bunched together, the spread between real interest rates widened out again subsequently as inflation diverged. Ironically, this placed some of those countries with previously high real interest rates (such as Ireland, Spain, Portugal and Greece) at the lower end of the range later: Figure 4.8 clearly shows a negative correlation between pre- and post-EMU real short-term rates. The fall in real interest rates in those countries with higher than average inflation is a potentially destabilizing factor, sustaining spending levels and hence upward demand pressure on prices in exactly the countries that already have relatively high inflation, hence working against the factors that tend towards inflation convergence.

[28] For example, Crucini et al. (2001) who stress that nominal exchange rate movements were of little effect in influencing real exchange rates over a five-year interval. But see Papell (2002).
[29] It is beyond the scope of this paper to discuss the empirical failings of the existing measures of output gaps. We employ the OECD measure in this study. See also European Central Bank (1999).

In addition its general contribution to excess demand, we already noted for Ireland the potentially large contribution of a fall in nominal and real interest rates to property price inflation. There is a fairly strong negative cross-sectional correlation between real interest rate declines in the run-up to EMU and commercial property inflation 1995-2001 (the correlation is –0.67).[30] Beyond the wealth effect of rising property values on domestic consumption, a boom in the property market may also store up a future adjustment problem.

Turning to another policy influence on the level of domestic demand, fiscal positions are partly endogenous, especially to the business cycle and to interest rates. Furthermore, budget deficits are somewhat constrained by the Stability and Growth pact, as well as being influenced by the scale and direction of intra-EU transfers. Nevertheless, to a large extent, within the period under review, the cyclically-adjusted primary surplus has been largely under the control of national governments, although there may be a policy feedback from observed inflation. However, there appears to be no cross-sectional correlation between inflation and the cyclically-adjusted primary surplus during 1999-2001: the bivariate correlation is –0.002.

With respect to another dimension of fiscal policy, changes in the indirect tax burden tend to show up in consumer prices. In principle, this is quite a complex thing to measure. However if we take the change in the share of GDP taken in taxes on goods and services as a rough and ready measure, we will get some indication of trends in indirect taxation. Interestingly, calculating this change for the period 1998-2001, we find that the correlation with post-EMU inflation is insignificantly negative; even if the outlier Ireland (for which the ratio of consumption to GDP declined sharply during the period) is removed, the correlation, although now positive, is still insignificant.

Panel Regressions

To conclude this section, we report results for multivariate panel regressions to establish the relative contributions of some of the key factors discussed above in

[30] For the eight countries where data is available. There is no cross-sectional bivariate correlation with residential property inflation – Italy, with a sharp fall in interest rates, experienced only modest house price rises 1995-2001. Starting with 1995 allows anticipatory price movements as discussed (in fact, the correlations for 1998-2001 are not significant.

driving inflation differentials within the eurozone over 1999-2001. A fairly general specification for inflation differentials can be written as

$$\pi_{it} - \pi_t^E = \beta * (z_{it} - z_t^E) - \delta\left([P_{it-1} - P_{it-1}^*] - [P_{t-1}^E - P_{t-1}^{E*}]\right) + \varepsilon_{it} \quad (2)$$

where π_{it}, π_t^E are the annual national and eurozone inflation rates respectively; z_{it}, z_t^E are national and eurozone variables that exert short-term influence on the inflation rate; P_{it}, P_t^E are the national and eurozone price levels and P_{it}^*, P_t^{E*} are the national and eurozone long-run equilibrium price levels.[31]

If we assert that the eurozone countries share a common long-run price level, this expression can be simplified to

$$\pi_{it} - \pi_t^E = \beta * (z_{it} - z_t^E) - \delta\left(P_{it-1} - P_{t-1}^E\right) + \varepsilon_{it} \quad (3)$$

The assumption of a common long-run price level is plausible for a putative convergence club such as the eurozone, with tight trade and institutional linkages eliminating income and productivity differentials over time.[32] [33] We also experimented with the alternative hypotheses that even long-run price levels may diverge due to productivity or income differences and we report results below for

[31] We do not include country fixed effects, since it is implausible that there exist permanent inflation differentials across eurozone member countries. This specification assumes that inflation differentials are stationary; equivalently, that national and eurozone price levels are cointegrated. Clearly, we cannot test these assumptions given the short time interval but these assumptions are firmly grounded in economic theory and so we are comfortable in treating these as maintained hypotheses. We note that much recent empirical work on real exchange rates postulates a non-linear speed of adjustment to the long-run equilibrium. Our short time span does not permit us to investigate such nonlinearities. Finally, this specification implicitly assumes a common speed of adjustment at local and European levels: again, more data could allow us to relax that assumption.

[32] See also Froot and Rogoff (1995) and the empirical work by Zussman (2003). The latter finds evidence of absolute convergence in price levels among OECD countries.

[33] We earlier remarked that the degree of price dispersion in Europe appears to comove with cycles in the euro-dollar (DM-dollar) exchange rate. To allow for this cyclical effect, one could write an expanded specification $\pi_{it} = \phi_t + \beta * z_{it} - \delta * P_{it-1} - \gamma * DOLDUM * P_{it-1} + \varepsilon_{it}$ where DOLDUM takes the value 1 if the dollar is in a strong phase and -1 if it is weak. In a short period during which the dollar was continuously strong, it is not possible to disentangle the long-term and cyclical price convergence effects. We return to this point later.

these cases. However, we do not find a significant role for these variables and so focus on the more restricted specification in our main discussion.[34]

In turn, the eurozone variables can be linearly combined into a time dummy, which allows us to write

$$\pi_{it} = \phi_t + \beta * z_{it} - \delta * P_{it-1} + \varepsilon_{it} \tag{4}$$

Following our analysis in the previous subsection, we include three variables in our z-vector. These are the rate of change in the nominal effective exchange rate (lagged by one period), the impulse in the cyclically-adjusted fiscal surplus and the output gap.[35] This gives us our empirical specification

$$\pi_{it} = \phi_t - \delta P_{it-1} + \beta_1 \Delta NEER_{it-1} + \beta_2 FISC_{it} + \beta_3 GAP_{it} + \varepsilon_{it} \tag{5}$$

where π_{it} is the annual inflation rate, P_{it-1} is the lagged price level, $\Delta NEER_{it-1}$ is the lagged growth rate of the nominal effective exchange rate, $FISC_{it}$ is the impulse in the cyclically-adjusted primary surplus and GAP_{it} is the output gap.[36]

Tables 4.4-5 show the results from the panel estimation. Table 4.4 displays the pooled OLS equations; GMM estimates are shown in Table 4.5, where we instrument for the fiscal impulse and the output gap using lagged values of these variables. We consider four measures of inflation: CPI (based on HICP data); CPI excluding energy (CPI-EN); GDP deflator (PGDP); and wages (WAGES).

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[34] Rogers (2002) also employed a productivity proxy in his empirical work but found it to be insignificant for this period. As is discussed further later in the paper, these variables may becomeg more important once the eurozone is enlarged to incorporate the accession countries.

[35] Of course, the fiscal position may primarily operate by affecting the size of the output gap. We allow for an additional independent effect, since the fiscal balance may shift the composition of expenditure towards domestically-produced goods, exacerbating inflationary pressures even if the output gap is not affected.

[3636] We measure inflation using the Eurostat HICP data; the price level is measured by the consumption price level in the Penn World Tables version 6.1 (this variable is highly correlated with the OECD PPP measure but is conceptually more appropriate); the nominal effective exchange rate, fiscal surplus and the output gap are from OECD sources. We lag the nominal effective exchange rate by one year in recognition of delayed pass-through from exchange rates to consumer prices. The impulse in the cyclically-adjusted fiscal surplus is measured by $PRIM_{it} - \sum_{j=t-1}^{j=t-6} PRIM_{ij} / 6$.

The table shows that the price convergence effect is highly significant for the three price-based measures of inflation, even if not for wages.[37] For CPI inflation, the -0.03 point estimate implies that a country with a price level one-third below the European average would experience an additional one percentage point of inflation. This is significant in terms of the inflation variation observed in the eurozone but also implies that the convergence process is quite gradual.

The impact of the exchange rate on inflation is significant across columns (1)-(8): a country that undergoes a depreciation of its nominal effective exchange rate that is larger than the European average will also have relatively higher inflation. The point estimate of -0.28 in the CPI equation means that a relative depreciation of 3.5 percent is associated with an additional one percentage point of inflation. This is a large effect: for instance, the Irish nominal effective exchange rate depreciated by a cumulative 11 percent during 1998-2000, whereas the French exchange rate weakened by only 4 percent.

In the OLS estimates, the fiscal surplus is not significant; however, it is somewhat significant in the GMM estimates for the CPI-EN and WAGE inflation measures. The positive sign on this variable is contrary to prior expectations: an increase in the fiscal surplus is associated with relatively higher inflation. In view of its fragility, we do not dwell on this result. [38]

Finally, the output gap is consistently important in all specifications. As might be expected, this variable is relatively more important for the domestically-generated inflation measures (the GDP deflator and wages) than for the broader indices.

These results show that a considerable proportion of the inflation differentials in the eurozone over 1999-2001 can be systematically related to a small number of

[37] In 1998, the Spanish and Portuguese consumer price levels were respectively 25 percent and 35 percent below the German level.
[38] A similar positive comovement is also found by Canova and Pappa (2003), who perform a sophisticated instrumental-variables procedure to guard against reverse causation.

macroeconomic variables.[39] The price convergence effect can be viewed as a long-run constraining factor on inflation differentials: long-run price levels in the eurozone should move together. The importance of the output gap highlights the role of short-run imbalances in generating local inflation pressures. However, controlling for the output gap, there does not seem to be a strong role for the fiscal impulse in determining inflation.

Perhaps the most novel finding is the important role played by the nominal effective exchange rate in explaining inflation differentials: eurozone member countries continue to have quite different trading patterns and hence exposure to external currency fluctuations is quite variable. We may view this source of inflation differentials as temporary along two dimensions. First, there is surely a substantial temporary component to the decline of the external value of the euro during 1999-2001: indeed, recent months have seen a sustained recovery. Second, trade patterns will continue to evolve, with a plausible shift towards a greater proportion of intra-eurozone trade. The importance of external trade will also decline if the eurozone club expands to include the 'outs' (especially the United Kingdom) and the accession countries. Moreover, to the extent that some non-joiners track the euro, this will limit the degree of volatility in nominal effective exchange rates (cf. Honohan and Lane, 1999). Finally, as was already noted, the introduction of the euro should over time alter pricing strategies, with more imports to the eurozone priced in euro rather than in foreign currency, shifting the impact of exchange rate shocks from consumers to producers.

Because they are likely to unfold over several years, it is too early to make much progress in detecting econometrically the danger, discussed informally above, of the amplitude and duration of price shocks being magnified in particular countries through destabilizing real interest rate and wage rate dynamics. As a longer data set accumulates, this will become a priority for further research.

[39] Regarding the estimation procedure, we note that serial correlation in the residuals is minor. In fact, taking the CPI inflation equation, the correlation between e_{it} and e_{it-1} is negative (-0.30). Moreover, there is no evidence of spatial correlation in the residuals: a regression of $E(e_i e_j)$ on the log of bilateral distance yields an adjusted R^2 of 0.01 (the correlation is 0.15).

Robustness checks

Tables 4.6-4.7 report the results for expanded specifications in which productivity or income levels are allowed to affect long-run price level differentials.[40] Since shifts in these variables alter the long-run equilibrium price level, we allow innovations in these variables in addition to the lagged level values to influence the inflation differential in columns (2) and (4). These variables are not significant in any of the specifications. Moreover, despite the reduction in degrees of freedom, the results for the other regressors are largely unaffected. We also ran regressions that excluded the fiscal variable: the results are little changed in this narrower specification (results in the appendix).

As another sensitivity check, Table 4.8 provides the results for the subsamples obtained by dropping one country at a time.[41] The main results are quite stable: the point estimates and the t-statistics vary relatively little. The main exception is the fiscal variable, which turns marginally positive in a couple of subsamples.

Relation to the existing literature

The empirical contribution that is closest to ours is Rogers (2002). His results are largely complementary to ours. However, he does not include the nominal effective exchange rate as an explanatory variable.[42] Moreover, he does not focus specifically on the 1999-2001 period (he provides results instead for 1997-2001 that combine pre-EMU and post-EMU data).[43] The European Central Bank (1999) also documents a strong bilateral relation between inflation differentials and output gaps but just using cross-sectional data for 1999.

[40] We report only the estimates for the CPI measure here. The appendix contains the tables for the other inflation measures.
[41] Here, we just show the GMM estimates for the CPI measure. The appendix contains the other tables.
[42] He does include a measure of openness to extra-eurozone trade. However, this variable will not have a stable sign : during periods of euro appreciation, it should have a negative sign; and a positive sign if the euro depreciates. In addition, the composition of extra-eurozone trade also matters in determining exposure to various bilateral exchange rate movements. This consideration is incorporated into the construction of the nominal effective exchange rate.
[43] His measures of the initial price level and the fiscal variables also differ from ours.

5. Counterfactuals

In the previous sections, we have documented and attempted to explain the inflation differentials among the EMU member countries over 1999-2001. In this section, we ask to what extent whether independent monetary policies would have delivered different outcomes.

As a simple illustration of the potential scale of the difference between the actual interest rates observed in the EMU members and what might have been adopted by national central banks, we calculated counter-factual country-specific interest rates using a version of the 'classical' interest rate rule proposed by Taylor (1993). The rule sets

$$R_t = 4.0 + 1.5 * (\pi_t - 2.0) + 0.125 * GAP_t \qquad (6)$$

This rule is based on an average real interest rate of 2.0 percent, an inflation target of 2.0 percent, π_t is the inflation rate and GAP_t is the OECD's calculated output gap for each country. This specification conforms to the standard principles of Taylor rules: respond aggressively to inflation signals but also take into account deviations of output from its estimated potential level.[44] Table 5.1 presents data on the distribution of the implied country-specific interest rates, expressed as deviations from the German rate.[45] The calculation confirms that 'freely-chosen' interest rates would have been considerably dispersed, with the range maximized in 2000 at 5.69 percentage points.[46]

A complementary approach to addressing this question is to treat the specification in equation (2) as a regime-independent model of inflation. In this case, monetary policy

[44] There is a literature on the specification of Taylor rules for open economies. Variation in trade openness may mean that the optimal coefficients in the Taylor rule should vary country by country. In addition, an additional exchange rate term could be added to the rule that would imply interest rate responses to exchange rate fluctuations. However, Leitemo and Soderstrom (2001) find that adding an exchange rate term adds little to performance and the simple rule here is useful for illustrative purposes.

[45] Some other authors have implemented similar rules for the aggregate eurozone economy (Faust et al 2001, von Hagen and Bruckner 2002). By expressing the constructed interest rates in terms of deviations from the German level, the impact of alternative choices concerning the target nominal interest rate and inflation rate is minimized.

[46] France has the lowest implied interest rate in each year; Ireland has the maximum in 1999-2000, with the Netherlands the maximum in 2001.

would operate by affecting the values of the regressors: in particular, would country-specific interest rate policies have meant different values for the output gap and the effective exchange rate?[47]

Taking these in reverse order, it seems likely that at least some of the member countries would have acted to prevent large movements in their effective exchange rates by raising interest rates in response to the dollar appreciation in 1999-2000. For instance, as was noted in section 3, the historical evidence for Ireland is that it would have acted to eliminate about half of the dollar-DM movement. A combination of higher interest rates and less currency depreciation would have acted to moderate inflation pressures in these countries.

With regard to the output gap, there are several reasons to believe output gaps would have been smaller under national monetary policies. Most obviously, a counter-cyclical monetary policy would have helped to close output gaps. In addition, as was discussed earlier, one source of domestic demand in the high growth economies has been the sharp fall in interest rates relative to pre-EMU levels in these countries: in the absence of EMU, any such interest rate reduction would have been smaller and would have been smoothed out under standard monetary procedures. Another contributor to output gaps has been the exchange rate depreciation in some of the countries: as noted above, the scale of depreciation in several countries would have been muted by interest rate increases under independent monetary policies.

Regarding the other variables included in equation (6), would fiscal policy have been more restrictive in the high-inflation countries under an alternative monetary regime? With higher interest rates, it seems likely that primary deficits would likely have been lower. However, it is plausible that the price level convergence effect may have been weaker in the absence of a common currency. The common currency has increased the transparency of price differentials (especially since the introduction of notes and coins in 2002) and may have also increased trade integration.[48] In that case, the low-

[47] We take the initial price level as largely independent of monetary policy during this period.
[48] See Rose (2000) and the subsequent empirical literature on this point. However, Rogers (2002) argues that the price level convergence effect is no stronger among the eurozone countries than among the wider EU club.

price countries would have experienced lower inflation and the high-price countries faster inflation.

The discussion so far in this section does suggest that a superior inflation performance may have been attainable under independent monetary policies. However, proponents of a single currency can point to some counter-arguments. First, the ongoing integration of European product and factor markets (possibly accelerated by the advent of EMU) will plausibly erode persistent inflation differentials. In line with the price level convergence effect, the scope for dispersion in traded goods prices is falling. Labour markets are also responding, with high-growth countries receiving net inflows of migrants, easing pressure on wage rates.[49] Finally, there are indications of increased portfolio diversification among the eurozone countries that should partially smooth out national income shocks through risk sharing. However, we also note that the absence of a eurozone federal fiscal system means that an important risk-sharing mechanism in the US is not available to the eurozone countries.

6. Implications for Accession Countries

The relevant initial conditions of the accession countries and other prospective euro members differ widely. Accordingly, while there are some general implications, these would have to be interpreted on a country-by-country basis, a task which is not attempted here.

Overall, the experience of the first several years of the system reveals that convergence of inflation rates cannot be expected to be as tight or as quick as had been anticipated by some. We view the 'price convergence' effect as generally benign and self-limiting: temporary inflation differentials are a necessary part of the transition to long-run real exchange rate equilibrium.

With respect to the divergence in inflation rates that is induced by variation in exposure to shocks to the external value of the euro, policy should not over-react to such dispersion since the nominal exchange rate movements themselves are sure to be

[49] The correlation between output gaps and net immigration during 1999-2000 was 0.70.

limited and largely self-correcting as long as monetary authorities in the leading countries continue to succeed in restraining inflation over the long-term.

The accession countries and the member states which have not adopted the euro are, on average, as highly specialized in trade with the current EMU participants as the latter are themselves (Table 6.1). If we take the non-EMU imports as a percentage of GDP, this is not much higher on average in the accession countries and is actually lower in each of the "out" countries, by comparison with the "ins". There is considerable variation. Estonia and Malta are rather highly exposed to non-EMU trade, though neither to the same extent as Ireland. These countries can be expected to experience wider fluctuations in their CPI inflation, though hardly to an extent that would make a case for delaying EMU membership.

Does CPI volatility from such a source matter for policy? In terms of monetary and exchange rate policy, if a case could be made for augmenting mean EMU-wide inflation with some function of the cross-country variance of inflation as the target for EMU policy, then it would follow that the external exchange rate of the euro could become a useful intermediate objective or indicator of monetary policy. However, the assessment of whether the ECB should stabilize the external value of the euro would surely be much more heavily influenced by other factors than this consideration.[50] On the whole, there seems little reason to over-react.

There is another potential dimension to exchange rate policy, namely the establishment of bilateral arrangements for stabilizing exchange rates between the euro and the currencies of "fringe" trading partners (Honohan, 1999). With enlargement both of the EU and EMU membership, the potential gains from such arrangements will already be largely secured and, in any case, would have little impact compared to the volatility of bilateral exchange rates vis-à-vis major trading partners such as the US and Japan.

[50] Some degree of exchange rate stability can be achieved via sterilized intervention (the ECB and other central banks in late 2000 established a floor to the dollar/euro rate through coordinated euro purchases on foreign exchange markets). In principle, a global target-zone system could also be envisaged by which Europe, the US and Japan coordinate monetary policies to limit exchange volatility among the major currencies. There seems little appetite for such a reform of the international monetary system at present.

Should national fiscal deficits and surpluses be employed as a tool to damp inflation fluctuations? The standard prescription is that fiscal policy should be more counter-cyclical to compensate for the absence of an independent monetary policy (cf. EEAG, 2003, Chapter 2). However, in line with Perotti (2003) and others, we found little econometric evidence of the stabilizing properties of discretionary adjustments to the budget balance beyond those captured in the output gap.[51] Moreover, the empirical investigation by Lane (2003) suggests that governments find it hard for political reasons to push the discretionary component of fiscal policy in a counter-cyclical direction. In combination with the well-known problem of correctly timing fiscal interventions, these results suggest that national fiscal policy does not offer a "silver bullet" in tackling excessive inflation differentials. It seems to us that further research on the appropriate role for discretionary fiscal policy in regional stabilization must be a high priority for European macroeconomists.

Perhaps the major message is for those involved in wage negotiations. Although we have argues that exchange-rate induced surges in national inflation are likely to be reversed, this view may not be shared by those negotiating on behalf of organized labour. Multi-year wage collective bargaining settlements based on an expectation of continued above-EMU average inflation could be very damaging to the competitiveness of labour in such circumstances. Given that the accession countries can be expected to support higher than average real wage increases on a sustained basis in the years ahead as their level of average productivity converges to the frontier, it will be much more difficult for negotiators in those countries to compute the appropriate and affordable rate of wage increase and the exchange-rate induced effects might easily be ignored or misinterpreted in making such calculations. Recognizing and calculating the external sources of inflation can, as we have shown, be of material significance here.

Macroeconomic conditions at entry also need careful management. We have already seen how a sharp fall in nominal and real interest rates contributed to demand pressure in Ireland and this will also ease budgetary constraints allowing a relaxation of fiscal

[51] The point estimates we obtained – though rarely significant – implied a disinflationary effect for expansionary fiscal policy, conditional on the output gap (a result also found by Canova and Pappa 2003). Indeed, this is the policy prescription of Duarte and Wolman (2002): income tax reductions during a boom can have a moderating impact on inflationary pressures.

discipline. New entrants should beware of allowing their economies to overheat in this way.[52] Careful attention should be paid to the rate at which currencies are pegged, especially for those countries which will experience a large fall in nominal interest rates. A more appreciated entry rate could help forestall a surge of property price and other inflation.

7. Conclusions

Despite the common currency, exchange rate movements have had a substantial effect on inflation movements and inflation differentials in EMU. This is partly because of the different degrees of exposure of member states to trade outside the euro zone. The diverging inflation rates have coincided with *convergence* of price levels is in part secular in nature and but may also reflect a recurrent – although largely unnoticed – feature of episodes of dollar strength. Much of the remaining pattern of inflation movements can be explained by national output gaps. The inclusion of fiscal imbalances adds no significant explanatory power. The initial fall in nominal and real interest rates – quite different across countries – likely not only contributed to inflationary pressures via raising aggregate demand in goods markets but may also have contributed to dispersion in property price movements in the run-up to and early years of EMU.

Although the observed differentials seem to have as a surprise to some observers, they are little larger than those experienced across US regions in the same years. To some extent, inflation differentials may be more persistent within a currency union than outside it in that national inflation rates and real interest rates are inversely related inside a currency union, generating a procyclical dynamic. From a policy perspective, finding institutional mechanisms that minimize the risk of real exchange rate overshooting is a high priority.

[52] Current inflation and real interest rate conditions differ widely among candidate countries. The latest 4-quarter mean inflation is almost 10 per cent, though less than 4 per cent for the ten countries expected to join the EU in 2004. Real ex post short-term interest rates recently varied from 10-11 per cent in Poland and Romania to negative values in Bulgaria. Real interest rates in Turkey have been extremely volatile.

Finally, although differential productivity growth has not featured centrally in the inflation experience of existing members in the early years, it will surely be a more relevant factor when accession countries join the euro. To the extent that inflation differentials reflect price level convergence and the operation of the Balassa-Samuelson mechanism, one can view such inflation differentials benignly. However, real appreciation inside a currency union also carries risks. With a low common nominal interest rate, real interest rates in the high-inflation countries will be negative. In turn, this may fuel an expenditure boom, generating extra inflationary pressure through an emerging output gap and a rapid runup in property prices. The potential overhang from such overheating pressures poses a serious risk for the accession countries.

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Table 4.1. *Summary Inflation Statistics: the Eurozone and US regions*

	Eurozone			US Regions		
	1999	2000	2001	1999	2000	2001
Mean	0.015	0.028	0.030	0.023	0.035	0.031
St Dev	0.008	0.010	0.011	0.008	0.008	0.009
CV	0.512	0.354	0.364	0.341	0.230	0.307
Max	0.025	0.052	0.052	0.042	0.058	0.054
Min	0.005	0.019	0.018	0.010	0.017	0.012
Range	0.020	0.033	0.034	0.032	0.041	0.042

Note: In this table, mean inflation rates are unweighted averages across eurozone member countries and US regions respectively. The US regions are XXX. Source: European data from Eurostat's HICP database; US data from Bureau of Labor Statistics.

Table 4.2. *Long-term Inflation Differentials*

			Range
(1)	Euro Core	1972-1998	0.20
(2)	US Regions	1976-1995	0.61
(3)	US Regions	1926-1995	0.95

Notes: Euro Core is Germany, Austria, Belgium, Netherlands, France and Italy. In columns (1)-(2), range is in average annual inflation rates (measured in DM for the Euro Core). In column (3), it is the mean range for non-overlapping decadal intervals over 1926-1995. Sources: Euro Core data adapted from Walton and Deo (1999); US Regions calculations adapted from Cecchetti et al (2002).

Table 4.3: Pass-through and related relationships

dep. var.:	*A* *Δneer*		*B* *Δcpi*		*C* *Δcpi*		*D* *Δcpi*		*E* *Δcpi*	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
a_1	0.000	0.4	1.967	3.9	1.962	3.5	1.115	3.6	1.012	1.8
a_2 (at)	-0.110	5.0			-0.023	1.3			-0.134	0.9
a_2 (be)	-0.169	7.7			-0.071	4.1			-0.355	3.5
a_2 (de)	-0.228	10.3			-0.037	2.1			-0.109	1.5
a_2 (fi)	-0.235	10.7			-0.105	6.1			-0.301	4.6
a_2 (fr)	-0.192	8.7			-0.046	2.6			-0.244	2.6
a_2 (ie)	-0.350	15.9			-0.103	5.9			-0.206	4.2
a_2 (it)	-0.186	8.4			-0.024	1.4			-0.100	1.1
a_2 (lu)	-0.072	3.3								
a_2 (ne)	-0.196	8.9			0.005	0.3			0.060	0.6
a_2 (pt)	-0.163	7.4			0.000	0.0			0.108	1.1
a_2 (sp)	-0.162	7.3			-0.030	1.7			-0.144	1.3
a_2			-0.043	6.0			-0.161	5.2		
a_3			-0.067	3.3	-0.064	3.4	-0.021	1.6	-0.019	1.3
a_4 (at)			-0.024	3.2	-0.024	3.3	-0.189	4.0	-0.202	3.4
a_4 (be)			-0.019	2.6	-0.020	2.7	-0.112	3.2	-0.117	2.6
a_4 (de)			-0.017	2.4	-0.018	2.5	-0.074	3.0	-0.079	2.5
a_4 (fi)			-0.024	3.1	-0.026	3.5	-0.111	4.5	-0.120	3.8
a_4 (fr)			-0.011	1.5	-0.012	1.6	-0.064	2.0	-0.073	1.7
a_4 (ie)			-0.068	6.7	-0.069	7.2	-0.117	7.7	-0.125	6.2
a_4 (it)			-0.030	3.8	-0.028	3.7	-0.110	4.0	-0.108	3.2
a_4 (ne)			-0.049	5.8	-0.045	5.7	-0.208	6.2	-0.175	4.4
a_4 (pt)			-0.052	5.8	-0.048	5.8	-0.213	6.1	-0.196	5.0
a_4 (sp)			-0.044	5.1	-0.041	5.1	-0.200	5.7	-0.192	4.6
ar(1)	0.404	5.2	0.803	14.5	0.845	14.5	0.708	10.9	0.831	11.1
Countries/obs.	11	143	10	140	10	140	10	140	10	140
Years	1999:1-2002:2		1999:1-2002:2		1999:1-2002:2		1999:1-2002:2		1999:1-2002:2	
Method	Unweighted panel		Unweighted panel		Unweighted panel		Unweighted panel		Unweighted panel	
RSQ/DW	0.854	2.06	0.895	1.82	0.925	1.62	0.898	1.78	0.914	1.75

Note: ar(1) is first order autocorrelation coefficient. Regression A is: $\Delta neer = a + b_i \Delta euro$; Variables: *Δneer*, *Δeuro* are log-change in the nominal effective exchange rate index (ifs ..ne) and in the (reciprocal of) euro/$ exchange rate (ifs 163..rh). Regressions B and C are of the form $\Delta cpi_i = a_1 + a_{2i} \Delta euro(-1) + a_3 cpi_i(-1) + a_{4i} euro(-2)$, where *cpi* is ifs line 64 (rebased); Regressions D and E replace *euro* with *neer*.

Table 4.4. *Panel Inflation Regressions: Pooled OLS Estimates*

	(1) CPI OLS	(2) CPI-EN OLS	(3) PGDP OLS	(4) WAGE OLS
Lagged Price Level	-0.030 (2.9)***	-0.042 (4.9)***	-0.065 (6.2)***	-0.013 (1.1)
D(NEER)	-0.28 (2.7)**	-0.3 (2.6)**	-0.39 (1.97)*	-0.44 (2.2)**
Fiscal Surplus	2.5 (0.3)	4.2 (0.6)	7.7 (0.7)	1.1 (1.1)
Output Gap	0.22 (2.65)**	0.28 (3.81)***	0.34 (3.62)***	0.59 (4.14)***
SE of Regression	0.007	0.006	0.009	0.009
Adjusted R Squared	0.61	0.75	0.65	0.68

Note: All equations include time dummies. Standard errors are White-corrected for heteroscedasticity.
*,**, *** denote significance at the 10, 5 and 1 percent levels respectively.

Table 4.5. *Panel Inflation Regressions: Pooled GMM Estimates*

	(1) CPI GMM	(2) CPI-EN GMM	(3) PGDP GMM	(4) WAGE GMM
Lagged Price Level	-0.032 (4.5)***	-0.046 (7.4)***	-0.067 (7.3)***	-0.018 (1.4)
D(NEER)	-0.28 (3.4)***	-0.26 (2.9)***	-0.36 (2.2)**	-0.35 (2.4)**
Fiscal Surplus	0.1 (1.7)	0.1 (2.8)**	0.1 (1.1)	0.2 (2.1)**
Output Gap	0.23 (4.0)***	0.34 (6.1)***	0.37 (2.7)**	0.71 (7.6)***
SE of Regression	0.007	0.006	0.009	0.009
Adjusted R Squared	0.6	0.73	0.65	0.65

Note: All equations include time dummies. Standard errors are White-corrected for heteroscedasticity. In the GMM estimation, the fiscal surplus and output gap are instrumented by their lagged values. *,**, *** denote significance at the 10, 5 and 1 percent levels respectively.

Table 4.6. *Expanded Specifications: CPI Inflation, OLS Estimation*

	(1) CPI OLS	(2) CPI OLS	(3) CPI OLS	(4) CPI OLS	(5) CPI OLS	(6) CPI OLS
Lagged Price Level	-0.030 (2.9)***	-0.029 (3.4)***	-0.039 (1.95)*	-0.036 (2.1)**	-0.039 (-1.98)*	-0.032 (-1.7)*
D(NEER)	-0.275 (2.7)**	-0.265 (2.8)**	-0.266 (2.6)**	-0.255 (2.3)**	-0.293 (-2.8)**	-0.174 (-1.1)
Fiscal Surplus	0.025 (0.3)		0.017 (0.2)	0.022 (0.3)	0.016 (0.2)	0.007 (0.1)
Output Gap	0.221 (2.7)**	0.221 (2.6)**	0.225 (2.7)**	0.223 (2.7)**	0.273 (1.9)*	0.172 (1.6)
Lagged Prod Level			0.004 (0.5)		0.004 (0.5)	
D(Prod)					-0.08 (-0.4)	
Lagged YC Level				0.002 (0.5)		0.001 (0.3)
D(YC)						0.073 (0.6)
SE of Regression	0.007	0.007	0.007	0.007	0.007	0.007
Adjusted R Squared	0.606	0.621	0.592	0.591	0.576	0.576

Note: Prod is labour productivity in the business sector; YC is GDP per capita.
Source: OECD Economic Outlook database.

Table 4.7. *Expanded Specifications: CPI Inflation, Pooled GMM Estimates*

	(1) CPI GMM	(2) CPI GMM	(3) CPI GMM	(4) CPI GMM
Lagged Price Level	-0.040 (2.6)**	-0.039 (2.8)**	-0.038 (3.0)***	-0.038 (2.8)**
D(NEER)	-0.270 (3.3)***	-0.307 (3.2)***	-0.259 (2.7)**	-0.254 (1.6)
Fiscal Surplus	0.068 (1.7)	0.043 (0.8)	0.075 (1.8)*	0.075 (2.1)*
Output Gap	0.239 (4.4)***	0.260 (3.1)***	0.240 (4.2)**	0.239 (2.7)**
Lagged Prod Level	0.004 (0.6)	0.004 (0.6)		
D(Prod)		-0.068 (0.4)		
Lagged YC Level			0.002 (0.6)	0.002 (0.6)
D(YC)				0.003 (0.03)
SE of Regression	0.007	0.008	0.007	0.008
Adjusted R Squared	0.586	0.574	0.585	0.565

Note: Prod is labour productivity in the business sector; YC is GDP per capita.
Source: OECD Economic Outlook database.

Table 4.8: *Sensitivity Analysis: CPI, GMM Estimates*

Sample	Lag Price Level	t-value	DNEER	t-value	PRIM	t-value	GAP	t-value	Adjusted R2
Full	-0.032	-4.532	-0.283	-3.427	0.073	1.713	0.231	3.992	0.683
Austria	-0.029	-2.730	-0.188	-2.081	0.048	0.853	0.265	4.760	0.667
Belgium	-0.033	-3.699	-0.283	-3.466	0.077	1.398	0.240	3.918	0.674
Finland	-0.038	-2.357	-0.367	-3.129	0.445	0.676	0.320	1.747	0.531
France	-0.027	-3.193	-0.281	-2.781	0.037	0.665	0.197	2.947	0.681
Germany	-0.033	-3.100	-0.302	-3.091	0.076	1.193	0.227	2.650	0.656
Ireland	-0.032	-3.349	-0.439	-2.070	0.059	0.757	0.274	2.134	0.607
Italy	-0.032	-3.794	-0.295	-3.314	0.061	1.028	0.210	2.818	0.690
Netherlands	-0.035	-4.992	-0.353	-4.119	0.073	1.969	0.189	3.337	0.836
Portugal	-0.036	-3.444	-0.258	-2.821	0.080	1.899	0.260	4.658	0.673
Spain	-0.035	-4.088	-0.248	-3.304	0.077	1.349	0.240	3.790	0.712
Mean	-0.033	-3.571	-0.300	-3.055	0.100	1.227	0.241	3.341	0.674
St Dev	0.003	0.767	0.067	0.602	0.115	0.480	0.038	0.980	0.073
Max	-0.027	-2.357	-0.188	-2.070	0.445	1.969	0.320	4.760	0.836
Min	-0.038	-4.992	-0.439	-4.119	0.037	0.665	0.189	1.747	0.531
Range	0.012	2.635	0.251	2.049	0.409	1.304	0.131	3.013	0.304

Note: Table reports results for subsamples obtained by dropping one country at a time from the estimation.

Table 5.1. Interest Rate Dispersion under Independent Monetary Policies

Year	Mean	StDev	Min	Max
1999	1.36	1.21	-0.19	3.21
2000	1.30	1.67	-0.17	5.52
2001	1.17	1.77	-0.60	4.37

Note: National interest rates as deviations from implied German interest rate.

Table 6.1: *Direction of Trade 2000-1*

	Non-EMU imports as % GDP	EMU as % Imports
EMU		
Austria	18.4	64.0
Belgium	33.9	59.1
Finland	22.5	33.1
France	12.1	55.3
Germany	19.6	41.9
Greece	17.0	46.9
Ireland	59.2	20.8
Italy	13.7	49.4
Luxembourg	33.0	74.0
Netherlands	36.3	40.1
Portugal	13.6	67.5
Spain	13.8	55.7
Average	***24.4***	***50.6***
Non-EMU EU		
Denmark	16.3	50.1
Sweden	19.4	48.6
United Kingdom	15.4	44.1
Average	***17.1***	***47.6***
Accession countries		
Bulgaria	32.9	43.7
Cyprus	27.2	39.6
Czech Republic	24.7	65.4
Estonia	51.2	38.8
Hungary	29.2	53.3
Latvia	27.5	39.9
Lithuania	29.4	34.9
Malta	57.7	44.1
Poland	13.0	52.8
Romania	16.1	52.5
Slovak Republic	39.7	46.0
Slovenia	21.5	63.6
Turkey	15.5	35.4
Average	***29.7***	***46.9***

Figure 3.1 Irish Inflation, 1995-2002

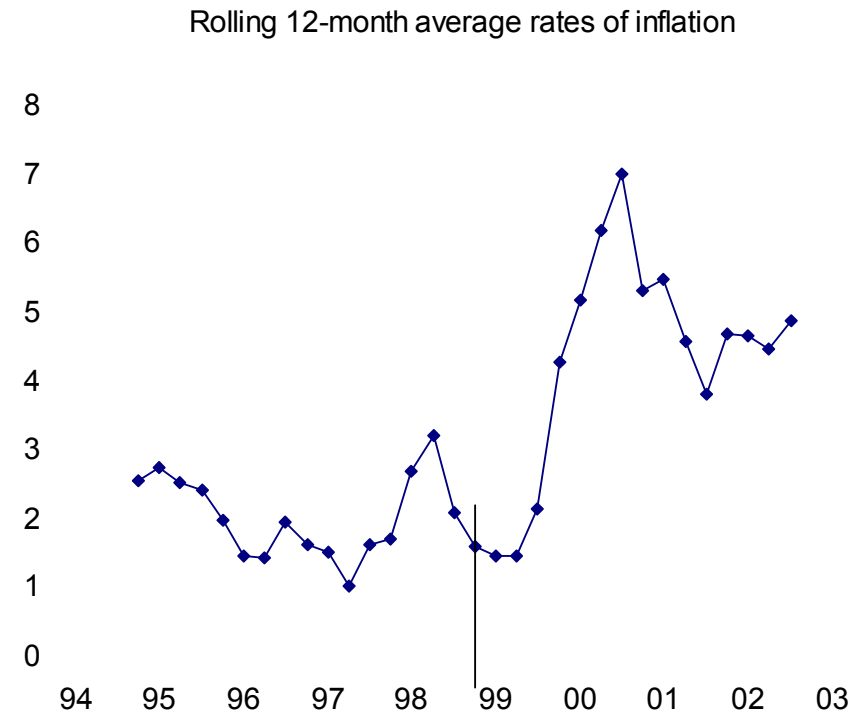

Figure 3.2 Irish real wages,1994-2002

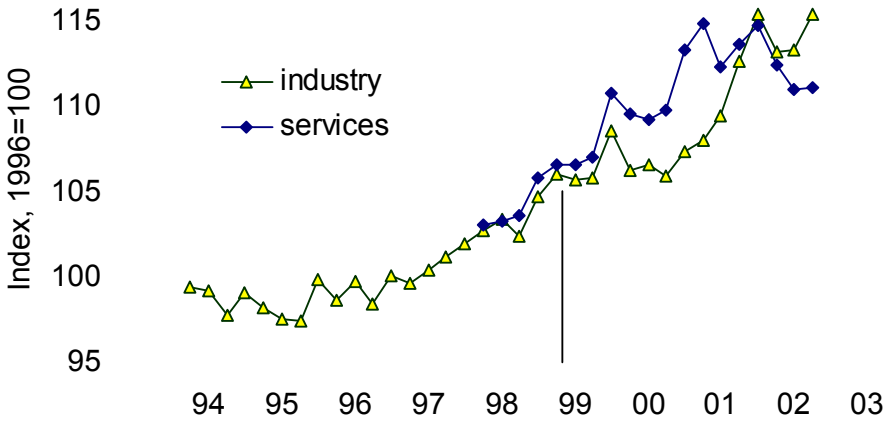

Figure 3.3 Irish Inflation and Currency Depreciation, 1994-2002
(Shows detrended CPI level and nominal effective exchange rate index)

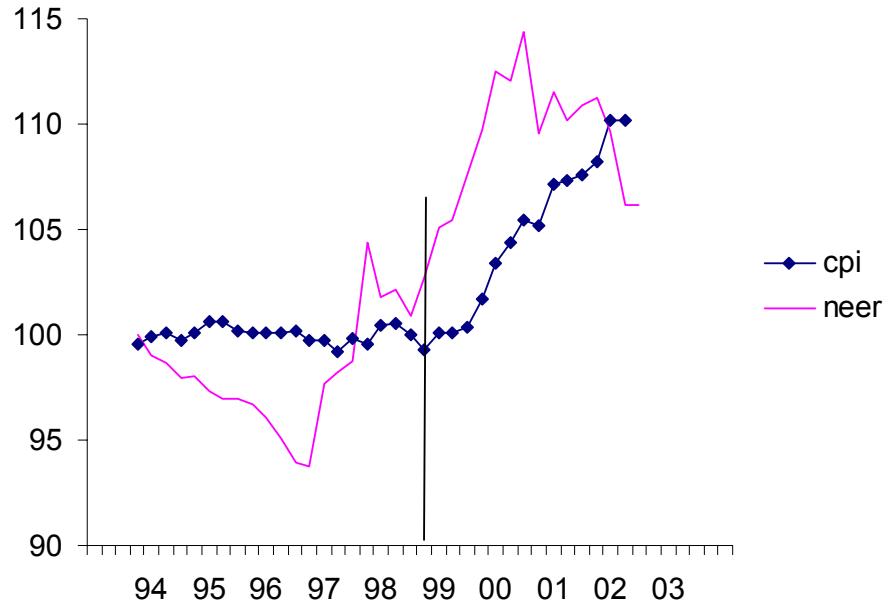

Figure 3.4 Real Interest Rates in Ireland, 1983-2002

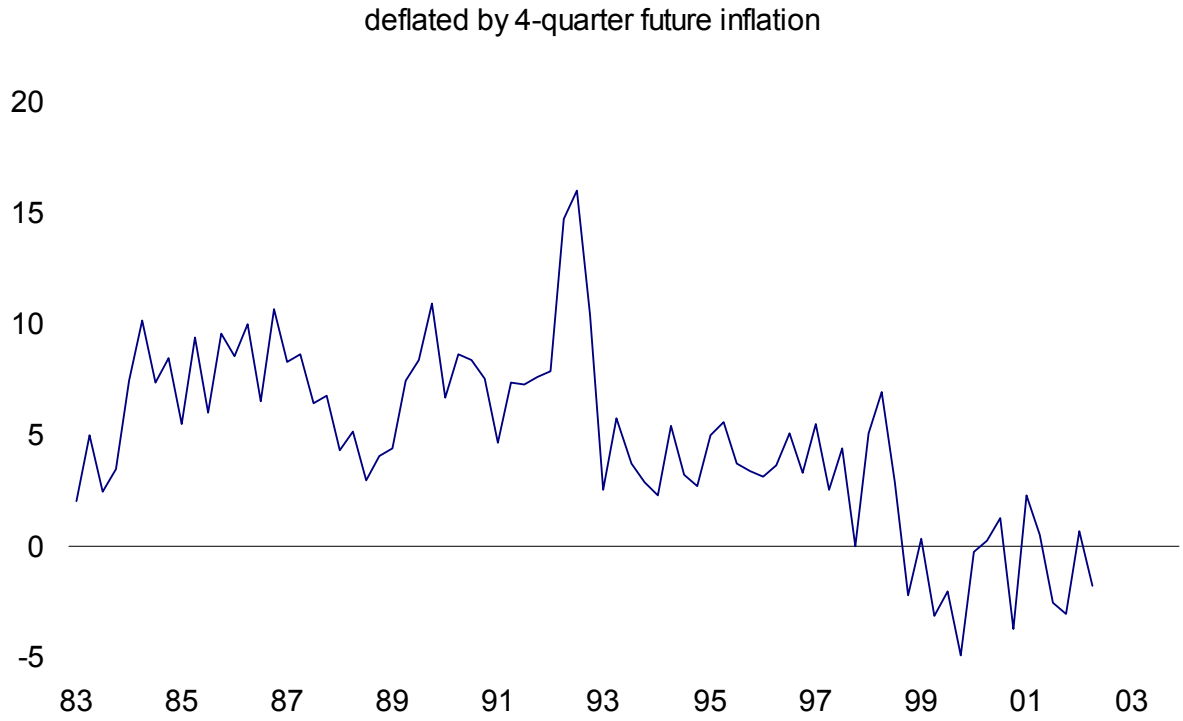

Figure 4.1 Distribution of Eurozone Inflation Rates, 1992-2002

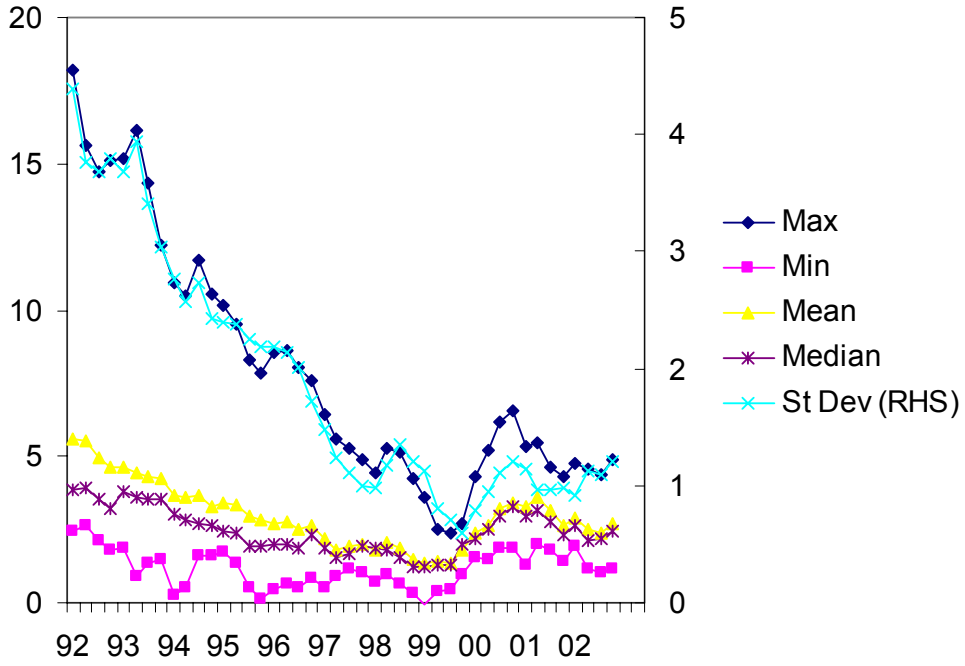

Figure 4.2 National Inflation Rates, 1992-2002

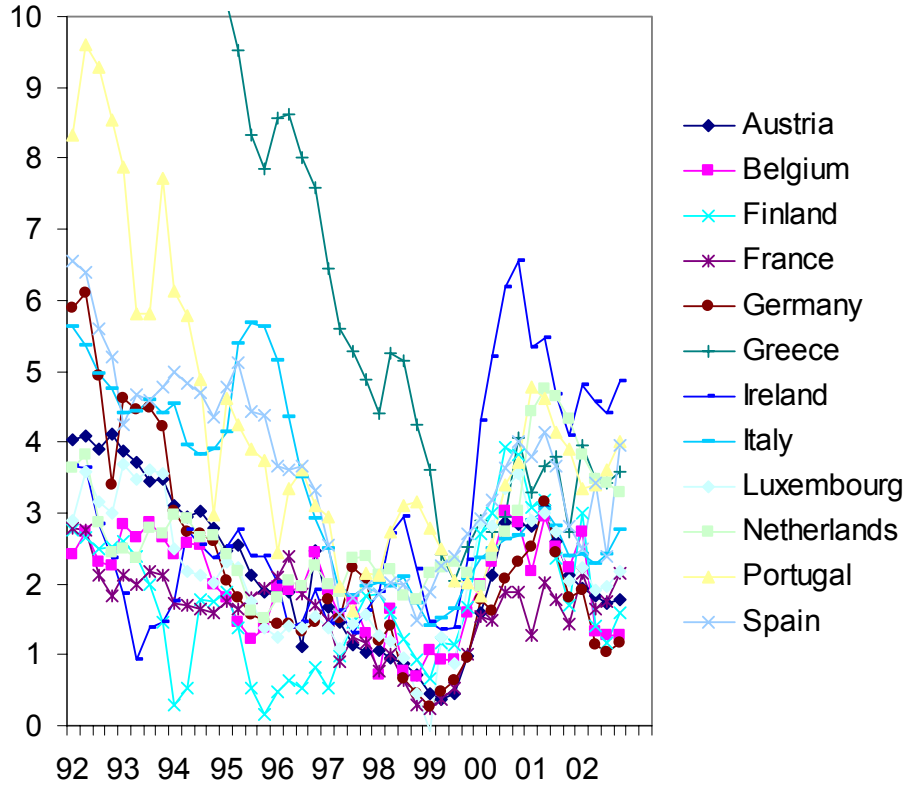

Figure 4.3 Currency Depreciation and Inflation : Eurozone, 1999-2002

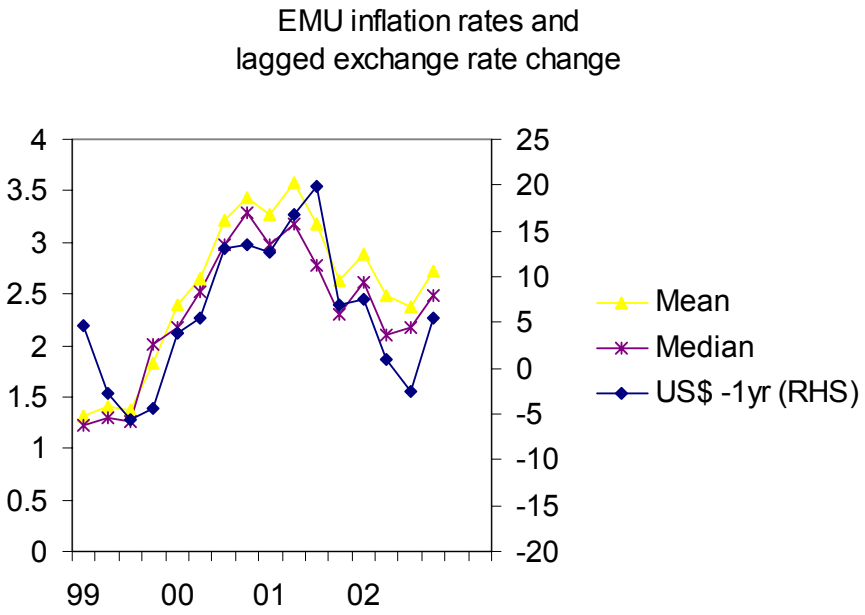

Figure 4.4 Currency Depreciation and Inflation : Germany, 1996-2002

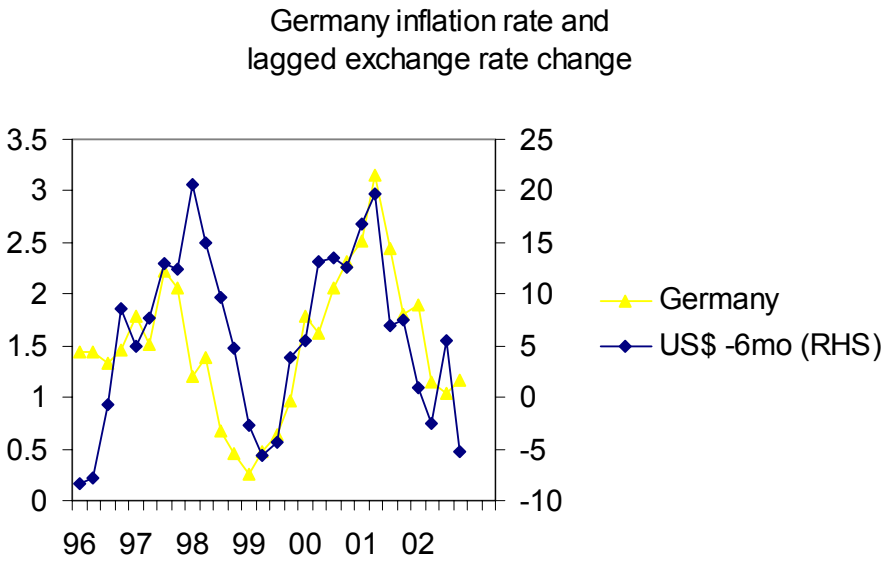

Figure 4.5 Productivity Growth and Real Appreciation, 1998-2001

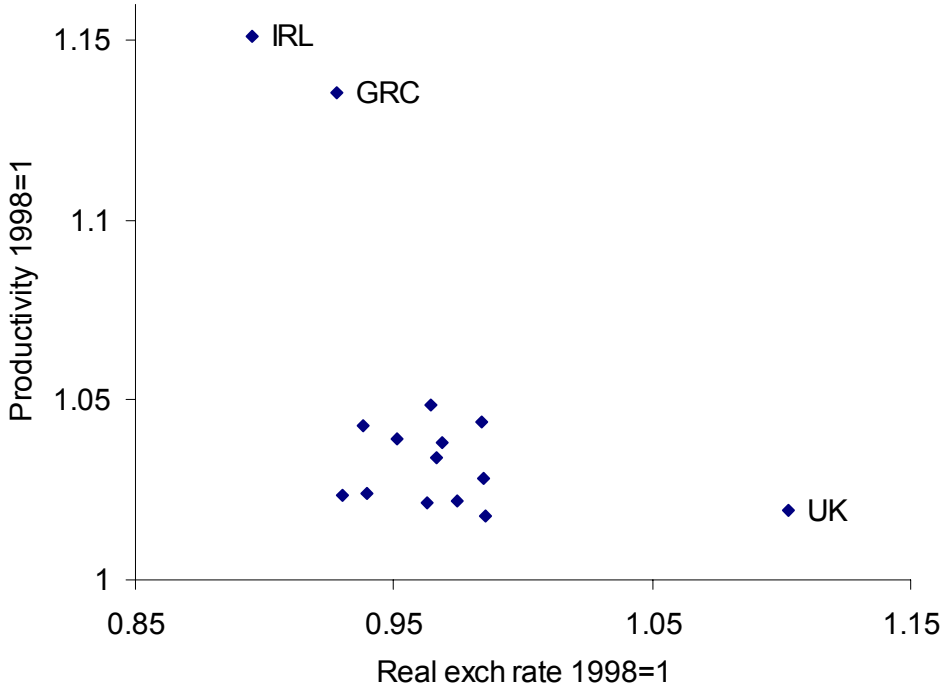

Figure 4.6 Price Level Convergence among EMU members, 1970-2002

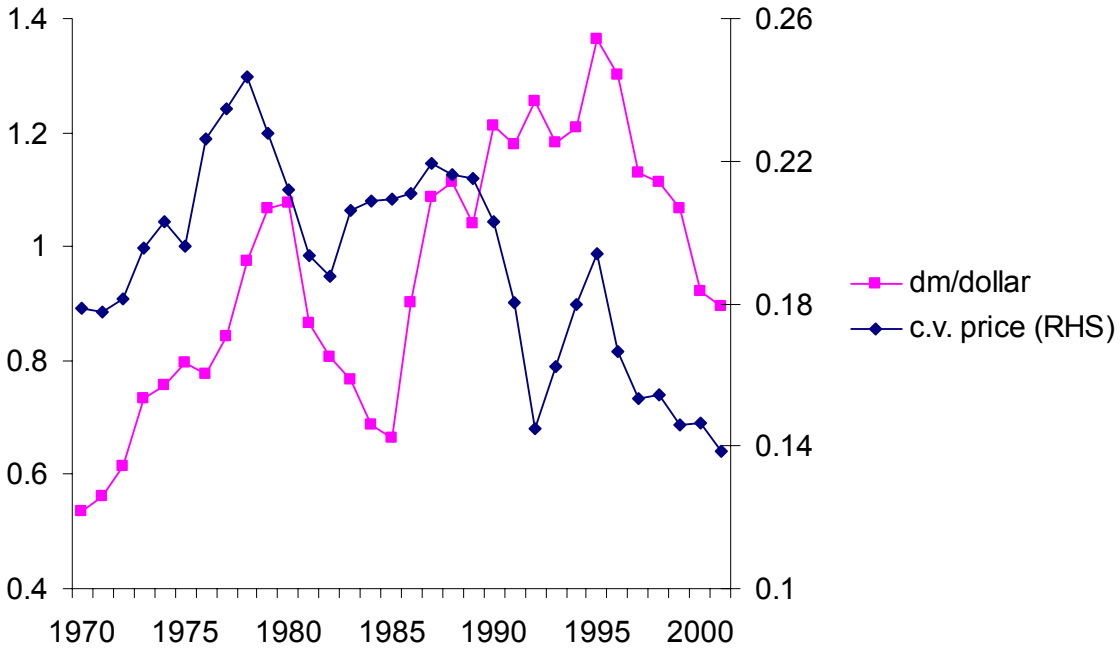

Figure 4.7 Price Levels and GDP Per Capita

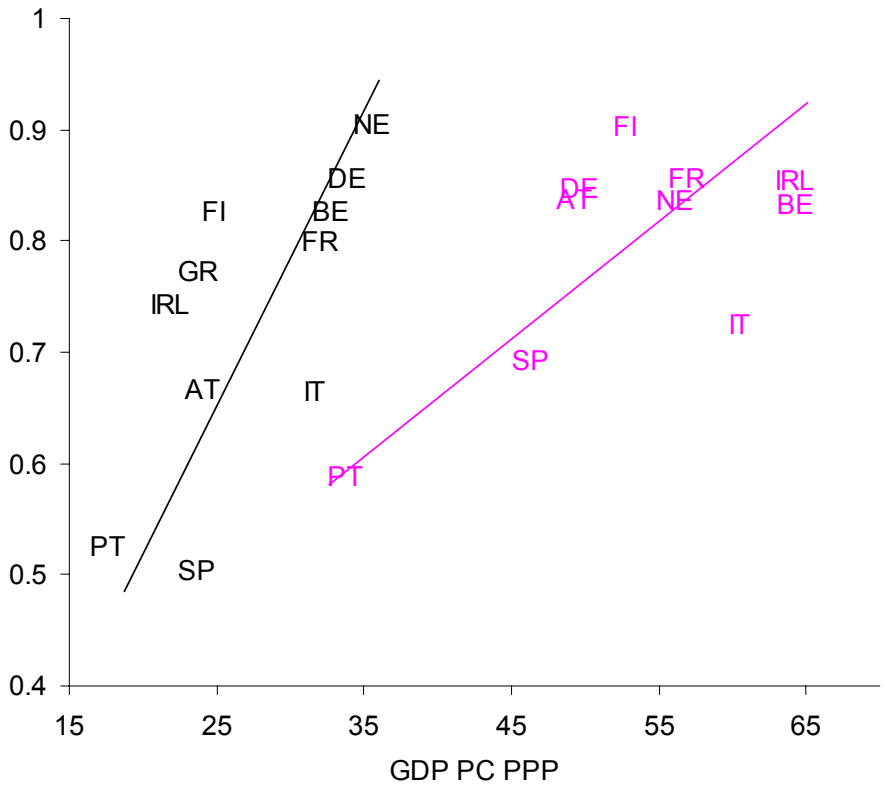

Figure 4.8 National Real Interest Rates: Before and Since EMU