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Macroeconomic Implications of Low Inflation in the Euro Area

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ABSTRACT

The ECB's official inflation objective is an increase in the Harmonised Index of Consumer Prices of below 2% in the medium run. Many commentators argue that there is a deflationary bias in this definition because the lower bound of the inflation objective is not clearly specified. It is also often claimed that the ECB's ambitious inflation objective increases the risk of a liquidity trap and may give rise to higher long-term unemployment because of rigid labour markets in the euro area. An assessment of the experience with the ECB's inflation objective over the first four years of EMU reveals that the discussion about the lower bound of the ECB's inflation objective is essentially pointless, because headline inflation was barely below two percent. Fears of a liquidity trap or higher unemployment also appear not to be supported by the empirical evidence. Another popular argument holds that the common monetary policy will lead to an increasing economic divergence in the euro area because of national inflation differentials which translate into national real interest rate differentials. We show that aggregate demand in the euro area countries is significantly affected by the euro area real interest rate, but not by national real interest rate differentials.

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1. Introduction

The creation of a monetary union in Europe on 1 January 1999 is undoubtedly one of the largest macro and politico-economic experiments in modern history. It was the cap stone of the so-called 'Maastricht Process' designed to achieve macro economic convergence, which had shaped monetary and fiscal policies in the countries striving for membership in European Monetary Union (EMU) over much of the 1990s.[1] The start of EMU was marked by the conversion of the national currencies of the member states into euros and the beginning of the operations of the new Euro System, the new European Central Bank (ECB) and the national central banks of the participating states (NCBs).[2]

The Maastricht Treaty provides the institutional framework for the ECB. The Treaty requires that the NCBs of all participating states must be politically independent. The ECB is similarly independent from the governments of the member states and the political bodies of the European Union. The ECB is owned by the NCBs. Monetary policy decisions are made by the Governing Council (ECB Council, for short) whose members are the NCB presidents and the six members of the ECB Board.[3] Formally, Council decisions are taken by majority vote, with each member having one vote and the ECB president a second one in the case of a tie. Numerous statements by the ECB president, Wim Duisenberg, indicate that the Council takes its decision by consensus or near-consensus rather than simple majority. In most instances, the debate seems to continue until a broad consensus is reached about the monetary policy proposal presented to the Council. In both aspects, the ECB Council seems to follow the practice of the Bundesbank Council in earlier years (von Hagen, 1999).

A significant feature of the Treaty is that it mandates the ECB to regard price stability as the principal objective of monetary policy, a heritage from a similar mandate in Germany's

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[1] For a review of fiscal policies in the EMU member states during the 1990s see Hughes-Hallett, Strauch and von Hagen (2001).

[2] In addition to the Euro system, there is also the European System of Central Banks (ESCB), which consists of the ECB and the NCBs of the European Union member states.

[3] The president of the European Council and a member of the European Commission have the right to participate in ECB Council meetings.

Bundesbank Act. But the Treaty does not define what price stability means in operational terms. The independence of the central bank as defined in the Treaty implies that such a definition can only be supplied by the ECB itself.

In October 1998, the ECB (1998, 1999) presented its strategy. It is based on a definition of price stability, and two "Pillars" that form the basis for the assessment of current developments and interest-rate decisions. The definition of price stability specifies the medium run rate of inflation which the ECB sees as compatible with the mandate to maintain price stability as the overriding objective of monetary policy as required by the Maastricht treaty. The ECB's definition of price stability is an annual increase in the Harmonized Index of Consumer Prices (HICP), its main gauge of average inflation in the euro area, of below two percent. The ECB's two-pillar strategy comprises a reference value for M3 growth (First Pillar) and a ''broadly based assessment of the outlook for the future price developments'' (Second Pillar).

Both elements of the ECB's strategy have been subject of a controversial debate both in academic as well as in policy circles. But while the two-pillar strategy was at center stage of discussion in the first years of EMU, the ECB's inflation objective has become the subject of increasing controversy more recently. Background of this controversial discussion are widespread concerns that the ECB's inflation objective may be too low given global economic developments and persistent inflation differentials in the euro area. In its recent revision of its monetary policy strategy, announced on 8 May 2003 (ECB, 2003), the ECB explicitly addressed these concerns by clarifying that its inflation objective is to maintain inflation rates below but close to 2%, in order to provide a sufficient cushion against the risk of deflation and in order to take into account the implication of inflation differentials within the euro area.

For the euro area as whole, there is a concern that the low inflation rates the ECB aims at may involve an unnecessary risk of deflation and aggravate the euro area's unemployment problem. The worldwide slump in equity prices since March 2000 has triggered fears that the whole industrialized world might experience a deflation spiral like Japan did in the 1990s[4].

[4] See for example The Economist of 12 October 2002 'Of debt, deflation and denial'.

Following the stock market crash in early 1990, Japan experienced a decade of financial fragility, weak economic activity and deflationary developments in goods prices, with consumer prices now falling continuously since 1999[5]. Other South East Asian countries, such as Hong Kong and Singapore, have also experienced asset price deflations followed by a marked drop in credit creation and goods price deflation in recent years. By the end of 2002 the euro area share prices (Euro Stox 50) had fallen by more than 50% from their peak in March 2000, so that it is of course easy to draw parallels. Another argument holds that, due to the labour market rigidities prevalent in the euro area, the low inflation objective adopted by the ECB could cause an increase euro area unemployment. If there is downward nominal wage rigidity, low inflation would give rise to downward real wage rigidity and higher unemployment. This would imply that that the ECB should adopt a somewhat higher inflation objective in order to provide some 'grease' for European labour markets.

Despite the introduction of the single currency in January 2002, differentials in national price developments continue to exist in the euro area. Persistent inflation differentials are often rationalized by the Balassa Samuelson effect. Countries with higher productivity growth in the tradable-goods sector should experience higher rates of inflation. Given the economic heterogeneity among euro area countries, there is scope for persistent differences in productivity growth performances and thus for inflation differentials in the euro area. Since all countries face the same short-term nominal interest rate set by the ECB, some critics argue that inflation differentials give rise to real interest rate differentials. Countries with lower than average inflation would face higher than average real interest rates. The result might be an aggravation of disinflationary or even deflationary pressures in countries with already below average inflation rates.

In this paper we will assess whether these concerns about the adverse macroeconomic implication of low inflation in the euro area are justified. The plan of the paper is as follows. Section 2 outlines and discusses the ECB's inflation objective. Section 3 assesses the area-wide macroeconomic implications of the ECB's current inflation objective. Section 4 analyses the significance of inflation differentials in the euro area. Section 5 concludes.

[5] Other South East Asian countries, such as Hong Kong and Singapore, have also experienced

2. The ECB's Inflation Objective

The Maastricht Treaty states that ''the primary objective of the ECB shall be to maintain price stability'' (Article 105(1)). The Treaty does not define what price stability means in operational terms. The independence of the ECB as defined in the Treaty implies that such a definition had to be supplied by the ECB itself. In October 1998 the ECB (ECB, 1998) announced that the Eurosystem's definition of price stability is a year-on year increase in the Harmonised Index of Consumer Prices of below 2% in the medium run. This definition explicitly specified an upper bound of the ECB's inflation objective, but was tacit about the lower bound. In a speech in November 1998, Wim Duisenberg, the ECB President, made clear that the Eurosystem's definition should be interpreted as excluding deflation, implying that the ECB's inflation objective was 0-2% inflation in the HICP.

This definition of the ECB'S inflation objective was not the same as the inflation objective implied by the reference value for M3 growth, the key characteristic of the First Pillar. The reference value is derived based on a simple velocity equation. The reference value takes the growth rate of potential output less an assumed velocity trend as a starting point and adds the implicit target inflation rate. In October 1998, the assumed growth rate of potential output was 2-2.5%, while the assumed trend in velocity was a decline of 0.5-1%. The announced reference value, which has remained unchanged since then, was 4.5% (ECB, 1999). The implied range of the target inflation rate is therefore 1-2%. This may be due to the fact that headline inflation was below 1% at the start of EMU and the ECB wanted to avoid the impression of starting monetary union with an inflation rate outside the target range. Remarks by the ECB's chief economist Otmar Issing in a speech in June 2002 in Milan suggested that the ECB sees the lower bound of its inflation objective at 1%. In the revision of its monetary policy strategy, announced in a press release on 8 May 2003 (ECB, 2003), the ECB clarified that ''it will aim to maintain inflation rates close to 2% over the medium term.''

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goods price deflation in recent years.

A look at the data suggests that the discussion about the lower bound of the ECB's inflation objective is essentially pointless. Figure 1 displays the development of the year-on-year euro area HICP inflation rate, the euro area output gap and the ECB's main refinancing rate since the start of EMU in January 1999 till December 2002. Monthly output gap data were generated by linear interpolation from quarterly output gap data, which were calculated as the percent gap between real GDP and potential real GDP. Potential GDP was calculated using a standard Hodrick-Prescott-Filter with a smoothing parameter of 1600 over the period 1970-2002. The figure reveals that HICP inflation in the euro area was above the upper bound of 2% since mid 2000 and significantly below the upper bound only in 1999, when average inflation was 1%. In the first four years of EMU, the annual euro area HICP inflation rate averaged 1.95%. The output gap was slightly negative in the first half of 1999 and turned positive in the second half. In the second half of 2001 the output gap turned again negative and continued to fall until the end of 2002.

How did the ECB respond to these developments? In May 1999, when HICP inflation was around 1% and economic activity showed signs of further weakening, the ECB cut its main refinancing rate by half a percentage point to 2.5%. In the second half of 1999 inflation and economic activity quickly rebounded, with inflation rising up to 3% in mid 2001. Over the same period, the ECB increased interest rates from 2.5 to 4.75%. In the second half of 2001, economic activity was weakening while inflation started to recede back towards the upper bound of the inflation objective of 2%. This was accompanied by rate cuts of 1.5 percentage points. In 2002 inflation hoovered around the 2% upper bound, while the main refinancing rate stayed unchanged at 3.25%. In December 2002 the ECB cut interest rates by a further half percentage point to 2.75% despite headline inflation remaining above 2%.

Figure 1: Inflation, Output and Interest Rates in the Euro Area

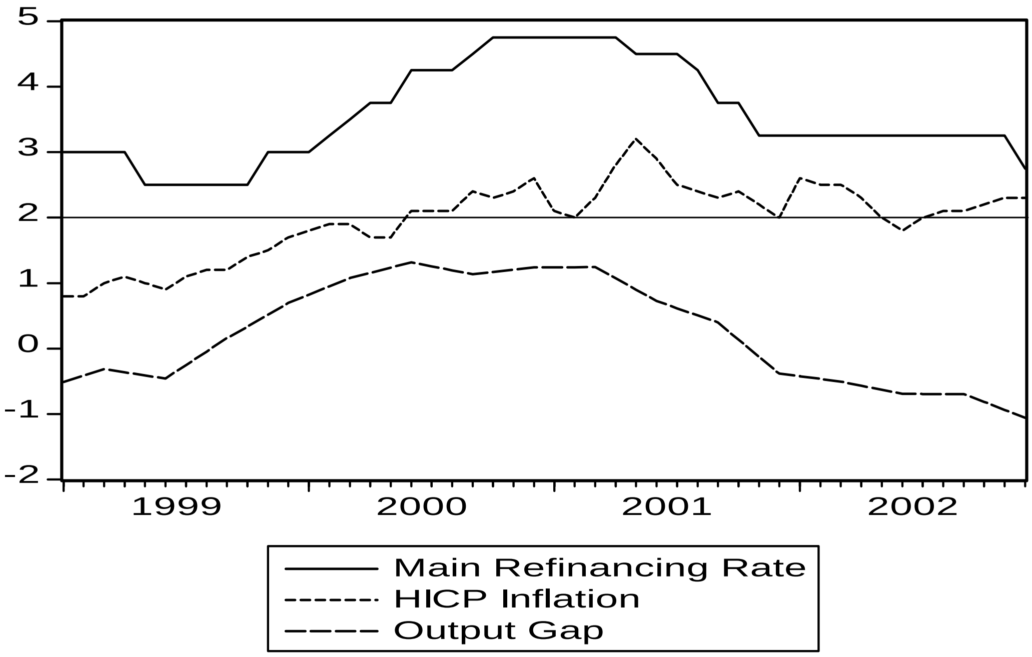
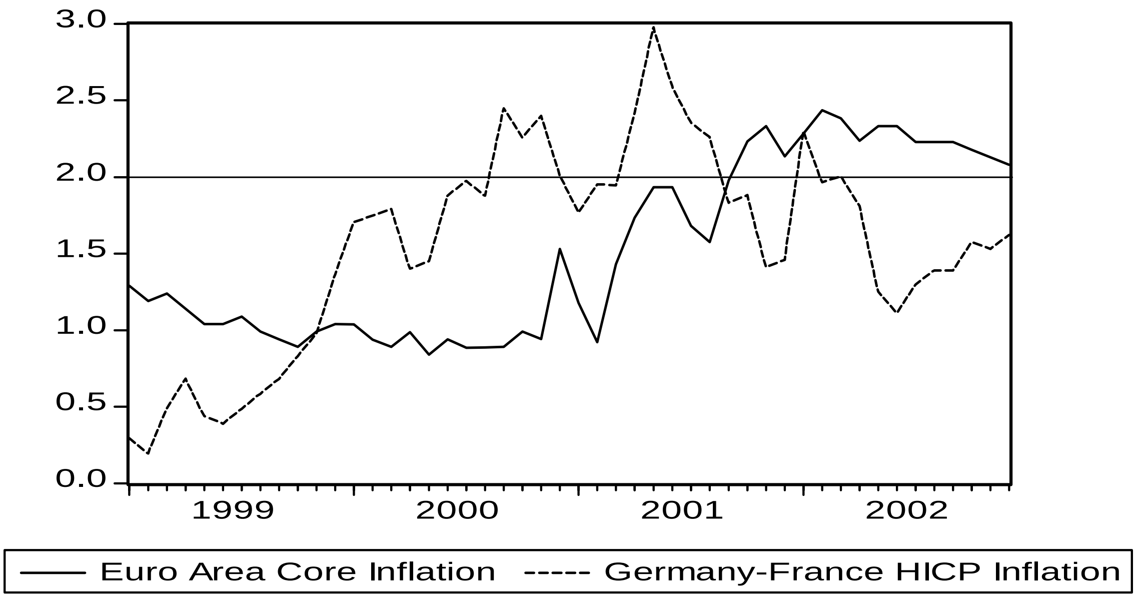


Figure 1 suggests that the main refinancing rate responded more to the output gap than to HICP inflation. This may reflect that the ECB tried to conduct policy in a forward looking way, since the output gap is often regarded as a leading indicator of inflation. Alternatively, it may reflect that the ECB also gives substantial weight to output stabilisation and does not only care about inflation. This interpretation is supported by evidence reported by Neumann (2002) and Hayo and Hofmann (2003), who find that the weight on the output gap is larger in an estimated ECB Taylor rule than in an estimated Bundesbank Taylor rule. Another potential explanation is that the ECB cares about core inflation rather than headline inflation. Core inflation is measured by excluding food and energy prices from the HICP and is often regarded as a better measure of monetary inflation than headline inflation[6]. Figure 2 shows that core inflation was at around 1% until the end of 2000 and stays above 2% since mid 2001. Thus, the development of the core inflation rate can neither explain the series of rate increases from November 1999 till October 2000, nor can it explain the rate cuts from May

[6] See Wynne (1999) for a review of the concept of core inflation.

2001 till December 2002. This observation is consistent with empirical results reported in Begg et al. (2002). Finally, it may also be that the ECB Council pays particular attention to economic and price developments in the two largest euro area economies, Germany and France, because of their dominant economic and political weight. Figure 2 reveals that average inflation in Germany and France was always below euro area inflation since the start of EMU. The average German-French inflation rate was below 2% in most periods and averaged 1.45%. This means that the ECB has delivered price stability, in the sense of its own definition, rather for Germany and France than for the euro area as a whole. Evidence reported by von Hagen and Brückner (2002) support this interpretation. They show that the interest rate moves of the ECB can be better described in terms of a Taylor rule for Germany and France rather than a Taylor rule for the euro area as a whole.

Figure 2: Alternative Inflation Measures for the Euro Area



3. The Macroeconomics of Low Inflation in the Euro Area

The pursuit of price stability as the overriding goal of monetary policy is based on theoretical and empirical findings that inflation causes real costs. Friedman (1969) argued that any opportunity cost associated with holding money gives rise to inefficient shoe-leather costs because households are forced to economise on money holdings[7]. Shoe-leather costs are minimised when nominal interest rates are zero, implying that there is an optimal rate of deflation equal to the level of the real interest rate. This is the famous Friedman rule. Phelps (1973) argued that the Friedman rule ignored that inflation is basically a tax on money holdings. This public finance approach to optimum inflation suggests that inflation should be positive, since an optimal tax system equalises the marginal costs of all taxes. The consensus view appears to be that neither a negative nor a positive rate of inflation, but rather price stability is the optimal goal for monetary policy[8]. Inflation and deflation both give rise to distortions in the relative price mechanism and, as a result, inefficient allocation of resources. Furthermore, since tax bases are nominal, positive and negative rates of inflation distort the tax system (see, e.g. Feldstein, 1997).

These arguments are the basis of the ECB's requirement to maintain price stability in the euro area formulated in the Treaty. However, in recent years this view has been challenged. For example, Svensson (2002) argues that the ECB should aim at an inflation rate of 2%, rather than below 2%, in order to have a larger cushion against the zero lower bound of nominal interest rates and the risk of a deflationary spiral in the euro area. The main argument is that if inflation is very low so are nominal interest rates so that a large negative shock is more likely to make the zero-bound on nominal interest rates binding. The risk of getting trapped in a deflationary spiral has been analysed in several studies based on shock simulations in calibrated structural models. By simulating the effect of stochastic shocks similar in magnitude to those experienced in the recent past, these studies derive probabilities of a binding zero bound on nominal interest rates as a function of the inflation target.

Orphanides and Wieland (1998) simulate a small estimated rational expectations model of the US economy, assuming that monetary policy is conducted based on a simple interest rate rule,

[7] The shoe-leather cost concept was originally developed by Bailey (1956).

either a Taylor (1993) or a Henderson-McKibbin (1993) rule[9], and that the economy is subject to shocks similar in magnitude to those observed for the US over the 1980s and 90s. Reifschneider and Williams (2000) simulate stochastic shocks in the Federal Reserve Board's macroeconometric model of the US economy, also assuming that policy rates are set based on a simple monetary policy rule. Hunt and Laxton (2002) simulate the Japan block in the IMF multi-country macroeconometric model 'MULTIMOD' assuming a Taylor rule for interest rate policy.

These studies are based on linear rational-expectations models, although the possibility of a binding zero bound of nominal interest rates introduces a highly non-linear element into the model. Solving the model under the assumption of linearity basically means solving the model conditioned on a non-binding zero lower bound on nominal interest rates. The possibility of a binding zero bound is therefore not reflected in private sector expectations. This means that the model solution becomes increasingly inaccurate the more likely a binding zero lower bound becomes. As a result, these models tend to underestimate the probability of a bind zero bound. Klaeffling (2002) addresses this issue by adopting a non-linear solution method to a small structural model of the economy with a truncated interest rate rule. The model is then solved based on a non-linear solution algorithm factoring in the possibility of a binding zero bound in the future into the consumption and pricing decisions of the private sector.

Table 1 summarises the results of the studies discussed below. The table reports the estimated probabilities of a binding lower bound on nominal interest rates as a function of the inflation target. It should be noted that the results are not fully comparable due to different assumptions on the level of the steady state real rate of interest. Orphanides and Wieland (1998) and Klaeffling (2002) assume a steady state real interest rate of 1%, while Reifschneider and Williams (2000) and Hunt and Laxton (2002) assume a steady real return of 2.5 and 2.2% respectively. How does the assumed level of the steady state real interest rate affect the simulation results? A higher steady state real interest rate is associated with a higher steady

[8] For an overview of the various costs of inflation see Fischer (1981) and Romer (2001).

[9] The Taylor rule has a coefficient of one on the inflation rate and of 0.5 on the output gap, while the Hederson-McKibbin rule is more aggressive with a coefficient of 2 on the inflation rate and one on the output gap.

state nominal interest rate given a specific inflation target. This means that for a given distribution of shocks the probability of hitting the zero lower bound will be lower. The historical real interest rate appears to be around 2.5%, suggesting that the results of Orphanides and Wieland (1998) and Klaeffling (2002) slightly overstate the risk if hitting the zero bound. The probabilities reported in Table 1 suggest that the risk of hitting the lower bound is negligible for inflation rates between 1 and 2 %, which is the range of inflation rates observed for the euro area. The simulation results apply to the US and Japan. However, the euro area is not fundamentally different in structure from these economies, so that the available evidence suggests that with the given inflation objective, there is only a negligible risk for the euro area to be driven into a deflationary spiral.

Table 1: The probability of hitting the zero bound

Inflation Target	0	1	2	3	4
Orphanides and Wieland (1998)	~10	~2	0	0	0
Reifschneider and Williams (2000)	14	9	5	1	0
Hunt and Laxton (2002)	9	2	1	-	-
Klaeffling (2002)	25	14	11	10	8

Once an economy is caught in a liquidity trap, what can monetary and fiscal policy do to escape it? In a recent paper, Buiter (2003) provides an comprehensive overview and discussion of the various policy options that have been presented in the literature. Svensson (2000) proposed a sharp depreciation of the exchange rate as a ‘foolproof’ way to escape a liquidity trap. Buiter shows that this is not necessarily the case. A depreciation may not work if the Marshall-Lerner condition is not satisfied and if a country is a net debtor. Also, Buiter presents a model where the effect of a depreciation on investment is negative as it reduces Tobin’s q. More promising strategies to escape a liquidity trap are a ‘carry-tax’ on base money, which would lower the zero bound on nominal interest rates, or a deployment of the Friedman helicopter, implemented by issuing base money to finance tax cuts, transfer payments or an increase in public spending.

Orphanides and Wieland (1998) show that the zero lower bound on nominal interest rates not only involves a risk of a deflationary spiral to evolve, but also implies a long-run Phillips Curve trade-off for sufficiently low rates of inflation. The rationale behind this result is that while monetary policy can always fully stabilise positive shocks, its stabilisation capacity with respect to negative shocks is limited by the zero bound for low target rates of inflation. This implies a positive relationship between average inflation and average output for sufficiently low rates of average inflation. As a result, the long-run Phillips curve is non-linear, positively sloped for low average rates of inflation and vertical for higher average inflation rates. Orphanides and Wieland note, however, that in their model a noticeable long-run Phillips Curve trade-off only emerges for average inflation rates below two percent and is fairly small.

In a highly influential paper, Akerlof et al. (1996) argue that, because of downward stickiness in nominal wages, low inflation may come at the cost of a higher long-run average unemployment rate. With stable prices, downward stickiness in nominal wages will translate into downward stickiness in real wages and, as a result, higher unemployment[10]. In this sense, inflation ‘‘greases’’ the wheels of the labour market. An empirical implication of this argument is that the long-run Phillips-Curve is non-linear: Vertical for high rates of inflation and negatively sloped for low rates. The validity of this hypothesis has been tested both at the macro level by estimating long-run Phillips Curve trade-offs using aggregate price and unemployment data and at the micro level by directly assessing the relevance of downward rigidity in nominal wages.

Akerlof et al. (1996, 2000) simulate a long-run Phillips Curve for the US based on an estimated non-linear inflation equation. Inflation is modelled as a function of inflation expectations, unemployment and a measure of nominal rigidity, which is formulated as a function of the standard deviation of the desired change in wages, the trend growth rate of

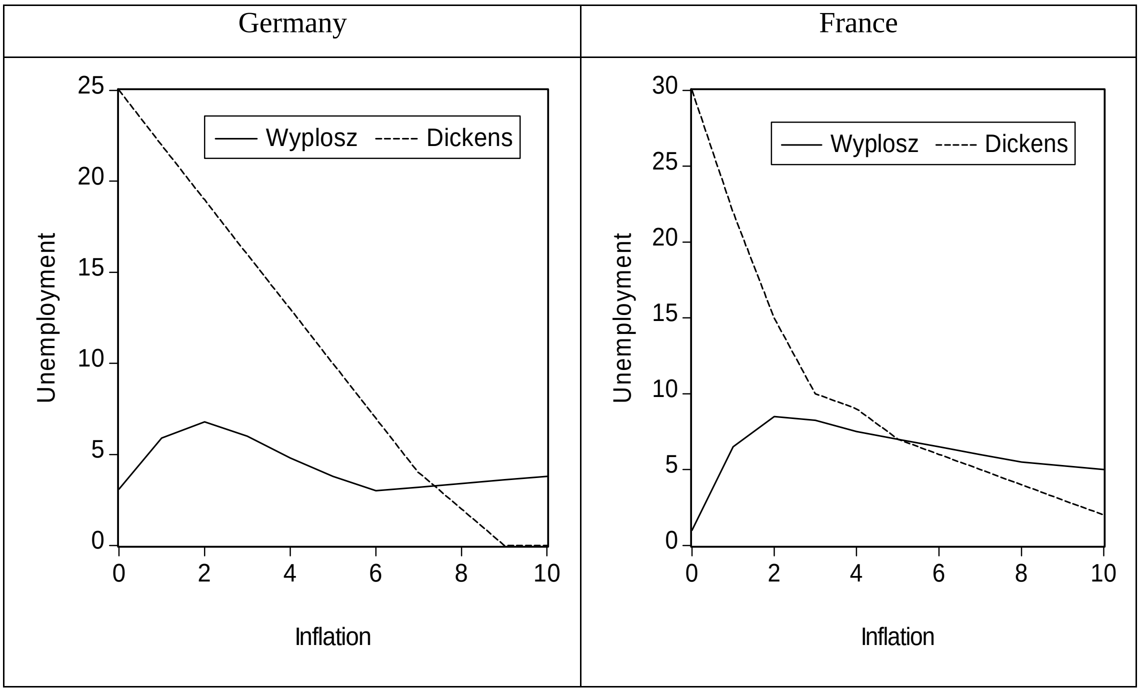
[10] This argument was originally made by Tobin (1972).

productivity and lagged inflation rates. They find empirical support for their hypothesis that downward nominal wage rigidity gives rise to a long-run Phillips Curve trade-off at low rates of inflation and conclude that the optimal inflation rate, i.e. the inflation rate that is associated with the lowest long-run average unemployment rate, lies in the range of 1.6-3.2% (Akerlof et al., 2000, p. 37).

Wyplosz (2001) simulates long-run Phillips-Curves for a sample of industrialised countries based on estimated non-linear long-run unemployment equations. Unemployment is modelled as a function of Tobin's q, which he includes following Phelps and Zoega (2000), and a polynomial of long-term inflation. Wyplosz finds support for a non-linear shape of the long-run Phillips Curve, but his results are not consistent across countries. Also, due to unavailability of data, he cannot include most determinants of long-term unemployment which are suggested by theory, such as the replacement ratio or union coverage[11]. The estimation results are therefore likely to suffer from omitted variable biases. In his discussion of Wyplosz's paper, Dickens (2001) applies the empirical framework of Akerlof et al. (1996, 2000) to other non-US industrialised countries and simulates long-run Phillips Curves based on the estimation results. It turns out that the different empirical frameworks used by Wyplosz on the one side and by Dickens on the other side yield fundamentally different results with respect to the shape of the long-run Phillips Curve. To demonstrate this, we show in Figure 3 long-run Phillips Curves for Germany and France, which we have calculated based on the results reported by Wyplosz and Dickens. The graphs reveal that the derived long-run Phillips Curves are fundamentally different. Obviously, Dickens' long-run Phillips Curves are highly implausible and not in line with the unemployment-inflation realities in Germany and France. The shape of Wyplosz's long-run Phillips Curves looks more plausible, but his estimates are rather imprecise and often not significantly different from the traditional vertical long-run Phillips Curve. Also, we tried to estimate specifications of the long-run Phillips Curve similar to that of Wyplosz but were unable to obtain any meaningful results.

[11] The various determinants of long-term unemployment are discussed and analysed in depth by Layard et al. (1991) and, more recently, by Blanchard (1997, 1998) and Blanchard and Wolfers (1999).

Figure 3: Long-run Phillips Curves



Source: Wyplosz (2001) and Dickens (2001), authors' calculations.

Thus, the evidence on the effect of inflation on long-term unemployment appears to be highly inconclusive and unreliable. Also, the studies discussed below are based on sample periods where very low rates of inflation were barely observed, so that in fact not sufficient observations in the relevant range of inflation are available in order to perform a convincing test of the hypothesis of a non-vertical long-run Phillips Curve at low inflation rates.

The evidence from micro data using data on wage settlements lends some support to the hypothesis of downward nominal wage rigidity. The evidence is usually based on the distribution of nominal wage and salary changes. Most studies find that this distribution is asymmetric, with wage cuts being substantially less common than wage increases and a disproportienately large share of unchanged wages[12]. However, Smith (2000) suggests that the concentration of nominal wage changes at zero may not necessarily reflect downward nominal wage rigidity but may also be due to measurement error and the wide-spread use of long-term wage contracts. But even if there is downward nominal wage rigidity, the macroeconomic effect of such rigidities has been questioned. Card and Hyslop (1997) and Smith (2000) argue that data on wage settlements tend to exaggerate the degree of aggregate nominal rigidity and that the macroeconomic effects of the nominal rigidities detected in wage settlement data are likely to be small.

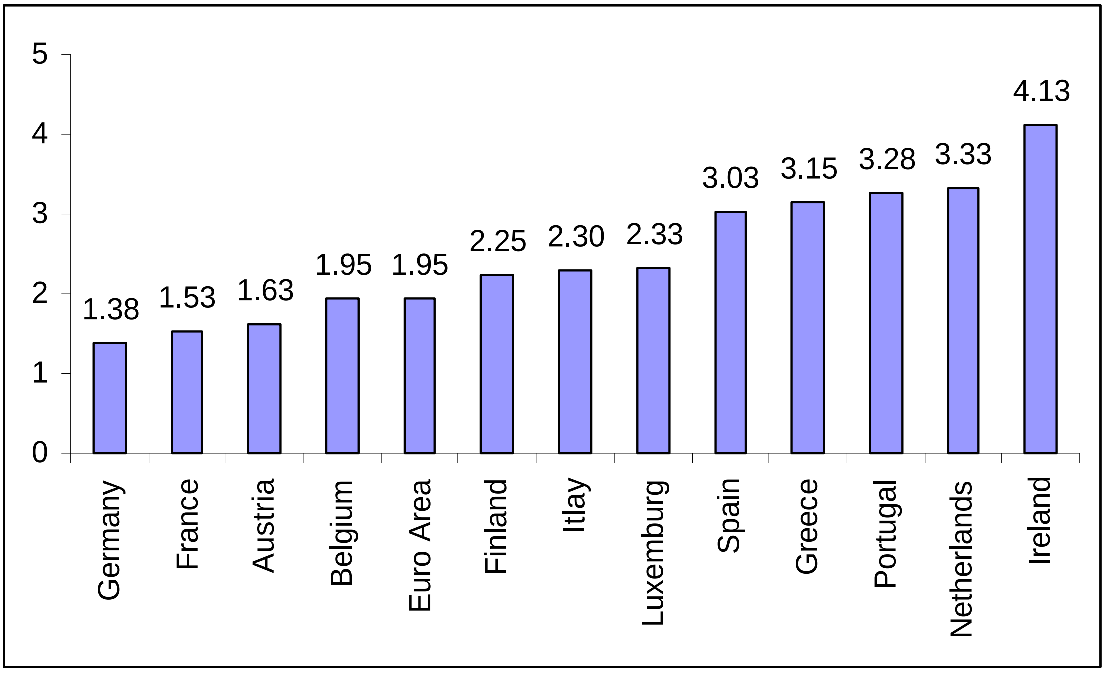
4. Macroeconomic Implications of Inflation Differentials in the Euro Area

Since the start of EMU in 1999, the persistence of inflation differentials has become an increasing reason of concern in policy circles. Since the ECB's monetary policy is directed at inflation in the euro area as a whole, persistent inflation differentials across euro area countries will give rise to persistent real interest rate differentials. As a result, the ECB's monetary policy may be overly tight for countries already experiencing low inflation and too loose for countries experiencing high inflation rates.

Figure 4 shows average HICP inflation rates in the euro area countries and the euro area in the first four years of EMU, 1999-2002. The figures reveal that there is substantial dispersion in euro area inflation rates. Compared to the euro area average of 1.95%, inflation was around half a percentage point lower in the two largest euro area countries, Germany and France, and around 0.3 percentage points lower in Austria. All other countries experienced higher inflation rates than the euro area aggregate, except for Belgium, where average inflation exactly equals the euro area average. Inflation was lowest in Germany (1.38) and highest in Ireland (4.13%), implying a maximum inflation differential of around 3 percentage points. In Spain, Greece, Portugal and the Netherlands, average inflation was around 2 percentage points higher than in Germany.

[12] See e.g. Akerlof et al. (1996) for the US, Nickell and Quintini (2000) for the UK and Knoppik

Figure 4: Average Inflation Rates in the Euro Area 1999-2002



Source: Deutsche Bundesbank, Monthly Bulletin, various issues, authors' calculations..

In order to asses how inflation dispersion has evolved since the introduction of the euro we report in Figure 5 the development of the standard deviation of the inflation rates in the euro area countries over this period. A common argument holds that, due to economic convergence, inflation differentials will tend to become smaller in a currency union. The graphs reveal that this was not the case in the euro area in the first four years of its existence. In 1999 the standard deviation of inflation rates was 0.6 in 1999 and rose to above 1 in 2000 and 2001. In 2002 it further increased to 1.2. Inflation dispersion in the euro area appears to have increased rather than decreased since the introduction of the euro.

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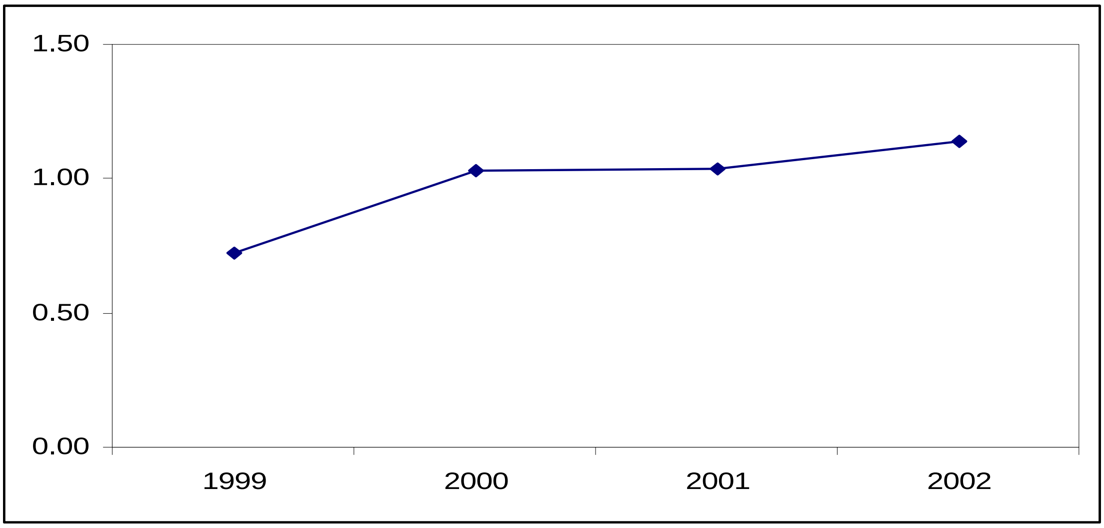
and Beissinger (1991) and Decressin and Decressin (2002) for Germany.

Figure 4: Standard Deviation of National Inflation Rates in the Euro Area



Source: Deutsche Bundesbank, Monthly Bulletin, various issues, authors' calculations.

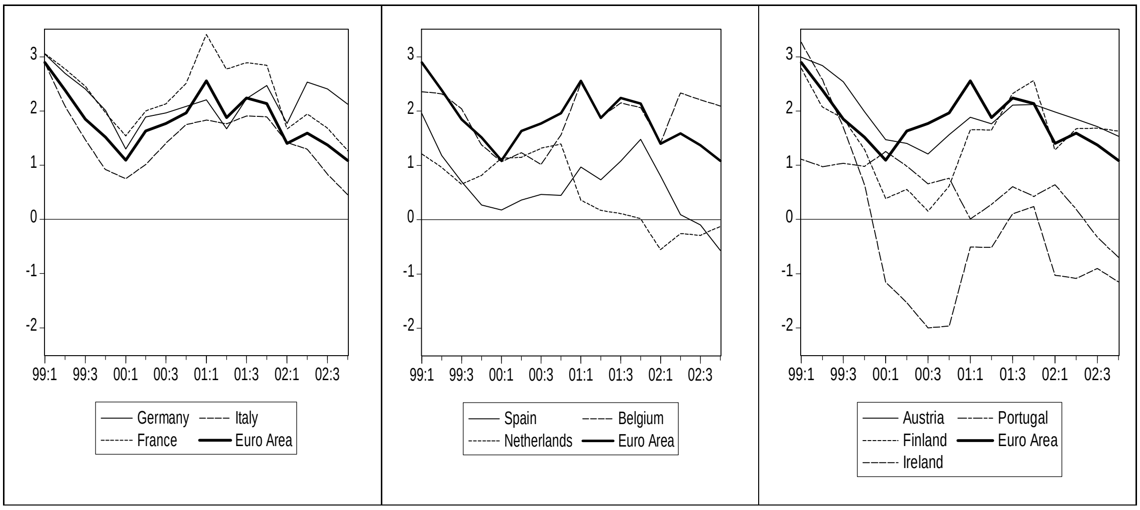
There are various explanations for persistent inflation differentials in a currency union. Inflation differentials may arise in the short-run because of different cyclical positions or because of different exposures to exogenous shocks such as oil price increase arising from differences in economic structure. Long-run inflation differentials can arise because of different productivity trends. The so called Balassa Samuelson effect suggests that differences in tradable goods productivity growth will give rise to inflation differentials also in a currency union. Perfect competition and mobility of labour between the tradable and the non-tradable goods sector implies that there is a common nominal wage for both sectors and that the nominal marginal product for each sector must equal the common wage rate: $p^T y^T = w = p^N y^N$, where p^T and p^N are respectively the price of tradables and non-tradables and y^T and and y^N are respectively the real marginal product in the tradables and the non-tradables sector. This implies that $\Delta y^T - \Delta y^N = \Delta p^N - \Delta p^T$. If productivity is growing slower in the non-tradables sector, non-tradables prices must rise faster in order to equalise nominal marginal products across sectors.

The aggregate price inflation is given by $\Delta p = a^{T}\Delta p^{T} + (1 - a^{T})\Delta p^{N}$, where a^{T} is the share of tradable goods in total consumption. Substituting for Δp^{N} we obtain aggregate price inflation as a function of tradable goods price inflation and the productivity differential between the tradable goods sector and the non-tradable goods sector: $\Delta p = \Delta p^{T} + (1 - a^{T})(\Delta y^{T} - \Delta y^{N})$. Exploiting the fact that the change in tradable goods prices has to be equal across countries and further assuming that the share of tradable goods in consumption a^{T} is also equal across countries, the inflation differential between two countries A and B is given by $\Delta p_{A} - \Delta p_{B} = (1 - a^{T})\left[(\Delta y_{A}^{T} - \Delta y_{A}^{N}) - (\Delta y_{B}^{T} - \Delta y_{B}^{N})\right]$. Thus, countries with higher productivity growth in the tradable goods sector relative to the non-tradable-goods sector will have higher inflation rates, also in a monetary union.

Canzoneri et al. (2001) assess the explanatory power of sectoral productivity trends for the development of real exchange rates for a sample of euro area countries over the period 1973-1991 and find empirical support for the Balasssa-Samuelson hypothesis. They conclude that the national inflation differentials that would be implied by the observed productivity differentials are rather large. Sinn and Reutter (2001) take the Balassa-Samualson effect as their point of departure to assess the likely effect of the common monetary policy on national price developments. They find that over the period 1987-1995 the productivity differential between tradable and non-tradable goods sector was much smaller in Germany than in the rest of the euro area countries, implying that that in the EMU inflation in Germany will be substantially lower than in the other euro area countries. Based on cross-country productivity differentials they conclude that euro area inflation must be at least 1% in order to avoid deflation in Germany.

Independent of their causes, the existence of persistent inflation differentials in the euro area implies persistent differentials in real interest rates across euro area countries. Figure 6 shows how national real interest rates, i.e. the three months EURIBOR less national four-quarter inflation, compares to the euro area real interest rate, i.e. the three months EURIBOR less four-quarter euro area inflation, since the start of EMU. The graphs suggest that real interest rates in Germany and France, the two largest euro area economies, were most of the time above the euro area real rate, while most other countries had below average real interest rates most of the time.

Figure 6: Real interest rate differentials in the euro area



What are the macroeconomic effects of these real interest rate differentials? A popular argument holds that countries with a boyant economy and higher than average inflation rates enjoy further stimulus by below average real interest rates, while weaker economies with a lower than average inflation rates are further weakened by higher than average real interest rates. This seems to imply that the common monetary policy will lead to an increasing economic divergence in the euro area[13]. The ECB will neither be able to dampen increasing inflationary pressures in the group of faster growing countries, nor will it be able to fend off deflationary developments in the weaker countries.

However, this line of argument disregards two important aspects. First, countries with lower than average inflation rates enjoy real depreciations vis-à-vis the rest of the euro area making their economies more competitive and thus stimulating net exports. Second, given the large degree of market integration in the euro area, it may be rather the real interest rate measured in euro area prices rather than the real interest rate measured in national prices that matters for aggregate demand. Consider a firm's decision to finance an investment project at a nominal rate i_t. The relevant (ex-post) real rate of interest is $i_t - p_t$, where p_t is the rate of change in the firm's sales prices. The question is, what is the relevant price level for firms in the euro area. If firms sell exclusively to their domestic market, the national price level of their home country reflects average sales prices. If they sell to all markets in the euro area, applying pricing to market, it is the aggregate euro area price level that matters for them.

In order to assess the empirical relevance of real interest rate differentials and relative price developments in euro area countries we estimate a simple backward-looking IS Curve of the form:

$$(1) \quad y_t = \sum_{i=1}^{n1} a_i y_{t-i} + \sum_{j=1}^{n2} b_{1j} r_{t-j} + \sum_{k=1}^{n3} b_{2k} e_{t-1} + \sum_{l=1}^{n4} b_3 y_{t-l}^{US} + e_t \ .$$

where y is the output gap measured as the percent gap between real GDP and potential real GDP, calculated using a standard Hodrick-Prescott-Filter with a smoothing parameter of 1600[14]. r is the ex-post real interest rate, i.e. the short-term nominal money market interest rate less four quarter CPI inflation. e is the real effective and y^{US} is the US output gap, which was included in order to control for external demand conditions. Data for seasonally adjusted real GDP, money market rates and the CPI, which was seasonally adjusted using the X-12 procedure of the US Census Bureau, were taken from the IMF International Financial Statistics. Real effective exchange rates were taken from the OECD Main Economic Indicators.

Equation 1 was estimated for ten euro area countries: Germany, France, Italy, Spain, Netherlands, Belgium, Austria, Finland, Ireland and Portugal. The equations were estimated jointly by Seemingly Unrelated Regression (SUR). The sample period is first quarter 1993 till

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[13] This is a version of the famous ''Walters Critique'' applied to EMU. For a discussion of the ''Walters Critique'' of the EMS see Miller and Sutherland (1990) and Pill (1996).

[14] The Hodrick-Prescott Filter trend was calculated over the period 1970-2001. The trend estimates from other trend filters, such as a bandpass filter, were very similar.

third quarter 2002. The sample period was chosen in order to focus on the period of completion of the internal market and the convergence to and completion of European Monetary Union. The regression was estimated both for the individual countries and by pooling the observations for the ten countries. The final specification was chosen by a general-to-specific modelling strategy, retaining all lags of a variable between the first and last lag significant at the 10% level, searching over up to five lags. If no lag was significant at least at the 10% level, the lag with the highest t-statistic was retained. The results are reported in Table 2. It turned out that in each regression equation only one lag of each explanatory variable was retained. The exception are the Netherlands, were all five lags of the real interest rate were retained. We report the estimated coefficients with t-statistics in parentheses. For the Dutch real interest rate we report the sum of the coefficients of the retained lags and the t-statistic for the hypothesis that the sum the coefficients equals zero.

Table 2: IS Curves for euro area countries, 1993-2002

	y_{t-i}	r_{t-j}	e_{t-k}	y^{US}_{t-l}	$\overline{R}^2$ DW
Germany *(Lags=1,1,1,1)*	**0.458** **(5.04)**	**-0.325** **(-3.49)**	0.003 (0.18)	**0.386** **(4.83)**	0.69 1.93
France *(Lags=1,1,1,1)*	**0.619** **(8.86)**	-0.013 (-0.50)	0.013 (0.89)	**0.35** **(5.81)**	0.88 2.05
Italy *(Lags=1,4,1,1)*	**0.549** **(6.01)**	-0.049 (-1.59)	**0.046** **(3.49)**	**0.223** **(2.74)**	0.75 2.18
Spain *(Lags=1,1,1,1)*	**0.40** **(4.40)**	**-0.09** **(-2.32)**	0.037 (1.55)	**0.271** **(3.64)**	0.86 1.92
Netherlands *(Lags=1,1-5,1,1)*	**0.451** **(4.53)**	-0.027 (-0.79)	0.02 (1.05)	**0.555** **(5.63)**	0.89 1.72
Belgium *(Lags=1,4,1,1)*	**0.35** **(3.76)**	**-0.112** **(-2.39)**	0.015 (0.71)	**0.552** **(5.02)**	0.78 1.76
Finland *(Lags=1,1,1,1)*	**0.15** **(1.58)**	**-0.513** **(-5.71)**	**-0.10** **(-3.09)**	**1.313** **(7.24)**	0.56 1.81
Portugal *(Lags=1,5,5,1)*	**0.236** **(2.07)**	**-0.225** **(-4.38)**	**0.10** **(1.92)**	**0.367** **(2.54)**	0.71 1.47
Austria *(Lags=1,1,1,1)*	**0.182** **(1.54)**	0.098 (0.79)	0.014 (0.42)	**0.531** **(4.06)**	0.48 1.93
Ireland *(Lags=1,5,1,1)*	**0.258** **(2.13)**	**-0.173** **(-2.79)**	0.064 (0.13)	**0.951** **(3.73)**	0.59 1.81
Pool *(Lags=1,1,1,1)*	**0.551** **(15.87)**	**-0.05** **(-3.24)**	**0.024** **(3.34)**	**0.40** **(9.71)**	0.67 1.94

Note: Lags indicates the lags retained for each explanatory variable in the order as the variables appear in the columns of the Table. T-statistics are in parentheses. Equations estimated by SUR.

The results suggest that the real interest rate is an important determinant of aggregate demand in euro area countries coming out significantly in six out of ten countries. The pooled regression yields a real interest rate elasticity of 0.5 which is significant at the 1% level. The effective real exchange rate is found to be a significant determinant of the output gap only in Italy and Portugal. In the other countries the exchange rate elasticities are insignificant, in Finland even significant with the wrong sign. This conclusion is reversed by the pooled estimator which yields an exchange rate elasticity of 0.25 which is significant at the 1% level. The results also suggest that external demand conditions are an important determinant of euro area output gaps. The lagged US output gap is found to be significant at the 1% level in all ten countries.

At a first glance these results appear to imply that real interest rate differentials do matter in the euro area. With aggregate demand in the individual euro area countries being significantly affected by national real interest rates, real interest rate differentials will give divergent economic performances. Or will they? It turns that the answer to this question cannot be given based on the standard specification of the IS Curve given by equation 1. The nation real interest rate can be written as $r = r^{euro} + (r - r^{euro})$, the sum of the real interest rate measured in units of euro area goods, i.e. the short-term nominal interest rate less the euro area inflation rate, and the difference between the real interest rate measured in units of national goods, i.e. the short-term nominal interest rate less the national inflation rate, and the euro real interest rate. Thus, in order to asses whether real interest rate differentials matter we have to estimate a slightly revised IS Curve of the form:

$$(2) \quad y_t = \sum_{i=1}^{n1} a_i y_{t-i} + \sum_{j=1}^{n2} b_{1j} r_{t-j}^{euro} + \sum_{j=1}^{n2} b_{2j} (r - r^{euro})_{t-k} + \sum_{k=1}^{n3} b_{2l} e_{t-l} + \sum_{l=1}^{n4} b_3 y_{t-l}^{US} + e_t \ .$$

The results obtained from re-estimating the regression equation with this revised specification are reported in Table 3. The results suggest that aggregate demand in the euro area countries is determined by the euro real interest rate, while the national real interest rate differentials do not appear to have a significant effect on national output gaps. The euro real interest rate elasticity is significant at the ten percent level in all countries except for France, Italy and

Austria. The pooled regression yield an elasticity for the euro real interest rate of -0.06 with a t-statistic of –4.07. The effect of the national real interest rate differential on the output gap is insignificant in all countries, except for Austria, where it is significantly positive. A c^2 test that the national real interest rate differential coefficients are zero in all countries cannot be rejected with a probability value of 0.87. The panel regression also yield an insignificant coefficient for the national real interest rate differentials. The effective real exchange rate is found to have a significantly positive effect on the output gap only in Italy and Portugal, while the pooled regression gives an elasticity for the real exchange rate of 0.25 with a t-statistic of 3.39. The US output gap remains significant at the 1% level in all tend countries.

Table 3: Macroeconomic Effects of Inflation Differentials in the Euro Area

	y_{t-i}	r_{t-j}^{euro}	$(r-r^{euro})_{t-j}$	e_{t-k}	y_{t-l}^{US}	$\overline{R}^2$ DW
Germany *(Lags=1,1,1,,1)*	**0.435** **(4.71)**	**-0.309** **(-3.15)**	-0.238 (-1.57)	0.017 (0.12)	**0.388** **(4.81)**	0.70 1.91
France *(Lags=1,1,1,1)*	**0.625** **(8.70)**	-0.033 (-0.74)	0.058 (0.33)	0.08 (0.49)	**0.354** **(5.98)**	0.88 2.11
Italy *(Lags=1,4,4,1)*	**0.568** **(5.90)**	-0.045 (-1.28)	-0.074 (-0.70)	**0.045** **(3.13)**	**0.232** **(2.84)**	0.75 2.21
Spain *(Lags=1,1,1,1)*	**0.376** **(4.26)**	**-0.092** **(-2.46)**	0.087 (0.95)	0.031 (1.32)	**0.284** **(3.93)**	0.87 1.98
Netherlands *(Lags=1,1-5,1,1)*	**0.338** **(2.43)**	**-0.138** **(-2.83)**	0.091 (1.20)	0.049 (2.13)	**0.756** **(6.83)**	0.87 2.08
Belgium *(Lags=1,4,1,1)*	**0.323** **(3.07)**	**-0.132** **(-2.37)**	-0.121 (-0.57)	0.007 (0.27)	**0.575** **(5.03)**	0.76 1.66
Finland *(Lags=1,1,1,1)*	**0.215** **(2.29)**	**-0.525** **(-6.04)**	-0.211 (-1.38)	**-0.071** **(-2.22)**	**1.372** **(7.93)**	0.91 2.17
Portugal *(Lags=1,5,5,1)*	**0.082** **(0.70)**	**-0.186** **(-3.82)**	0.064 (0.61)	**0.084** **(1.76)**	**0.435** **(3.27)**	0.71 1.47
Austria *(Lags=1,1,1,1)*	**0.157** **(1.29)**	0.188 (1.42)	0.46 (1.77)	0.028 (0.80)	**0.524** **(4.01)**	0.47 1.95
Ireland *(Lags=1,5,1,1)*	**0.272** **(2.24)**	**-0.186** **(-2.34)**	-0.198 (-1.12)	0.019 (0.33)	**0.973** **(3.28)**	0.55 1.81
Pool *(Lags=1,1,1,1)*	**0.55** **(15.94)**	**-0.061** **(-4.07)**	0.01 (0.31)	**0.025** **(3.39)**	**0.39** **(9.71)**	0.67 1.94

Note: Lags indicates the lags retained for each explanatory variable in the order as the variables appear in the columns of the Table. T-statistics are in parentheses. Equations estimated by SUR.

5. Conclusions

The ECB's official inflation objective is an increase in the Harmonised Index of Consumer Prices of below 2% in the medium run. Many commentators argue that there is a deflationary bias in this definition of the inflation objective because the lower bound of the inflation objective is not clearly specified and that the low inflation objective increases the risk of a liquidity trap and may give rise to higher long-term unemployment because of rigid labour in the euro area. An assessment of the experience with the ECB's inflation objective over the first four years of EMU reveals that the discussion about the lower bound of the ECB's inflation objective is essentially pointless, because headline inflation was barely below two percent. This observation is consistent with the ECB's recent monetary policy revision, where it was clarified that the ECB aims at an inflation rate below but close to 2% (ECB, 2003).

Fears of a liquidity trap or higher unemployment because of low inflation in the euro area also appear not to be supported by the empirical evidence. The empirical evidence on the liquidity trap suggests that the risk of hitting the zero lower bound of nominal interest rates is negligible for medium run inflation rates between 1 and 2 %, which is the range of inflation rates observed for the euro area. The evidence on the effect of inflation on long-term unemployment appears to be highly dependent on the chosen modelling strategy and must therefore be deemed to be inconclusive and unreliable.

A popular argument also holds that the common monetary policy will lead to an increasing economic divergence in the euro area because of national inflation differentials which translate into national real interest rate differentials. Countries with a boyant economy and higher than average inflation rates enjoy further stimulus by below average real interest rates, while weaker economies with a lower than average inflation rates are further weakened by higher than average real interest rates. We argue that, given the large degree of market integration in the euro area, it may be rather the real interest rate measured in euro area prices than the real interest rate measured in national prices that matters for aggregate demand. In order to assess the empirical relevance of real interest rate differentials and relative price developments in the euro area countries we estimate simple backward-looking IS Curves for ten euro area countries. We show that aggregate demand in the euro area countries is significantly affected by the euro area real interest rate, but not by national real interest rate differentials.

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