Regional Inflation Dynamics within and across Euro Area Countries and a Comparison with the US*

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Abstract

We investigate co-movements and differences in inflation dynamics of different regions within and across euro area countries using a novel disaggregate dataset. We employ a model where regional inflation dynamics are explained by common euro area and country specific factors and an idiosyncratic regional component. We find that there is a substantial common area wide component, likely related to the common monetary policy in the euro area and to external developments, in particular exchange rate movements and changes in oil prices. The effects of the area wide factors differ across regions, however. We also find a substantial national component. Our findings do not differ substantially before and after the formal introduction of the euro in 1999, suggesting that convergence has largely taken place before the mid 90s. Analysing US regional inflation developments yields similar results regarding the relevance of common US factors. Finally, we find that disaggregate regional inflation information, as summarised by the area wide factors, is important in explaining aggregate euro area and US inflation rates, even after conditioning on macroeconomic variables. Therefore, monitoring regional inflation rates within euro area countries can enhance the monetary policy maker's understanding of aggregate area wide inflation dynamics.

Key words: regional inflation dynamics, euro area and US, common factor models

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1 Introduction

It is highly important for the conduct of the ECB's monetary policy to investigate whether and to what extent economic heterogeneity within the euro area has been declining due to the higher integration of labour, product and capital markets in the advent to the European Monetary Union (EMU) and after the introduction of the euro in 1999. Why is it of interest in this context to analyse regional inflation dynamics within as well as across euro area countries on a disaggregated level? Large and persistent differences in regional inflation rates might lead to contradicting demands concerning the conduct of monetary policy[1]. Therefore, it is essential for policy makers to understand how and to what extent differences between inflation rates across different regions arise within and across national borders of euro area countries. The analysis in this paper will show that using regional data will provide additional important insights that might not be revealed by more aggregate information.

The issue of inflation differentials in monetary unions has been recently addressed theoretically by several authors. Based on the framework developed by Obstfeld & Rogoff (1995, 2000), Duarte & Wolman (2002) and Altissimo, Benigno & Palenzuela (2005) build an open economy model including both a traded and non-traded sector and use it to analyse inflation differentials in the euro area. They find that fiscal measures and productivity differentials are an important source for inflation differentials within the euro area.

However, there is - to the knowledge of the authors - no theoretical framework that considers inflation differences between regions within a country. Instead, 'region' in the existing literature usually refers to euro area countries. The models in the theoretical literature cited above provide a framework that is in some important aspects not appropriate for our analysis. To analyse regional inflation differentials within countries, we would need a model where, for example, the majority of fiscal policy decisions and decisions on institutional structures and regulations are taken on a different level of aggregation as inflation dynamics are determined and where heterogeneity of agents' reaction within national borders is allowed, not only between two different countries. We leave theoretical work on this extension for future research and focus on an empirical investigation of regional inflation developments.

With our analysis focusing on regional inflation we complement the literature on euro area inflation dynamics and convergence (see e.g. Beck & Weber (2001), Engel & Rogers (2004), Hubrich (2005) and Hendry & Hubrich (2006) and Marcellino, Stock & Watson (2003)) to shed additional light on inflation dynamics and on the issue of the effect of EMU on inflation

[1]For this argument, see e.g. Cecchetti, Mark & Sonora (2002) in their analysis of price index convergence of US cities.

rates in the euro area, not only across countries or sectors but also across regions.

We have collected a unique data set on prices and real variables for a large number of regions within euro area countries, covering a large part of the euro area. Within a factor model framework we decompose regional inflation rates into euro area, national and regional components, similar to Forni & Reichlin (2001) in their analysis of output fluctuations in the euro area and the US. One aim is to explore the strength of co-movements among all regional inflation rates. This common component might be due to the convergence process towards European Monetary Union implying similar monetary policy of national central banks in Europe, the common monetary policy in the euro area since 1999 as well as external developments. Country-specific factors might arise due to fiscal policy measures, such as changes to unemployment benefits or tax changes, price liberalisation measures, administrative price changes, and more generally through institutional structures including product market regulations and financial market regulations. Other special economic factors that may lead to divergencies of inflation rates are production structures, trade patterns and labour market institutions. However, for the latter three characteristics it is less clear whether they are country-specific or whether they are related to regions that represent only a part of a country or that reach across national borders. For example, although there might be some general wage bargaining process for a country as a whole, recently more regional and/or sector-specific wage agreements occur. A region specific inflation component might also be due to low labour market mobility creating different labour market conditions across regions, e.g. between the East and the West of Germany or the North and the South of Italy. It is also conceivable that the effects of measures taken at the national or area wide level can differ across regions.

Recent developments in factor analysis allow the estimation of our model for regional inflation even in the presence of a rather short temporal dimension of the sample, which is compensated by a rather large longitudinal dimension. Specifically, we employ principal component based estimators for the factors, along the lines of Stock & Watson (2002b). While more sophisticated estimation techniques are available, see e.g. Forni, Hallin, Lippi & Reichlin (2000, 2005), the differences are usually minor both in simulation experiments and in empirical applications, see e.g. Kapetanios & Marcellino (2004), Favero, Marcellino & Neglia (2005), although this will depend on the unknown data generating process.[2] An

[2] A somewhat related methodological approach to ours is chosen by Kose, Otrok & Whiteman (2003). They analyse the common dynamic properties of business cycles using a Bayesian dynamic latent factor model. Their focus is to investigate the existence of a common world factor and the role of factors common to a group of countries. Similarly, Ciccarelli & Mojon (2005) investigate the existence of a world factor driving the inflation rates across countries.

additional advantage of the principal components in our context is that the estimated factors are linear combinations of current regional inflation rates only - while the other estimation methods involve leads and lags. This simplifies their interpretation.

In Section 2 we describe the regional data set we have prepared for this paper, present some key descriptive statistics and discuss their implications. The data set contains monthly series from 1995(1) to 2004(10) for Austria, Finland, Germany, Italy, Portugal and Spain, covering about 2/3 of the euro area in terms of economic activity. For the other euro member countries, regional data are either not available or their collection started only very recently. We have also collected disaggregated US data to compare our findings for the euro area.

In Section 3 we present in more detail the factor based econometric framework. In the Appendix we explain and evaluate an alternative approach to modelling regional inflation dynamics based on macro variables along the lines of the global VAR analysis by Peseran, Schuerman & Weiner (2004), which appears to perform worse than the factor based method for our regional data set.

The subsequent empirical analysis presented in Section 4 focuses on the area wide and national components in regional inflation rates and involves three stages. First, we estimate the area wide factors based on all regional inflation rates. We find one main factor explaining about 50% of the variability in the data. The first three area wide factors, common to all regions, explain about 75% of the variability in regional inflation data, suggesting important commonality across all regions. We postulate that these factors are related to common demand developments within the euro area, mostly related to monetary policy, to changes in oil prices that might in recent years be related to supply as well as demand effects, or to external developments, related to exchange rate movements.

At the second stage of our analysis, we estimate the country specific factors, based on the principal components of the residuals of the regression of each of the regional inflation rates on the euro area factors. Our results show that three country-specific common factors explain at least 65% of the remaining variability in regional inflation, also in the large countries.

In the third step we regress regional inflation rates on the estimated area wide and national factors, finding that both types of factors are strongly significant and that the model explains a large part of the variability in regional inflation, and it appears to be correctly specified for most regional inflation series from a statistical point of view.

In Section 5 we evaluate three additional aspects of regional inflation dynamics. First, we consider whether regional inflation is better explained by area wide inflation than by the area wide factors, but this turns out not to be the case. Moreover, when area wide inflation is used as a regressor there is a spurious increase of about 25% in our measure of regional inflation persistence.

Second, the analysis discussed in the main text is based on the level of inflation. If inflation would actually be so persistent as to be integrated of order one, we might find a lower number of factors to be relevant when analyzing the level of regional inflation, since stationary factors would be more difficult to detect (see (Bai & Ng, 2002)). Therefore, we repeat the whole analysis for changes in inflation to investigate the sensitivity of our results toward the stationarity assumption for inflation, finding that the main results do not change.

Third, we consider explicitly the effects of the introduction of the euro. The question arises whether regional inflation dynamics differ after the introduction of the euro in comparison with the period before the start of the European Monetary Union (EMU). Split sample analysis for the pre- and post-1999 period reveals a limited impact. However, this could be due to the fact that the EMU was announced well before '99 so that the convergence process could have mostly taken place by 1995, the starting date of our sample.

Section 6 compares the results for the euro area with those for the US, employing data from US metropolitan areas. We find that the first common factor explains a similar amount of variability of regional inflation in the US as in the euro area, and that US regional inflation dynamics are also well explained by the factor based representation.

Section 7 investigates the question to what extent aggregate euro area and US inflation can be explained by the area wide factors extracted from the regional data set. We find that in both cases the area wide factors are important explanatory variables in addition to standard aggregate macro variables such as labour market or monetary variables. This result suggests that area wide factors derived from regional inflation data capture additional aspects relevant at the aggregate level in addition to the information captured by the aggregate macroeconomic variables we consider, and provides a further justification for monitoring regional inflation dynamics.

Finally, in Section 8 we summarize the main findings of the paper and discuss their implications for the conduct of monetary policy.

2 Regional inflation data

For our study we collected a large set of European regional consumer price data. The data set contains consumer price index (CPI) data from six EMU member countries and comprises a total of 70 locations. These data cover about 2/3 of the euro area in terms of economic activity and span the period 1995(1) to 2004(10) on a monthly frequency. For the remaining euro area countries comparable regional data are not available or at least not for a similar time span. An overview of the countries and regions that are included in our study is given in Tables 1 and 2. More specifically, we are using price data for 12 German states ('Länder'), 9 Austrian regions, 5 Finnish regions, 19 Italian cities, 18 Spanish regions ('communidades'), and 7 Portuguese regions. In all cases the regions correspond to NUTS-II regions, except for Germany where only data for NUTS-I regions are available. The Nomenclature of Territorial Units for Statistics (NUTS) was established by Eurostat in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. Statistical Regions are defined at three levels: NUTS I, NUTS II, and NUTS III where NUTS III corresponds to the most detailed level of regional disaggregation. As data for Austria were only available at a city level we compiled NUTS-II level data for Austrian regions by computing a weighted regional CPI index. Weights were given by the number of inhabitants of the respective cities. Data for Italy were available for a sufficiently long time period only for the main city in each of the NUTS II regions. As Table 1 indicates, all data were provided either by a country's national statistical office (Austria, Finland, Italy, Spain and Portugal) or by the respective region's statistical office (Germany).

All data are monthly, non-seasonally adjusted and are available in index form. Inflation rates π_t are computed as year-on-year percentage changes in the price index in the following way:

$$\pi_t = 100 * (\ln P_t - \ln P_{t-12},) \tag{1}$$

where P_t represents the respective price index in t. There is no evidence of seasonality in the year-on-year inflation rates based on the graphs of the series reported in Figures 1 and 2.

Figure 1 also illustrates the importance and extent of regional inflation rate dispersion for our sample. Regional dispersion is considerable, spanning a band of around 4 percentage points. Additionally, one can observe that there does not seem to be a tendency for overall inflation dispersion to decrease over time (no σ-convergence). Table 3 provides some descriptive statistics. Looking at the mean inflation rates, we can see that the lowest average inflation rate over the sample period prevailed in Germany, followed by Finland, Austria, Italy, Portugal, and Spain (in that order). Notice also that the average national inflation dispersion (about 1.5 percentage points) is considerably smaller than the regional dispersion that we saw in Figure 1 (about 4 percentage points). Looking at the reported cross-sectional dispersion measures (measured by the standard deviations of regional mean inflation rates), we can see that dispersion at a national level is lower than at the EMU level. Nevertheless, dispersion is still important also at the national level. This indicates that regional data might contain information that is not available in national data only.

When we split the sample into a 'pre-EMU' (1995 - 1998) and an 'EMU' (1999 - 2004) subsample, two major observations can be made. First, mean inflation rates are always lower in the 'pre-EMU' subperiod (see Table 3). Second, inflation dispersion remains more or less stable across the two subperiods, in line with the visual impression from Figure 1. The first observation probably reflects the large efforts of EMU countries to meet the Maastricht criteria before 1999. The second observation shows that, despite substantial harmonization efforts, considerable heterogeneities across EMU regions continue to exist.

Table 4 contains Augmented Dickey Fuller (ADF) unit root test results for the inflation rate series contained in our sample. As is well-known, the power of single-equation unit root tests critically depends on the length of the time span for which data is available. Since our sample period for year-on-year inflation (1996.01 - 2004.10) is very short, it is probably not very surprising that for only about 25% of the regions the null hypothesis of a unit root can be rejected. Given the low power of this test we will nevertheless base most of our analysis on inflation level data rather than first differences.[3] However, as a sensitivity check we will also repeat the analysis for first differences (see Section 5.2).

Finally, to benchmark and compare our results with a long-established common currency area, we collected regional consumer price indices for the US. A more detailed description of these data is given in Section 6.

3 The econometric framework

In this section we model the regional data for the euro area described above using a factor specification. In particular, if we define x_{ijt} as the (standardized) inflation rate in region i of country j at period t, then

$$\begin{aligned} x_{ijt} &= \lambda_{ij} f_t + \eta_{ij} g_{jt} + e_{ijt}, \\ i &= 1, ..., N_j, \quad j = 1, ..., 6 \quad t = 1, ..., T, \end{aligned} \tag{2}$$

where f_t are the area wide common factors with associated loadings λ_{ij}, that can differ across regions, g_{jt} are the national common factors with associated loadings η_{ij} (also allowed to differ

[3]Recently developed panel unit root tests are not suited in our context due to the substantial comovement across regional inflation rates, evident from Figure 1, which would bias the tests substantially, see Banerjee, Marcellino & Osbat (2004).

across regions), and e_{ijt} is an idiosyncratic region specific component. N_j is the number of regions for country j. A similar framework was used by Forni & Reichlin (2001) to analyse regional output fluctuations.

To identify the model, the area wide and the national factors are assumed to be orthonormal and orthogonal with the idiosyncratic components, while precise technical conditions on the permitted temporal and longitudinal correlation in the idiosyncratic components are given in Stock & Watson (2002a, 2002b). Notice that the component $\lambda_{ij} f_t$ could be also written as $\lambda_{ij} P P^{-1} f_t$ where P is a full rank matrix whose dimension is equal to the number of factors. Under our assumption of orthonormal factors, it must be $P = I$. However, other more structural identification schemes could be possible, and in this sense our estimated factors are not 'structurally' identified. We will comment on some consequences of this feature for the interpretation of the empirical results later on.

Notice also that the specification in (2) nests dynamic models where the factors can have a delayed impact on regional inflation. For example, denoting the area wide common factors by q_t and their lags by q_{t-1}, the model

$$x_{ijt} = \alpha_{ij} q_t + \beta_{ij} q_{t-1} + \eta_{ij} g_{jt} + e_{ijt}, \tag{3}$$

is equivalent to

$$\begin{aligned} x_{ijt} &= \lambda_{ij} f_t + \eta_{ij} g_{jt} + e_{ijt}, \\ f_t &= \begin{pmatrix} q_t \\ q_{t-1} \end{pmatrix}, \quad \lambda_{ij} = \begin{pmatrix} \alpha_{ij} & \beta_{ij} \end{pmatrix}. \end{aligned} \tag{4}$$

The economic rationale of the model in (2) is that there are some common factors underlying regional inflation dynamics, such as the common monetary policy within the euro area (or similar monetary policies in the convergence to the euro), and common external developments such as oil prices and the exchange rate. These very few factors, f_t, should explain the bulk of the variation in regional inflation, but there could also be a national component of inflation, related for example to remaining labour and goods markets heterogeneity within the euro area members. This national component should be captured by the national factors, g_{jt}. The remaining unexplained component, e_{ijt}, is related to pure regional variables, such as local labour market conditions, which could matter even more than their national counterparts due to the low labour mobility across European regions. Structural regional differences related for example to factor endowments or population differences should not matter, since we analyze standardized data where a region specific mean is subtracted from each variable prior to fitting the factor model.

In the Appendix we present an alternative, variable based regression approach for modelling regional inflation dynamics, related to the global VAR model by Peseran et al. (2004). We also present some empirical results, indicating that the factor model is a better representation of our data set.

4 The area wide and national components of regional inflation

4.1 How much comovement?

The starting point of our empirical analysis is the estimation of the area wide and national common factors, $\widehat{f}_t$ and $\widehat{g}_{jt}$, respectively, in equation (2). Stock & Watson (2002a) proved that, under mild regularity conditions, the factors can be consistently estimated by principal components of the variables. Therefore, to estimate the area wide factors, we extract up to six principal components from the pooled regional dataset, which contains a total of 70 time series.

The first panel of Table 5 reports the eigenvalues of the variance covariance matrix of the variables in decreasing order, the proportion of variance explained by each component, and the cumulated explained variance. These figures are useful to select the number of common factors. Statistical information criteria for the selection of the number of factors, in particular those proposed by Bai & Ng (2002), are hardly applicable in our context due to the rather small sample size and the presence of some correlation across the idiosyncratic components. In these conditions the information criteria tend to indicate either just one or the maximum pre-specified number of factors. The first factor explains about 48% of the variance in all regional inflation rates, whereas about 75% of the variance of all series is explained by three factors. There is a substantial drop of about 50% between the variance explained by the third and the fourth factor, 0.106 and 0.054, respectively. Furthermore, the second and third factors are significant in the models for all regions. Overall, these results suggest that three area wide factors are sufficient to explain regional inflation. Therefore, we assume that there are three area wide factors, and estimate them by the first three principal components of the regional variables. Also, from an economic point of view we would expect at least three different common shocks, related to demand shocks (common monetary policy), supply shocks (e.g. oil prices) and external developments.[4]

For each country we then clean the regional series from the common area wide effects by regressing them on the three estimated area wide factors. The principal components of the resulting residuals can be used to estimate the national factors. This procedure is justified by the assumed orthogonality of the area wide, national and regional components.

The principal component analysis of the resulting residuals is reported in the other panels of Table 5 for Austria, Germany, Spain, Finland, Italy and Portugal. A limited number of national factors seems capable of summarizing efficiently the information in the national residual inflation series. In general three factors are again sufficient to explain about 75% of the variance of the series, with higher values for the smaller countries due to their lower number of regions. For Germany the fourth factor might be significant and for Italy the choice is not clear-cut, but for the sake of comparability we assume that there are three national common factors in each country. Furthermore, from an economic perspective we would expect at least three factors to be relevant, reflecting the role of labour market institutions, fiscal policy measures and institutional structures, including product market regulations and financial regulations.

4.2 Explaining regional inflation with area wide and national factors

After having estimated the area wide and national factors, we now study how strong their joint explanatory power is for each regional inflation series.

We start by estimating an ADL(1,1) model where each regional inflation series is regressed on its own lag, the factors, and one lag of each factor, namely

$$x_{ijt} = \lambda_{ij} f_t + \eta_{ij} g_{jt} + \alpha_{ij} f_{t-1} + \beta_{ij} g_{t-1} + \rho_{ij} x_{ijt-1} + u_{ijt}. \tag{5}$$

We then test the (so-called COMFAC) restrictions on the parameters, $\alpha_{ij} + \rho_{ij}\lambda_{ij} = 0$ and

[4] When the factors are regressed on area wide variables such as the short-term interest rate, M3 growth, the exchange rate and the growth in oil prices, these variables have, as expected, a good explanatory power. However, due to the mentioned lack of structural identification it is not possible to associate each factor with specific area wide macroeconomic variables. Additional insight into the economic interpretation of the factors could be provided by a structural factor approach along the lines of Forni, Giannone, Lippi & Reichlin (2005). However, our data set is not rich enough for such an approach to be implemented, since most real variables are not available on a monthly basis on the regional level.

$\beta_{ij} + \rho_{ij}\eta_{ij} = 0$, which imply that the model can be written as

$$x_{ijt} = \lambda_{ij} f_t + \eta_{ij} g_{jt} + e_{ijt}, \tag{6}$$
$$e_{ijt} = \rho_{ij} e_{ijt-1} + u_{ijt},$$
$$u_{ijt} = i.i.d.N(0, \sigma_{ij}^2).$$

In most cases the restrictions are not rejected, so that (6) represents our specification of the regional inflation dynamics. Notice that in this specification the parameter ρ_{ij} provides a measure of the persistence of inflation (conditional on the variables and factors), since it is equal to the coefficient of lagged inflation in the ADL(1,1) formulation of the model. The fact that estimated rather than true factors are used in (6), e.g. $\hat{f}_t$ rather than f_t, in general creates no generated regressor problems due to the fast convergence rate of the factor estimator, see Bai (2003).

In Table 6 we report parameter estimates for model (6). The loadings (and standard errors) of the three area wide common factors are presented in the columns labeled PCi_ALL, those of the national factors in PCi_CS, i=1,2,3, and the estimated persistence of inflation, $\widehat{\rho}_{ij}$, in the column AR(1). We also report the adjusted R^2 of each regional regression, and the p-values of tests for no correlation (LM), homoskedasticity (White) and normality (JB) of the residuals u_{ijt}.

A few remarks are in order. First, both the area wide and the national factors are strongly significant in virtually all regions. This confirms the remaining importance of the national components of inflation dynamics. Second, there is a large variability in inflation persistence, for example the range for Germany is 0.51 to 0.92. Third, the explanatory power of the model is quite good, with an average value of the adjusted R^2 of 0.964. This is not surprising given the previous findings on the high explanatory power of a few principal components. Finally, the p-values of the tests on the residuals are in general above the standard value of 0.05, rejection of one of the null hypotheses under consideration happens in less than 15% of the regions. This provides substantial support in favour of the model (6) as a congruent representation for regional inflation series.

Another interesting issue that can be analysed within the representation (6) is whether the area wide factors have the same effects across all regions, namely whether $\lambda_{ij} = \lambda$. Despite the fact that the factors are not separately identified, if the restriction $\lambda_{ij} = \lambda$ holds for f_t it can be shown that it will also hold for any rotation of the factors Pf_t where P is a full rank matrix.

The p-value for testing the hypothesis of equality of the loading across the 70 regions is very low for all factors (Table 6). Therefore, the hypothesis of homogeneity is rejected. From an economic point of view this is an important finding, since it implies that the deviation of regional inflation from a common average value can partly be attributed to developments that affect the euro area as a whole. As mentioned in the introduction, this result is very likely due to asymmetries in the economic structure of the regions.

5 Some additional aspects of regional inflation dynamics

In this section we evaluate some additional aspects of regional inflation dynamics. We present and discuss a summary of the results. Detailed tables are available from the authors upon request.

5.1 The role of area wide inflation for regional inflation dynamics

The first issue we evaluate is the role of area wide inflation for explaining regional inflation dynamics. We have seen that the area wide factors are statistically significant and yield congruent statistical models. However, from the economic point of view, they could just be a proxi for area wide inflation.

To investigate whether this is the case, we consider the model

$$\begin{aligned} x_{ijt} &= \gamma_{ij}\pi_t + \eta_{ij}g_{jt} + e_{ijt}, \qquad (7) \\ e_{ijt} &= \rho_{ij}e_{ijt-1} + u_{ijt}, \\ u_{ijt} &= i.i.d.N(0, \sigma_{ij}^2), \end{aligned}$$

where π_t is the area wide inflation rate. Estimating this model, γ_{ij} is always statistically different from zero and the estimated values are close to one. However, when the area wide factors are added as regressors, area wide inflation looses its significance.

Notwithstanding the previous result, it can be interesting to analyze the deviations of regional inflation from the common area wide level as a function of national factors, for example to evaluate convergence issues. This is equivalent to estimating the model (7) imposing the restriction $\gamma_{ij} = 1$.

Overall, there are no major signs of misspecification of the estimated equations, and the national factors are strongly significant in explaining deviations of regional inflation from the area wide level. However, the average fit of the model decreases with respect to the model in (6), from 0.964 to 0.858, and, more importantly, there is an increase of about 25% in the average estimated persistence of inflation, from 0.76 to 0.94. This provides a serious warning for analyses of inflation convergence: it is better to regress regional inflation on several area wide factors rather than just taking it in deviations from area wide inflation. Otherwise, there can be a substantial spurious increase in persistence.

5.2 An analysis of changes in inflation

The analysis presented so far has been based on the level of inflation. If inflation would actually be integrated of order one, we might find a lower number of factors to be important when analyzing the level of regional inflation, since stationary factors would be more difficult to detect (see (Bai & Ng, 2004)). Therefore, we now consider changes in inflation to investigate the sensitivity of our results toward the stationarity assumption for inflation.

Overall, the results emerging from the principal component analysis for the regional inflation changes, for the euro area and for each of the six countries do not change with respect to Table 5. With three area wide factors we can still explain a substantial fraction of the variability of all series, 0.469, though smaller than for inflation levels (0.754), and even higher figures are obtained for the three national factors, with the exception of Italy (0.318) and Spain (0.417). For the sake of comparability, we will continue the exercise assuming the existence of three area wide and national factors also for the changes in inflation.

When the changes in regional inflation are regressed on the new set of factors, a few interesting findings emerge. First, in general all factors are strongly significant. Second, their explanatory power is quite good, the average adjusted R^2 is 0.748 (it was 0.964 for the levels), and their relative role with respect to the persistence in the series increases. Third, the average persistence parameter is -0.10 (versus 0.76 for the levels). Since this parameter is equal to $\rho - 1$, the fact that the average persistence is negative provides some evidence for overdifferencing the regional inflation series. This is a further justification for our choice of conducting the analysis in terms of the level of inflation. Finally, the models remain statistically well specified on the basis of the outcome of the diagnostic tests on the residuals.

On the basis of these results, which are neither qualitatively nor substantially different from those in Section 4, we will continue our investigation of regional inflation dynamics using inflation in levels.

5.3 The effects of EMU

The introduction of the euro in 1999 and the associated delegation of monetary policy to the ECB represent major institutional changes that can have a large impact on inflation dynamics. In particular, we would expect a larger area wide component for inflation and a decline in dispersion in the long run. However, since the formation of a European Monetary Union was to some extent expected since the early '90s, the convergence process has been a continuous, slowly evolving process such that there could be no major changes in regional inflation dynamics after the formal introduction of the euro.

A nice feature of the estimation procedure we adopt for the factor model is that it requires a large longitudinal dimension more than a large temporal dimension. Therefore, we can split our already short sample into two subsamples, and evaluate whether the figures before and after 1999 differ. In particular, we consider the samples 1995-98, 1999-2004, and we also look at 1991-94 for a subset of the regions (due to data availability) in order to have a benchmark for the more recent periods.

As discussed in Section 2, there is an increase in the mean inflation rate and no major change in dispersion of regional inflation after the introduction of the euro in 1999. However, there is a marked decline in regional inflation dispersion in comparison with the period 1991-1994, where it is 1.45 compared to 0.61 in 1995-98 and 0.70 in 1999-2004 (see Table 3).

An interesting feature of the principal component analysis for the euro area is that the fraction of variance explained by the first three factors decreases in 1999-2004 in comparison with 1995-98, from 0.896 to 0.799. Both values are higher than the full sample figure, 0.754, indicating there can indeed be some differences in the two subperiods. In particular, it seems that commonality in inflation evolution slightly decreased after the convergence phase. The different values are mostly due to the contribution of the first factor in explaining the variability of all series: it was 0.687 in the run-up to the monetary union but decreased to 0.562 afterward (and it was even lower, 0.483 in the full sample).

With respect to the first subperiod, the contribution of the first factor and of the first three factors is higher for 1991-94 than for 1999-04 likely due to the common downward trend in regional inflation rates, which decrease from an average value of 4.89% in 1991-94 to 1.89% in 1995-98. The contribution of the factors is highest in 1995-98, which provides further evidence in favour of the idea that commonality in inflation was maximum in the period closer to the adoption of the euro, related to the explicit inflation criterion to be satisfied for adoption of the euro.[5]

[5] As another procedure to evaluate the extent of the differences before and after the euro, we construct full

Repeating the split sample analysis at the national level, the same temporal pattern of commonality as for the euro area emerges for Austria, Spain, Portugal and, even more markedly, for Italy. Instead, for Germany and Finland there are basically no changes before and after 1999. However, for Germany there are major differences in the period 1991-94, with substantially higher commonality, as a consequence of the convergence in inflation following the reunification.

We also evaluated the role of the area wide and national split factors in explaining regional inflation rates, by running regressions similar to those in Table 6 The major feature is a higher persistence in regional inflation in 91-94 compared to the more recent period, but in all subsamples the factors maintain their importance as regressors, the fit is always good, though not better than for the full sample, and the models remain correctly specified.

In summary, allowing for different driving forces before and after the euro can have some effects, in particular the commonality of inflation seems to have slightly decreased after 1999 after a peak in the run-up to the monetary union. However, the explanatory power of the area wide and national factors for regional inflation on average does not increase in the two subsamples. On this basis we believe that our full sample results are reliable and not affected by major structural breaks.

6 Euro regions and US cities

To benchmark and compare our results with a long established common currency area, we have collected data for the US. Unfortunately price data at the state level do not seem to be available, and those for the main metropolitan areas also present several problems of availability. In the end, we have bi-monthly data for a comparable sample, 1995-2004, for eleven metropolitan areas.[6]

sample factors by joining the estimated subsample factors (PC_SPLIT), and we evaluate how similar they are with respect to the full sample factors we obtained in the previous section (PC). PC1_SPLIT and PC1 are highly correlated, -0.964, where the negative value is just due to a different normalization. Instead, the correlations between PC2_SPLIT and PC2 and PC3_SPLIT and PC3 are lower, 0.585 and -0.523, respectively.

[6]In particular, monthly CPI data are available for Chicago-Gary-Kenosha, New York-Northern New Jersey-Long Island, and Los Angeles-Riverside-Orange County. For Detroit-Ann Arbor-Flint, Houston-Galveston-Brazoria, Miami-Fort Lauderdale, Philadelphia-Wilmington-Atlantic City, and San Francisco-Oakland-San Jose CPI data are released in even-numbered months. For Boston-Brockton-Nashua, Cleveland-Akron, and Dallas-Fort Worth data are available in odd-numbered months. For US areas for which data are available monthly only even month data are used. Also, at the beginning of the sample, data for Philadelphia-Wilmington-Atlantic City and San Francisco-Oakland-San Jose were monthly, but switched to even month. For Dallas-Fort Worth data were released in even-numbered months at the beginning of the sample, while the reverse is true for Miami-Fort Lauderdale.

Panel 2 of Table 3 reports some descriptive statistics for the US data. Comparing these data with the analogous euro area figures the following conclusions can be drawn: First, average inflation seems to be somewhat higher (2.50% compared to 2.18%) for US regions than for euro area regions. However, also for US regions inflation rates are somewhat lower between 1995-1998 (pre-EMU period) than after 1999 (EMU-period). A big difference between the two samples exists with respect to the measured degree of inflation dispersion. For euro area regions the dispersion is about twice as large as that for US regions. This holds for both observed subperiods and suggests that the degree of segmentation across European regional markets is considerably larger than that across US regional markets. National policies are one candidate variable to explain the larger degree of heterogeneity across euro area inflation rates. However, the euro area data set also contains a much larger number of regions, which also contribute to the higher dispersion.

The principal component analysis indicates that also for the US the first three components explain a substantial proportion of variance, 80%, see the first panel of Table 7, versus 75% for the euro area (with many more regions). In particular, the first component explains 57% of the variance in regional inflation versus 48% for the euro area.

When the estimated factors are used to explain the regional inflation dynamics in the US, they are in general strongly significant, the average adjusted R^2 is about 0.80, the average persistence is 0.54 (versus 0.76 for the euro area), and there are basically no signs of misspecification of the models, see Table 8.

In summary, the factor based methodology to analyse regional inflation provides good and interesting results also for the US, though the size of the data set is rather limited. With respect to the euro area, the main difference is the lower degree of persistence of inflation, which characterizes not only the aggregate variable but also the regional series.

7 Aggregate inflation dynamics: Euro area and the US

So far we have evaluated the role of the estimated area wide and national factors in explaining regional inflation. Now we consider whether they can also provide useful information for aggregate inflation.

In the first panel of Table 9 we show that the euro area (HICP) inflation is strongly correlated with the first factor extracted from the regional dataset (-0.90), with lower values for the second and third ones. It should be noted that area wide HICP is not constructed by aggregating regional series and that the principal components are derived by combining the regional series on the basis of their capacity to explain the variance in regional inflation and not on the basis of GDP weights. Therefore, the high correlation of the first factor with euro area inflation is not due to an accounting identity.

We model euro area aggregate inflation by regressing it on a set of rather standard macroeconomic variables including the euro area short-term interest rate (IS), unemployment (UR) and the growth rate of oil prices ($POIL$), of euro area money supply ($M3$), of nominal effective exchange rate (EXR), unit labour costs (ULC) and industrial production (IP), using the restricted ADL(1,1) model formulation.[7] From the second panel of Table 9 only the growth rate of money, oil prices and industrial production are significant, often with the wrong sign, and the reduction in the standard error of the regression with respect to a simple AR(1) model is minor, from 0.194 to 0.169 (the adjusted R^2 changes from 0.85 to 0.89). When the three area wide factors are added to the regressor set, a number of interesting results emerge. First, all the three factors are strongly significant. Second, the coefficients of the macroeconomic variables are systematically and substantially more precisely estimated. Third, the list of significant macroeconomic variables changes. It now includes the short-term interest rate, the growth rate of unit labour costs and the unemployment rate. Only the latter variable appears with the wrong sign, maybe because unemployment did not play a strong role in wage bargaining in the euro area. Fourth, the standard error of the regression decreases substantially, to 0.108, and the adjusted R^2 increases to about 0.96. Fifth, there is a major decrease in inflation persistence from 0.94 to 0.57.[8] Finally, the diagnostic tests on the residuals (LM test for no serial correlation, White test for homoscedasticity, and Jarque-Bera test for normality) suggest that there is no indication of any major mis-specification of the underlying model.

To evaluate whether the results can be affected by the possible endogeneity of the regressors, we have estimated the equation by two stage least squares, using the second lag of all regressors as instruments. There are no relevant changes in the results presented in the final row of Table 9.

Regarding the US, from the top panel of Table 10 the first area wide factor is as in the euro area strongly correlated with CPI inflation. Moreover, from the second panel of Table 10 the effects of the inclusion of the factors into the equation for aggregate inflation are also

[7]This equations could be considered as a reduced form of more structural Phillips curve type equations, that we augment with monetary and international variables. We leave the investigation of Phillips curve regressions on a regional level for further research.

[8]Note that this result of a more moderate inflation persistence is more in line with studies carried out within the inflation persistence network of the ESCB (for a summary see Angeloni, Aucremanne, Ehrmann, Gali, Levin & Smets (2005).

similar to those for the euro area. In particular when US inflation is regressed on macro variables only, the gains with respect to a pure AR specification are minor, while adding also the factors significantly increases the adjusted R^2 from 0.68 to 0.85. In this case the main contribution comes from the first factor, and additional dynamics is needed for the model to have uncorrelated errors. An instrumental variables regression by two stage least squares (TSLS) with five lags of dependent and independent variables as instruments does not substantially change the estimation results. Finally, the value of the measure of inflation persistence is very similar to what we have found for the euro area, 0.59 vs 0.57.

In summary, the factors extracted from the regional dataset appear to be quite important also to explain aggregate inflation. Due to the lack of identification of the factors, it is unfortunately only possible to provide alternative economically plausible interpretations, and not a single explanation for their relevance for area wide inflation. They might proxi for omitted variables, or they reduce the measurement errors when variables like industrial production growth are used as proxi for the output gap, or they could truly capture the effects of regional inflation co-movements, that are not captured in aggregate information, on area wide inflation. In any case, the results of this section provide additional evidence in favour of the relevance of studying inflation at a regional disaggregate level.

8 Conclusions

In this paper we analyse regional inflation dynamics in the euro area using a novel disaggregate dataset. It contains CPI data at a regional level within euro area countries, on a monthly frequency, covering 2/3 of the euro area in terms economic activity.

We employ a model where regional inflation is explained by common euro area and country specific factors and a remaining idiosyncratic regional component. We also consider an alternative modelling approach, where regional inflation is explained by area wide and country specific macroeconomic variables. However, while there are no major qualitative changes in the results, this approach is dominated by the factor based specification, in the sense that the macro variable based regressions have lower explanatory power for regional inflation than the factor models.

A number of findings regarding the role of regional inflation heterogeneity within and across countries emerge.

First, there is a substantial common area wide component in regional inflation rates, likely related to the common monetary policy in the euro area, to external developments, in particular to changes in oil prices and exchange rate movements. While the area wide factors are strongly significant and have a high explanatory power, their loadings are different across different regions, which suggests that differences in regional inflation developments are partly due to area wide phenomena.

Second, the national components are relevant for explaining regional inflation, with idiosyncratic regional variability playing a minor role. Overall the component of regional inflation variation that is not due to area wide and external developments is on average about 25 %.

Third, our findings do not differ substantially before and after the formal introduction of the euro in 1999, even though the average level of regional inflation has changed. This indicates a limited effect of EMU on inflation dynamics from the mid 90s onwards. However, both the average level of inflation and the regional dispersion were substantially higher in the early 90s, suggesting that convergence has largely taken place before the mid 90s.

Fourth, analysing US regional inflation developments yields similar results regarding the relevance of common US factors, but inflation dispersion is substantially lower (even though the latter result could be due to the lower number of units in the US dataset).

Finally, we find that disaggregate regional inflation information, as summarised by the area wide factors, is important in explaining aggregate euro area and US inflation rates, even after conditioning on macroeconomic variables.

Therefore, monitoring regional inflation rates within euro area countries appears to provide relevant additional information for the monetary policy maker.

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Appendix: Factor model versus regression based approach to modelling regional inflation

As an alternative modelling approach to the factor model presented in Section 3, regional inflation could be made dependent on area wide, national and regional macroeconomic variables. Let us consider for simplicity the case where regional inflation depends on area wide variables only, z_t, so that

$$x_{ijt} = \lambda_{ij} z_t + e_{ijt}. \tag{8}$$

In this model, the regional variables are linked together by the area wide variables z_t, as for example in the Global VAR models of Peseran et al. (2004) at a national level.

To analyse whether our results for regional inflation obtained with the factor based regressions are robust in comparison with those obtained in a macro variable based approach, we have estimated an extended version of the model in (8) using money, interest rates, exchange rate and oil prices as euro area macroeconomic variables to capture area wide determinants of inflation, including common monetary policy within the euro area and common external developments such as oil price and exchange rate changes. We have also added the unemployment rate, the growth rate in wages, unit labour cost and industrial production as country-specific variables, since their heterogeneous behaviour in the countries under analysis can have different effects on regional inflation. The results of the regressions on the macroeconomic variables are available from the authors upon request.

The macroeconomic variables are strongly significant. However, the values of the adjusted R^2 are systematically lower than the corresponding numbers for the factor based regressions, the losses are around 10 %.

Another interesting feature which can be evaluated is whether the rejection of homogeneity of the coefficients of the area wide factors detected within the factor based approach holds also in this variable based framework.

The p-values of the test for the null hypothesis of homogeneity do not reject in this case, except for money $M3$ and oil prices in Italy and short-term interest rates in Portugal. In particular, the impact of a short-term interest rate and area wide M3 does differ significantly across regions, which is of importance from a monetary policy point of view. However, this finding appears to be due to the substantially higher estimation uncertainty of the coefficients of the macro variables compared with those of the factors.

A final important question is to evaluate whether the factors have additional explanatory power if included in the macro variable based regression.

Therefore, we have regressed regional inflation series on both the factors and the macro variables, i.e.

$$\pi_{ijt}^{reg} = \nu_{ij} + \lambda_{ij} f_t + \eta_{ij} g_{jt} + a_{ij} z_t + b_{ij} y_{jt} + e_{ijt}, \tag{9}$$

where f_t and g_{jt} are the area wide and national factors and z_t and y_{jt} are the area wide and national variables. In the final two columns of Table 6 we report, for each region, an F-test (F-test 1) for the non-significance of, respectively, the area wide and national factors, i.e. testing $H_0 : \lambda_{ij} = 0$ and $\eta_{ij} = 0$, in equation (9). Furthermore, we report an F-test for the non-significance of the area wide and national macro variables (F-test 2), i.e. testing $H_0 : a_{ij} = 0$ and $b_{ij} = 0$ in equation (9). The zero effect of the factors is rejected in each region at a 5% significance level, while the zero effect of the macroeconomic variables is only rejected in 25 out of 70 regions. Therefore, macro variables might be excluded from the model in many regions, but factors always have to be included.

On the basis of these results and of the previous finding on the improved goodness of fit, we conclude that the factor model provides a better representation for our regional inflation data set.

Table 1: Countries and Regions Included in our Study

Germany (12 NUTS-I Regions)
Regions: Baden-Württemberg, Bayern, Berlin, Brandenburg, Hessen, Mecklenburg-Vorpommern, Niedersachen, Nordrhein-Westfalen, Saarland, Sachsen, Sachsen-Anhalt, Thüringen **Data Source:** Statistical offices of the individual German states
Austria (9 NUTS II Regions)
Regions: Burgenland, Kärnten, Niederösterreich, Oberösterreich, Salzburg, Steiermark, Tirol, Vorarlberg, Wien **Data Source:** Statistics Austria
Finland (5 NUTS-II Regions)
Regions: Ita-Suomi, Etela-Suomi, Lansi-Suomi, Pohjois-Suomi, Aland **Data Source:** Statistics Finland
Italy (20 Major Cities of NUTS-II Regions)
Regions: Ancona, Aosta, Bari, Bologna, Cagliari, Campobasso, Firenze, Genova, L'Aquila, Milano, Napoli, Palermo, Perugia, Potenza, Reggio Calabria, Roma, Toino, Trento, Trieste, Venezia **Data Source:** Istituto Nazionale di Statistica (ISTAT)
Spain (18 NUTS-II Regions)
Regions: Andalucia, Aragon, Principado de Asturias, Baleares, Canarias, Caabria, Castilla y Leon, Castilla La Mancha, Cataluna, Ceuta y Melilla, Extremadura, Galicia, Communidad Madrid, Cummunidad Murcia, Navarra, Pais Vasco, La Rioja, Communidad Valenicana **Data Source:** Instituto Nacional de Estadistica (INE)
Portugal (7 NUTS-II Regions)
Regions: Acores, Algarve, Altenejo, Centro, Lisbon, Madeira, Norte **Data Source:** Instituto Nacional de Estatistica (INE)
U.S.A. (11 Metropolitan Areas)
Regions: Boston-Brockton-Nashua, Chicago-Gary-Kenosha, Cleveland-Akron, Dallas-Fort Worth, Detroit-Ann Arbor-Flint, Houston-Galveston-Brazoria, Los Angeles-Riverside-Orange County, Miami-Fort Lauderdale, New York-Northern New Jersey-Long Island, Philadelphia-Wilmington-Atlantic City, San Francisco-Oakland-San Jose **Data Source:** Bureau of Labor Statistics (BLS)

Table 2: Country/Region Short Names

Full	Short	Full	Short	Full	Short Name
		Countries			
Austria	AU	Germany	DE	Finland	FI
Italy	IT	Spain	ES	Portugal	PO
USA	US				
		Regions			
Cast. la Mancha	alba	Marche	anco		
Extremadura	bada	Baden-Württemb.	bade	Cataluna	barc
Puglia	bari	Bayern	baye	Berlin	berl
Emilia-Romagna	bolo	Brandenburg	bran	Burgenland	burg
Sardegna	cagl	Molise	camp	Ceuta e Melilla	ceut
Norte	coim	Algarve	evor	Centro	faro
Toscana	fire	Lisboa	func	Liguria	geno
Ita-Suomi	hels	Hessen	hess	Etela-Suomi	joen
Krnten	kaer	Lansi-Suomi	kokk	Galicia	laco
Canarias	lapa	Abruzzo	laqu	Alentejo	lisb
La Rioja	logr	Madrid	madr	Mecklenburg-Vorp.	meck
Milano	mila	Murcia	murc	Campania	napo
Niedersachsen	nied	Niederösterreich	nied	Nordrhein-Westf.	nord
Oberösterreich	ober	Pohjois-Suomi	oulu	Asturias	ovie
Sicilia	pale	Baleares	palm	Navarra	pamp
Umbria	peru	Reg.Aut.d.Acores	pont	Reg.Aut.d.Madreira	port
Calabria	regg	Lazio	roma	Sachsen-Anhalt	saan
Saarland	saar	Sachsen	sach	Salzburg	salz
Pais Vasco	sans	Cantabria	sant	Aragon	sara
Andalucia	sevi	Steiermark	stei	Aland	tamp
Thüringen	thue	Tirol	tiro	Piemonte	tori
Trento	tren	Friuli-Venezia	trie	Valencia	vale
Castilla Leon	vall	Veneto	vene	Vorarlberg	vora
Wien	wien				

Table 3: Descriptive Statistics for Euro Area and US Regional Inflation Rates (1995.01 - 2004.10, 1995.01 - 1998.12, 1999.01 - 2004.10))

Euro Area						
	1995-2004		1995-1998		1999-2004	
	Mean	Std. Dvt.	Mean	Std. Dvt.	Mean	Std. Dvt.
All Regions	2.18	0.63	1.89	0.61	2.26	0.70
Germany	1.35	0.15	1.21	0.21	1.31	0.20
Austria	1.62	0.10	1.19	0.17	1.73	0.11
Finland	1.41	0.09	1.07	0.05	1.60	0.13
Italy	2.26	0.22	2.13	0.33	2.22	0.22
Spain	2.87	0.22	2.45	0.25	3.06	0.24
Portugal	2.85	0.15	2.41	0.28	3.09	0.12
U.S.A.						
	Mean	Std. Dvt.	Mean	Std. Dvt.	Mean	Std. Dvt.
All Regions	2.50	0.29	2.28	0.43	2.68	0.35

Notes:
The mean year on year CPI inflation rate (mean) is computed as the cross-sectional mean of all regional mean inflation rates (geometric mean) included in the respective sample. The computation of the standard deviation (std. dvt.) is likewise based on the cross-section of the geometric means of all regional mean inflation rates included in the respective sample.

Table 4: : ADF Unit Root Tests on euro area regional inflation series, 1995-2004

	Total Number of Regions	Number of Rejections (5% Significance Level)
All Regions	70	17
Germany	12	8
Austria	9	0
Finland	5	0
Italy	19	8
Spain	18	1
Portugal	7	0

Notes:
1) Results are based on regressions including a constant and lagged differences up to the highest significant lag with a maximum of 12 lags.
2) Critical values are taken from MacKinnon (1991).

Table 5: Euro Area Wide and National Factors

	Comp. 1	Comp. 2	Comp. 3	Comp. 4	Comp. 5	Comp. 6
			All Regions			
Eigenvalue	33.499	11.384	7.381	3.732	2.964	1.876
Variance Prop.	0.483	0.164	0.106	0.054	0.043	0.027
Cumulative Prop.	0.483	0.647	0.754	0.808	0.850	0.877
			Austria			
Eigenvalue	1.343	0.513	0.238	0.195	0.163	0.128
Variance Prop.	0.501	0.192	0.089	0.073	0.061	0.048
Cumulative Prop.	0.501	0.693	0.782	0.854	0.915	0.963
			Germany			
Eigenvalue	0.701	0.501	0.385	0.328	0.160	0.100
Variance Prop.	0.291	0.208	0.160	0.136	0.066	0.042
Cumulative Prop.	0.291	0.500	0.659	0.796	0.862	0.904
			Spain			
Eigenvalue	1.195	0.604	0.491	0.186	0.155	0.144
Variance Prop.	0.380	0.192	0.156	0.059	0.049	0.046
Cumulative Prop.	0.380	0.572	0.728	0.787	0.836	0.882
			Finland			
Eigenvalue	1.468	0.072	0.062	0.018	0.008	
Variance Prop.	0.901	0.044	0.038	0.011	0.005	
Cumulative Prop.	0.901	0.945	0.984	0.995	1.000	
			Italy			
Eigenvalue	1.283	0.860	0.451	0.350	0.320	0.288
Variance Prop.	0.299	0.201	0.105	0.082	0.075	0.067
Cumulative Prop.	0.299	0.500	0.606	0.687	0.762	0.829
			Portugal			
Eigenvalue	1.341	0.778	0.440	0.155	0.105	0.102
Variance Prop.	0.453	0.263	0.149	0.052	0.035	0.035
Cumulative Prop.	0.453	0.716	0.864	0.917	0.952	0.987

Notes:

1) The area wide factors ('All Regions') are estimated as the principal components extracted from a dataset with all the regions of all countries and the sample period 1995-2004.

2) The national factors are estimated as the principal components, extracted for each country from the residuals of a regression of regional inflation rates on area wide components over the same sample period. We report eigenvalues associated with the first 6 principal components, the proportion of variance explained by each component, and the cumulative proportion of explained variance.

Table 6: Explaining regional inflation in the euro area

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
au_burg	-0.099	0.111	0.055	0.364	-0.933	0.157	0.920	0.994	0.268	0.222	0.216	0.000	0.835
	0.006	0.010	0.011	0.011	0.027	0.024	0.044						
au_kaer	-0.129	0.077	-0.024	0.306	-0.036	0.140	0.612	0.913	0.528	0.364	0.388	0.000	0.488
	0.012	0.023	0.027	0.038	0.078	0.087	0.083						
au_nied	-0.164	0.094	-0.019	0.188	0.282	0.613	0.828	0.960	0.105	0.625	0.604	0.000	0.074
	0.015	0.025	0.028	0.028	0.068	0.063	0.060						
au_ober	-0.145	0.107	0.038	0.290	0.097	0.125	0.820	0.965	0.006	0.099	0.989	0.000	0.067
	0.013	0.024	0.027	0.026	0.063	0.059	0.064						
au_salz	-0.130	0.089	-0.023	0.481	0.145	-0.460	0.674	0.994	0.030	0.144	0.688	0.000	0.131
	0.004	0.007	0.008	0.010	0.022	0.023	0.078						
au_stei	-0.158	-0.002	0.061	0.299	-0.135	0.248	0.586	0.872	0.801	0.213	0.005	0.000	0.481
	0.015	0.026	0.031	0.045	0.092	0.103	0.079						
au_tiro	-0.112	0.144	-0.048	0.206	0.125	0.156	0.872	0.963	0.734	0.827	0.571	0.000	0.019
	0.015	0.024	0.028	0.027	0.067	0.060	0.046						
au_vora	-0.115	0.161	-0.067	0.293	0.223	0.341	0.810	0.957	0.020	0.029	0.550	0.000	0.000
	0.014	0.025	0.029	0.029	0.070	0.066	0.062						
au_wien	-0.125	0.123	-0.049	0.304	0.064	0.193	0.712	0.961	0.022	0.921	0.748	0.000	0.001
	0.011	0.020	0.023	0.027	0.065	0.061	0.087						
Mean	-0.131	0.100	-0.009	0.303	-0.019	0.168	0.759						
Std. dev.	0.021	0.047	0.048	0.085	0.365	0.281	0.118						
Min	-0.164	-0.002	-0.067	0.188	-0.933	-0.460	0.586						
Max	-0.099	0.161	0.061	0.481	0.282	0.613	0.920						
de_bade	-0.093	0.164	0.093	-0.144	0.327	0.169	0.858	0.969	0.698	0.434	0.211	0.000	0.142
	0.013	0.022	0.027	0.054	0.044	0.047	0.051						
de_baye	-0.093	0.175	0.107	-0.614	0.163	-0.134	0.619	0.964	0.418	0.267	0.889	0.000	0.004
	0.008	0.015	0.018	0.045	0.042	0.047	0.081						
de_berl	-0.085	0.195	0.061	-0.192	0.240	0.438	0.909	0.953	0.959	0.974	0.022	0.000	0.123
	0.017	0.028	0.034	0.068	0.055	0.057	0.042						

... to be continued

Table 6: ... continued

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
de_bran	-0.088	0.109	0.240	-0.457	0.117	-0.422	0.856	0.970	0.008	0.605	0.037	0.000	0.001
	0.014	0.022	0.027	0.053	0.043	0.046	0.055						
de_hess	-0.041	0.229	-0.004	0.200	0.613	0.498	0.547	0.985	0.417	0.047	0.940	0.000	0.492
	0.004	0.008	0.010	0.026	0.025	0.029	0.082						
de_meck	-0.074	0.131	0.263	0.609	0.492	-0.591	0.924	0.947	0.885	0.766	0.000	0.000	0.094
	0.019	0.029	0.035	0.072	0.058	0.060	0.046						
de_nied	-0.109	0.163	0.151	0.080	0.274	0.117	0.662	0.979	0.729	0.916	0.454	0.000	0.191
	0.007	0.012	0.015	0.037	0.033	0.037	0.074						
de_nord	-0.101	0.190	0.103	-0.002	0.246	0.172	0.869	0.971	0.109	0.318	0.414	0.000	0.507
	0.014	0.022	0.027	0.053	0.043	0.046	0.059						
de_saan	-0.076	0.120	0.267	-0.283	0.140	-0.377	0.666	0.965	0.011	0.887	0.025	0.000	0.000
	0.009	0.016	0.019	0.051	0.042	0.047	0.083						
de_saar	-0.096	0.191	0.141	-0.208	0.226	0.145	0.508	0.956	0.200	0.595	0.002	0.000	0.764
	0.007	0.013	0.016	0.043	0.043	0.049	0.090						
de_sach	-0.078	0.160	0.159	0.091	0.246	-0.203	0.817	0.970	1.000	0.295	0.000	0.000	0.072
	0.012	0.020	0.025	0.050	0.042	0.045	0.056						
de_thue	-0.077	0.181	0.095	0.023	0.307	-0.166	0.906	0.968	0.416	0.628	0.000	0.000	0.143
	0.015	0.023	0.028	0.056	0.045	0.047	0.045						
Mean	-0.084	0.167	0.140	-0.075	0.283	-0.030	0.762						
Std. dev.	0.017	0.034	0.083	0.320	0.143	0.341	0.151						
Min	-0.109	0.109	-0.004	-0.614	0.117	-0.591	0.508						
Max	-0.041	0.229	0.267	0.609	0.613	0.498	0.924						
es_alba	-0.156	-0.012	-0.043	0.253	-0.169	0.019	0.650	0.990	0.191	0.891	0.603	0.000	0.009
	0.005	0.008	0.010	0.015	0.028	0.024	0.075						
es_bada	-0.135	-0.012	-0.096	0.136	-0.157	0.027	0.943	0.976	0.996	0.358	0.971	0.000	0.339
	0.013	0.019	0.022	0.027	0.061	0.038	0.034						
es_barc	-0.138	-0.007	-0.088	0.291	-0.050	-0.010	0.917	0.987	0.604	0.781	0.361	0.000	0.124
	0.009	0.014	0.017	0.019	0.045	0.028	0.041						

... to be continued

Table 6: ... continued

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
es_ceut	-0.135	-0.020	-0.091	-0.056	-0.775	-0.499	0.850	0.964	0.563	0.030	0.633	0.000	0.183
	0.015	0.024	0.028	0.033	0.077	0.048	0.064						
es_laco	-0.158	-0.049	-0.084	0.284	-0.007	-0.049	0.840	0.979	0.403	0.323	0.774	0.000	0.478
	0.011	0.018	0.021	0.024	0.055	0.036	0.059						
es_lapa	-0.117	0.060	-0.050	0.014	0.444	-0.887	0.680	0.996	0.977	0.980	0.948	0.000	0.007
	0.003	0.006	0.007	0.010	0.021	0.016	0.070						
es_logr	-0.146	-0.046	-0.077	0.326	0.311	0.064	0.706	0.957	1.000	0.038	0.681	0.000	0.185
	0.011	0.020	0.023	0.032	0.065	0.051	0.077						
es_madr	-0.153	-0.017	-0.042	0.213	-0.160	-0.045	0.871	0.982	0.198	0.022	0.389	0.000	0.006
	0.011	0.018	0.020	0.024	0.053	0.034	0.049						
es_murc	-0.153	-0.032	-0.131	0.186	-0.352	-0.092	0.853	0.974	0.517	0.548	0.411	0.000	0.105
	0.012	0.021	0.024	0.027	0.061	0.040	0.055						
es_ovie	-0.148	-0.008	-0.104	0.277	-0.085	-0.056	0.769	0.965	0.230	0.005	0.002	0.000	0.233
	0.012	0.021	0.024	0.030	0.065	0.046	0.066						
es_palm	-0.157	0.001	-0.084	0.116	0.110	0.138	0.432	0.960	0.473	0.750	0.975	0.000	0.003
	0.006	0.011	0.013	0.025	0.042	0.042	0.092						
es_pamp	-0.117	0.023	-0.095	0.308	0.048	-0.022	0.839	0.967	0.171	0.036	0.124	0.000	0.116
	0.013	0.022	0.027	0.030	0.067	0.045	0.037						
es_sans	-0.149	-0.007	-0.112	0.276	0.048	0.032	0.889	0.982	0.497	0.997	0.699	0.000	0.425
	0.011	0.017	0.020	0.023	0.054	0.034	0.049						
es_sant	-0.154	-0.047	-0.075	0.289	0.094	-0.032	0.636	0.945	0.919	0.301	0.822	0.000	0.974
	0.010	0.019	0.023	0.035	0.066	0.056	0.081						
es_sara	-0.162	-0.070	-0.038	0.294	0.095	0.052	0.742	0.983	0.309	0.319	0.874	0.000	0.632
	0.008	0.014	0.016	0.021	0.044	0.032	0.054						
es_sevi	-0.159	-0.043	-0.073	0.189	-0.191	-0.008	0.799	0.990	0.548	0.181	0.649	0.000	0.006
	0.007	0.012	0.014	0.017	0.036	0.025	0.061						
es_vale	-0.159	-0.027	-0.075	0.208	-0.183	-0.012	0.752	0.988	0.991	0.286	0.349	0.000	0.198
	0.006	0.012	0.014	0.018	0.036	0.027	0.072						

... to be continued

Table 6: ... continued

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
es_vall	-0.161	-0.021	-0.042	0.253	0.039	-0.004	0.752	0.991	0.220	0.212	0.814	0.000	0.358
	0.006	0.011	0.012	0.015	0.033	0.024	0.060						
Mean	-0.148	-0.019	-0.078	0.214	-0.052	-0.077	0.773						
Std. dev.	0.014	0.029	0.026	0.104	0.262	0.240	0.124						
Min	-0.162	-0.070	-0.131	-0.056	-0.775	-0.887	0.432						
Max	-0.117	0.060	-0.038	0.326	0.444	0.138	0.943						
fi_hels	-0.053	0.126	-0.108	0.347			0.906	0.983	0.014	0.090	0.733	0.000	0.000
	0.010	0.017	0.019	0.028			0.037						
fi_joen	-0.078	0.187	-0.104	0.451			0.635	0.986	0.081	0.454	0.372	0.000	0.318
	0.005	0.010	0.011	0.020			0.079						
fi_kokk	-0.082	0.184	-0.071	0.464			0.725	0.984	0.127	0.062	0.000	0.000	0.911
	0.007	0.012	0.014	0.024			0.068						
fi_oulu	-0.074	0.220	-0.128	0.486			0.850	0.975	0.019	0.402	0.878	0.000	0.022
	0.012	0.020	0.023	0.033			0.052						
fi_tamp	-0.067	0.195	-0.101	0.460			0.590	0.990				0.000	0.125
	0.004	0.007	0.009	0.016			0.081						
Mean	-0.071	0.182	-0.102	0.442			0.741						
Std. dev.	0.012	0.035	0.020	0.055			0.136						
Min	-0.082	0.126	-0.128	0.347			0.590						
Max	-0.053	0.220	-0.071	0.486			0.906						
it_anco	-0.072	-0.075	0.033	0.229	-0.066	0.128	0.929	0.958	1.000	0.559	0.099	0.000	0.212
	0.014	0.025	0.033	0.052	0.076	0.064	0.034						
it_bari	-0.084	-0.076	0.088	0.008	0.066	-0.062	0.953	0.970	0.145	0.900	0.192	0.000	0.086
	0.013	0.022	0.029	0.046	0.068	0.056	0.031						
it_bolo	-0.101	-0.138	0.093	0.313	0.347	0.136	0.566	0.948	0.000	0.001	0.001	0.000	0.166
	0.008	0.014	0.017	0.035	0.044	0.054	0.083						
it_cagl	-0.105	-0.217	0.238	0.089	0.115	0.446	0.880	0.936	1.000	0.083	0.007	0.000	0.323
	0.018	0.030	0.039	0.061	0.089	0.077	0.048						

... to be continued

Table 6: ... continued

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
it_camp	-0.096	-0.133	0.223	-0.153	-0.068	-0.455	0.827	0.894	0.080	0.134	0.060	0.000	0.159
	0.022	0.037	0.045	0.078	0.104	0.098	0.065						
it_fire	-0.112	-0.124	0.069	0.382	0.004	0.065	0.573	0.937	0.019	0.237	0.680	0.000	0.058
	0.009	0.015	0.019	0.038	0.047	0.057	0.081						
it_geno	-0.097	-0.115	-0.003	0.171	-0.241	-0.020	0.859	0.971	1.000	0.501	0.674	0.000	0.235
	0.012	0.021	0.025	0.040	0.060	0.052	0.053						
it_laqu	-0.137	-0.077	0.071	0.065	-0.562	0.042	0.433	0.961	0.141	0.207	0.056	0.000	0.001
	0.006	0.011	0.013	0.028	0.033	0.044	0.091						
it_mila	-0.097	-0.161	0.083	0.174	0.079	0.057	0.937	0.977	0.361	0.165	0.258	0.000	0.611
	0.011	0.019	0.024	0.038	0.057	0.047	0.038						
it_napo	-0.091	-0.132	0.117	-0.053	-0.215	0.185	0.874	0.960	0.678	0.057	0.613	0.000	0.740
	0.014	0.024	0.032	0.050	0.069	0.062	0.053						
it_pale	-0.125	-0.189	0.042	0.049	-0.282	0.085	0.828	0.927	0.260	0.086	0.306	0.000	0.562
	0.018	0.032	0.038	0.062	0.094	0.085	0.067						
it_peru	-0.129	-0.176	0.115	0.078	0.105	0.140	0.674	0.933	0.861	0.090	0.000	0.000	0.008
	0.012	0.022	0.026	0.050	0.066	0.075	0.075						
it_pote	-0.110	-0.120	0.076	-0.062	-0.337	-0.182	0.752	0.950	0.641	0.251	0.850	0.000	0.098
	0.013	0.021	0.026	0.047	0.062	0.066	0.073						
it_regg	-0.124	-0.119	0.179	0.033	0.213	-0.535	0.589	0.946	0.480	0.302	0.040	0.000	0.407
	0.009	0.016	0.020	0.041	0.049	0.062	0.085						
it_roma	-0.122	-0.156	0.152	0.079	0.127	-0.009	0.633	0.966	0.216	0.253	0.444	0.000	0.030
	0.008	0.014	0.016	0.034	0.041	0.050	0.083						
it_tori	-0.102	-0.050	0.050	0.203	-0.014	-0.420	0.850	0.937	0.615	0.367	0.000	0.000	0.118
	0.017	0.030	0.037	0.060	0.085	0.078	0.053						
it_tren	-0.105	-0.057	-0.038	0.635	-0.345	-0.051	0.884	0.959	0.161	0.336	0.034	0.000	0.010
	0.015	0.025	0.032	0.051	0.072	0.064	0.054						
it_trie	-0.139	-0.136	0.068	0.352	0.069	-0.223	0.588	0.957	0.650	0.255	0.000	0.000	0.000
	0.008	0.014	0.018	0.035	0.044	0.052	0.081						

... to be continued

Table 6: ... continued

Region	PC1_ALL	PC2_ALL	PC3_ALL	PC1_CS	PC2_CS	PC3_CS	AR(1)	Adj.R2	LM	White	JB	F-Test 1	F-Test 2
it_vene	-0.108	-0.142	0.064	0.301	0.222	-0.046	0.756	0.972	0.464	0.010	0.241	0.000	0.425
	0.010	0.018	0.020	0.035	0.048	0.048	0.074						
Mean	-0.108	-0.126	0.090	0.152	-0.041	-0.038	0.757						
Std. dev.	0.018	0.044	0.070	0.187	0.233	0.240	0.154						
Min	-0.139	-0.217	-0.038	-0.153	-0.562	-0.535	0.433						
Max	-0.072	-0.050	0.238	0.635	0.347	0.446	0.953						
po_coim	-0.110	-0.058	-0.207	0.467	0.164	-0.089	0.799	0.963	0.113	0.085	0.263	0.000	0.836
	0.014	0.023	0.026	0.031	0.043	0.050	0.063						
po_evor	-0.094	-0.020	-0.202	0.372	0.178	0.119	0.748	0.962	0.880	0.839	0.732	0.000	0.229
	0.011	0.020	0.024	0.031	0.042	0.050	0.070						
po_faro	-0.089	-0.033	-0.222	0.430	0.304	-0.241	0.604	0.941	0.044	0.392	0.676	0.000	0.190
	0.010	0.019	0.023	0.035	0.049	0.058	0.081						
po_func	-0.068	-0.077	-0.128	0.398	-0.572	0.673	0.718	0.993	0.946	0.800	0.719	0.000	0.536
	0.005	0.008	0.010	0.013	0.018	0.021	0.073						
po_lisb	-0.110	-0.037	-0.164	0.293	0.278	0.008	0.807	0.956	0.010	0.793	0.015	0.000	0.375
	0.014	0.025	0.030	0.034	0.047	0.054	0.062						
po_pont	-0.004	-0.046	-0.205	0.311	-0.641	-0.681	0.652	0.995	0.851	0.547	0.737	0.000	0.724
	0.003	0.006	0.007	0.010	0.014	0.017	0.081						
po_port	-0.109	0.024	-0.163	0.347	0.175	0.145	0.714	0.974	0.974	0.818	0.982	0.000	0.320
	0.009	0.016	0.019	0.025	0.034	0.041	0.080						
Mean	-0.084	-0.035	-0.185	0.374	-0.016	-0.009	0.720						
Std. dev.	0.038	0.032	0.034	0.063	0.407	0.412	0.074						
Min	-0.110	-0.077	-0.222	0.293	-0.641	-0.681	0.604						
Max	-0.004	0.024	-0.128	0.467	0.304	0.673	0.807						

Notes:

1) The table reports the estimated coefficients and standard errors (2nd line) for regressions of regional inflation rates on area wide factors (PCi_ALL) and country-specific factors (PCi_CS), over the period 1995-2004, allowing for AR(1) errors. The next four columns report the adjusetd R2 of each regression and the p-values of tests for no correlation (LM), homoskedasticity (White) and Normality (JB) of the residuals. The final two columns report, respectively, F-tests for the non-significance of the factors (F-test 1) and of the macro variables (F-test 2) in a nesting model when each series is regressed on the factors and on the macro variables, as described in the Appendix. For each country, we also report some summary statistics.

Table 7: US area wide factors

	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6
Eigenvalue	7.167	1.663	1.209	0.792	0.701	0.432
Variance Prop.	0.568	0.132	0.096	0.063	0.055	0.034
Cumulative Prop.	0.568	0.699	0.795	0.858	0.913	0.947

Notes:

1) The area wide factors are estimated as the principal components extracted from the inflation series for the metropolitan areas. 2)See notes to Tables 5.

Table 8: Explaining regional inflation in the US

	US_PC1	US_PC2	US_PC3	AR(1)	AdjR2	LM	White	JB
US_BOST	-0.234	-0.058	-0.062	0.621	0.705	0.167	0.015	0.010
	0.052	0.112	0.114	0.144				
US_CHIC	-0.279	-0.313	0.114	0.102	0.712	0.311	0.727	0.325
	0.030	0.065	0.075	0.146				
US_CLEV	-0.203	-0.241	0.120	0.819	0.813	0.786	0.193	0.816
	0.046	0.098	0.098	0.087				
US_DALL	-0.363	0.242	0.171	0.760	0.987	0.456	0.061	0.732
	0.012	0.026	0.025	0.097				
US_DETR	-0.165	-0.524	-0.098	0.334	0.648	0.130	0.256	0.946
	0.042	0.090	0.100	0.133				
US_HOUS	-0.264	-0.071	-0.267	0.426	0.713	0.061	0.058	0.641
	0.043	0.089	0.098	0.135				
US_LOSA	-0.186	-0.165	-0.513	0.478	0.801	0.441	0.114	0.888
	0.037	0.075	0.083	0.127				
US_MIAM	-0.692	0.461	0.327	0.760	0.987	0.456	0.061	0.732
	0.022	0.049	0.048	0.097				
US_NEWY	-0.118	0.089	-0.187	0.284	0.785	0.120	0.321	0.855
	0.015	0.031	0.036	0.141				
US_PHIL	-0.230	0.170	-0.727	0.649	0.780	0.016	0.147	0.140
	0.045	0.098	0.104	0.121				
US_SANF	-0.099	-0.473	0.293	0.725	0.902	0.873	0.680	0.584
	0.032	0.067	0.068	0.100				

Notes:

1) The table reports the estimated coefficients and standard errors (2nd line) for regressions of regional inflation rates on area wide factors (PCi_ALL), over the period 1995-2004, allowing for AR(1) errors. The next four columns report the adjusetd R2 of each regression and the p-values of tests for no correlation (LM), homoskedasticity (White) and Normality (JB) of the residuals.

Table 9: Explaining euro area inflation with area wide factors

Correlation Matrix: Level of Inflation

	HICP_euro	PC1_ALL	PC2_ALL	PC3_ALL
HICP_euro	1.000	-0.904	0.042	0.087
PC1_ALL	-0.904	1.000	0.000	0.000
PC2_ALL	0.042	0.000	1.000	0.000
PC3_ALL	0.087	0.000	0.000	1.000

Regression Results: Level of Inflation

	C	PC1_ALL	PC2_ALL	PC3_ALL	M3_euro	IS_euro	EXR_euro	POIL_euro	ULC_euro	UR_euro	IP_euro	AR(1)
HICP_euro	2.261				-0.098	0.016	-0.004	0.006	0.106	0.029	-0.024	0.940
	0.496				0.034	0.101	0.008	0.002	0.100	0.021	0.012	0.044
	AdjR2	0.889	LM	0.357	White	0.442	JB	0.510				
HICP_euro	2.399	-0.074	0.043	0.038	-0.023	-0.109	-0.002	0.001	0.074	0.029	-0.012	0.574
	0.225	0.007	0.011	0.012	0.018	0.042	0.005	0.001	0.042	0.006	0.009	0.093
	AdjR2	0.955	LM	0.213	White	0.205	JB	0.066				
HICP_euro	2.281	-0.067	0.055	0.017	0.011	-0.104	-0.003	0.002	0.009	0.033	-0.025	0.506
TSLS	0.341	0.013	0.026	0.017	0.025	0.062	0.011	0.002	0.060	0.008	0.016	0.123
	AdjR2	0.951	LM	0.001	White	0.04	JB	0.29				

Notes:
Sample period: 1996(1) - 2004(10); Model: ADL(1,1), regressors: euro area nominal interest rate (IR), unemployment (UR) and the growth rate of oil prices ($POIL$), euro area money supply ($M3$), nominal effective exchange rate (EXR), unit labour costs (ULC) and industrial production (IP), possibly adding three area wide factors; Estimation method: OLS and two stage least squares (TSLS) with the second lag of dependent and independent variables as instruments; reported values are estimated parameters (1st row) and standard errors (2nd row); p-values of tests for no correlation (LM), homoskedasticity (White) and Normality (JB) of the residuals

Table 10: Explaining US inflation with area wide factors

Correlation Matrix

	US_ CPI	US_ PC1	US_ PC2	US_ PC3
US_CPI	1.000	-0.897	-0.179	-0.082
US_PC1	-0.897	1.000	0.000	0.000
US_PC2	-0.179	0.000	1.000	0.000
US_PC3	-0.082	0.000	0.000	1.000

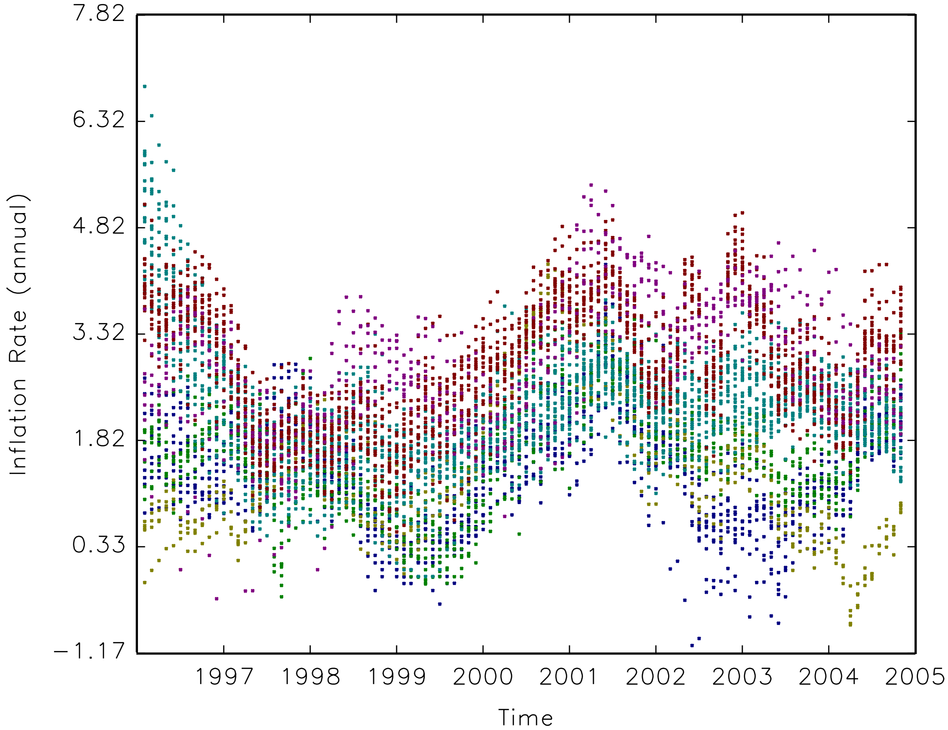
Explaining US inflation

	C	US_ PC1	US_ PC2	US_ PC3	US_ M3	US_ IS	US_ EXR	US_ POIL	US_ ULC	US_ UR	US_ IP	AR(2)	AR(3)
US_CPI	0.015				0.136	0.010	-0.004	0.012	0.034	-0.010	-0.106	0.382	0.275
	0.006				0.060	0.005	0.017	0.003	0.044	0.043	0.043	0.173	0.172
	ADJR2	0.689	LM	0.239	White	0.518	JB	0.776					
US_CPI	0.016	-0.002	-0.001	-0.001	0.096	0.004	-0.020	0.003	0.014	-0.004	-0.009	0.293	0.293
	0.003	0.000	0.000	0.001	0.035	0.003	0.010	0.002	0.030	0.008	0.029	0.155	0.150
	ADJR2	0.923	LM	0.35	White	0.48	JB	0.71					
US_CPI	0.017	-0.002	-0.001	-0.001	0.081	0.004	-0.015	0.002	0.011	0.004	-0.008	0.167	0.205
(TSLS)	0.046	0.000	0.000	0.001	0.048	0.003	0.013	0.002	0.039	0.009	0.034	0.226	0.205
	ADJR2	0.923	LM	0.35	White	0.48	JB	0.71					

Notes:

Sample period: 1995 - 2004; Model: ADL(3,3), regressors: US nominal interest rate (IR), unemployment (UR) and the growth rate of oil prices ($POIL$), money supply ($M3$), nominal effective exchange rate (EXR), unit labour costs (ULC) and industrial production (IP), possibly adding three area wide factors; Estimation method: OLS and two stage least squares (TSLS) with five lags of dependent and independent variables as instruments; reported values are estimated parameters (1st row) and standard errors (2nd row); p-values of tests for no correlation (LM), homoskedasticity (White) and Normality (JB) of the residuals

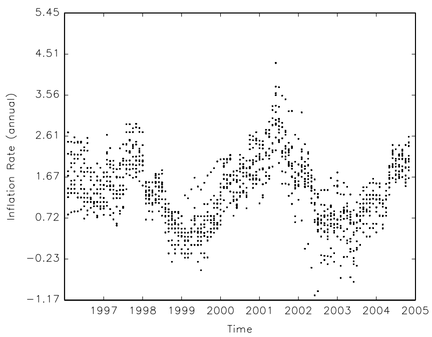
Figure 1: Regional European Inflation Rates: 1995 - 2004



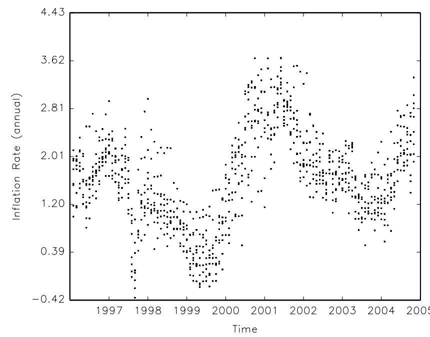
Note: *Figure 1 plots cross-sectional inflation rates for Germany, Austria, Finland, Italy, Spain, and Portugal. Inflation rates are computed as year-on-year percentage changes in the underlying consumer price index.*

Figure 2: Regional European Inflation Rates: Grouped by Countries

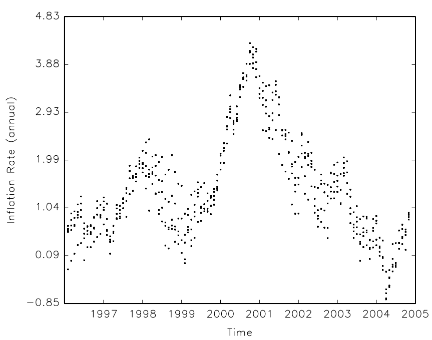
(a) Germany



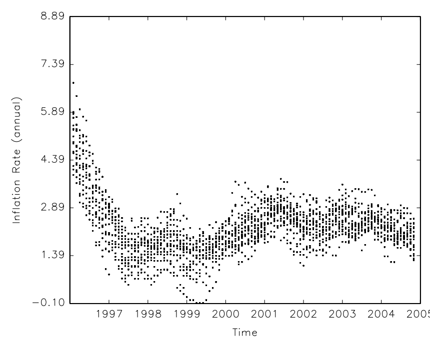
(b) Austria



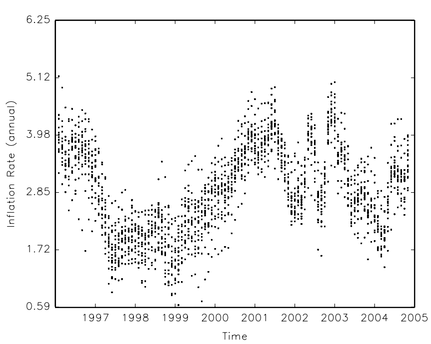
(c) Finland



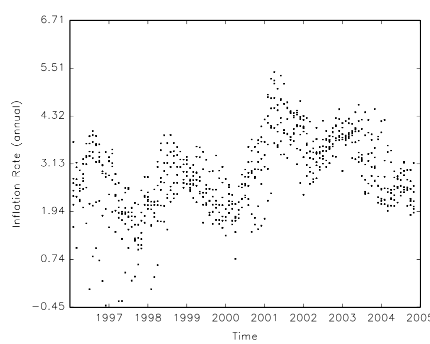
(d) Italy



(e) Spain



(f) Portugal



Notes: *Figure 2 plots cross-sectional inflation rates for Germany, Austria, Finland, Italy, Spain, and Portugal. Inflation rates are computed as year-on-year percentage changes in the underlying consumer price index.*