Global Inflation*

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Abstract

This paper shows that inflation in industrialized countries is largely a global phenomenon. First, inflations of (22) OECD countries have a common factor that alone account for nearly 70% of their variance. This comovement is not only due to the trend components of inflation (up from 1960 to 1980 and down thereafter) but also to fluctuations at business cycle frequencies. Second, there is a robust "error correction mechanism" that brings national inflation rates back to Global Inflation. A simple model that accounts for this feature consistently beats standard benchmarks used to forecast inflation 4 to 8 quarters ahead across samples and countries.

Key Words: Global Inflation, common factor, international business cycle, OECD countries

JEL: E31, E37, F42

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1 Introduction

The idea that national macroeconomic developments depend on international conditions is not new. Only recently, however, we are starting to get measures of this dependence. For instance, Kose, Otrok and Whiteman (2003), KOW thereafter, find that the world common component to expenditure time series of 60 countries explains between one fourth and one half of the variance of these series in OECD countries.[1] As KOW put it:

> "[...] Understanding the sources of international economic fluctuations is important both for developing business cycle models and making policy".

By definition, the main risk of ignoring international developments is to overrate the importance of domestic developments. And these include domestic macroeconomic policies.

Surprisingly, the studies of global macroeconomic developments had, initially, mostly focused on the real business cycle. However, the fluctuations of inflation have been strikingly similar around the world. All OECD countries have experienced long term swings in the level of inflation. Inflation has progressively risen in the 1960s and 1970s before it declined in the 1980's. Inflation has further declined in the early to mid-1990's and has since then remained low and stable, except since late 2007, when inflation rates have been accelerating in most countries.

This paper provides a detailed analysis of the international comovement of inflation and bring in two important contributions. We show that: (i) the international comovement of inflation has been strikingly high, and (ii) this commonality may be exploited to improve the forecasting of national inflation.

Prominent economists have recently pointed to the common disinflation trend around the world (e.g. Rogoff, 2003) or at least OECD countries (e.g. Levin and Piger, 2004). These studies may overlook two important aspects of the international comovement of inflation. First, they restrict their analyses to the post 1980 disinflation, hence disregarding the possibility that the previous phase, i.e. the acceleration of inflation between 1960 and 1980, was also very much a shared experience of most countries of the world (a point described early on by McKinnon, 1982 and Darby and Lothian, 1983 among others). Second, they focus strictly on the downward trend or on downward breaks of the inflation process, while, as we show in this paper, there is more than sufficient evidence of co-movements of inflation at the business cycle frequencies as well.

[1] See also Forni and Reichlin (2001) and Canova, Ciccarelli and Ortega (2007) and references therein.

We proceed in three sequential steps. We first document the fact with a simple common factor analysis. We estimate a measure of Global Inflation using the quarterly inflation series of 22 OECD countries, and quantify the extent to which one common factor helps explain commonalities in national inflations, from 1960 to 2008 at both low and business cycle frequencies. Then we study the empirical implications of our stylized fact for the dynamics and the predictability of national inflation and check whether it is possible to exploit the commonality across inflation processes to improve the inflation forecast upon existing benchmarks.

Our main results can be summarized as follows.

First the intuition that inflation is global is decidedly confirmed by the data. We indeed show that a simple average of 22 OECD countries inflation, which we call Global Inflation, accounts for almost 70 percent of the variance of inflation in these countries between 1960:1 and 2008:2. The qualitative result is not only robust to different sample periods, but is also independent of whether the analysis is performed at the low frequencies or a the business cycle frequencies, where the variance explained by Global Inflation is about 37 percent on average, and much larger in numerous countries.

Second, Global Inflation is an attractor of national inflation, in that national deviations from their projection on this attractor are reverted. The evidence is again uniform and robust across different sample periods and different countries. We also document differences in the impact of Global Inflation across countries and find, for instance, that countries that have experienced stronger commitment to price stability (e.g. Germany) are less affected than those with weaker inflation discipline (e.g. Italy). Interestingly and perhaps more importantly, this kind of "Error Correction Mechanism" helps predict national inflation of most OECD countries at various horizons and over several samples. As a result, our forecasting model of inflation augmented with the Global Inflation consistently outperforms standard $AR(p)$ and naïve models of inflation, as well as augmented Phillips curve models à la Gerlach (2004). This seems to be true also in the recent period where unpredictability of inflation has been documented by the recent literature.[2] We argue that existing forecasting models of inflation fail to exploit international information which can improve predictability upon a simple naïve benchmark. These results could lead Global Inflation model to become a new standard for forecasting inflation in OECD countries.

Several papers on the international comovement of inflation have appeared since the first circulation of this paper in 2005. Mumtaz and Surico (2008) and Monacelli and Sala (2007) use factor models to decompose sectorial national inflation rates into world and national compo-

[2]For recent systematic comparisons of forecasting models of inflation see Atkenson and Ohanian (2001), Banerjee and Marcellino (2003), D 'Agostino et al. (2006), and Stock and Watson (1999, 2007).

nents. Wang and Wen (2007) try to replicate the empirical fact that comovement in inflation rates is higher than the one in output growth in a variety of calibrated New Keynesian two-country models. They also show that in the context of New Keynesian open-economy models, international spillovers of inflation are weak and therefore cannot be the origin of inflation comovement. Cecchetti et al. (2007) investigate the reasons why most G7 countries went through the Great Inflation in the seventies and provide evidence in favour of similar changes in monetary regimes. The main conclusions of these papers are usually not in contradiction with our own.

Our work relates only marginally to the literature on "Globalization and inflation" that analyzes whether the integration of the world economy would change inflation dynamics.[3] We argue in a companion paper (Ciccarelli and Mojon, 2008, Section 3) that inflation has been dominated by common shocks ever since the sixties and this has not changed over time. Arguably, globalization implies similar terms of trade shocks for OECD countries, an hypothesis that is fully compatible with our model of inflation but that we do not analyze in this paper.

As a final remark, we shall note that the economic and econometric arguments we use in this paper do not claim to drain all the reasons why inflation could be driven by Global outcomes, nor pretend to be exhaustive on the empirical investigation of our findings. We are confident, however, that our results may provide a good starting point for exploring the hypothesis that inflation should –to some extent– be modelled as a global rather than a local phenomenon.

2 Inflation as a global phenomenon

In this section we document the empirical fact that inflation has largely been a global phenomenon over the last 45 years. We first describe our data and their necessary transformations. Then, we estimate the Global Inflation using simple alternative measures. Finally, we provide some descriptive statistics over different sub-samples and different sub-groups of countries.

2.1 Data

Sources and transformations of all data are described in more detail in the appendix.

The data used in this section are values of the CPI indices available quarterly from the OECD main economic indicators database from 1960 onward. Our analysis mainly focuses on quarterly year-on-year (y-o-y) inflation rates, which, by construction, have no seasonal pattern.

[3] See the IMF Spring 2006 World Econmic Outlook; Chen, Imbs and Scott (2004), and the debate on the global slack which opposes Borio and Filardo (2007) to Ball (2006), Rogoff (2006), Woodford (2007) and Ihrig et al. (2007).

To analyze the fluctuations over the business cycle frequency, we consider a transformation of the data that filter out the lowest and the highest frequencies. We do this using a band-pass filtered CPI inflation rates with a pass band that removes all frequencies but the periods of 6 to 32 quarters.

2.2 Estimating Global Inflation

In what follows, we briefly describe and compare results for three alternative measures of Global Inflation, namely:

1. a cross-country average,
2. the aggregate OECD inflation, published by the OECD, and
3. a measure based on static factor analysis.[4]

Results reported in subsequent sections are mainly based on the simplest and most intuitive measure, the cross-country average.

The "average" measure is the simple average of the y-o-y inflation rates of the 22 countries that have been members of the OECD for most of the sample period 1961:2–2008:2.[5] The aggregate OECD inflation is a weighted average of all OECD countries' inflation, where the weights are proportional to GDP. Regarding the common factor analysis, we opted for a parsimonious approximate factor representation (see e.g. Forni et al., 2000; Stock and Watson, 2002) which decomposes inflation rates for the pool of countries as

$$\underset{n\times 1}{\Pi_t} = \underset{n\times 1}{\Lambda}\underset{1\times 1}{f_t} + \underset{n\times 1}{\varepsilon_t} \tag{1}$$

where the first term captures the effect of a common factor (f_t), to which each country responds differently through Λ, whereas the last term refers to the idiosyncratic dynamics which captures the components generated by shocks whose effects remain local. We assume orthogonality between f_t and ε_t, and normality of the error term.

An estimation of the factor is obtained using static principal component methods described in Stock and Watson (2002). Data have been previously demeaned and standardized to have unit variance before estimating f_t.

Figure 1 reports the three measures of Global Inflation.[6] Two observations are in order. First, the "average" and the factor model measures are almost identical, while the OECD

[4]Results are almost identical when using a dynamic factor model as introduced, e.g., by Forni et al. (2000).

[5]The 8 OECD countries that we do not include in our sample are the Czech Republic, Hungary, Iceland, Korea, Mexico, Poland, the Slovak Republic and Turkey.

[6]The OECD aggregate and the "average" have been de-meaned and standardized for the figure.

aggregate deviates from the other two series, especially in the second half of the 1980's, presumably because of the different sample of countries. Second, the fluctuations and trends in the Global Inflation reflect the major events of the last 45 years. All measures are characterized by two trends: up from 1960 until the late-seventies (associated with the two oil shocks and the decline in OECD productivity) and down thereafter (reflecting tight monetary policies and the debt crisis); and by five or six cycles along the way. Given that both the 1970's Great Inflation and the subsequent tight monetary policy have been observed in most countries, the trend components of Global Inflation perhaps should not come as a surprise. As a matter of fact, Corvoiser and Mojon (2005) show that breaks in the mean of inflation largely coincide through out the OECD: around 1970, around 1982 and, to a lesser extent, around 1992. Cecchetti et al (2007) show that the great inflation of the seventies coincide with prolonged periods of overly accommodative monetary policy across OECD countries. However, it is not clear why large changes in monetary stances have coincided. In addition, the comovement of inflation at business cycle frequencies is also somewhat surprising. Standard open economy models (Clarida et al, 2002; Woodford, 2007; and Wang and Wen, 2007) conclude that international inflation spillovers should be limited. Hence, further investigation of the nature of international inflation comovement is warranted.

To gauge the extent to which the inflation in individual countries are related to Global Inflation, Figure 2 reports the inflation series of the G7 and of the Euro area with their projections on the common factor. Visual inspection reveals not only that the trend is captured accurately, but also that the most relevant cyclical movements are indeed common.

2.3 Descriptive statistics

Table 1 reports the share of the variance of national inflation series that is explained by Global Inflation for each of the three measures introduced in the previous section: the simple cross-country average, the OECD aggregate inflation, and the first static common factor.[7] In each case, the national idiosyncratic variance is the complement to one of the figures reported in the table. The last column also shows the share of the variance explained by the second static factor. The table also reports the variance decomposition exercise for the euro area inflation rate.

All measures of Global Inflation explain more than two thirds of national inflation rates fluctuations on average. The co-movement of inflation is decidedly large. By way of comparison, we find that the global business cycle accounts on average "only" for about one third of the

[7] This share is defined as $\lambda_i^2 var(f_t)/var(\pi_{it})$. It is equivalent to the R-square of a regression of the national inflation rate on Global Inflation and a constant.

variance of industrial production growth in OECD countries.[8] It is also clear that the second common factor of the inflation series explains only a very limited share of the variance of national inflation series, on average. We consider this fraction small enough to model national inflation rates with one common factor only. We also note that the OECD aggregate inflation under performs the other three measures. We conjecture that this is because this aggregate includes countries that are not in our sample. Moreover, within our sample of countries, we also found that averages that are weighted by country size under perform the factors and the simple unweighted average (not reported).

Table 1 ranks (the column 'average' being the reference) the countries by increasing share of the inflation variance that is explained by the common factor. Only five countries have less than 60% of this variance explained by Global Inflation. Four of these five countries, Greece being the exception, are usually seen as low inflation economies. We also note that the ranking of the countries has little to do with geography nor the nature of the exchange rate regime.

The fact that non-European countries are spread through out the distribution casts doubt on the argument that Global Inflation among OECD countries is just a reflection that a majority of these countries are located in Europe. We actually estimated another measure of Global Inflation using a sample of six countries evenly split across time zones: Canada, US, UK, the euro area, Japan and Australia. We obtain a even higher median (0.75 instead of 0.73) and mean (0.74 instead of 0.71) share of inflation variance that is explained by Global Inflation (see the top panel of Table 2). This result reinforces our conjecture that the comovement of national inflation rates does not necessarily reflect only European economic developments.

Moreover, the high degree of comovement in inflation may be seen as trivial because (European) countries in our sample have participated to a monetary union since 1999 after they had pegged their currency to the Deutsche Mark in one way or another since the late 1970's. For these countries, most of our sample period, from 1960 to 1973 and then from 1979 to 2007, would be closer to a fixed exchange rate regime than to a one of floating exchange rate. For the other countries in the sample, the high degree of comovement could also come from the long periods of the last 45 years when exchange rate were fixed, mainly up to the mid 1970's or under some form of pegs.[9] However, the degree of comovement of inflation remains strikingly high if one looks at countries that did not pursue any sort of fixed exchange rate policies. This can be seen from the second and third panels of Table 2 were we consider the

[8] A similar proportion has been found by KOW and used to document the importance of a common world real factor.

[9] For instance, the US and Japan were de facto pegging their currencies between February 1973 and February 1978; Australia had its exchange rate to the US Dollar fluctuate within a narrow horizontal band form October 1974 until November 1982, and the UK were shadowing the ECU in the late 1980's (Reinhart and Rogoff, 2002).

same sub-set of 6 countries as in the previous paragraph, though, this time, on the post 1974, as well as on the post 1983 sample. We obtain again a high degree of comovement of inflation among countries whose exchange rates were not formally tied together.[10]

Another somewhat easy explanation of the magnitude of inflation comovement is that it simply reflects common trends in the inflation series. This is why we now explore how much of the business cycle fluctuations in inflation are correlated across countries. In Table 3 we report (again ranked taking the column 'average' as reference) estimates of the share of de-trended inflation that is associated to a common factor. The national inflation series were detrended using Baxter and King (1999) band pass filter, which extracts cycles of length comprised between 6 and 32 quarters long with a truncation of 12 lags. These cyclical components of inflation are then used for extracting the common factor at business cycles frequencies (Figure 3). Again, the share of national inflation variance that is common is very large by any standard with mean and median of the order of 37 percent.[11,12]

The co-movement of inflation is not only due to the trend component associated with the 1970's great inflation and the coincidence of the countries's inflations gradual acceleration up to 1980 and the gradual disinflation that followed. Global Inflation actually explains a large share of the inflation variance also in countries like Switzerland and Germany, that is countries where the 1970's inflation has been much smaller than in the average of OECD countries. A comparison of the ranking of countries in Tables 1 and 3 indicates that, in relative terms, Global Inflation seems to matter more at business cycle frequencies for low-inflation countries, where the share of variance explained by Global Inflation is among the lowest when we don't remove the trend (Table 1), and just below the average when we do remove it (Table 3). This should be contrasted with the experience of countries such as Sweden and Portugal where the common factor of de-trended inflation has less explanatory power for local inflation developments than the non de-trended measure. These results tend to confirm the argument of Cecchetti et al. (2007) and could be taken as a first indication that the low frequency comovement of inflation is likely due to monetary policy.

We have also computed the cross-correlation of Global Inflation with national inflation series at several leads and lags. This exercise is useful to figuring out whether inflation tends to lag or lead Global Inflation in some of the countries. Results (not reported, but available upon

[10]One notable exception is Germany for the post 1983 sample. The divergence of German inflation from the world evolution around the reunification explain this low degree of co-movement.

[11]These results hold for other detrending methods such as the HP fitler or the first difference filter of inflation.

[12]An alternative approach, which consists of comparing the coherence of the cross spectra of Global Inflation and national inflation rates at each frequencies, provides very similar results. For most countries, this coherence is positive and typically superior to 0.5 at both low and business cycle frequencies. The results (not reported) are available upon request to the authors.

request) show that almost no country is markedly leading or lagging Global developments. This allows us to discard the possibility that inflation in a particular country (e.g. the U.S.) has been systematically spilling over to the rest of the OECD countries and that our focus on Global Inflation mistakenly picks up that one country sets the OECD inflation trend.

Finally, we have checked that Global Inflation is not simply a stand-in for typical common shocks such as commodity prices. This is easily tested with standard regression analyses where the dependent variable is national inflation and the explanatory variables are lags of Global Inflation. The explanatory power of Global Inflation remains unaffected for all countries when we control for lags of commodity price growth rates. Moreover, in an out-of-sample exercise, the average RMSE across models of national inflations regressed on lags of Global Inflation and commodity prices is considerably worse than the average RMSE of the same models with only lags of Global Inflation as covariate.[13] Hence, Global Inflation is standing in for more than commodity prices which we know to be similar for all countries.

In sum, the evidence provided neatly documents a new and robust stylized fact: the commonality of inflation across OECD countries. In the next section we investigate some implications of this fact.

3 Predictive implications of Global Inflation

The impact of Global Inflation on national inflation rates is described in this section. We show that Global Inflation behaves as an attractor of the national inflation rates. This mechanism is important both to guide our understanding of the inflation process and to pursue practical policy purposes such as forecasting.

3.1 Global Inflation is persistent and "attractive"

Using the simple framework of the factor representation of section 2, it is easy to show that domestic inflation reverts to the global component – which acts as an "attractor" – and is characterized by stationary fluctuations around the latter. In the factor representation, an estimate of national inflation is simply given by

$$\begin{aligned} \hat{\varepsilon}_{i,t} &= \pi_{i,t} - \hat{\lambda}_i \hat{f}_t \\ \hat{\varepsilon}_{i,t} &= \rho_i \hat{\varepsilon}_{i,t-1} + \upsilon_{i,t} \end{aligned}$$

where $\hat{\lambda}_i$ is an estimate of the country-specific loading and $\hat{f}_t$ is our preferred measure of Global Inflation.

[13] The exercise is similar to the one conducted in Section 3, with a 10-year rolling RMSE computed over the sample 1995-2008. All unreported results are available upon request.

To check whether domestic inflation reverts to the global component it suffices to check the stationarity of $\hat{\varepsilon}_{i,t}$. Table 6 reports the estimates of ρ_i the first autoregressive coefficients in an AR(1) representation for $\hat{\varepsilon}_{i,t}$.[14] Estimates of ρ_i are on average not higher than 0.5, which implies that, in the available sample of countries, a temporary shock to inflation is on average absorbed in 5-7 quarters at most. On the other hand, the same estimate for the Global Inflation is on average much higher than those of country inflations, both on the whole sample and on single subsamples.

On the whole sample, therefore, the global component captures the most persistent and possibly non-stationary part of inflation.[15] This result is in line with the finding that estimated global factor would capture the non-stationarity of the data used to estimate the factor (see e.g. Bai and Ng, 2002). In this case, then, the Global Inflation behaves as an attractor and domestic inflation fluctuates around its projection on this attractor.

Incidentally, the importance of the global component of inflation leads us to reconsider the debate on inflation persistence. Two main conclusions emerge from the recent studies on inflation persistence. First, empirical estimates of inflation persistence fall when statistically significant shifts or breaks in the mean of inflation are accounted for.[16] Second, the question of what drives the break in the mean has not received a clear answer yet.[17] Both evidence on the importance of the mean of inflation and of common patterns in possible breaks in the mean are consistent with the view that inflation is a global phenomenon. Therefore, consistently with our findings and considering our measure of Global Inflation as a common long run mean, we can conclude also that inflation of 22 OECD countries exhibit lower persistence once we control for the dependence of the national inflation processes on Global Inflation. In a previous version of this work, we have also shown that inflation persistence might have not been stable over time.[18] The question of stability is relevant from an econometric point of view, as any measure of persistence of a time-varying structure is biased if time variation is not accounted for. Our results broadly confirm the time-varying ones, where the global factor captures the persistent component of inflation on the whole sample, and its persistence declines over the last 10-15 years.[19]

[14]For this exercise we use annualised quarter-on-quarter trasformations of seasonally adjusted inflation series, i.e. $\pi_{i,t} = 400\,(P_{i,t}/P_{i,t-1} - 1)$.

[15]With a year-on-year transformation, the AR(1) coefficient of the global component is not different from one, whereas the average coefficient of country inflations is not higher than 0.85.

[16]Robalo Marques (2004), among others, has recently argued that the mean of inflation plays a crucial role in the definition of persistence and that any estimate of persistence should be seen conditional on a given assumption for the mean of inflation.

[17]See for instance the discussion by Rogoff (2003).

[18]See Ciccarelli and Mojon (2008). See also at this respect Mumtaz and Surico (2008).

[19]See Table 7 in Ciccarelli and Mojon (2008). For a similar result with disaggregate data see also Angeloni et

It is also worth noting that the estimates of the loadings of inflation rates on Global Inflation are evenly distributed, across countries, around one (see Table 7 in Ciccarelli and Mojon, 2008). These loadings summarizes the “echo” of Global Inflation changes on national inflation rates, on average, since 1960. Countries that have been historically considered as high inflation countries, not surprisingly, have a loading higher than one. Germany, on the contrary, has the lowest loading among G7 countries. The sub-sample results, with notable exceptions, would also indicate some sort of convergence to more similar values.

3.2 A new benchmark for forecasting inflation?

A well documented result in the forecasting literature is that reliable leading indicators of inflation are scarce. For example, Stock and Watson (1999, 2002), Banerjee et al (2005) and Banerjee and Marcellino (2006) all conclude that, while some leading indicators of inflation outperform the forecasts based on simple AR(p) models of inflation in some countries and for some sample periods, none has yet emerged that systematically beat the AR(p) (typically AR(1) or AR(2) of level inflation), or even the Random walk (RW). It has been also argued therefore that – especially over the last 10-15 years – inflation has become harder to forecast, in the sense that *it has become much more difficult for an inflation forecaster to provide value added beyond a univariate model* (Stock and Watson, 2007). This finding had already been documented by Atkeson and Ohanian (2001) – who found that backwards-looking Phillips curve forecasts were inferior to a RW forecast– and more recently by D'Agostino et al. (2006) – who show that the ability to predict several measures of inflation and real activity declined remarkably, relative to naïve forecasts, since the mid-1980s.

All this literature, however, only focuses on the U.S. economy. To the best of our knowledge, a systematic comparison of similar features for the other industrialized economies has not been carried out yet. The issue is also partially related to the debate on the Great Moderation, which has also not attained an international momentum. Both topics are on our current research agenda. For our purposes here, however, the previous discussion can help shed new light on the issue of predictability of inflation, particularly by taking into account the international commonalities of inflation. The question is: Can the international environment help predict national inflation?

In this section, we sketch an answer by considering a parsimonious specification simply augmented with the global component of inflation.

Consistently with previous sections, we start from the usual common h-step ahead spec-

al. (2006).

ification

$$\pi^h_{i,t+h} = \alpha^h_{i,0} + \alpha^h_{i,1}(L)\,\pi_{i,t} + \alpha^h_{i,2}(L)\,\hat{f}_t + u_{i,t+h} \tag{2}$$

where the factor $\hat{f}_t$, instead of summarizing hundreds of series, is simply the common component of the 22 national inflation series:

$$\pi_{i,t} = \lambda_i f_t + \varepsilon_{i,t}$$

estimated with the average or the static principal component approach.

Notation and strategy are similar to the ones employed by Stock and Watson (2002). In particular, the multistep forecasts is linear in $\hat{f}_t$ and π_t (and lags), and an h-step-ahead projection is used to construct the forecasts directly. Therefore, after estimating all unknown up to time T, we use (2) and forecast $\pi^h_{i,T+h}$ from $\hat{\alpha}^h_{i,0} + \hat{\alpha}^h_{i,1}(L)\,\pi_{i,T} + \hat{\alpha}^h_{i,2}(L)\,\hat{f}_T$ for each unit i and step h. The dependent variable is defined as $\pi^h_{i,t} = (400/h)\ln(P_t/P_{t-h})$ – the h-period annualized inflation in the price level P_t – whereas $\pi_{i,t} = \pi^1_{i,t}$ is the q-o-q quarterly inflation rate.

As said, this specification is a well known factor-augmented econometric relationship. Here we simply argue that a very parsimonious search of the factor f_t, only based on an average of inflation series, can outperform or be as competitive as the usual benchmarks, without the need to choose an optimal number of factors from hundreds of variables. The important issue, however, is the appropriate consideration of an international ingredient summarized in f_t, which, as remarked above, works as an attractor for national inflations.

Because we want to keep the discussion limited to the scope of the paper, we check the forecasting performance of our model only against three natural competitors. The first one is an AR(p) of the form

$$\pi^h_{i,t+h} = \alpha_{i,0} + \alpha_{i,1}(L)\,\pi_{i,t} + \varepsilon_{i,t+h} \tag{3}$$

where the lag length p is optimally chosen with a standard BIC.

The second model is a naive benchmark which we call Random Walk (RW):

$$\pi^h_{i,t+h} = \pi_{i,t} + \varepsilon_{it+h} \tag{4}$$

We pay particular attention to this naive specification – especially on recent samples – to check the issue of the unpredictability raised e.g. by D'Agostino et al. (2006) and Stock and Watson (2007).

A third benchmark can be considered along the lines of Stock and Watson (1999), Nicoletti-Altimari (2001) and Gerlach (2004) by setting an augmented Phillips curve model where the first difference of inflation depends on its own lags and on the lags of the growth rates of industrial production (IP), commodity price including energy (CoP) and a monetary measure (M3). Specifically, it is:

$$\begin{aligned}\pi^h_{i,t+h} &= \alpha_{i,0} + \alpha_{i,1}(L)\,\pi_{i,t} + \alpha_{i,2}(L)\,\Delta IP_{it} \\ &\quad + \alpha_{i,3}(L)\,\Delta M3_{it} + \alpha_{i,4}(L)\,\Delta CoP_t + \varepsilon_{i,t+h}\end{aligned}$$

The experiment is conducted in a "pseudo real-time" framework with all models re-estimated at each step using only information up to time t. We optimally choose the lag length for the AR component of each model, while fixing to four the number of lags of f_t. The evaluation and comparison are made over three forecasting periods, 1980-2004, 1980-95 and post 1995, and for eight forecasting horizons (quarters). We report results only for the last subsample at the one and two-year ahead horizon. The choice of the subsamples is motivated by the issue of unpredictability over the last 15-20 years, and the choice of the horizon by the policy relevance.[20]

Tables 5 report the RMSE of our preferred specification (2) relative to the RMSE of the four competing models. Clearly, our specification is preferred in a forecasting sense if the reported statistic is lower than one. A rough comparison across the three benchmarks can also be made: the bigger the reported statistics for a model the better its performance with respect to the others. So, for instance, if the reported statistics for RW is greater than the one for AR, then the former is preferred. The significance of these ratios is checked with a simple test on the difference between two competing Mean Squared Forecast Errors, adjusting the statistic when models are nested (Clark and West, 2007). Bold entries in the table denote 10% significance.

Overall, our model outperforms the competing models in forecasting inflation on average, across forecast horizon and over evaluation periods, and for most countries. Improvements for the median country are of the order of 25% with respect to the augmented Phillips curve specification, 22% percent with respect to the AR and 18% with respect to the naive benchmark. Our model seems therefore to perform particularly well on the "policy" horizon, and over the last 10 years, when inflation has become less predictable.

To put our results in perspective, Figure 4 reports 10-year rolling forecast RMSE. While the forecast errors for inflation have steadily declined over time for all models, the Global Inflation model has consistently outperformed competing models, in particular in the sample that includes the recent 2007 and 2008 acceleration of inflation.

[20]Results for other subsamples and horizons are not reported because qualitatively very similar. A version of them are available in Ciccarelli and Mojon (2005).

Global Inflation anchoring of national inflations seems to have increased from the 1990's on (e.g. Rogoff, 2003). Hence, the unpredictability of inflation may be less relevant for our "global" model than for closed economy models of inflation.[21]

Our preliminary conclusion, then, is that a simple parsimonious extension of a standard AR model, where we consider the attraction role of the Global Inflation, outperform robust predictors of inflation. The results confirm also the importance of exploiting the international links and commonalities as advocated by the recent empirical Factor-Model literature. What makes our contribution particularly valuable is the search of the factors in a global more than a local space, and the interpretation of the common factor as an attractor of national inflation. Our parsimonious specification, where the global factor is a simple average of 22 national inflation series, seems to forecast well future developments of national inflation. The latter result, which holds across countries, samples periods and forecasting horizons, is obviously one of the main contributions of our current research and surely deserve further investigation.

4 Conclusions

In this paper, we have shown that the inflation of the OECD countries have moved together over the last 45 years. This comovement accounts for 70% of the variability of country inflation, on average. Moreover, there is a powerful and robust "error correction mechanism" that brings national inflation rates back toward the level of their long term projection on Global Inflation. As a first practical application of the idea of Global Inflation, we present a parsimonious model of inflation forecast. The preliminary findings suggest that the new specification beats standard competitors.

The main open question is to assess whether these results reflect some sort of statistical "return to the mean" phenomenon or whether some deeper endogenous economic adjustments are at work. For example, some determinants of inflation are Global: the price of commodities is the same for all countries; KOW have shown that there is a global business cycle; last but not least, it seems that monetary policy concepts are effectively spreading among central banks. In some periods, bad monetary policy strategies are dominating for a majority of countries (e.g.

[21]Inflation has become less predictable since 1995 in the sense that the RMSE of the naive model is almost consistently lower than the one for the AR and the Phillips curve models (both for the US and on average across countries). Figure 4 shows, however, that this unpredictability tendency might be over, for the RMSE of a standard AR model becomes lower than the one of a naive benchmark in 2004, at the one-step ahead horizon, and as of the end of 2007 also at the four-step ahead horizon, with a clear tendency to close the gap also at the highest horizon considered here.

the seventies). At other times, good strategies might appear dominant (e.g., since 1995). Why is that so and what has been the role of monetary policies in the commonality of inflation is left for future research. In particular, given the consensus that monetary policy ought to achieve price stability, a structural analysis of inflation commonality should help assess the potential benefits of monetary policy coordination.

Even though this paper has not investigated the theoretical underpinnings of inflation commonality, we are confident that our results provide a good starting point for exploring the hypothesis that inflation should –to some extent– be modelled as a global rather than a local phenomenon, and that our fact will be used as a method for gauging the validity of inflation theories.

In any event, the results reported in this paper suggest that central bankers should at least exchange views and cooperate in the design of their monetary policy concepts. Hence, paraphrasing the conclusion of the 1848 Communist Manifesto we would like to invite:

"*central bankers of all countries: unite!*"

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APPENDIX. Data sources and transformation

Definition	*Source*	*Sample*	*Transformation*
Consumer price indices	OECD Main Economic Indicators	1960:1 - 2008:2	y-o-y growth rates
Industrial production	IMF International Financial Statistics	1960:1 - 2007:2	y-o-y growth rates
Commodity prices	Commodity Research Bureau, Inc.: CRB Commodity Index Report; www.freelunch.com	1960:1 - 2008:2	y-o-y growth rates
Broad money (M3)	euro area countries (Eurostat Balance sheet items); Canada, Denmark, Sweden and United Kingddom (OECD MEI); Australia, Japan, New Zeland, Norway Switzerland and United States (OECD Economic Outlook); for Austria, Belgium, Finland, France, Germany, Ireland	1960:1 - 2007:2	y-o-y growth rates

Table 1. Share of inflation variance explained by alternative measures of Global Inflation

	Average	OECD	Static factor	
			first	second
Greece	0.42	0.66	0.38	0.15
Switzerland	0.47	0.24	0.41	0.16
Japan	0.56	0.30	0.52	0.14
Netherlands	0.58	0.26	0.58	0.19
Germany	0.60	0.33	0.57	0.16
New Zeland	0.63	0.62	0.61	0.14
Portugal	0.65	0.65	0.63	0.09
United States	0.68	0.72	0.66	0.02
Norway	0.70	0.58	0.68	0.03
Australia	0.73	0.70	0.71	0.06
Denmark	0.73	0.54	0.71	0.00
Austria	0.74	0.40	0.72	0.12
Spain	0.75	0.58	0.74	0.03
Sweden	0.76	0.64	0.71	0.02
Luxembourg	0.76	0.47	0.77	0.02
United Kindom	0.83	0.66	0.81	0.00
Finland	0.83	0.58	0.81	0.01
Canada	0.83	0.75	0.81	0.04
Belgium	0.84	0.56	0.83	0.03
Ireland	0.85	0.60	0.86	0.00
Italy	0.86	0.81	0.86	0.03
France	0.89	0.73	0.90	0.00
mean	0.71	0.56	0.69	0.06
median	0.74	0.59	0.71	0.03
euro area	0.95	0.76	0.95	0.00

Note: The table reports the proportion of variance explained by alternative measures of Global Inflation. For the algebraic definition of this share, see Section 2.3 and footnote 7 of the paper. The estimation sample is 1961:1-2008:2. The euro area aggregate inflation is not included in the pool of 22 countries used to estimate Global Inflation.

Table 2: Share of inflation variance explained by average inflation for a selection of six countries

	1961:1-2008:2	1975:1-2008:2	1984:1-2008:2
Australia	0.71	0.70	0.37
Canada	0.83	0.86	0.68
Germany	0.63	0.63	0.26
UK	0.88	0.91	0.83
Japan	0.62	0.83	0.66
US	0.78	0.80	0.66
mean	0.74	0.79	0.58
median	0.75	0.82	0.66

Note: The table reports the proportion of variance explained by Global Inflation as defined in column 1 of Table 1, i.e. the unweighted average of the inflation rates of the six countries of this table. For the algebraic definition of this share, see Section 2.3 and footnote 7 of the paper.

Table 3. Share of detrended inflation variance explained by alternative measures of Global Inflation

	Average	OECD	Static factor
Portugal	0.03	0.01	0.02
Spain	0.10	0.00	0.03
New Zeland	0.10	0.01	0.05
Norway	0.15	0.02	0.09
Greece	0.27	0.08	0.17
Sweden	0.27	0.29	0.19
Netherlands	0.29	0.08	0.29
Denmark	0.30	0.21	0.21
Germany	0.32	0.08	0.26
Australia	0.35	0.20	0.26
Canada	0.36	0.20	0.29
Finland	0.39	0.15	0.34
Luxembourg	0.40	0.05	0.40
United Kingdom	0.40	0.24	0.35
United States	0.43	0.57	0.42
Switzerland	0.44	0.22	0.33
Austria	0.47	0.12	0.43
Japan	0.54	0.49	0.47
Ireland	0.57	0.19	0.56
France	0.61	0.49	0.64
Italy	0.61	0.41	0.60
Belgium	0.62	0.23	0.63
mean	0.37	0.20	0.32
median	0.37	0.20	0.31
Euro area	0.83	0.34	0.84

Note: The inflation series are detrended by applying the band pass filter of Baxter and King (1999), removing all frequencies but the periods of 6 to 32 quarters. The euro area aggregate inflation is not included in the pool of 22 countries used to estimate Global Inflation. Estimation sample: 1961:1-2008:2.

Table 4: Persistence of the Global and the National Components of Inflation

	1960-2008		1960-1980		1980-1990		1990-2008	
	ρ	stderr	ρ	stderr	ρ	stderr	ρ	stderr
Euro area	0.47	0.06	0.22	0.11	0.36	0.14	0.55	0.09
G7								
United States	0.62	0.06	0.65	0.09	0.47	0.12	0.20	0.11
Canada	0.33	0.07	0.28	0.11	0.61	0.12	0.26	0.12
United Kingdom	0.45	0.06	0.35	0.11	0.52	0.11	0.17	0.12
Japan	0.54	0.06	0.37	0.10	0.33	0.14	0.03	0.12
Germany	0.54	0.06	0.47	0.10	0.40	0.14	0.42	0.10
France	0.55	0.06	0.50	0.10	0.24	0.15	0.28	0.11
Italy	0.43	0.07	0.43	0.10	0.03	0.15	0.54	0.10
median	*0.54*	*0.06*	*0.43*	*0.10*	*0.40*	*0.14*	*0.26*	*0.11*
mean	*0.49*	*0.06*	*0.44*	*0.10*	*0.37*	*0.13*	*0.27*	*0.11*
Other Euro/EU								
Austria	0.18	0.07	0.10	0.11	0.08	0.15	0.16	0.12
Belgium	0.44	0.07	0.42	0.10	0.52	0.13	0.22	0.12
Denmark	0.10	0.07	-0.03	0.11	-0.03	0.16	0.37	0.10
Finland	0.43	0.07	0.41	0.10	0.37	0.15	0.33	0.11
Greece	0.73	0.05	0.44	0.10	0.39	0.14	0.56	0.10
Ireland	0.19	0.07	0.02	0.11	-0.34	0.14	0.63	0.09
Luxembourg	0.47	0.06	0.41	0.10	0.48	0.13	0.09	0.12
Portugal	0.06	0.07	-0.14	0.11	0.61	0.11	0.39	0.11
Spain	0.37	0.07	0.39	0.10	0.16	0.15	-0.13	0.12
Sweden	0.18	0.07	0.02	0.11	0.23	0.14	0.10	0.11
The Netherlands	0.42	0.06	0.21	0.11	0.07	0.16	0.40	0.11
median	*0.37*	*0.07*	*0.21*	*0.11*	*0.23*	*0.14*	*0.33*	*0.11*
mean	*0.32*	*0.07*	*0.20*	*0.11*	*0.23*	*0.14*	*0.28*	*0.11*
Others								
Australia	0.29	0.07	0.02	0.11	0.32	0.15	0.20	0.12
New Zeland	0.59	0.06	0.57	0.09	0.51	0.13	0.46	0.11
Norway	0.18	0.07	0.12	0.11	0.44	0.14	-0.10	0.12
Switzerland	0.61	0.06	0.63	0.09	0.33	0.15	0.28	0.11
median	*0.44*	*0.07*	*0.34*	*0.11*	*0.38*	*0.14*	*0.24*	*0.11*
mean	*0.42*	*0.07*	*0.33*	*0.10*	*0.40*	*0.14*	*0.21*	*0.11*
Global Inflation	0.94	0.02	0.93	0.04	0.88	0.05	0.68	0.08

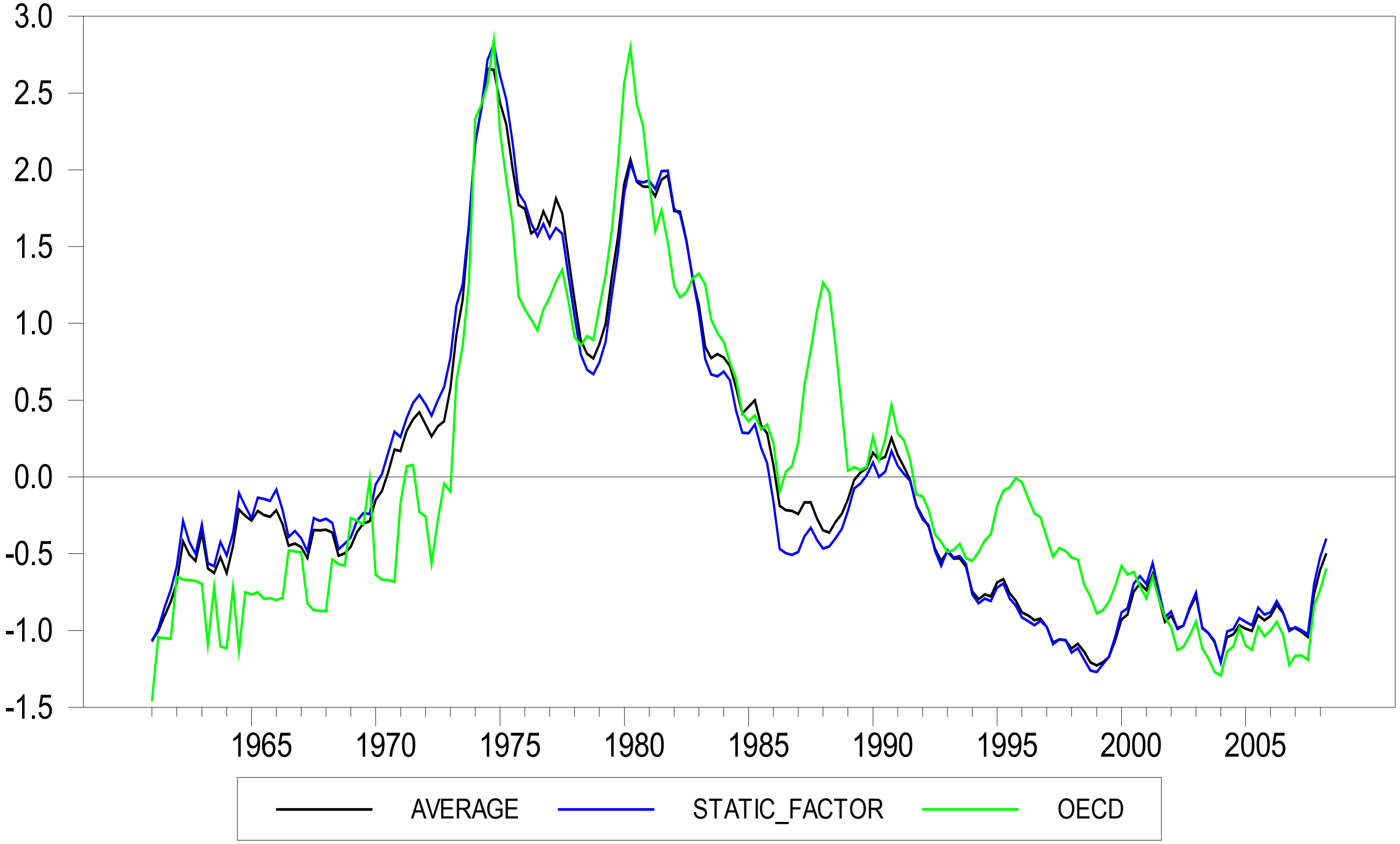
Note: The table reports the estimates of the first autoregressive coefficient of national inflations (defined as π_{it}-$\lambda_i f_t$) and their standard errors over four samples. An AR(1) is asssumed for both national and Global inflation. Estimation technique is OLS. The factor is estimated with a simple average.

Table 5: RMSE of the Global Inflation model relative to standard benchmarks (1995:1-2008:2)

	4-step ahead			8-step ahead		
	RW	AR	PHIL	RW	AR	PHIL
Euro area total	0.82	**0.90**	**0.70**	0.89	**0.85**	**0.69**
G7						
United States	**0.82**	1.03	**0.82**	**0.78**	**0.83**	**0.81**
Canada	**0.63**	**0.84**	**0.86**	**0.56**	**0.76**	0.77
United Kingdom	1.11	**0.72**	**0.62**	1.37	**0.67**	**0.59**
Japan	1.08	1.06	1.58	1.35	1.03	2.32
Germany	**0.70**	0.89	**0.89**	**0.78**	**0.91**	0.94
France	**0.81**	0.90	**0.73**	**0.80**	**0.80**	**0.77**
Italy	1.10	**0.70**	**0.60**	1.15	**0.53**	**0.48**
median	*0.82*	*0.89*	*0.82*	*0.80*	*0.80*	*0.77*
mean	*0.89*	*0.88*	*0.87*	*0.97*	*0.79*	*0.95*
Other Euro/EU						
Austria	**0.79**	**0.75**	**0.73**	**0.76**	**0.72**	**0.75**
Belgium	**0.69**	0.90	**0.74**	**0.53**	**0.67**	**0.60**
Denmark	1.35	**0.70**	**0.83**	1.35	**0.63**	0.95
Finland	1.07	0.93	**0.72**	1.10	**0.80**	**0.69**
Greece	0.95	**0.75**	**0.68**	1.08	**0.66**	**0.64**
Ireland	1.23	1.34	0.90	1.03	1.20	**0.74**
Luxembourg	**0.85**	1.11	**0.85**	**0.78**	0.97	**0.78**
Portugal	1.11	**0.48**	**0.53**	1.15	**0.44**	**0.50**
Spain	**0.81**	**0.71**	**0.77**	0.83	**0.58**	**0.80**
Sweden	1.07	**0.91**	**0.89**	1.24	**0.87**	**0.81**
The Netherlands	**0.80**	**0.77**	**0.85**	0.90	**0.89**	**0.89**
median	*0.95*	*0.77*	*0.77*	*1.03*	*0.72*	*0.75*
mean	*0.97*	*0.85*	*0.77*	*0.98*	*0.77*	*0.74*
Others						
Australia	**0.66**	0.86	**0.82**	**0.58**	**0.78**	**0.71**
New Zeland	**0.75**	**0.67**	**0.55**	**0.74**	**0.57**	**0.47**
Norway	**0.52**	**0.71**	**0.66**	**0.51**	**0.65**	**0.64**
Switzerland	1.18	**1.06**	0.94	1.80	1.07	**1.18**
median	*0.70*	*0.78*	*0.74*	*0.66*	*0.72*	*0.68*
mean	*0.78*	*0.83*	*0.74*	*0.91*	*0.77*	*0.75*
Overall median	*0.82*	*0.86*	*0.77*	*0.89*	*0.78*	*0.75*
Overall mean	*0.91*	*0.86*	*0.79*	*0.96*	*0.78*	*0.81*

Note: The entries are the ratios of root mean squared errors of the Global inflation forecast model to the one obtained with a random walk (RW), an AR(p) (AR), and a Phillips Curve augmented with industrial production, commodity prices and money (PHIL). In all models the AR order (p) is optimally chosen using BIC. Four lags of Global Inflation are used in our preferred specification. Evaluation period: 1995:1-2008:2 for RW and AR and 1995:1-2007:4 for PHIL.

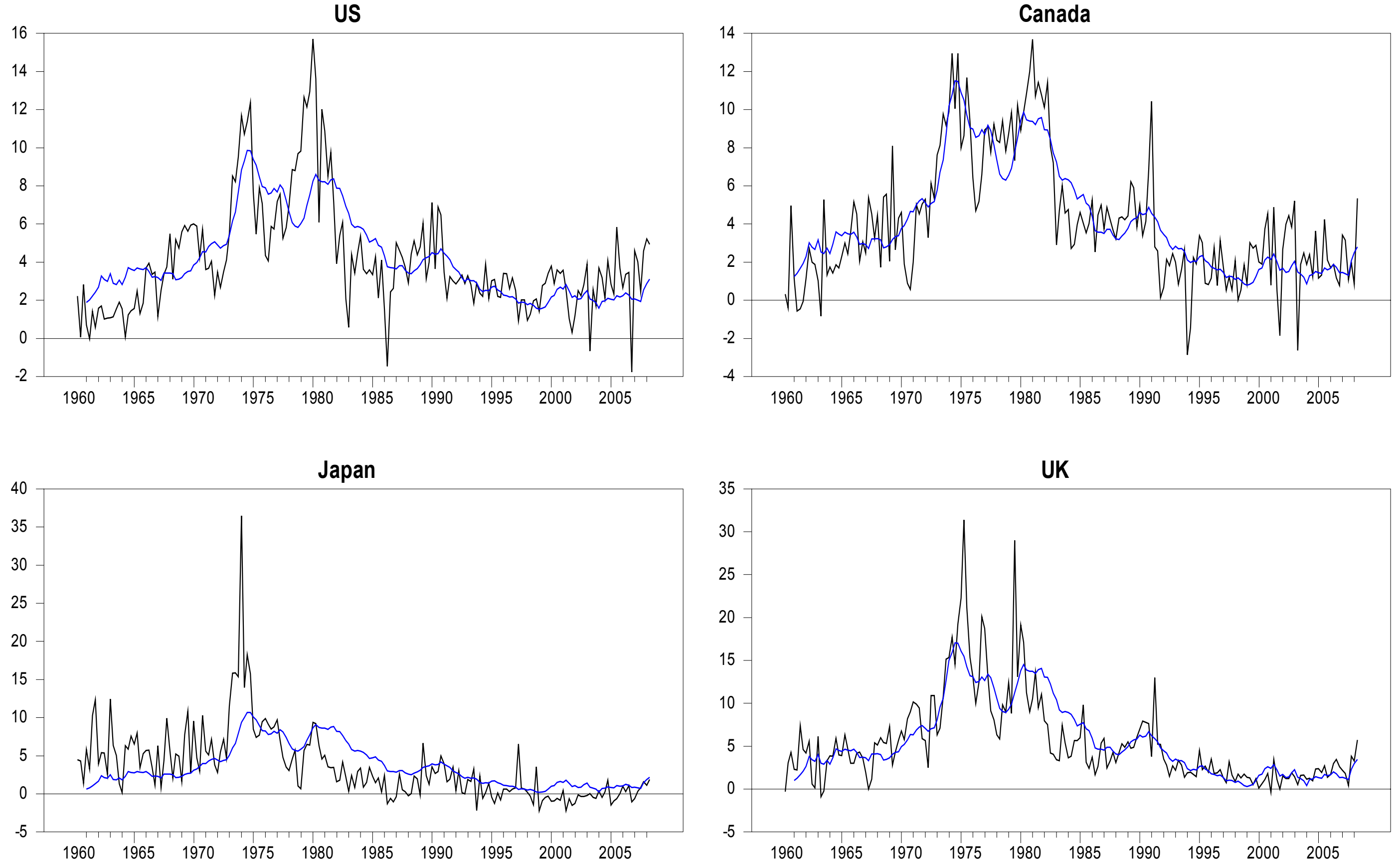
Figure 1: Measures of Global Inflation



Note: The chart plots three measures of Global Inflation: a simple cross-country average (AVERAGE), a static factor measure (STATIC_FACTOR), and the aggregate OECD weighted measure (OECD).

Figure 2a : G7 and euro area inflation and their projection on Global Inflation

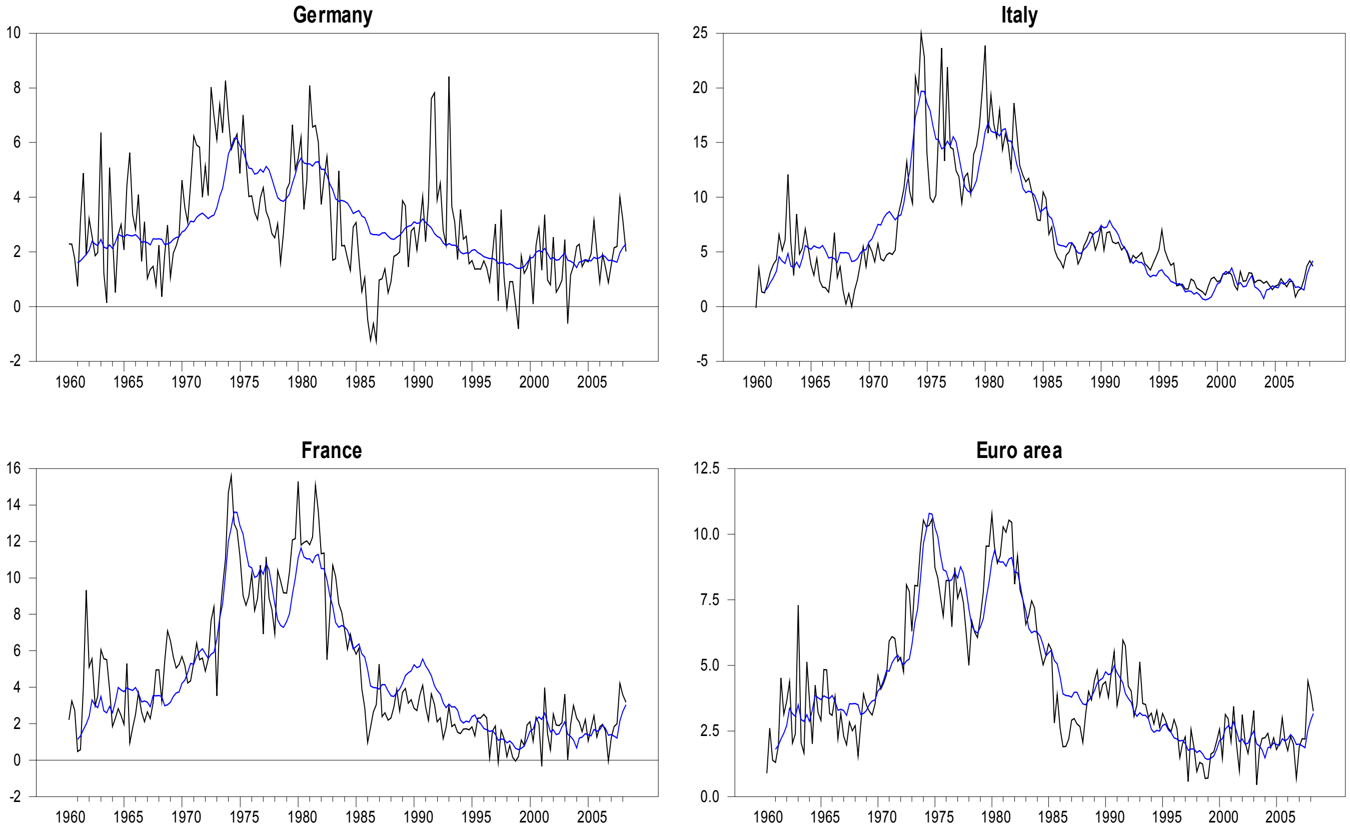
United States, Japan, Canada and United Kingdom (1960:2-2008:2)



Note: The charts report domestic inflations and their projections on the Global Inflation (measured by simple average). Estimation technique is OLS. Dependent variable is a deseasonalized quarter-on-quarter inflation rate.

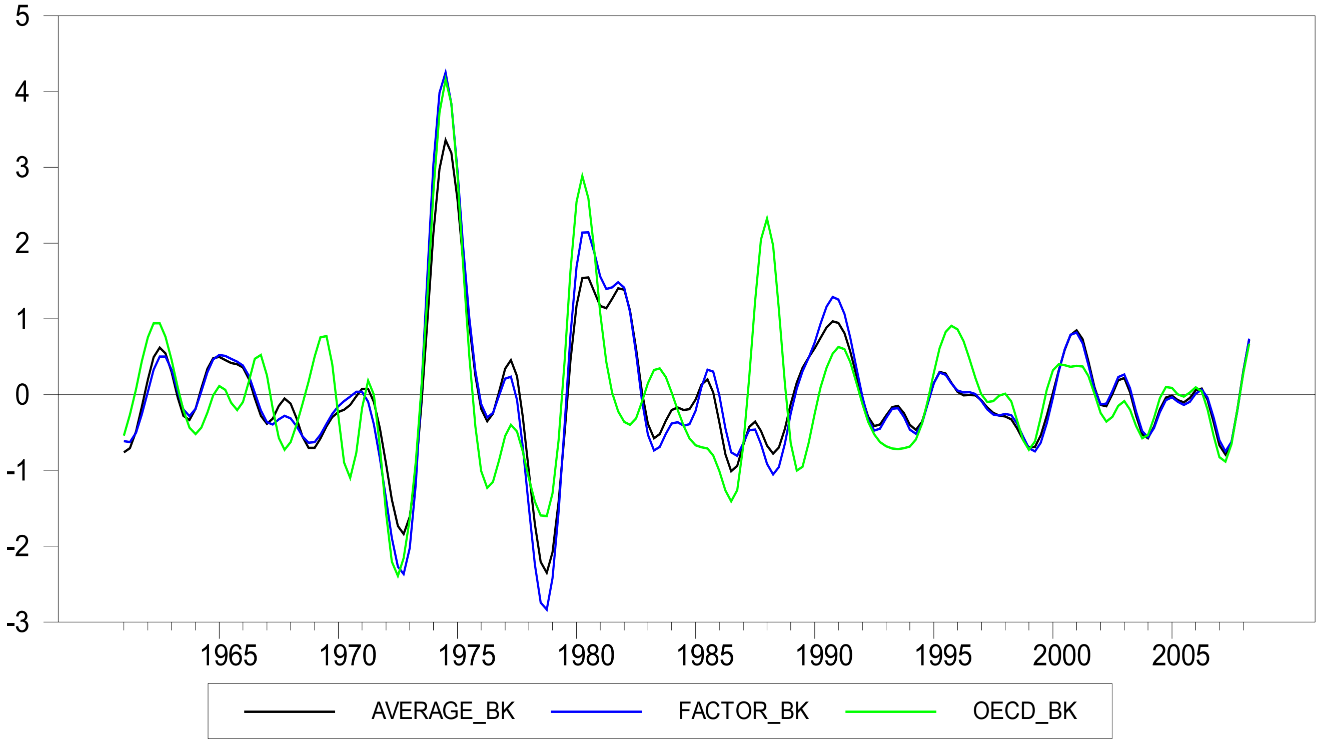
Figure 2b : G7 and euro area inflation and their projection on Global Inflation

Germany, France, Italy and Euro area (1960:2-2008:2)



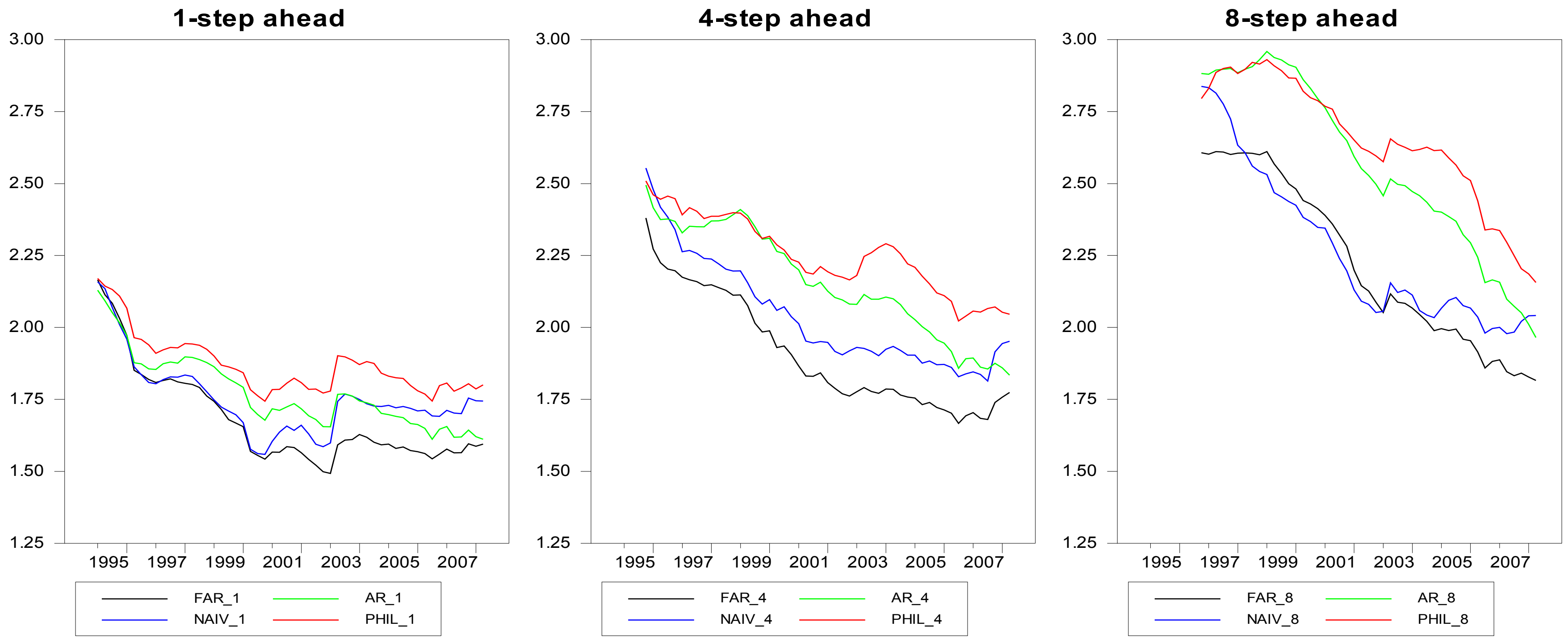
Note: The charts report domestic inflations and their projections on the Global Inflation (measured by simple average). Estimation technique is OLS. Dependent variable is a deseasonalized quarter-on-quarter inflation rate.

Figure 3: Measures of Global de-trended Inflation



Note: The chart reports three measures of detrended Global Inflation: the detrended cross-country simple average (AVERAGE), a detrended static factor measure (FACTOR), and the detrended OECD weighted measure (OECD). The inflation series are detrended with Baxter and King (1999), removing all frequencies but the periods of 6 to 32 quarters.

Figure 4: 10-year rolling RMSE for the average country



Note: The charts display 10-year rolling RMSE averaged across countries for four forecasting competitors: The Global Inflation model (Eq. 2 in the paper), denoted with FAR; an Autoregressive model (Eq. 3 in the paper), denoted with AR; a naïve benchmark (Eq. 4 in the paper), denoted as NAIV; and a Phillips curve model (Eq. 5 in the paper with only commodity prices as covariate), denoted as PHIL. Figures are reported for three forecasting horizons: 1-quarter, 4-quarter, and 8-quarter-ahead. The values at each date represent the RMSE computed over the previous ten years until that date.