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# External Causes of Euro Zone Inflation Differentials

## A Re-examination of the Evidence

*Whether the Economic and Monetary Union (EMU) satisfies the criteria of an optimum currency area (OCA) has been the subject of much debate. Probably the greatest consensus exists on the trade criterion. In general authors conclude from the high levels of intra-EU trade that the European countries are closely interlinked. In that sense, they would constitute an optimal currency area. In this light, recent empirical evidence that external factors such as exchange rates and oil prices are able to explain inflation differentials between EMU countries is surprising. This paper re-examines the evidence using new and revised data and comes to the opposite conclusion.*

Why would the European Central Bank (ECB) look at regional differences in inflation rates across the euro zone? In general, the ECB focuses on average economic conditions in the euro zone and tries to ignore national idiosyncrasies as much as possible.[1] This seems to be in line both with its mandate, which is to maintain price stability in the euro zone as a whole, and with the absence of instruments to fine-tune monetary policy to cyclical circumstances in individual EMU countries. Yet in a recent paper the ECB concedes that its monetary policy must take into account the size, persistence and determinants of differences in inflation rates.[2] According to the ECB "the ECB's monetary policy strategy attributes a secondary role to inflation differentials when calibrating the safety margin for admissible inflation in the euro area".[3] The recent inflation experience in the euro zone underpins the ECB's concern. After the introduction of the euro, the cross-country variation in the inflation rates of member states has not fallen quickly. In the run-up to EMU, all countries except Greece fulfilled the inflation criterion of the Maastricht Treaty. However, in each year since 1999, three or more countries have failed to fulfil the Maastricht criterion, as the decrease in Greek inflation has been more than offset by increases in Dutch, Irish and Portuguese inflation rates.

The main concern is that inflation differentials are more than just temporary deviations from the euro zone average. Empirical evidence on the size and persistence of inflation differentials is provided by Cecchetti, Mark and Sonora[4] for United States cities, by Rogers,[5] Berk and Swank[6] and Ortega[7] for European countries and by Alberola and Marqués[8] and Eijffinger and De Haan[9] for Spanish provinces. Most studies conclude that relative price levels between regions converge at a surprisingly slow rate; in case of the US cities the half-life of convergence is approximately 9 years. Persistent inflation differences may influence inflationary expectations and can amplify regional business cycles. Within a monetary union, the adjustment mechanism can be vulnerable to a self-reinforcing effect.[10] With a uniform nominal interest rate, the domestic real interest rates will be lower in high inflation regions, discouraging savings and stimulating consumption and investment. Compared to a monetary policy which is conducted nationally via a Taylor-type interest rate rule, the real interest rate channel no longer acts as a brake on the cycle but instead accelerates regional economic developments. This effect may be further amplified by wealth

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[1] A glance at the ECB monthly reports, which mostly contain data on euro aggregates but seldom include subdivisions by country, would confirm this statement. A notable exception is fiscal data.

[2] European Central Bank: Inflation differentials in the euro area: potential causes and policy implications, Frankfurt am Main 2003, ECB.

[3] Ibid., p. 6.

[4] S. G. Cecchetti, N. C. Mark, R. J. Sonora: Price index convergence among United States cities, in: International Economic Review, Vol. 43, No.4, 2002, pp. 1081-1099.

[5] J. H. Rogers: Price level convergence, relative prices and inflation in Europe, Federal Reserve Bank International Finance Discussion No. 699, 2001.

[6] J. M. Berk, J. Swank: Regional price adjustment in a monetary union, the case of EMU, De Nederlandsche Bank MEB series No. 7, 2002.

[7] E. Ortega: Persistent inflation differentials in Europe, Banco de España Working Paper No. 0305, 2003.

[8] E. Alberola; J. M. Marqués: On the relevance and nature of regional inflation differentials: the case of Spain, Banco de Espana Working Paper No. 9913, 1999.

[9] S. C. W. Eijffinger, J. de Haan: European Monetary and Fiscal Policy, Oxford 2000, Oxford University Press, p. 65.

[10] See e.g. I. J. M. Arnold, C. Kool: The role of inflation differentials in regional adjustment: evidence from the United States, in: Kredit und Kapital, No. 1, 2004.

effects, as low real interest rates may inflate share and real estate prices. The sole remaining countervailing force is the appreciation of the real exchange rate, yet the elimination of nominal exchange rates within the union reduces the speed with which this variable adjusts. An additional, more specific, concern is the possibility that high inflation in some regions might push inflation rates towards deflationary levels elsewhere, which in the presence of downward nominal rigidity might have adverse economic consequences.[11]

Regional differences in inflation rates thus complicate the ECB's monetary policymaking, as the common interest rate policy may be too lax for some countries but too tight for others. It is therefore important for policymakers to know the sources of these inflation differentials, as the appropriate policy responses may differ accordingly. Are inflation differentials due to structural phenomena, such as rigidities in product or labour markets or structural differences in trade orientations of member countries? Or are they of a transitional nature and will further business cycle synchronisation following the introduction of the euro lead to a withering away of inflation differentials? This paper will not give a definite answer to these questions, nor review the increasing literature on this subject.[12] Instead, we focus on one specific set of explanations of regional inflation differentials, which has recently been advanced by Honohan and Lane[13] and by the ECB.[14] These contributions suggest that external factors may play a big role in accounting for regional inflation differentials. HL (p. 95) conclude that, "Despite the common currency, exchange rate movements have had a substantial impact on inflation differentials in EMU, reflecting the different degrees of exposure of member states to trade outside the euro zone". In addition to this, the ECB also looks at different sensitivities to energy prices. Constructing an external exposure indicator composed of exchange rate variables and oil dependency, the ECB concludes that "for most countries, the inflationary pressure seems to be broadly in line with their structural exposure to external shocks".[15]

This paper aims to reassess this empirical evidence. The set-up of the paper is as follows. First, we explore the compatibility of the finding that external factors are important for euro zone inflation differentials with the literature. This part motivates our reassessment. We then present and discuss our model, data and empirical results. Using new and revised data, we are unable to corroborate the significance of external factors and arrive at the opposite conclusion. There is currently no substantial evidence that external factors have euro zone-wide importance in explaining inflation differentials since the introduction of the euro. In the few specifications where the exchange rate is significant, this seems to be due to the Irish outlier. Instead, the national output gap is the main significant explanatory variable in our regressions. Next, we look ahead and address the question whether we may expect external factors to become more important in explaining inflation differentials after the entry of new EU members into EMU. The final part summarises and concludes.

### Compatibility with the Literature

We find the recent results on the importance of external factors in explaining euro zone inflation differentials surprising in light of findings from three separate strands of the literature on, respectively, 1) optimum currency areas, 2) monetary transmission and 3) exchange rate pass-through.

First, there has been much debate on whether EMU satisfies the criteria of an optimum currency area (OCA).[16] Well-known OCA criteria are: 1) the degree of trade between countries; 2) the extent to which countries experience different shocks; 3) the degree of labour mobility and 4) the amount of fiscal transfers between regions. Probably the least controversy exists on the trade criterion. In general, authors conclude from the high levels of intra-EU trade that the European countries are closely interlinked.[17] Recent data on euro zone countries' shares of trade with EMU partners show that these are well above 50% for all EMU countries except Ireland (37.3%) and Finland (48.1%).[18] This suggests that according to the trade criterion at least the core of the EMU would constitute an optimal currency area. Moreover, there are indications that the introduction of the single currency has further boosted trade within the euro zone by between 4 and 16%.[19] These authors also conclude that in the run-up to EMU, intra-euroland trade flows increased more than bilater-

[11] See H. W. Sinn, M. Reuter: The Minimum Inflation Rate for Euroland, NBER Working Paper No. 8085, 2001.

[12] For recent reviews see E. Alberola: Interpreting inflation differentials in the euro area, in: Economic Bulletin, Banco de Espana, April 2000; European Central Bank, op. cit.; I. Angeloni, M. Ehrmann: Euro Area Inflation Differentials, mimeo March 2004.

[13] P. Honohan, P. R. Lane: Divergent inflation rates in EMU, in: Economic Policy, Vol. 18, Issue 37, 2003, pp. 357-394, hereafter HL.

[14] European Central Bank, op. cit.

[15] Ibid., p. 29.

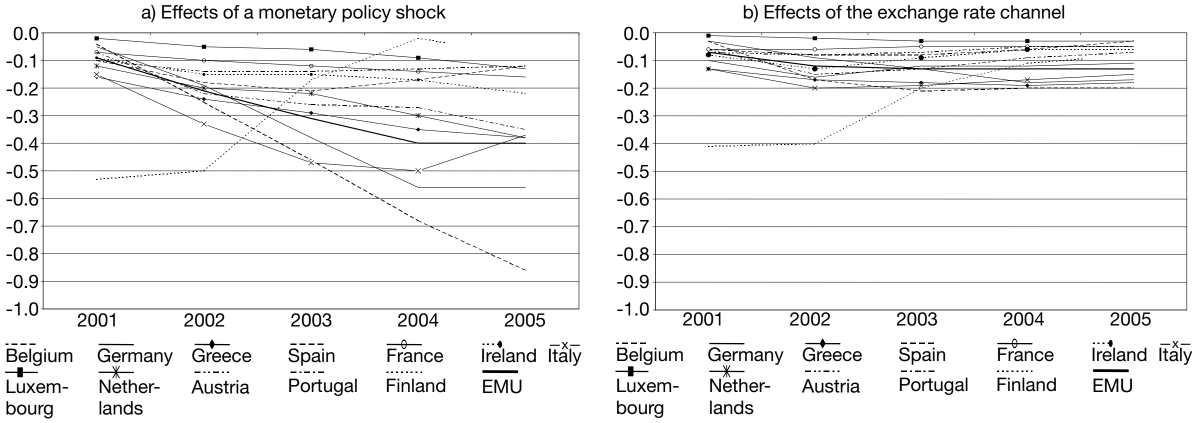
[16] For recent surveys see F. Mongelli: "New" views on the optimum currency area theory: what is EMU telling us?, ECB Working Paper No. 138, 2002; and J. Fidrmuc: The Endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement, Bank of Finland Working Paper No. 8, 2001.

[17] See e.g. textbook treatments of this subject in R. Baldwin, C. Wyplosz: The Economics of European Integration, 2004, McGrawHill; and D. Miles, A. Scott: Macroeconomics: Understanding the Wealth of Nations, New York 2002, Wiley.

[18] See A. Micco, E. Stein, G. Ordoñez: The currency union effect on trade: early evidence from EMU, in: Economic Policy, Vol. 18, Issue 37, pp. 25-64, here Table B1, p. 58.

[19] Ibid.

**Figure 1**
**Effects of a Monetary Policy Shock and Exchange Rate Channel on Consumer Deflators**
(% deviation from baseline)




Source: P. J. A. van Els, A. Locarno, J. Morgan, J.-P. Villetelle: Monetary policy transmission in the euro area: What do aggregate and national structural models tell us?, ECB Working Paper No. 95, 2001.

al trade flows between non-euro zone countries; when after 1999 trade flows fell due to the global slowdown, trade flows between euro zone countries fell to a lesser extent. These strong intra-European trade linkages do not seem to fit very well with the HL findings: the better the trade OCA criterion is satisfied, the smaller one would expect the impact of differential trade exposures on inflation differentials to be.

A second strand of the literature with which the importance of external factors is hard to reconcile relates to the differential transmission of monetary policy shocks across the euro zone. Although the euro zone can be described as a large closed economy, this doesn't imply that it is immune to external factors. Empirical work by Peersman and Smets[20] and van Els et al.[21] shows that for the euro zone as a whole, the exchange rate channel is important in the transmission of monetary policy. In addition, Warmedinger[22] shows that increases in euro area inflation during the first two years of EMU can be attributed largely to oil price and exchange rate developments. Yet these findings relate to external effects on EMU aggregates and do not necessarily imply the existence of differential effects across EMU member countries. With a few notable exceptions the large literature on the differential impact of monetary policy across the euro zone focuses on the credit and interest rate channels of monetary transmission, not on the exchange rate channel. The neglect of the exchange rate channel in the recent survey by Angeloni, Mojon, Kashyap and Terlizzese is telling: "It should be stressed that, while historically the exchange rate channel has been important for each of the constituent countries, we expect monetary policy to influence the euro area economy (which is much more closed to international trade than the average of the constituent countries) mainly through domestic channels of transmission".[23]

Two exceptions to the closed-economy orientation of the monetary transmission literature are Mojon and Peersman[24] and van Els et al.[25] Mojon and Peersman use the VAR methodology to describe the effects of monetary policy in 10 countries of the euro area. Although the monetary policy shocks lead to different patterns in the exchange rate responses, they conclude: "More interesting is that the different patterns in the exchange rate responses are not reflected in the responses of prices and output" (p. 17). The monetary policy experiment in van Els et al. contains a detailed breakdown by transmission channel of price and output effects following an interest rate shock. The results are derived using large scale macroeconomic models of the central banks of the Eurosystem. The simulation experiment involves a 100 basis point increase in the short-term interest rate for two years, accompanied by an assumed response on exchange rates and long term interest rates. Figure 1a shows the total effect of

[20] G. Peersman, F. Smets: The monetary transmission mechanism in the Euro area: more evidence from VAR analysis, ECB Working Paper No. 91, 2001.

[21] P. J. A. van Els, A. Locarno, J. Morgan, J.-P. Villetelle: Monetary policy transmission in the euro area: What do aggregate and national structural models tell us?, ECB Working Paper No. 95, 2001.

[22] T. Warmedinger: Import prices and pricing-to-market effects in the euro area, ECB Working Paper No. 299, 2004.

[23] I. Angeloni, B. Mojon, A. K. Kashyap, Daniele Terlizzese: Monetary Transmission in the Euro Area : Where Do We Stand?, ECB Working Paper No. 114, 2002, pp. 9-10.

[24] B. Mojon, G. Peersman: VAR description of the effects of monetary policy in the individual countries of the euro area, ECB Working Paper No. 92, 2001.

[25] P. J. A. van Els, A. Locarno, J. Morgan, J.-P. Villetelle, op. cit.

the monetary tightening on the consumer price deflator; Figure 1b shows the effect which can be attributed to the exchange rate channel. Apart from Finland, which shows a strong initial impact on the price level via the exchange rate channel, the dispersion between the impacts via the exchange rate channel seems to be rather low, especially compared to the much larger dispersion in the total effects (which include the effects of monetary tightening through other transmission channels) in Figure 1a. Unfortunately, the absence of standard errors makes it impossible to test whether these differential responses are significant.

Third, the finding that external factors are major drivers behind euro zone inflation differentials fits badly with recent contributions to the literature on exchange rate pass-through. Cunningham and Haldane[26], Taylor[27] and Gagnon and Ihrig[28] emphasise the role of a stability oriented monetary policy in reducing exchange rate pass-through and put forward the view that the pricing power of firms (and thus the extent to which they are able to pass on exchange rate changes to prices) will depend on the inflationary environment. The basic intuition goes as follows. In a low inflation environment firms will be more cautious in raising prices. When competitors do not follow their price increase, they will lose out in terms of competitiveness. In contrast to a high inflation environment, they will not be bailed out by a strong general increase in prices. The empirical evidence in Gagnon and Ihrig shows that there is indeed a significant link between estimated rates of pass-through and inflation variability: the decline in pass-through rates in recent decades has coincided with a decline in the variability of inflation rates. Applied to EMU, this would imply that a credible low-inflation monetary policy by the ECB could lower pass-through rates (especially in those countries which do not have a history of monetary stability) and thus reduce the impact of exchange rates on inflation differentials.

Summarising the preceding discussion, from the OCA, the monetary transmission and the pass-through literatures, differential trade exposures across euro zone countries do not emerge as natural candidates for the explanation of euro zone inflation differentials. The conclusions from these three separate strands of the literature seem hard to reconcile with the HL and ECB findings and therefore warrant a re-examination.

[26] A. Cunningham, A. G. Haldane: The monetary transmission mechanism in the United Kingdom: pass-through and policy, Central Bank of Chile Working Paper No. 83, 2000.

[27] J. B. Taylor: Low Inflation, Pass-Through, and the Pricing Power of Firms, in: European Economic Review, Vol.44, No. 7, 2000.

[28] J. Gagnon, J. Ihrig: Monetary Policy and Exchange Rate Pass-through, Federal Reserve Bank International Finance Discussion Paper No. 704, 2001.

## Re-examining the Effect of External Factors on Inflation Differentials

In this part we re-examine the evidence for the external causes of inflation differentials in the euro area. First we briefly describe the model which is used to underpin our inflation equation. We next describe the data and report our empirical results. These consist of the following parts. We start off replicating the annual panel regressions in HL and examine their robustness to a variety of changes in the specification. We also compare EMU results to pre-EMU findings. Furthermore, we follow the ECB in reconstructing a synthetic indicator of "external exposure" and assess its explanatory value in the panel regressions. In the next part we will have a closer look at data for the new EMU entrants.

### The Model

Our starting-point is the familiar textbook aggregate supply and demand framework.[29] The aggregate demand curve can be specified as follows:

$$(1)\; y_t = \bar{y}_t + a_1(y_{t-1} - \bar{y}_{t-1}) + a_2(\Delta m_{t-1} - \pi_{t-1}) + a_3\Delta q_{t-1} + \varepsilon_t^d$$

In (1), real output $y_t$ depends on potential output $\bar{y}_t$, the lagged output gap $(y_{t-1} - \bar{y}_{t-1})$, the lagged growth rate of real money balances $(\Delta m_{t-1} - \pi_{t-1})$ and the lagged change in the real effective exchange rate $\Delta q_{t-1}$ (foreign currency per unit of domestic currency). All variables are in logarithms with exception of the inflation rate; $\varepsilon_t^d$ is a demand shock.

The aggregate supply curve is:

$$(2)\; \pi_t = \bar{\pi}_t + b_1(y_t - \bar{y}_t) + b_2(p_{t-1} - \bar{p}_{t-1}) + \varepsilon_t^s$$

In (2) the inflation rate ($\pi_t$) depends on core inflation ($\bar{\pi}_t$), the output gap and the lagged deviation from the long-run equilibrium price level $(p_{t-1} - \bar{p}_{t-1})$. Both $p_{t-1}$ and $\bar{p}_{t-1}$ are in logarithms; $\varepsilon_t^s$ is a supply shock. Core inflation is given by:

$$(3)\; \bar{\pi}_t = \lambda\pi_t + (1 - \lambda)\pi_{t-1},$$

where $(1-\lambda)$ indicates the magnitude of backward-looking behaviour. Finally, equation (4) expresses the change in the real exchange rate as a function of changes in the nominal exchange rate $\Delta e_t$ and the difference between domestic inflation and foreign inflation ($\pi_t^*$).

$$(4)\; \Delta q_t = \Delta e_t + \pi_t - \pi_t^*$$

Substituting (1), (3) and (4) into (2) yields our inflation equation:

$$(5)\; \pi_t = \alpha_1\pi_{t-1} + \alpha_2(y_{t-1} - \bar{y}_{t-1}) + \alpha_3\Delta m_{t-1} + \alpha_4\Delta e_{t-1} + \alpha_5(p_{t-1} - \bar{p}_{t-1}) + \alpha_6\pi_{t-1}^* + \varepsilon_t$$

[29] The model below closely resembles the model in M. Burda, C. Wyplosz: Macroeconomics: a European text, 1997, Oxford University Press, p. 383.

In (5) the $\alpha$'s are a function of $\lambda$, the *a*'s and *b*'s in equations (1)-(3); $\varepsilon_t$ is a combination of supply and demand shocks. The following assumptions are still needed to arrive at a specification resembling the one in HL. First, since our purpose is to examine inflation differentials within the euro area, all variables need a country subscript. We use time dummies to capture the EMU-wide common movements in inflation and in the explanatory variables. Second, we suppress $\bar{p}_{t-1}$, assuming that in the long run the equilibrium price level of country *i* equals the European equilibrium price level. We also suppress the foreign inflation rate, because the nominal exchange variability vis-à-vis non-euro zone trading partners is similar to the real exchange rate variability. In contrast to HL, our specification includes money growth. We use this variable to check whether the introduction of the euro has indeed weakened the national link between money and inflation, as one would expect in a monetary union. Another difference with HL is that we do not include a fiscal variable. Fiscal variables were insignificant in HL and are anyhow not the focus of this investigation. We finally arrive at the following specification:

$$(6)\ \pi_{i,t} = \alpha_0 + \alpha_t + \alpha_1\pi_{i,t-1} + \alpha_2(y_{i,t-1} - \bar{y}_{i,t-1}) + \alpha_3\Delta m_{i,t-1} + \alpha_4\Delta e_{i,t-1} + \alpha_5 p_{i,t-1} + \varepsilon_{i,t}$$

where $\alpha_t$ are the time dummies. The incorporation of backward-looking behaviour with the inclusion of the lagged inflation rate in (6) is absent from HL. As we will see below, this has major empirical implications.

### Descriptive Statistics

We use annual data for the period 1991-2003 from the ECB, the IMF's International Financial Statistics, OECD's Economic Outlook, Penn World Tables, De Nederlandsche Bank, and UNCTAD.[30] Table 1 reports for each country descriptive statistics on the inflation rate, the annual log change of the nominal effective exchange rate ($\Delta e$), the output gap and the percentage change in the money supply.[31] Table 1 confirms that, notwithstanding a decrease in the cross-sectional average and standard deviation of inflation rates, in the first four years of EMU the inflation experiences have been quite different across EMU members. Averaged over the 1999-2003 period, five out of twelve EMU-members did not meet the EMU inflation criterion. Excluding Greece, the average standard deviation of inflation decreased only slightly, from 1.1 in the pre-EMU period to 0.8 after the introduction of the euro. A second observation is that both over time and over the cross-section the output gap improved, but the average standard deviation has remained approximately the same. With regard to money growth, the means and standard deviations do not point to a major change after the start of EMU. In contrast, the standard deviations of $\Delta e$ have dropped significantly since 1999 (on average 1.8 percentage points).

The convergence of $\Delta e$ is shown in Figures 2a and 2b. Figure 2a combines the time-series of $\Delta e$ for all EMU members except Greece. In Figure 2b we report measures for the cross-sectional variability in of $\Delta e$: the

[30] See box.

[31] The annual log change is a proxy for the annual percentage change. For the remainder of this part we shall refer to percentage change instead of the log change.

The quarterly and annual data are gathered from various sources. A detailed overview is been given in the table below.

**Data Overview**

| Description | Freq. | Period | Source |
|---|---|---|---|
| Inflation rate | Annual | 1990-2003 | OECD Economic Outlook No. 74 |
| „ | Quarterly | 1991-2003 | IMF IFS, derived from CPI (line 64) |
| CPI | „ | 1990-2003 | IMF IFS |
| Output gap[a] | Annual | „ | OECD Economic Outlook No 74 |
| Money growth[b] | „ | „ | De Nederlandsche Bank and ECB |
| NEER (period averages) | „ | „ | IMF IFS |
| „ | Quarterly | 1979-2003 | „ |
| Nominal exchange rate (period averages) | Annual | | „ |
| „ | Quarterly | 1993-2003 | „ |
| Price level[c] | Annual | 1990-2002 | OECD |
| Net oil imports[d] | „ | 1991-2001 | UNCTAD Handbook of Statistics |
| Non oil imports[d] | „ | „ | UNCTAD and IMF IFS |
| GDP in US$ | „ | 1990-2002 | OECD |
| Oil price (US$ per barrel) | „ | 1990-2003 | OECD Economic Outlook No. 74 |
| Trade shares | „ | 2000-2002 | IMF Directions of Trade |

[a] The output gap of Luxembourg was not available and is estimated. The Hodrick-Prescott filter is used to smooth real GDP and therefore estimate potential GDP. Subsequently, the output gap is calculated according to the OECD's definition: $y\text{-}\bar{y} = (Y\text{-}\bar{Y}/\bar{Y}) \times 100$. Luxembourg's real GDP is available till 2002 and is collected from the OECD National Accounts.

[b] Data prior to 2002 is gathered from the DNB. The observations for 2002 and 2003 are derived from the ECB's aggregate balance sheet of the MFI sector. The latter two observations are therefore a proxy for the individual annual money growth rates.

[c] The price level is in fact the relative price level to the US price level (= 100). The price level for country *i* is calculated as follows: $P = (PPP_{GDP} / E) \times 100$. The purchasing power parity (*PPP*) for GDP and the nominal exchange rate *E* are both in national currency per US$.

[d] Net oil imports are derived from the SITC3. Non oil imports are total imports (IMF IFS) subtracted with the total oil imports (SITC3). The oil (net) imports of Belgium and Luxembourg are unfortunately only available as of 1999. The oil imports of Belgium and Luxembourg prior to 1999 are derived from their combined data which is available as of 1990.

**Table 1**
**Descriptive Statistics**

| | $\pi$ | | $y$-$\bar{y}$ | | $\Delta m$ | | $\Delta NEER$ | |
|---|---|---|---|---|---|---|---|---|
| 1992-1998 | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) |
| Belgium (BE) | 1.8 | 0.6 | -1.1 | 1.1 | 6.1 | 5.7 | 0.4 | 2.7 |
| Germany (GE) | 2.5 | 1.7 | -1.2 | 1.2 | 6.4 | 3.7 | 0.7 | 3.5 |
| Spain (ES) | 3.9 | 1.6 | -2.9 | 1.6 | 6.4 | 3.2 | -3.8 | 4.4 |
| Finland (FN) | 1.7 | 1.1 | -6.6 | 3.6 | 1.9 | 4.2 | -2.4 | 9.1 |
| France (FR) | 1.7 | 0.6 | -2.4 | 1.3 | 2.1 | 4.4 | 1.1 | 2.4 |
| Ireland (IR) | 2.1 | 0.6 | -1.9 | 2.2 | 18.2 | 8.7 | -0.6 | 3.4 |
| Italy (IT) | 3.8 | 1.4 | -1.5 | 0.9 | 3.7 | 3.4 | -3.7 | 8.3 |
| Luxembourg (LX) | 2.1 | 1.0 | -1.5 | 2.8 | 3.6 | 3.5 | 0.0 | 1.3 |
| Netherlands (NL) | 1.9 | 0.5 | 0.5 | 0.9 | 6.4 | 3.7 | 0.4 | 3.0 |
| Austria (OE) | 2.1 | 1.0 | 0.3 | 1.0 | 4.0 | 2.7 | 0.5 | 2.0 |
| Portugal (PT) | 4.4 | 2.4 | -0.6 | 2.3 | 9.9 | 4.1 | -1.0 | 3.2 |
| Greece (GR) | 9.7 | 4.3 | -3.2 | 1.2 | 13.5 | 4.5 | -5.2 | 2.8 |
| Average | 3.1 | 1.4 | -1.8 | 1.7 | 6.9 | 4.3 | -1.1 | 3.8 |
| Average excl. GR | 2.5 | 1.1 | -1.7 | 1.7 | 6.2 | 4.3 | -0.8 | 3.9 |
| 1999-2003 | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) | Mean (%) | Std. dev. (%) |
| Belgium (BE) | 1.9 | 0.7 | 0.3 | 1.7 | 4.4 | 2.6 | -0.7 | 1.7 |
| Germany (GE) | 1.2 | 0.5 | -1.2 | 1.4 | 3.8 | 3.0 | -1.1 | 2.5 |
| Spain (ES) | 3.1 | 0.6 | -0.2 | 0.6 | 8.7 | 1.3 | -0.8 | 1.7 |
| Finland (FN) | 2.0 | 0.8 | -0.8 | 1.3 | 4.5 | 4.7 | -0.9 | 2.7 |
| France (FR) | 1.6 | 0.6 | -0.7 | 1.2 | 7.2 | 1.1 | -0.9 | 1.9 |
| Ireland (IR) | 4.1 | 1.1 | 5.2 | 1.8 | 11.4 | 4.4 | -1.6 | 3.3 |
| Italy (IT) | 2.4 | 0.4 | -0.5 | 1.0 | 5.3 | 2.1 | -1.0 | 1.9 |
| Luxembourg (LX) | 2.3 | 1.0 | 1.8 | 2.7 | 5.3 | 15.0 | -0.3 | 0.5 |
| Netherlands (NL) | 3.1 | 1.3 | 1.6 | 2.2 | 8.7 | 2.9 | -0.8 | 2.0 |
| Austria (OE) | 1.5 | 0.7 | 0.7 | 1.5 | 4.5 | 2.8 | -0.6 | 1.2 |
| Portugal (PT) | 3.3 | 0.9 | 0.3 | 2.6 | 4.6 | 4.1 | -0.8 | 1.8 |
| Greece (GR) | 3.2 | 0.7 | -0.8 | 1.3 | 7.3 | 5.8 | -1.6 | 3.0 |
| Average | 2.5 | 0.8 | 0.5 | 1.6 | 6.3 | 4.2 | -0.9 | 2.0 |
| Average excl. GR | 2.4 | 0.8 | 0.6 | 1.6 | 6.2 | 4.0 | -0.9 | 1.9 |

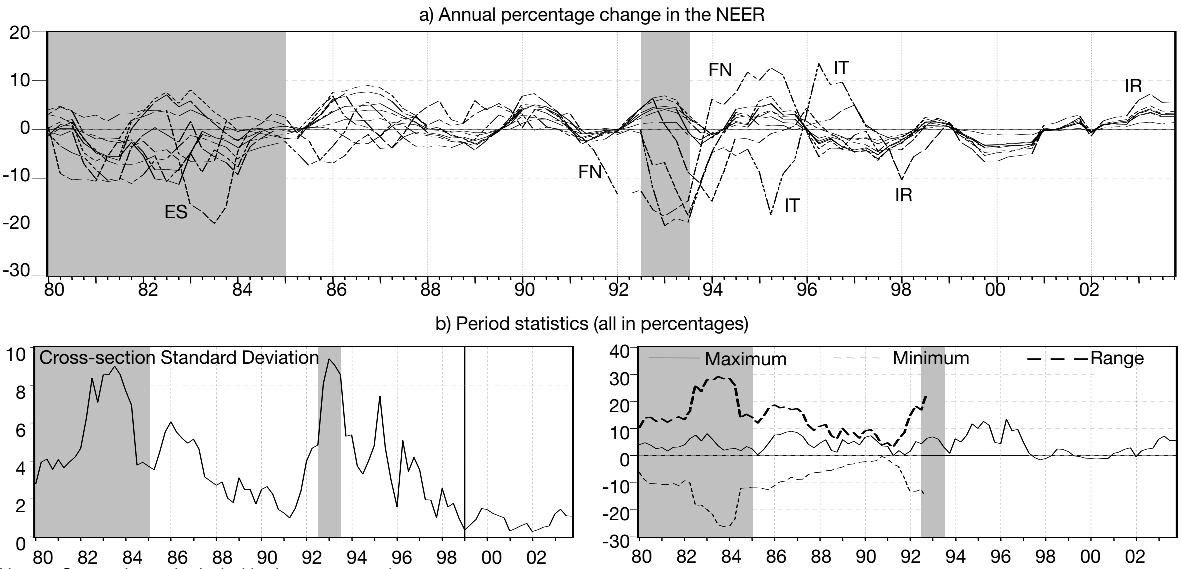
standard deviation and the range. We can identify two periods of strongly increased cross-sectional variability: 1) the period of dollar strength in the early eighties and 2) the period of turbulence in the ERM in the early nineties. In between the cross-sectional variability was particularly low in the period 1990-1991, when expectations of a quick and smooth start of EMU were high. As one would expect, the lowest level of cross-sectional variability in $\Delta e$ has been achieved since the introduction of a common currency. After the sharp increase during the ERM-crisis at the beginning of the 1990s both the range and the cross-sectional standard deviation of $\Delta e$ declined from 26.6% and 9.4% to 1.0% and 0.3% respectively in the first quarter of 2002 (see Figure 2b). Small cross-country differences in the development of $\Delta e$ have remained, however, and it is an empirical matter how important these are in explaining inflation differentials.

### Empirical Results

Next, we re-estimate the HL panel regressions for a large number of alternative specifications. The aim is to examine the robustness of the HL findings to changes in lags, to the inclusion of other variables, to the revision of data and to the exclusion of particular countries from the panel.[32] All specifications are estimated by pooled least squares (with White Heteroskedasticity consistent covariances) for two samples: the pre-EMU period (1992-1998) and the EMU period (1999-2003). Table 2 reports the estimation results for (variations on)

[32] Greece has been excluded from all panel regressions because it entered EMU in 2001.

**Figure 2**
**Annual Percentage Change and Period Statistics for the NEERs within the Euro Area**




Note: Greece is not included in the cross-section.

**Table 2**
**Inflation Differentials within the EMU (excl. Greece), 1992 – 2003**

| | 1992 - 1998 | | | | | | 1999 - 2003 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) |
| $\pi_{t-1}$ | ***0.58 | ***0.61 | | ***0.56 | ***0.59 | | ***0.41 | ***0.39 | | ***0.44 | ***0.44 | |
| | *11.07* | *11.28* | | *10.93* | *11.06* | | *3.16* | *3.13* | | *2.89* | *2.98* | |
| $(y-\bar{y})_t$ | **0.08 | **0.08 | 0.06 | | | | ***0.25 | ***0.24 | ***0.35 | | | |
| | *2.22* | *2.27* | *1.49* | | | | *4.42* | *4.18* | *8.24* | | | |
| $(y-\bar{y})_{t-1}$ | | | | **0.07 | **0.07 | ***0.10 | | | | **0.19 | **0.17 | ***0.33 |
| | | | | *1.97* | *2.03* | *2.71* | | | | *2.36* | *2.11* | *5.50* |
| $\Delta m_{t-1}$ | **0.03 | | ***0.06 | **0.03 | | **0.05 | -0.01 | | 0.00 | -0.02 | | -0.02 |
| | *2.30* | | *2.55* | *2.45* | | *2.45* | *-1.04* | | *-0.27* | *-1.31* | | *-1.27* |
| $\Delta e_{t-1}$ | ***-0.06 | ***-0.06 | ***-0.08 | ***-0.06 | ***-0.06 | ***-0.09 | -0.05 | -0.02 | -0.04 | -0.18 | -0.12 | ***-0.22 |
| | *-3.37* | *-2.93* | *-3.64* | *-3.41* | *-2.96* | *-4.41* | *-0.63* | *-0.30* | *-0.61* | *-1.82* | *-1.26* | *-2.86* |
| $p_{t-1}$ | 0.00 | 0.00 | ***-0.03 | 0.00 | -0.01 | ***-0.03 | **-0.03 | ***-0.03 | ***-0.04 | -0.02 | -0.02 | ***-0.04 |
| | *-0.39* | *-0.82* | *-4.37* | *-0.88* | *-1.37* | *-4.58* | *-2.51* | *-2.57* | *-4.11* | *-1.81* | *-1.78* | *-3.35* |
| Adj. $R^2$ | 0.83 | 0.83 | 0.64 | 0.83 | 0.83 | 0.65 | 0.70 | 0.70 | 0.63 | 0.62 | 0.61 | 0.56 |
| F-stat. | 35.63 | 37.16 | 14.32 | 35.33 | 37.00 | 15.37 | 14.43 | 16.23 | 12.28 | 10.81 | 11.72 | 9.53 |
| ESS | 25.11 | 26.62 | 55.69 | 25.29 | 26.72 | 53.03 | 17.04 | 17.32 | 21.15 | 21.29 | 22.15 | 25.34 |
| DW | 2.26 | 2.29 | 0.82 | 2.22 | 2.25 | 0.89 | 2.51 | 2.51 | 1.34 | 2.65 | 2.74 | 1.64 |
| Obs. | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 | 5 | 5 |
| Total | 77 | 77 | 77 | 77 | 77 | 77 | †54 | †54 | †54 | 55 | 55 | 55 |

Note: ***/** is significant at 1/ 5%; t-statistics in italics; † the 2003 output gap is not available for Luxembourg.

equation (6). Columns (d) and (j) show the results for the original specification in equation (6). For the pre-EMU sample, lagged inflation, the lagged output gap, lagged money growth and the lagged change in the NEER are all significant at a 5% level. Moreover, columns (a) to (f) show that – for the pre-EMU period – the results for the NEER are quite robust to changes in the specification. This also applies to the lagged output gap and money growth. The lagged price level becomes significant in the absence of the lagged inflation rate.

A comparison with the EMU-period (1999-2003) reveals some major differences. First, only in the specification which excludes the lagged inflation rate (which is the one used by HL) do we find a significant effect for the NEER. This implies that the basic HL result is robust to the update of the sample period to 2003 and to data revisions (in particular in the OECD output gap estimates). Yet, in all other specifications the coefficient on the NEER is insignificantly different from zero at a 5% level. So either the inclusion of the lagged inflation rate or the switch from the lagged output gap to the current output gap renders the exchange rate

**Table 3**
**Inflation Differentials within the EMU (excl. Ireland & Greece), 1992 – 2003**

| | 1992 - 1998 | | | | | | 1999 - 2003 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) |
| $\pi_{t-1}$ | ***0.57 | ***0.62 | | ***0.54 | ***0.59 | | ***0.47 | ***0.45 | | ***0.47 | ***0.46 | |
| | *8.35* | *10.39* | | *8.23* | *10.01* | | *4.79* | *4.39* | | *3.74* | *3.81* | |
| $(y-\bar{y})_t$ | **0.07 | **0.08 | 0.04 | | | | **0.21 | 0.21 | ***0.26 | | | |
| | *2.12* | *2.25* | *0.96* | | | | *2.07* | *1.97* | *2.61* | | | |
| $(y-\bar{y})_{t-1}$ | | | | 0.06 | 0.06 | 0.07 | | | | 0.12 | 0.08 | **0.21 |
| | | | | *1.79* | *1.85* | *1.90* | | | | *1.13* | *0.82* | *2.13* |
| $\Delta m_{t-1}$ | 0.03 | | ***0.12 | 0.03 | | ***0.11 | -0.02 | | -0.01 | -0.03 | | -0.03 |
| | *1.37* | | *3.64* | *1.44* | | *3.57* | *-1.26* | | *-0.70* | *-1.35* | | *-1.30* |
| $\Delta e_{t-1}$ | ***-0.06 | ***-0.05 | ***-0.07 | ***-0.05 | ***-0.05 | ***-0.08 | -0.14 | -0.15 | -0.07 | -0.12 | -0.12 | -0.08 |
| | *-3.17* | *-2.79* | *-3.30* | *-3.22* | *-2.77* | *-4.13* | *-0.86* | *-0.87* | *-0.41* | *-0.70* | *-0.57* | *-0.46* |
| $p_{t-1}$ | 0.00 | 0.00 | ***-0.03 | -0.01 | -0.01 | ***-0.03 | **-0.02 | **-0.02 | ***-0.04 | **-0.02 | **-0.02 | ***-0.04 |
| | *-0.75* | *-0.77* | *-4.59* | *-1.28* | *-1.36* | *-4.71* | *-2.42* | *-2.37* | *-4.58* | *-2.17* | *-2.13* | *-4.40* |
| Adj. $R^2$ | 0.85 | 0.84 | 0.72 | 0.84 | 0.84 | 0.73 | 0.63 | 0.63 | 0.53 | 0.57 | 0.56 | 0.48 |
| F-stat. | 35.30 | 38.28 | 18.97 | 34.73 | 37.61 | 19.74 | 10.24 | 11.20 | 7.81 | 8.37 | 8.73 | 6.74 |
| ESS | 22.45 | 23.07 | 40.98 | 22.77 | 23.43 | 39.75 | 14.05 | 14.59 | 18.44 | 16.41 | 17.49 | 20.42 |
| DW | 2.16 | 2.24 | 1.12 | 2.13 | 2.21 | 1.16 | 2.44 | 2.45 | 1.20 | 2.38 | 2.49 | 1.30 |
| Obs. | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 | 5 | 5 |
| Total | 70 | 70 | 70 | 70 | 70 | 70 | †49 | †49 | †49 | 50 | 50 | 50 |

Note: ***/** is significant at 1/ 5%; t-statistics in italics; † the 2003 output gap is not available for Luxembourg.

**Table 4**
**PEX and Inflation Differentials within the EMU (excl. Greece), 1992 – 2002**

| | 1992 - 1998 | | | | | | 1999 - 2002 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) |
| $\pi_{t-1}$ | ***0.59 | ***0.62 | | ***0.57 | ***0.59 | | **0.35 | **0.33 | | **0.41 | **0.40 | |
| | *11.44* | *11.68* | | *11.15* | *11.36* | | *2.17* | *2.13* | | *2.30* | *2.34* | |
| $(y-\bar{y})_t$ | **0.07 | **0.07 | 0.05 | | | | ***0.25 | ***0.26 | ***0.32 | | | |
| | *1.99* | *2.11* | *1.20* | | | | *3.67* | *3.79* | *5.81* | | | |
| $(y-\bar{y})_{t-1}$ | | | | 0.06 | **0.07 | ***0.09 | | | | 0.18 | 0.16 | ***0.28 |
| | | | | *1.86* | *1.97* | *2.53* | | | | *1.75* | *1.59* | *3.25* |
| $\Delta m_{t-1}$ | **0.03 | | **0.06 | **0.03 | | **0.05 | -0.01 | | -0.01 | -0.02 | | -0.02 |
| | *2.06* | | *2.44* | *2.17* | | *2.33* | *-0.80* | | *-0.46* | *-1.05* | | *-1.00* |
| $\Delta pex_{t-1}$ | ***0.35 | ***0.33 | ***0.46 | ***0.35 | ***0.34 | ***0.52 | 0.08 | 0.01 | 0.17 | 0.32 | 0.21 | 0.46 |
| | *2.95* | *2.74* | *2.80* | *3.01* | *2.81* | *3.28* | *0.31* | *0.04* | *0.72* | *1.08* | *0.91* | *1.55* |
| $p_{t-1}$ | 0.00 | -0.01 | ***-0.04 | -0.01 | -0.01 | ***-0.04 | **-0.03 | **-0.03 | ***-0.04 | -0.02 | -0.02 | ***-0.03 |
| | *-0.55* | *-0.94* | *-4.57* | *-0.98* | *-1.45* | *-4.67* | *-2.16* | *-2.12* | *-3.54* | *-1.64* | *-1.53* | *-2.90* |
| Adj. $R^2$ | 0.83 | 0.82 | 0.63 | 0.83 | 0.82 | 0.64 | 0.66 | 0.66 | 0.62 | 0.57 | 0.57 | 0.53 |
| F-stat. | 34.61 | 36.56 | 13.81 | 34.46 | 36.52 | 14.73 | 11.31 | 13.06 | 11.09 | 8.22 | 9.18 | 7.95 |
| ESS | 25.74 | 26.99 | 57.08 | 25.84 | 27.01 | 54.60 | 15.91 | 16.12 | 18.07 | 19.82 | 20.48 | 22.40 |
| DW | 2.14 | 2.17 | 0.74 | 2.11 | 2.14 | 0.80 | 2.51 | 2.53 | 1.50 | 2.72 | 2.79 | 1.70 |
| Obs. | 7 | 7 | 7 | 7 | 7 | 7 | 4 | 4 | 4 | 4 | 4 | 4 |
| Total | 77 | 77 | 77 | 77 | 77 | 77 | 44 | 44 | 44 | 44 | 44 | 44 |

Note: ***/** is significant at 1/ 5%; t-statistics in italics.

variable redundant. Second, in contrast to the pre-EMU period, the coefficients on the (lagged) output gap are now much larger and more significant. Both the short and long run impact of the output gap are roughly double the pre-EMU estimates. Before 1999 an output gap of 1% resulted in an inflation differential of 0.07-0.08 and 0.15-0.20 respectively in the short and long run. The estimates are 0.17-0.25 and 0.29-0.42 for the EMU sample. This finding corroborates the evidence in Bofinger[33] on the re-emergence of the Phillips curve in the euro zone.[34] Third, national money growth has ceased to be a significant variable in explaining inflation differentials since the introduction of the euro, confirming our expectation that the link between money and inflation differentials has weakened in the monetary union.

### The Irish Exception?

Table 3 checks whether the significance of the NEER in the original HL specification is driven by the Irish exception. We have re-estimated all specifications for a panel which in addition to Greece now also excludes Ireland. In general the exclusion of Ireland leads to a deterioration of the estimation results. For the pre-EMU sample, the (lagged) output gap and money growth are less significant. The exchange rate variable, however, remains significant across all pre-EMU specifications. For the EMU period, the statistical significance of the NEER drops due to the exclusion of Ireland: none of the specifications now includes a significant NEER. This supports the notion of the "Irish outlier". The evidence for the re-emergence of the Phillips curve is also weakened by the exclusion of Ireland. The (lagged) output gap remains significant in the absence of lagged inflation. However, when we include lagged inflation only the current output gap is (borderline) significant.

### Putting It All Together: Trade and Oil Dependency

The ECB has constructed a synthetic indicator of "external exposure" to assess the joint impact of factors like oil dependency, openness, geographical trade structure and the commodity composition of imports on inflation differentials in the EMU.[35] This indicator – called *pex* – is calculated as follows:

(7) $pex_i = \alpha_i \beta \Delta e_i + \gamma_i (\Delta p_{oil} - \Delta e_{€/\$})$

where $\alpha_i$ is the non-oil import share of country *i* relative to GDP, $\beta$ is the pass-through coefficient (assumed to be 0.8 across all countries), $\Delta e_i$ is the country-specific percentage change in the NEER, $\Delta e_{€/\$}$ is the percentage change in the euro-dollar exchange rate (dollar per euro), $\Delta p_{oil}$ is the percentage change in the oil price (in dollars), and $\gamma_i$ is the net oil import share of country *i* relative to GDP. An increase in *pex* should result in a higher inflation rate as an appreciating NEER and a higher oil price (in euro) lead to higher import prices. The ECB suggests a positive relation between the inflation rate and the *pex*[36] but does not control for other variables. We shall try to do this by incorporat-

[33] P. Bofinger: The Stability and Growth Pact Neglects the Policy Mix between Fiscal and Monetary Policy, in: INTERECONOMICS, Vol. 38, No.1, pp. 4-7.

[34] In contrast to Bofinger, we use output gaps instead of real GDP growth. Another difference is that we also estimate specifications including lagged inflation and the lagged output gap.

[35] European Central Bank, op. cit., p. 29.

[36] Ibid., chart 13, p. 29.

**Table 5**
**The Two Components of the PEX and Inflation Differentials within the EMU (excl. Greece), 1992 – 2002**

| | 1992 - 1998 | | | | | | 1999 - 2002 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) |
| $\pi_{t-1}$ | ***0.59 | ***0.62 | | ***0.57 | ***0.59 | | **0.36 | **0.34 | | **0.41 | **0.40 | |
| | *11.31* | *11.52* | | *11.02* | *11.18* | | *2.20* | *2.15* | | *2.26* | *2.34* | |
| $(y-\bar{y})_t$ | **0.07 | **0.07 | 0.05 | | | | ***0.25 | ***0.25 | ***0.32 | | | |
| | *1.99* | *2.11* | *1.26* | | | | *3.84* | *3.85* | *5.78* | | | |
| $(y-\bar{y})_{t-1}$ | | | | 0.06 | **0.07 | ***0.09 | | | | 0.18 | 0.16 | ***0.28 |
| | | | | *1.86* | *1.98* | *2.52* | | | | *1.78* | *1.63* | *3.17* |
| $\Delta m_{t-1}$ | **0.03 | | **0.06 | **0.03 | | **0.05 | -0.01 | | -0.01 | -0.02 | | -0.02 |
| | *2.05* | | *2.42* | *2.14* | | *2.30* | *-1.12* | | *-0.66* | *-1.31* | | *-1.25* |
| $-\alpha_{i,t}\,\beta\Delta e_{i,t}$ | ***0.28 | ***0.27 | ***0.36 | ***0.29 | ***0.28 | ***0.41 | 0.14 | 0.06 | 0.20 | 0.35 | 0.24 | **0.47 |
| | *2.98* | *2.81* | *2.58* | *3.00* | *2.85* | *2.95* | *0.75* | *0.38* | *1.19* | *1.54* | *1.21* | *2.16* |
| $\gamma_{i,t}(\Delta p_{oil} - \Delta e_{€/\$,i})_t$ | 0.38 | 0.44 | 0.17 | 0.47 | 0.54 | 0.27 | -0.36 | -0.38 | -0.18 | -0.32 | -0.34 | -0.16 |
| | *0.73* | *0.83* | *0.20* | *0.89* | *1.00* | *0.31* | *-0.45* | *-0.49* | *-0.25* | *-0.37* | *-0.40* | *-0.21* |
| $p_{t-1}$ | 0.00 | -0.01 | ***-0.04 | -0.01 | -0.01 | ***-0.04 | **-0.03 | **-0.03 | ***-0.04 | -0.02 | -0.02 | ***-0.03 |
| | *-0.55* | *-0.94* | *-4.58* | *-0.98* | *-1.43* | *-4.68* | *-2.08* | *-2.04* | *-3.54* | *-1.63* | *-1.51* | *-2.96* |
| Adj. $R^2$ | 0.83 | 0.82 | 0.62 | 0.83 | 0.82 | 0.64 | 0.66 | 0.66 | 0.62 | 0.58 | 0.57 | 0.54 |
| F-stat. | 31.24 | 32.75 | 12.39 | 31.12 | 32.76 | 13.22 | 10.16 | 11.44 | 9.67 | 7.63 | 8.23 | 7.22 |
| ESS | 25.74 | 26.98 | 56.98 | 25.82 | 26.97 | 54.54 | 15.47 | 15.79 | 17.77 | 18.89 | 19.81 | 21.52 |
| DW | 2.13 | 2.16 | 0.75 | 2.11 | 2.13 | 0.81 | 2.61 | 2.61 | 1.54 | 2.84 | 2.88 | 1.78 |
| Obs. | 7 | 7 | 7 | 7 | 7 | 7 | 4 | 4 | 4 | 4 | 4 | 4 |
| Total | 77 | 77 | 77 | 77 | 77 | 77 | 44 | 44 | 44 | 44 | 44 | 44 |

Note: ***/** is significant at 1/ 5%; t-statistics in italics.

ing the *pex* in our panel framework. We were able to construct the *pex* for the period 1991-2001 (see box for details). Prior to EMU we have replaced the euro-dollar exchange rate with the local currency per dollar rate. The impact of the *pex* on the inflation differentials has been assessed by replacing $\Delta e_{i,t-1}$ with $pex_{i,t-1}$ in equation (6). Table 4 reports the empirical findings. Before EMU the *pex* is highly significant: a one percentage point increase in the *pex* results in an inflation differential of 0.33-0.35 and 0.82-0.85 respectively in the short and long run. After 1999 the *pex* is significant in none of the specifications. Results for the other variables are comparable to Table 2. We have also checked whether splitting the *pex* into its two components (the non-oil component $-\alpha_{i,t}\beta\Delta e_{i,t}$ and the oil component $\gamma_{i,t}(\Delta p_{oil} - \Delta e_{€/\$,i})_t$ would change the results. Table 5 shows that the non-oil component of the *pex* is the major driving force behind the significant relationship between the *pex* and the observed inflation differentials prior to EMU. After 1999 the non-oil component becomes significant in the HL specification, see column (l). This finding confirms the results in Table 2 and suggests that differences in oil dependency are not a major cause of divergences in the inflation rate across the euro area.

### The NEERs of the New EU Members

In this part we address the question whether differential trade exposures could become more important in explaining euro zone inflation differentials when the EMU is enlarged with the new EU members (CEEC10).[37] We do this by comparing their actual NEERs with a set of hypothetical NEERs, calculated under the assumption that the new EU members entered EMU in January 1999. The NEERs of the CEEC10 have been derived as geometric weighted averages of bilateral exchange rates with their trading partners, using the IMF's methodology. The trade weights are average weights for the years 2000 to 2002.

The first three columns of Table 6 show the average trade weights for the CEEC10 with different regions. For most countries the total trade weight exceeds 90%. Cyprus and Slovenia are the exceptions. For these two countries the Middle East and Croatia are also important trading partners. The extended European Union (EU25 = EU15 + CEEC10) is an important

**Table 6**
**Average Trade Weights CEEC10**
(percentages)

| | Selection | | | | | | |
|---|---|---|---|---|---|---|---|
| | Industrial Countries | Europe | Asia | Total | EU25 | EMU12 | EMU22 |
| Cyprus | 60.0 | 12.2 | 6.8 | 78.9 | 48.5 | 34.1 | 36.0 |
| Czech R. | 72.8 | 19.5 | 2.8 | 95.1 | 79.9 | 59.3 | 73.6 |
| Estonia | 64.8 | 23.7 | 4.2 | 92.6 | 67.4 | 40.4 | 51.0 |
| Hungary | 74.4 | 14.5 | 4.6 | 93.5 | 72.5 | 59.9 | 66.7 |
| Latvia | 61.8 | 30.9 | 1.0 | 93.7 | 76.5 | 36.3 | 57.0 |
| Lithuania | 52.1 | 38.8 | 2.4 | 93.3 | 60.5 | 29.8 | 45.7 |
| Malta | 67.6 | 4.1 | 19.6 | 91.3 | 50.8 | 40.9 | 42.3 |
| Poland | 72.1 | 18.3 | 5.2 | 95.7 | 73.8 | 55.3 | 64.4 |
| Slovenia | 70.9 | 12.7 | 2.3 | 85.9 | 73.0 | 60.7 | 68.7 |
| Slovak R. | 59.1 | 35.6 | 1.6 | 96.3 | 79.3 | 50.7 | 75.6 |

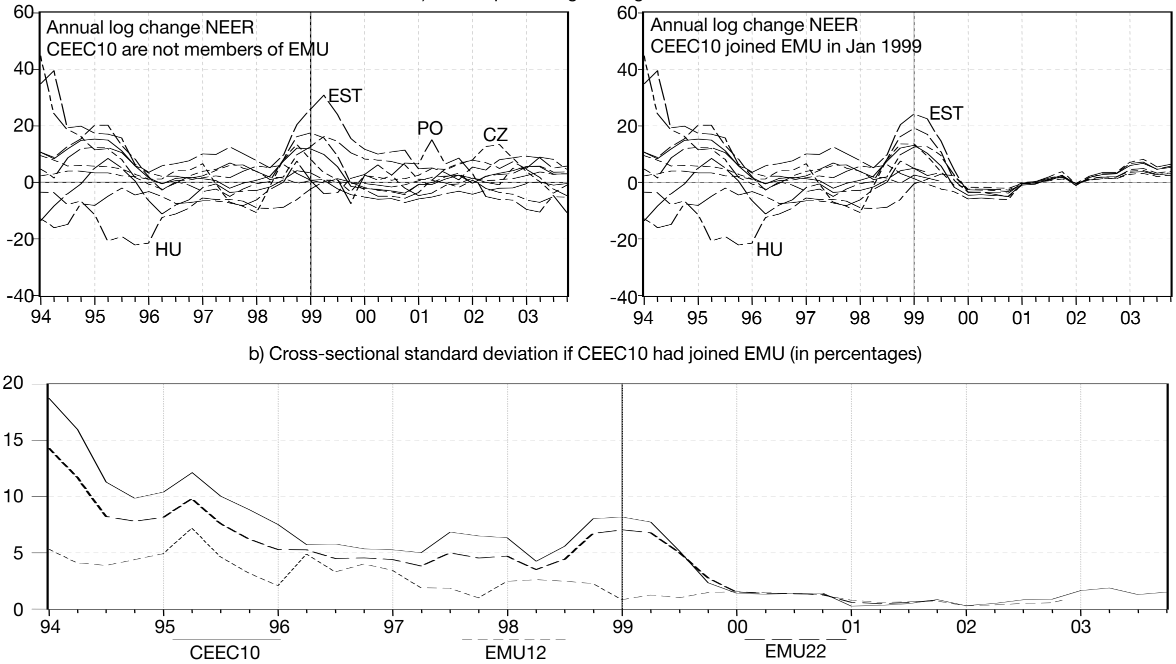
Note: EU25 consists of the EU15 plus the CEEC10; EMU22 consists of EMU12 plus CEEC10.

Sources: IMF Direction of Trade Statistics and own calculations.

[37] The new EU members or the Central Eastern European Countries (CEEC10) are Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia.

**Figure 3**
**Annual Percentage Change for the NEERs of the new EU Members**

a) Annual percentage change in the NEER




trading partner for all new EU members. For most of the new EU members the trade share exceeds 60%; for some countries the trade share is even as high as 80%. Trade shares with the euro zone (EMU12) are obviously smaller, especially for more distant countries like Cyprus and Lithuania. If the EMU were enlarged with the CEEC10 (EMU22) the intra-EMU trade share would be higher than 50% for all countries except Cyprus (36%), Lithuania (46%), and Malta (42%). This suggests that the impact of differential trade exposures on inflation differentials within the enlarged EMU22 would be small.

In Figure 3 the actual NEERs of the new EU members are compared to the hypothetical NEERs, under the scenario that the CEEC10 had joined EMU in January 1999.[38] The comparison shows a strong convergence in the development of the NEERs in the accession countries. Figure 3b plots the cross-sectional standard deviations of $\Delta e$ for three sets of countries: the accession countries (CEEC10), the enlarged EMU (EMU22) and, for the purpose of comparison, the original EMU12 group. For the pre-EMU period, the inclusion of the CEEC10 increases the cross-sectional standard deviation considerably. However, under the EMU scenario the cross-sectional variability in $\Delta e$ increased only slightly after the inclusion of the accession countries.

[38] This is done by fixing the local currency rates to the euro. As the changes are calculated on a year-on-year basis, "full" convergence starts in 2000.

The cross-sectional standard deviation for the EMU22 declines to approximately 0.3 per cent in the first quarter of 2002; this is identical to the cross-sectional standard deviation for the EMU12. The cross-sectional standard deviations for EMU12 and EMU22 recently increased to 1.1 and 1.3 percent respectively. Combining this information with the empirical findings for the EMU above suggests that the trade exposures of the CEEC10 should not become a major source of inflation differentials within the enlarged EMU.

## Conclusions

In this paper we have re-examined whether external factors are important in explaining inflation differentials in the euro zone. In contrast to earlier findings, we conclude that in the euro zone exchange rate developments do not appear to be a major driver of inflation differentials. Before 1999 the development in the NEER was significantly related to inflation differentials across a large set of different specifications. After 1999, however, the NEER is significant in just one specification. This exception is due to the exclusion of lagged inflation and the inclusion of the Irish outlier. In general the output gap performs best in explaining inflation differentials, corroborating earlier findings of the re-emergence of the Phillips curve in the euro zone. When the accession countries enter EMU the cross-country variability in exchange rate developments will increase only slightly, suggesting that in the future exchange rate developments are unlikely to be a major factor behind euro zone inflation differentials.