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International Comovements, Business Cycle and Inflation: a Historical Perspective

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Abstract
Using a dynamic factor model, we uncover four main empirical regularities on international comovements in a long-run panel of real and nominal variables. First, the contribution of world comovements to domestic output growth has decreased over the post-WWII period. The contribution of regional comovements, however, has increased significantly. Second, the share of inflation variation due to a global factor has become larger since 1985. Third, over most of the post-WWII period, international comovements within regions have accounted for the bulk of fluctuations in business cycle and inflation. Fourth, prices have become significantly less countercyclical during the post-1984 sample, with the largest contribution due to external developments.

JEL classfication: E30, F40, N10.

Keywords: output growth, in.ation, geographic identi.cation, dynamic factor model

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1 Introduction

The theory and empirics of international comovements in real variables have a long-standing tradition in macroeconomics popularized by the seminal contribution of Backus, Kehoe and Kydland (1992). Since then, a growing empirical literature has used different statistical methods to assess difference and similarities in the growth rates of output, investment, consumption and productivity across countries and regions of the world. Prominent examples include Artis and Okubo (2009), Kose, Otrok and Whiteman (2003 and 2008), Kose, Otrok and Prasard (2008) and Crucini, Kose and Otrok (2008).

The theory and empirics of international comovements in nominal variables is, in contrast, more scant. On the theoretical side, Henriksen, Kydland and Sustek (2009) have put forward a theory of international comovements in inflation and nominal interest rates based on technology spillovers. On the empirical side, Ciccarelli and Mojon (2009), Mumtaz and Surico (2009) and Neely and Rapach (2008), among others, have studied the contribution of global inflation to fluctuations in national inflation rates.

What all the empirical contributions mentioned above have in common is the exclusive focus on either real or nominal variables, with no attempt to study the international regularities in the correlations between national real activities and national inflation rates across countries. This is particularly surprising in the light of another influential contribution by Backus and Kehoe (1992), where prices are shown to have become countercyclical moving from the intra-wars to the post-WWII period.

This paper tries to fill the gap between empirical contributions on real variables and empirical contributions on nominal variables by jointly identifying international comovements in output growth and inflation in a long-run historical dataset covering 36 countries and four continents. The statistical framework is a dynamic latent factor model in which a world output growth (inflation) factor is identified as the only common component to all output growth (inflation) series in our panel. Regional factors are defined similarly within each region, but they are required to be orthogonal to the global factors. This set of restrictions make it possible to perform a variance decomposition analysis between world, regional and country-specific features. International factors are allowed, but not required, to be correlated at the same geographic level. This modeling choice makes it possible to decompose the output growth-inflation correlation into domestic and external contributions.

For most countries, our dataset goes back to the XIX^{th} century. The very long time span encourages a focus on different sub-samples, which reflect different waves of economic globalization. Our main results can be summarized as follows. First, there is strong evidence of increasing similarities in output growth rates *within* regions but there is evidence of differences *between* regions, consistent with the notion of a decoupling of international business cycles. Second, there is some tentative evidence of an increase in the degree of synchronization of inflation rates across the world. But, third, regional factors still account for the bulk of fluctuations in both output growth and inflation. Fourth, moving from the pre- to the post-1984 period, prices have become significantly less countercyclical across the world, with the largest contribution made by international comovements.

We introduce the statistical model, the data, the (geographical) identification strategy and the estimation method in section 2. In the following part, we report the estimates of world and regional factors. Section 4 presents the decomposition of the variance of output growth and inflation into world and regional features, while section 5 performs the geographical decomposition for the output growth-inflation correlation. The appendix provides details on the data and further results.

2 The statistical model

The goal of the paper is to decompose geographically the international regularities in a panel of real and nominal variables. We seek for a minimal model structure that can be suited to pursue two main objectives. First, to identify separately international comovements in output growth and international comovements in inflation while still allowing an interaction between real and nominal forces. Second, to disentangle international comovements *between* regions (global comovements) from international comovements *within* regions (regional comovements). In this section, we show that by imposing some appropriate restrictions in an otherwise standard dynamic factor model we fulfill our intentions of separating real from nominal comovements, and world from regional comovements.

2.1 A dynamic factor model for output growth and inflation

We model the degree of comovements in output growth and inflation using a dynamic factor model in the tradition of Forni and Reichlin (1998), Stock and Watson (1998) and Forni, Hallin, Lippi and Reichlin (2001). The model is based on the idea that common movements in a large dataset can be efficiently summarised via a set of latent factors. The main advantage of these models is that they allow the researcher to characterise the degree of synchronisation and comovement without making strong a priori assumptions.

Consider an annual data set (to be described in detail below) of output growth rates, Δy_t, and inflation rates, π_t, for N countries: $Y_{i,t} = \{\Delta y_{i,t}, \pi_{i,t}\}$. Our dynamic factor model is defined by the following set of equations:

$$Y_{i,t} = \beta_i W_t^{\pi} + \gamma_i W_t^{\Delta y} + \kappa_{j,k} R_{k,t}^{\pi} + \mu_{j,k} R_{k,t}^{\Delta y} + v_{it} \quad \forall i = 1...N \tag{1}$$

where W_t^{π} denotes the common factor (across all countries) in inflation, $W_t^{\Delta y}$ denotes the common factor in output. $R_{k,t}^{\pi}$ denotes a factor specific to inflation in all countries belonging to region $k = 1..K$. Similarly, $R^{\Delta y}_{k,t}$ denotes a regional output factor. The vector of idiosyncratic (country-specific) components is denoted by v_{it}.

The dynamics of the world and regional factors are described by two independent VAR(1) models:

$$W_t = \alpha^w + \rho^w W_{t-1} + e^w_t \tag{2}$$

$$R_t = \alpha^r + \rho^r R_{t-1} + e^r_t \tag{3}$$

where $W_t \equiv \{W^\pi_t, W^{\Delta y}_t\}$, $R_t \equiv \{R^\pi_t, R^{\Delta y}_t\}$, $e^w_t \tilde{} N(0, \Sigma^w)$ and $e^r_t \tilde{} N(0, \Sigma^r)$ with the Σ matrices being diagonal.

The idiosyncratic components in (1) follow bi-variate VAR(1) processes. That is, for country i the dynamics of the idiosyncratic error term associated with $\{\Delta y_{i,t}, \pi_{i,t}\}$ are described by:

$$V_{it} = A_i V_{it-1} + \varepsilon_{it} \tag{4}$$

where $V_t = \{v^\pi_{it}, v^{\Delta y}_{it}\}$ and $\varepsilon_{it} \tilde{} N(0, \Omega_i)$ with Ω being a full matrix.

It is worth emphasizing that the structure in (2)-(3) implies that global and regional factors are mutually orthogonal. This will allow us, in section 4, to carry a variance decomposition analysis to estimate the components of business cycle fluctuations and inflation fluctuations due to world, regional and country-specific factors. On the other hand, the structure in (2)-(3) makes clear that real and nominal features can be correlated at the same geographical level. Together with the covariance matrix Ω between the domestic component of output growth and the domestic component of inflation being full, this will allow us, in section 5, to decompose the output growth-inflation correlation into components due to world, region and country-specific forces.

2.2 Data

The data set has been constructed using several sources including the global financial database (GFD), Maddisson (MAD), Total Economy Database (TED) and the International Financial Statistics (IFS) at the IMF. GFD has sourced the historical data from Mitchell (1980 and 1995), who in turn compiled the data from a variety of sources ranging from government publications and publications by the League of Nations and United Nations.

For 36 countries, annual data for GDP growth and CPI inflation were available over more than 75 years. The regions covered are North and South America, Europe, Asia and Oceania. The panel is unbalanced, but the longest available time series extends back to 1821. Note that for some countries observations for a few years are missing in the middle of the sample, especially around the time of the great depression and the second World War. In the next section (step 4 of the Gibbs sampling algorithm), we describe how we deal with missing observations. A full description of the data set is provided in Table 1 of the appendix. For each country and sub-sample, tables 2 and 3 report averages and standard deviations for output growth and inflation.

2.3 Identification and estimation

We estimate the dynamic factor model in equations (2) to (4) using Gibbs sampling. The Gibbs sampling algorithm cycles through the following steps:

1. Conditional on a starting value for the factors F_t^x with $x = w, r$, $F_t^w \equiv W_t$ and $F_t^r \equiv R_t$ (which we obtain using principal components) and a value for Σ^x, the VAR coefficients $\Psi^x = \{\alpha^x, p^x\}$ are drawn from $\Psi^x \tilde{} N(M^x, Q^x)$

$$\begin{aligned} Q^x &= \left(N_0^{-1} + F_{t-1}^{x\prime} \left(I \otimes \Sigma^x\right)^{-1} F_{t-1}^x\right)^{-1} \\ M^x &= V^x \left(N_0^{-1}\Psi_0 + \left(F_{t-1}^{x\prime} \left(I \otimes \Sigma^x\right)^{-1} F_{t-1}^x\right) \Psi_{OLS}^x\right) \end{aligned} \tag{5}$$

where Ψ_0 is the prior mean which we set to zero, N_0 is the prior variance which is set to an identity matrix and Ψ^x_{OLS} denotes OLS estimates of the VAR coefficients.

2. Conditional on $F_t \equiv [F_t^w, F_t^r]$ and the factor loadings $\Xi = \{\beta_i, \gamma_i, \kappa_{j,k}, \mu_{j,k}\}$ the elements of Ω_i are drawn from an Inverse Wishart distribution: $\Omega_i\tilde{}IW(V_t'V_t)$ where the scale matrix is denoted by $V_t'V_t$ and the degrees of freedom are given by the length of the sample. Conditional on a draw for Ω_i, the VAR coefficients A_i are drawn from a conditional distribution of the same form as (5) with same priors.

3. Drawing the factor loadings Ξ is complicated by the serial and cross-sectional correlation in v_{it} from equation (1). In order to derive the conditional distribution of Ξ we treat equations (1) and (4) as a state-space system and use the algorithm described in Carter and Kohn (2004). That is, for each country, conditional on F_t, Ω_i and A_i we re-write the observation equations as

$$\begin{pmatrix} \Delta y_{i,t} & \pi_{i,t} \end{pmatrix} = \begin{pmatrix} W_t^{\Delta y} & R_{k,t}^{\Delta y} & 0 & 0 & 1 & 0 \\ 0 & 0 & W_t^{\pi} & R_{k,t}^{\pi} & 0 & 1 \end{pmatrix} \begin{pmatrix} \gamma_{i,t} \\ \mu_{i,k,t} \\ \beta_{i,t} \\ \kappa_{i,k.t} \\ v_{it}^{\Delta y} \\ v_{it}^{\pi} \end{pmatrix}$$

$$\begin{pmatrix} \gamma_{i,t} \\ \mu_{i,k,t} \\ \beta_{i,t} \\ \kappa_{i,k.t} \\ v_{it}^{\Delta y} \\ v_{it}^{\pi} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & A_{11} & A_{12} \\ 0 & 0 & 0 & 0 & A_{21} & A_{22} \end{pmatrix} \begin{pmatrix} \gamma_{i,t-1} \\ \mu_{i,k,t-1} \\ \beta_{i,t-1} \\ \kappa_{i,k.t-1} \\ v_{it-1}^{\Delta y} \\ v_{it-1}^{\pi} \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \varepsilon_{it}^{\Delta y} \\ \varepsilon_{it}^{\pi} \end{pmatrix}$$

and use the Kalman filter to derive $E\left(\Xi_i/F_t, A_i, \Omega_i\right)$ and $VAR\left(\Xi_i/F_t, , A_i, \Omega_i\right)$.

4. Conditional on F_t, A_i, Ω_i and Ξ_i we use the Kalman filter and smoother to derive the $E\left(Y_{i,t}/F_t, A_i, \Omega_i, \Xi_i\right)$ and $VAR\left(Y_{i,t}/F_t, A_i, \Omega_i, \Xi_i\right)$. We sample missing observations from the normal distribution with this mean and variance.

5. Conditional on A_i, Ω_i and Ξ_i the distribution of the latent factor is normal. The algorithm in Carter and Kohn (2004) is used to draw from this conditional distribution. The distribution of the factors F_t is linear and Gaussian:

$$F_T \backslash A_i, \Omega_i, \Xi_i \sim N\left(F_{T\backslash T}, P_{T\backslash T}\right)$$
$$F_t \backslash F_{t+1,} A_i, \Omega_i, \Xi_i \sim N\left(F_{t\backslash t+1, F_{t+1}}, P_{t\backslash t+1, F_{t+1}}\right)$$

where $t = T-1, ..1$, and:

$$\begin{aligned} F_{T\backslash T} &= E\left(F_T \backslash A_i, \Omega_i, \Xi_i\right) \\ P_{T\backslash T} &= Cov\left(F_T \backslash A_i, \Omega_i, \Xi_i\right) \\ F_{t\backslash t+1, Z_{t+1}} &= E\left(F_t \backslash A_i, \Omega_i, \Xi_i\right) \\ P_{t\backslash t+1, Z_{t+1}} &= Cov\left(F_t \backslash A_i, \Omega_i, \Xi_i\right) \end{aligned}$$

As shown by Carter and Kohn (2004) the simulation proceeds as follows. First we use the Kalman filter to draw $F_{T\backslash T}$ and $P_{T\backslash T}$ and then proceed backwards in time using:

$$F_{t|t+1} = F_{t|t} + P_{t|t} P_{t+1|t}^{-1} \left(F_{t+1} - F_t\right)$$

$$P_{t|t+1} = P_{t|t} - P_{t|t} P_{t+1|t}^{-1} P_{t|t}$$

If more than one lag of the factors appears in the VAR model, this procedure has to be modified to take account of the fact that the covariance matrix of the shocks to the transition equation (used in the filtering procedure described above) is singular. For details see Kim and Nelson (1999).

We repeat these steps 20,000 times and use the last 1000 draws for inference. The posterior moments show little change across the retained draws providing some evidence in favour of convergence.[1] The factor model has two identification problems. First, the sign

[1] These results are available on request.

of the factor loadings and the factors are not identified separately. Second, the scale of the factor is not identified. In order to fix the sign, we impose the condition that at least one factor loading (on a specific factor) has to be positive. For example, we impose the condition that the world factors should load with a positive coefficient on output growth and inflation in UK. We also require the regional factor for Europe to load positively on data for the UK, the regional factor for North America to load positively on US data, the Asian factor to load positively on Chinese data and the South American factor to load positively on Brazilian data. The final estimates are not sensitive to this normalisation and similar results are obtained if alternative countries are chosen. In order to fix the scale, we assume Σ^x to be a diagonal matrix with elements on the main diagonal chosen to match the scale of the data.

3 The estimated factors

In this section, we report the estimates of international and regional comovements in both output growth and inflation based on the dynamic factor model (1)-(4).[2] It is worth emphasizing that the geographic categorization of comovements between world, regions and countries refers to the effects, rather than to the sources, of the comovements. For instance, the problems in the U.S. sub-prime mortgage which triggered the 2008-2009 financial crisis across the world will be deemed as world-wide in our statistical model. The invention of a new technology whose diffusion is uneven across regions of the world, in contrast, will be deemed region-specific.

3.1 World factors

The top (bottom) panel of figure 1 reports the estimated world output growth (inflation) factor. These are the international comovements that are loaded by, respectively, all output

[2] Similar results are obtained using the growth rates of real GDP per capita.

growth series and all inflation series in our panel. In the pre-1914 period, the world output factor fluctuated around zero, suggesting that most countries were growing at their historical averages. The world inflation factor, in contrast, was characterized by far more negative values, suggesting that the alternating waves of inflation and deflation that were integral part of the commodity-based classic gold standard regime resulted in inflation rates below their historical averages for most of the countries in our panel.

The 1915-1959 sample was dominated by the two world wars, clearly visible as large negative values for world output growth and large positive values for world inflation, and the great depression, clearly visible as negative values for both output growth and inflation factors. The post-WWI deflation and recession were associated to aggressive monetary policies in the U.S., U.K., and other countries in an attempt to restore price levels to their prewar gold standard levels. These attempts, however, were inconclusive and led to a number of banking and currency crises in Denmark, Italy, Finland, Netherlands, and Norway. The New York stock market boom in 1928 was associated with a significant reduction in the U.S. capital flows to central Europe and Latin America and precipitated currency crises in Australia, Argentina, Uruguay, and Brazil. The Wall Street crash was rapidly reflected in stock market crises around the globe.

The 1960s appear as a benign period for international comovements on both real and nominal fronts. The great inflation of the 1970s generated a negative comovements between domestic output growth and domestic inflation for most countries in our sample, which is exemplified in figure 1 as large negative values for world output on the backdrop of large positive values for inflation, especially around the oil price surges of 1973 and 1979. The sharp U.S. monetary contraction of the early 1980s coincides with a domestic recession and below average growth rates in most world economies.

Over the 1985-2007 period, negative values of the world output growth factor have clustered around the time of the U.S. recession of the early 1990s and the burst of the dot.com bubble at the beginning of the new millennium. Interestingly, the Russian default and the consequent Asian crises have emerged as significant international comovements neither for output growth nor for inflation.

3.2 Regional factors

The previous section presents results for international comovement *between* regions. This section reports estimates of the international factors *within* macro regions. These are the factors that are loaded by the series of either output growth or inflation in all countries within the same region. There are of course many different ways of cutting the data and regions could be identified according to geography, culture, trade and other features of the national economies.

The categorization used in this paper is geographic with the five selected regions representing Europe, North America, Oceania, Asia and South America. The full list of countries is detailed in the appendix. Although, the North American region only comprises Canada and the United States, the South American hyperinflation episodes would make it heroic to estimate a regional factor for the whole America. A case could be made for Oceania to be part of the Asian block. It should be noted, however, that in our statistical model regional factors are allowed, but not required, to be related one to another via equation (2).

Figure 6 presents the output growth regional factors. The world wars had also a regional component in Europe and North America, which however was not shared by other regions of the world. The great depression of the 1929-1932 had a further regional effect in Canada and United States. The regional component in Oceania appears statistically insignificant whereas the lower growth of South America around the time of the hyperinflations of the

1980s and early 1990s is shared by no other regions. Once more, the Asian crises of the 1990s do not generate a regional comovement in output, possibly reflecting the heterogeneity in the timing of events across countries.

Moving to the regional comovements in inflation, figure 2 shows clear localized patterns for most areas. These patterns coincide with historical episodes that we have already discussed and therefore they will not be repeated here. Further episodes that are worth noting are the 1980s inflation in Australia and New Zealand, which preceded the wave of inflation targeting adoptions in the region; the South American hyperinflations of the 1980s and beginning of the 1990s; the sharp rise in the Asian factor at the end of WWII.

4 Variance decomposition

In this section we decompose the variance of output growth and inflation into contributions due to world factor and regional factors. Furthermore, we consider how these contributions have changed over four sub-samples which are deemed by Baldwin and Martin (1999), among others, to represent successive waves of globalization: 1860-1914, 1915-1959, 1960-1984 and 1985-2007. The variance decomposition is based on equation (1). That is:

$$\begin{aligned} VAR(\Delta y_{i,t}) &= \hat{\gamma}_i^2 VAR(W_t^{\Delta y}) + \hat{\mu}_{j,k}^2 VAR(R_{k,t}^{\Delta y}) + VAR(v_{it}^{\Delta y}) \\ VAR(\pi_{it}) &= \hat{\beta}_i^2 VAR(W_t^{\pi}) + \hat{\kappa}_{j,k}^2 VAR(R_{k,t}^{\pi}) + VAR(v_{it}^{\pi}) \end{aligned}$$

Then variance of CPI inflation π and real GDP growth Δy due to the world factor is given as:

$$\frac{\hat{\gamma}_i^2 VAR(W_t^{\Delta y})}{\hat{\gamma}_i^2 VAR(W_t^{\Delta y}) + \hat{\mu}_{j,k}^2 VAR(R_{k,t}^{\Delta y}) + VAR(v_{it}^{\Delta y})} \text{ and } \frac{\hat{\beta}_i^2 VAR(W_t^{\pi})}{\hat{\beta}_i^2 VAR(W_t^{\pi}) + \hat{\kappa}_{j,k}^2 VAR(R_{k,t}^{\pi}) + VAR(v_{it}^{\pi})} \quad (6)$$

Similarly, the variance due to the regional factor is given by:

$$\frac{\mu_{j,k}^2 VAR(R_{k,t}^{\Delta y})}{\hat{\gamma}_i^2 VAR(W_t^{\Delta y}) + \hat{\mu}_{j,k}^2 VAR(R_{k,t}^{\Delta y}) + VAR(v_{it}^{\Delta y})} \text{ and } \frac{\kappa_{j,k}^2 VAR(R_{k,t}^{\pi})}{\hat{\beta}_i^2 VAR(W_t^{\pi}) + \hat{\kappa}_{j,k}^2 VAR(R_{k,t}^{\pi}) + VAR(v_{it}^{\pi})} \tag{7}$$

We use estimates of the unconditional variance of the factors W_t and $R_{k,t}$ and the idiosyncratic term v_{it} to evaluate these expressions. To summarize our results effectively, we follow Kose, Otrok and Prasad (2008) and report, for each region and sub-sample, the average variance share based on either (6) or (7) computed across all countries that belong to the same region. The results of the variance decomposition for each country are reported in the appendix.

4.1 Output growth

In the top (bottom) panel of figure 3, we report the variance share due to the world (regional) factor averaged across all countries in each region. Table 4 in the appendix reports the full set of results for all countries in our panel. Different histograms represent different sub-samples, which range from the 1860-1914 (darkest colour) to 1985-2007 (the lightest colour). No regular pattern emerges over time for the world factor, whose contribution appears relatively stable. Global comovements never explain, on average, more than 25% of business cycle fluctuations and over the full sample they account, on average, for about 10%. In all regions but North America and Oceania, the contribution of the world factor has decreased over the post-WWII period. With the same exceptions, the average variance share due to the global factor in the latest sub-sample is significantly smaller than the average variance share in the pre-1914 period.

The most interesting actions in figure 3 occur in the bottom panel, which displays the average contributions of the regional factor to the variance of output growth. Four results stand out. First, with the exception of the very first sub-sample, the regional contribution to business cycle fluctuations have always been above 25%, and in the post-1984 period always above 50% Today, the average regional contributions are 80% in Europe and South America, 50% in North America and 83% in Asia and Oceania. Second, in all regions, the average contributions during the first globalization wave of the pre-1914 period have been significantly lower than the average regional contributions during the latest globalization wave of the post-1984 sample. Third, the average variance shares accounted by the regional factor have typically increased over time. Fourth, in virtually all periods and regions the regional contributions to business cycle fluctuations have been higher than the world contributions in the top panel.

Altogether, the results of this section support the notion of a decoupling of business cycles across the world. Similarities in the growth rates of output are increasing among countries that belong to the same region (bottom panel of figure 3) but they are either decreasing or remaining small across countries that belong to different regions (top panel of figure 3). These results complement the evidence in Kose, Otrok and Prasad (2008), who reach a similar conclusion using a data set with a smaller time series dimension but a larger cross section.

4.2 Inflation

Based on the formulas in (6) and (7), in figure 4 we report the average contribution to inflation variance coming from the world factor (top panel) and the regional factor (bottom panel), which are the regional average counterparts of table 5 in the appendix. Over the post-WWII period, the contributions of the world factor have increased in all regions but Oceania becoming in Europe (South America) as large as twice (three times) the values over the pre-1984 period. International comovements explain about 40% of fluctuations in Canada and United States, and 25% in Europe and South America. In all regions but Asia the latest sub-sample is characterized by an average variance share due to the global factor that is higher than the average variance share in the pre-1914 period. This is in contrast to the finding for output growth variance where the largest contributions from the world factor were associated to the earliest sub-sample.

The bottom panel in figure 4 presents the average contributions of the regional factor. International comovements within regions are very important also for inflation. With the exception of Europe and North America in the very first sub-sample, the regional contributions to inflation variation have always been above 25%. Today, these contributions range, on average, from 42% in North America to 84% in Asia. In most regions, the average portion of inflation variance accounted by international comovements within the region is lower that some time in the past, and in Europe and North America it has even decreased over the post-WWII era.

The findings from this section provide some tentative evidence of increasing similarities in the inflation rates across the world, as argued for instance by Ciccarelli and Mojon (2009) using a model with no regional factors. This conclusion, however, needs an important qualification: regional factors remain the main driving force behind movements in national inflation rates for most countries in our panel. Overall, the variance decomposition analysis reveals that the process of decoupling of national business cycles has been accompanied by an increase in the synchronisation of national inflation rates.

5 On the cyclical properties of prices

In an important contribution in international macroeconomics, Backus and Kehoe (1992) showed that for ten developed economies prices became counter-cyclical moving from the intra-wars to the post-WWII period. Ravn and Sola (1995) extended their result for the G4 until 1994. The goal of this section is twofold. First, we are interested in assessing the cyclical properties of prices for (i) a larger number of countries, including emerging and developing economies, and (ii) a longer period of time since the XIX^{th} century until 2007. Second, we wish to evaluate the extent to which any possible change in the price cyclicality can be attributed to international factors.

There are at least two reasons to suspect that the output growth-inflation correlation may have a significant international component. A number of authors, including Rogoff (2006), Bean (2006) and the reference therein, have argued that an increased competition from economies with a large supply of labour as well as migration may reduce the cyclical sensitivity of profit margins. Similarly, if it becomes increasingly easier to off-shore activities to economies with low wages, domestic workers have less of an incentive to push for higher wages when unemployment falls and employers are in a better position to resist such claims.

Another strand of the literature, exemplified by Gavin and Kydland (1999) in the real business cycle tradition and Ireland (2003) within the sticky price framework, has shown examples in which a relatively more (less) aggressive monetary response to inflation (output) generates a reduction in the countercyclicality of prices. To the extent that the wave of inflation targeting adoptions which begun around the end of the 1980s can be regarded as a change towards a more anti-inflationary policy stance across the world, then we would expect the cyclical properties of prices to have changed internationally over the post-WWII period.

In the top panel of figure 5, we report regional averages of the unconditional correlation between output growth and inflation.[3] The correlations behind these values are reported, for each country, in table 6 of the appendix. The Backus-Kehoe finding is apparent in most regions where prices switched from being pro-cyclical in the intra-wars period to

[3]Similar results are obtained using log differences and an HP filter with either $\lambda = 100$ as in Backus and Kehoe (1992) or $\lambda = 6.25$ as in Ravn and Uhlig (2002).

counter-cyclical over most of the post-WWII era. In Europe, table 6 reveals that 10 out of 18 countries had a similar experience, though this is masked in figure 5 by a few large negative values in some remaining economies. What is new relative to Backus and Kehoe (1992), at least to our knowledge, is the finding that prices have become significantly less countercyclical moving from the pre- to the post-1984 sample.

The bottom panel of figure 5 presents the output growth-inflation correlation due to external comovements, which are measured as the average of world and regional factors weighted by their variances. Table 7 in the appendix reports the full geographical decomposition for each country and sub-sample.[4]

The main result from the geographical decomposition is that a change in the contribution of external developments accounts for most of the post-WWII decline in the countercyclicality of prices in Europe, Oceania and South America, consistent with the view that increased competition in goods and labor markets may have changed the structure of the economy in these regions.

As for North America, the decline in the output growth-inflation correlations from the pre-1984 to the post-1984 period appears country-specific, consistent with the view that Volcker's appointment as Fed Chairman initiated a shift towards a more anti-inflationary monetary policy stance.

The results for Asia are more difficult to interpret as the geographical patterns of correlation for China, India and Japan display large swings in the contribution of the world factor (see table 7).

The overall picture from this section seems to point to external developments as the main driver of the lesser counter-cyclicality of prices across the world.

[4]These correlations are produced by simulating the value of GDP growth and inflation for each country under the assumption that either the world factor, regional factor or the country factor (idiosyncratic component) are the only driver of these series. The table reports the correlation coefficient using these counterfactual estimates of inflation and output.

6 Conclusions

In this paper, we have documented some empirical regularities in a long-run international panel of GDP growth and CPI inflation series. The main findings can be summarized as follows. There is strong evidence in favour of increasing similarities in the growth rates of output *within* regions but increasing differences *between* regions. This has been referred to in the literature as decoupling of international business cycles. There is some evidence of increasing similarities in the inflation rates of countries in different regions but this should be weighted against the finding that regional factors still account for the bulk of inflation (and output growth) fluctuations in most of the countries in our panel. The correlation between output growth and inflation has become less negative in the most recent past and the largest portion of the change can be attributed to international factors.

While the analysis in this paper has tried to establish a set of stylized facts for inflation and output growth, both across countries and over time, a few questions remain open. The finding of a significant role for regional factors in both real and nominal fluctuations, for instance, calls for further analyses on the sources of these geographical comovements. A sensible speculation is that the rise of intra-regional trade may account for a significant portion of the changes in international comovements.

It would be interesting to assess the extent to which our geographic decomposition between international and national factors could be squared with the classic economic decomposition between supply and demand shocks. The fact that the country-specific contributions to the output growth-inflation correlation were positive over most of our sample suggests that this may be an intriguing avenue for future research.

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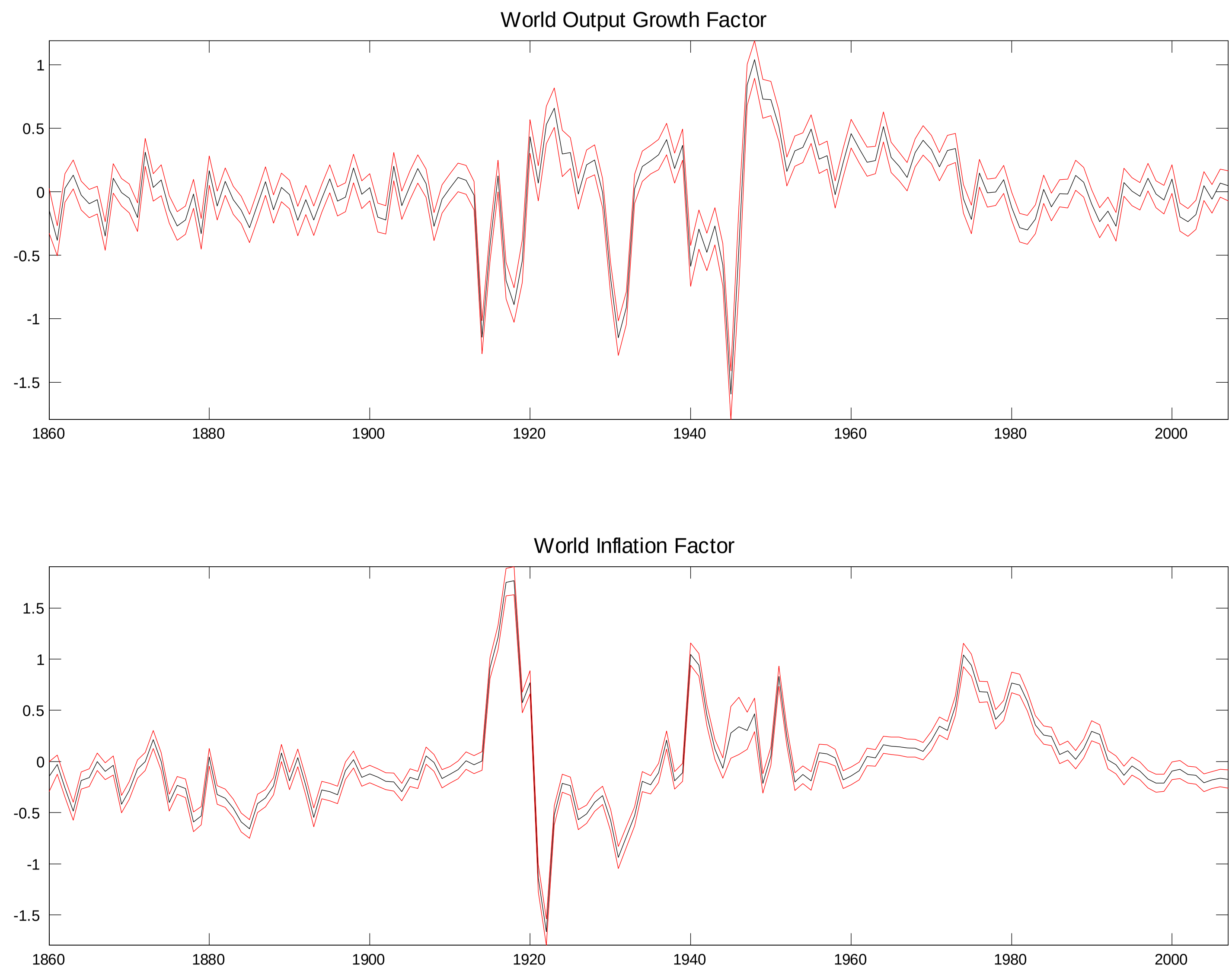
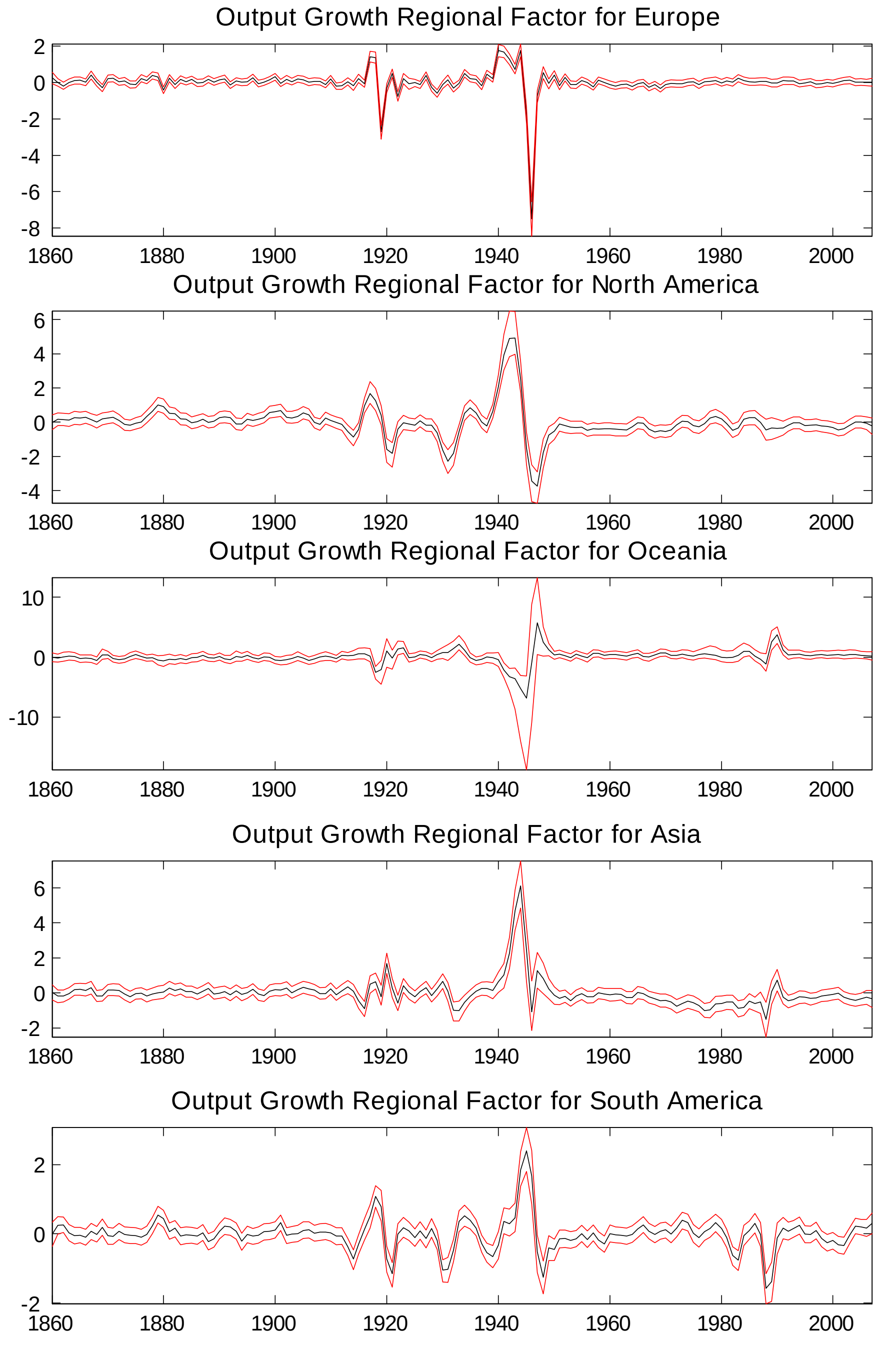


Figure 1: world factors for output growth and inflation (based on standardised data)



regional factors for output growth (standardised units)

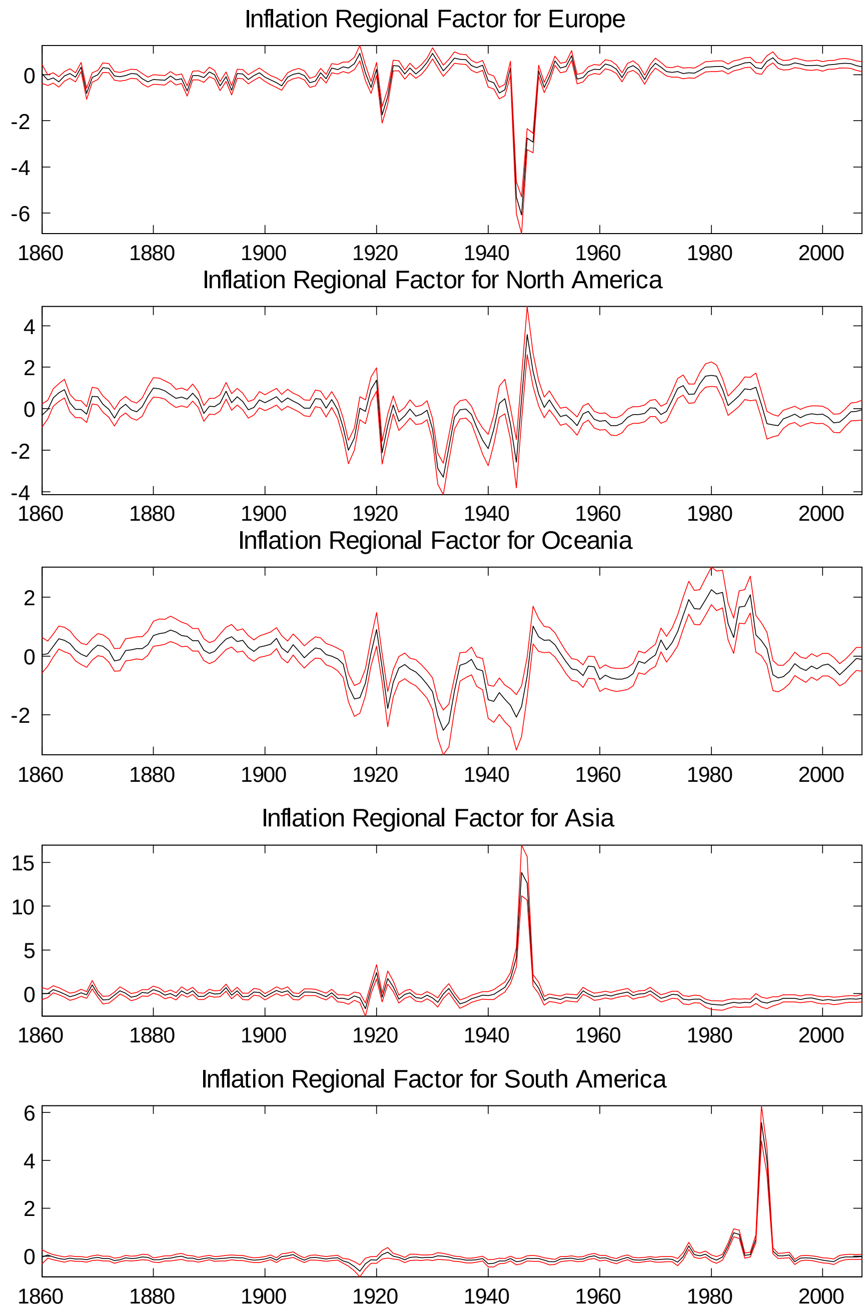


Figure 2: regional factors for inflation (standardised units)

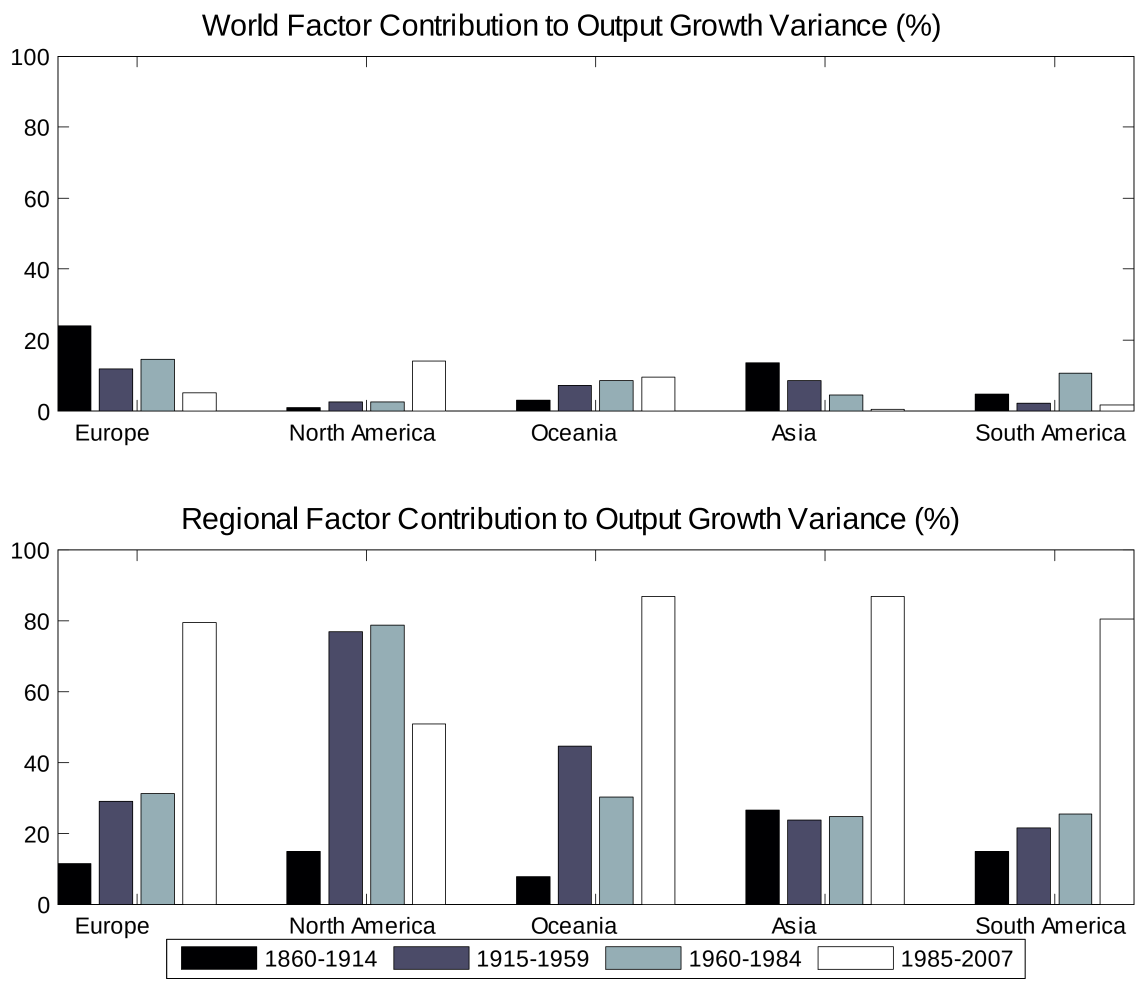


Figure 3: output growth variance decomposition (regional averages).

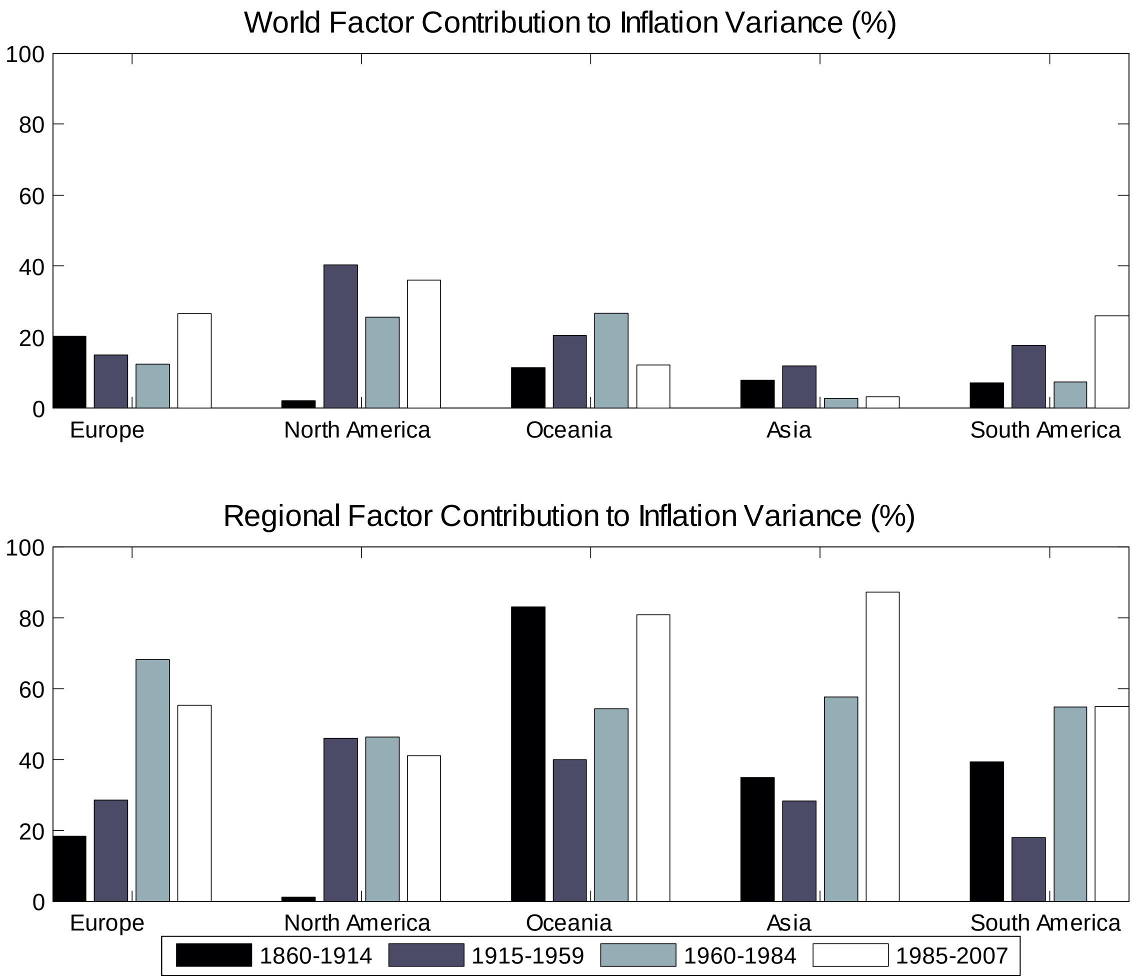


Figure 4: inflation variance decomposition (regional averages).

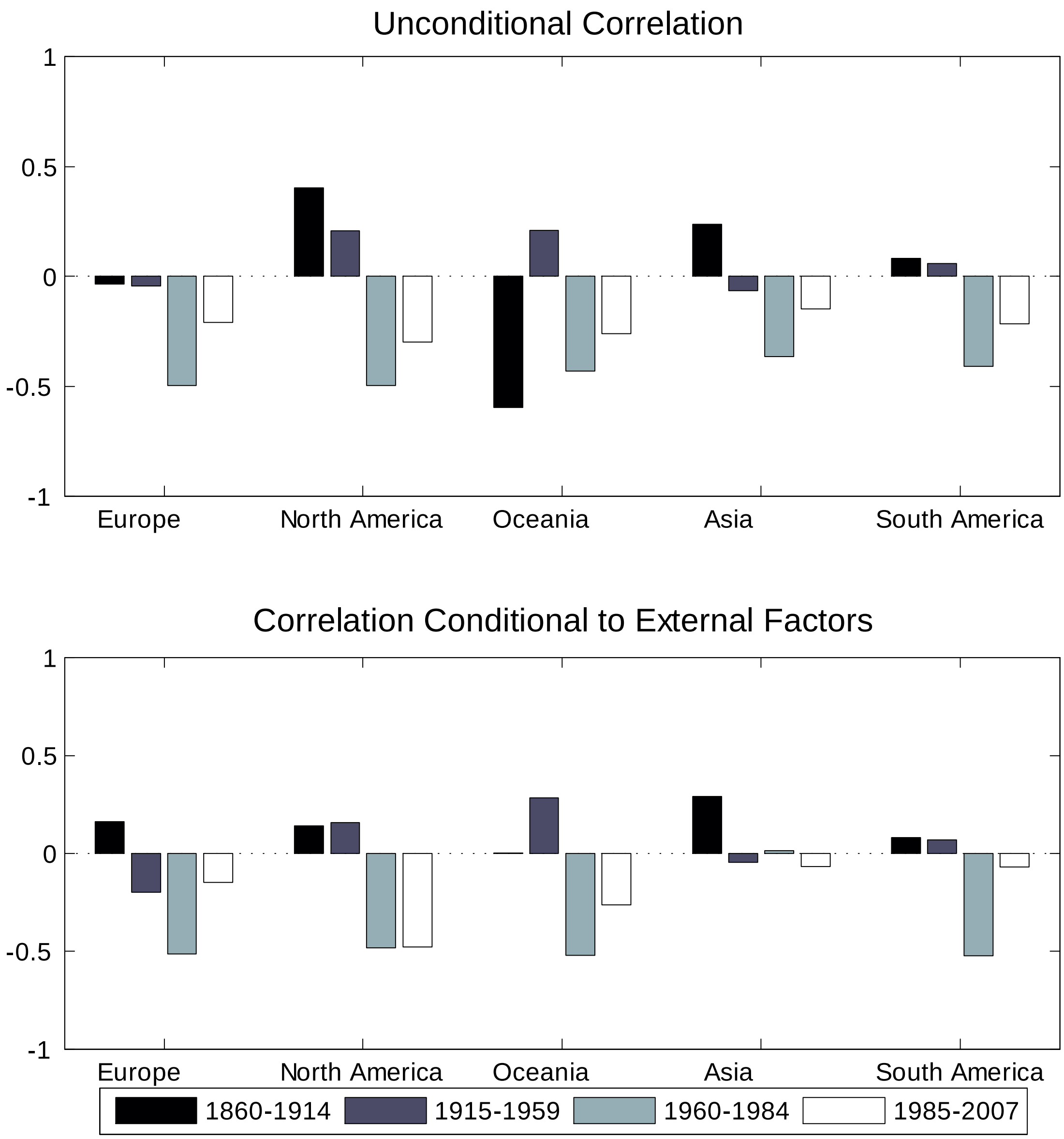


Figure 5: decomposition of the output growth-inflation correlation (regional averages).

Appendix: data and further results

This appendix describes the data, their sources and further results that have been used to construct some of the figures in the main text. Throughout the appendix, we will use the following abbreviations.

- MAD: Angus Maddisson, World Population, GDP and Per Capita GDP, 1-2003 AD at http://www.ggdc.net/maddison/.
- TED: Total Economy Database at http://www.ggdc.net/dseries/totecon.html.
- GFD: Global Financial Database at https://www.globalfinancialdata.com/.
- BoE: Bank of England.
- IFS: International Financial Statistics database available at http://www.imfstatistics.org/imf/imfbrowser.aspx?branch=ROOT
- Allen: Robert Allen, Wages, Prices & Living Standards: The World-Historical Perspective at http://www.economics.ox.ac.uk/members/robert.allen/WagesPrices.htm

All data are annual. GDP data are at 1990 prices, USD converted at Geary-Khamis PPPs. MAD data end in 2003 but cover longer samples than TED. So, TED data are only used to compute growth rates for the period 2003-2007, which are then applied to the level of the MAD series in 2003 to fill the observations for the remaining years.

As for notation, π is CPI inflation and Δy is real GDP growth. The letter $\mathbf{W}$ ($\mathbf{R}$) refers to the contribution of the world (regional) factor. For each region, table and sub-sample, we also report in bold the statistics of interest averaged across all countries belonging to that region. Table 1 presents the data and defines the regions of the world. Tables 2 and 3 show the world-region variance decomposition for output growth and inflation over four different sub-samples. Table 4 reports the evolution of the unconditional correlation between output growth and inflation. Table 5 decompose the latter into changes due to world and regional factors.

Table 1: list of countries, samples, variables and data sources

Country	*Full-sample*	*Variables and sources*	*Region*
Argentina	1901-2007	π (GFD), Δy (MAD+TED+IFS)	South America
Australia	1901-2007	π (GFD), Δy (MAD+TED)	Oceania
Austria	1871-2007	π (GFD), Δy (MAD+TED)	Europe
Belgium	1847-1913	π (Allen), Δy (MAD)	Europe
	1921-1939	π (GFD), Δy (MAD)	
	1947-2007	π (GFD), Δy (MAD+TED)	
Brazil	1871-2007	π (GFD), Δy (MAD+TED+IFS)	South America
Canada	1911-2007	π (GFD), Δy (MAD+TED)	North America
Chile	1925-2007	π (GFD), Δy (MAD+TED)	South America
China	1930-1938	π (GFD), Δy (MAD)	Asia
	1979-2007	π (GFD), Δy (TED)	
Columbia	1910-2007	π (GFD), Δy (MAD+TED+IFS)	South America
Denmark	1864-2007	π (GFD), Δy (MAD+TED)	Europe
Finland	1921-2007	π (GFD), Δy (MAD+TED)	Europe
France	1840-2007	π (GFD), Δy (MAD+TED)	Europe
Germany	1854-2007	π (GFD), Δy (MAD+TED)	Europe
Greece	1923-2007	π (GFD), Δy (MAD+TED)	Europe
Hungary	1925-1942	π (GFD), Δy (MAD)	Europe
	1951-2007	π (GFD), Δy (TED)	
India	1884-2007	π (GFD), Δy (MAD+TED)	Asia
Ireland	1923-2007	π (GFD), Δy (MAD+TED)	Europe
Italy	1861-2007	π (GFD), Δy (MAD+TED)	Europe
Japan	1882-2007	π (GFD), Δy (MAD+TED)	Asia
Mexico	1901-1913	π (GFD), Δy (MAD)	South America
	1919-2007	π (GFD), Δy (MAD+TED)	
Netherlands	1880-2007	π (GFD), Δy (MAD+TED)	Europe
New Zealand	1916-2007	π (GFD), Δy (MAD+TED)	Oceania
Norway	1831-2007	π (GFD), Δy (MAD+TED)	Europe
Peru	1901-2007	π (GFD), Δy (MAD+TED+IFS)	South America
Phillipines	1903-1940	π (GFD), Δy (MAD)	Asia
	1951-2006	π (GFD), Δy (TED)	
Poland	1930-1938	π (GFD), Δy (MAD)	Europe
	1951-2007	π (GFD), Δy (TED)	
Portugal	1931-2006	π (GFD), Δy (MAD+TED)	Europe
Spain	1914-2007	π (GFD), Δy (MAD+TED)	Europe
Sweden	1856-2007	π (GFD), Δy (MAD+TED)	Europe
Switzerland	1880-2007	π (GFD), Δy (MAD+TED)	Europe
Taiwan	1913-2007	π (GFD), Δy (MAD+TED)	Asia
Turkey	1924-2007	π (GFD), Δy (MAD+TED)	Asia
United Kingdom	1870-2007	π (GFD), Δy (MAD+TED)	Europe
United States	1871-2007	π (GFD), Δy (MAD+TED)	North America
Uruguay	1871-2007	π (GFD), Δy (MAD+TED+IFS)	South America
Venezuela	1914-2007	π (GFD), Δy (MAD+TED+IFS)	South America

Table 2: averages of output growth and inflation rates (%)

	1860-1914		1915-1959		1960-1984		1985-2007	
	ΔY	π	ΔY	π	ΔY	π	ΔY	π
Austria	1.92	0.20	1.93	26.31	3.60	4.87	2.45	2.19
Belgium	1.90	1.71	1.59	2.79	3.48	5.42	2.19	2.02
Denmark	2.66	0.29	2.78	3.51	3.11	7.73	1.88	2.62
Finland	2.40	na	3.35	7.67	3.81	7.93	2.25	2.64
France	1.19	0.30	2.04	11.95	3.84	7.16	2.25	2.10
Germany	2.28	1.07	2.25	12.11	3.01	3.83	1.63	1.82
Greece	na	na	2.18	9.76	4.90	9.60	2.57	9.94
Ireland	na	na	1.00	2.43	4.04	9.46	6.00	2.99
Italy	1.74	0.39	2.21	13.83	4.01	9.34	1.83	4.03
Netherlands	2.08	-0.25	2.85	2.81	3.39	5.44	2.52	2.07
Norway	2.25	0.33	3.05	3.00	4.06	6.75	2.78	3.34
Portugal	1.42	na	2.79	2.49	4.57	12.25	3.14	6.24
Spain	1.40	na	1.81	5.54	5.67	10.47	3.35	4.39
Sweden	2.04	0.40	2.90	2.79	2.98	6.82	1.98	3.29
Switzerland	2.46	0.07	3.00	1.78	2.59	4.12	1.38	1.88
Hungary	na	na	4.17	-0.78	2.81	3.32	0.75	14.67
Poland	na	2.13	2.97	36.70	3.27	7.22	1.89	36.74
United Kingdom	0.02	0.00	0.01	0.02	0.02	0.08	0.03	0.03
Europe	**1.84**	**0.55**	**2.38**	**8.04**	**3.51**	**6.77**	**2.27**	**5.72**
Canada	3.70	2.47	3.40	2.07	4.15	5.67	2.75	2.72
United States	3.59	1.00	3.19	2.41	3.51	5.23	2.97	2.98
North America	**3.64**	**1.73**	**3.30**	**2.24**	**3.83**	**5.45**	**2.86**	**2.85**
Australia	3.46	2.00	2.91	3.00	3.92	6.57	3.48	3.89
New Zealand	4.28	na	3.01	2.35	2.90	8.21	2.36	3.84
Oceania	**3.87**	**2.00**	**2.96**	**2.67**	**3.41**	**7.39**	**2.92**	**3.86**
China	na	na	3.75	50.78	4.95	3.02	7.53	6.53
India	1.29	0.51	0.85	2.63	3.64	7.28	5.69	7.72
Japan	2.29	2.23	3.35	12.42	6.47	6.40	2.09	0.72
Philippines	4.80	0.41	6.07	-0.98	4.45	10.97	3.54	6.86
Taiwan	3.50	3.79	4.00	31.24	9.10	6.32	5.07	1.99
Turkey	na	na	5.08	5.51	5.14	19.12	3.86	48.90
Asia	**2.97**	**1.73**	**3.85**	**16.93**	**5.62**	**8.85**	**4.63**	**12.12**
Argentina	5.00	1.18	3.18	8.03	2.80	4.72	1.94	63.05
Brazil	2.26	1.03	4.68	9.04	5.49	42.01	2.25	42.65
Chile	2.89	7.71	2.89	13.00	2.54	-9.00	5.77	10.40
Colombia	3.33	2.73	4.14	5.60	4.70	15.66	2.99	17.48
Mexico	2.42	2.33	3.31	5.53	5.56	15.41	2.46	24.90
Peru	4.58	2.05	3.84	5.81	3.60	25.32	2.35	15.96
Uruguay	3.34	0.64	3.12	4.33	1.14	40.92	1.77	-42.02
Venezuela	2.03	na	7.35	1.94	2.80	24.86	0.96	6.39
South America	**3.23**	**2.52**	**4.06**	**6.66**	**3.58**	**19.99**	**2.56**	**17.35**

Table 3: standard deviations of output growth and inflation rates

	1860-1914		**1915-1959**		**1960-1984**		**1985-2007**	
	ΔY	π	ΔY	π	ΔY	π	ΔY	π
Austria	3.82	2.75	15.80	60.76	2.15	1.82	1.16	0.94
Belgium	1.69	9.24	6.78	8.12	2.27	2.91	1.32	0.76
Denmark	1.93	4.01	5.72	7.55	2.54	2.71	1.48	0.93
Finland	3.68	na	6.32	12.67	2.51	3.99	3.34	1.77
France	4.78	1.45	11.45	15.34	1.94	3.44	1.32	0.85
Germany	3.46	5.09	15.35	411.25	2.00	1.60	1.81	1.32
Greece	na	na	11.18	527.58	3.60	8.09	1.88	6.01
Ireland	na	na	2.12	4.64	2.11	5.32	3.04	1.18
Italy	3.94	3.66	8.80	26.09	2.68	6.05	1.18	1.54
Netherlands	2.81	3.65	11.67	6.38	2.38	2.28	1.40	1.17
Norway	2.14	3.62	5.65	9.44	1.53	3.00	1.50	2.02
Portugal	2.28	na	5.59	5.32	3.57	8.42	2.44	3.69
Spain	4.59	na	5.85	8.24	3.24	5.16	1.66	1.77
Sweden	3.08	3.58	3.95	8.82	2.00	3.07	1.90	2.88
Switzerland	5.54	2.64	5.48	7.42	3.08	2.17	1.51	1.68
Hungary	na	na	6.31	1133.60	2.16	2.78	4.55	7.39
Poland	na	9.03	6.38	113.73	3.61	12.62	4.53	51.57
United Kingdom	2.11	4.25	4.30	7.09	1.94	5.26	1.63	1.91
Europe	**3.28**	**4.41**	**7.70**	**131.89**	**2.52**	**4.48**	**2.09**	**4.97**
Canada	5.17	1.52	6.92	6.07	2.19	3.34	1.93	1.49
United States	4.83	4.46	7.94	6.41	2.46	3.33	1.28	1.04
North America	**5.00**	**2.99**	**7.43**	**6.24**	**2.33**	**3.34**	**1.60**	**1.26**
Australia	5.56	3.94	4.32	5.51	2.18	4.25	1.26	2.69
New Zealand	5.56	na	6.42	5.12	3.64	4.80	2.18	3.94
Oceania	**5.56**	**3.94**	**5.37**	**5.32**	**2.91**	**4.52**	**1.72**	**3.31**
China	na	na	5.36	69.18	6.67	3.17	3.99	7.27
India	5.69	5.09	5.18	9.99	3.62	6.33	1.99	2.93
Japan	4.91	18.78	12.30	32.73	3.67	3.91	2.01	1.44
Philippines	8.48	13.22	7.12	21.45	2.97	49.18	2.18	3.67
Taiwan	2.62	5.26	11.66	75.30	4.12	8.19	3.19	1.71
Turkey	na	na	9.00	12.58	2.93	17.02	5.13	13.18
Asia	**5.42**	**10.59**	**8.44**	**36.87**	**4.00**	**14.64**	**3.08**	**5.03**
Argentina	6.41	10.39	5.28	16.06	4.34	257.08	6.14	106.85
Brazil	5.28	7.54	4.17	8.18	4.11	24.14	2.75	320.91
Chile	5.43	0.00	10.38	14.34	6.46	262.86	2.96	6.64
Colombia	2.66	16.03	3.04	11.29	1.82	7.02	2.43	6.73
Mexico	4.77	8.82	4.86	11.99	3.15	17.92	3.35	24.21
Peru	2.58	11.96	4.82	7.81	4.72	22.75	6.50	205.60
Uruguay	9.67	9.38	7.56	7.67	4.09	18.93	4.90	322.84
Venezuela	7.03	na	9.24	8.38	3.73	93.03	5.96	110.12
South America	**5.48**	**9.16**	**6.17**	**10.72**	**4.05**	**87.97**	**4.37**	**137.99**

Table 4: output growth variance decomposition (%)

	1860-1914		**1915-1959**		**1960-1984**		**1985-2007**	
	W	**R**	**W**	**R**	**W**	**R**	**W**	**R**
Austria	3.08	39.04	4.21	2.82	20.38	34.20	1.05	96.42
Belgium	25.06	34.63	1.13	84.05	55.59	11.10	0.07	98.80
Denmark	4.19	6.55	0.79	49.14	4.58	38.04	0.17	95.24
Finland	2.48	14.76	7.14	63.98	34.12	4.59	18.50	70.78
France	9.17	11.74	17.73	73.93	6.07	85.12	0.12	98.95
Germany	8.75	53.14	13.36	5.43	32.29	26.78	0.70	98.76
Greece	90.11	5.99	41.79	29.74	4.32	24.54	1.20	47.15
Ireland	90.21	5.73	1.01	1.79	1.84	7.92	3.93	51.47
Italy	0.41	1.81	65.76	1.09	1.21	78.21	0.10	98.47
Netherlands	0.45	7.09	45.20	32.65	37.54	23.91	0.31	91.55
Norway	0.58	1.46	5.94	50.68	6.13	5.83	1.73	58.20
Portugal	0.44	4.20	0.68	9.94	4.27	60.01	0.50	90.96
Spain	1.23	3.82	1.00	1.89	2.54	47.36	0.13	96.41
Sweden	13.18	3.89	1.54	46.67	34.48	8.57	3.22	93.78
Switzerland	2.69	1.74	1.20	30.45	2.41	36.68	0.30	96.58
Hungary	90.16	5.80	1.35	14.93	2.59	37.16	43.24	25.94
Poland	90.73	5.91	2.07	22.78	1.98	3.97	2.57	49.61
United Kingdom	0.14	1.53	1.45	0.69	8.72	27.99	13.29	72.69
Europe	**24.06**	**11.60**	**11.85**	**29.04**	**14.50**	**31.22**	**5.06**	**79.54**
Canada	0.62	16.96	5.07	74.80	3.94	78.66	1.91	97.14
United States	1.24	12.89	0.04	78.85	1.08	79.07	26.15	4.57
North America	**0.93**	**14.92**	**2.56**	**76.83**	**2.51**	**78.86**	**14.03**	**50.86**
Australia	0.53	3.59	0.63	82.82	18.19	28.69	8.58	77.48
New Zealand	5.54	12.13	2.27	6.43	2.57	31.82	1.32	96.26
Oceania	**3.04**	**7.86**	**1.45**	**44.62**	**10.38**	**30.25**	**4.95**	**86.87**
China	35.60	43.77	1.23	14.65	1.63	22.57	1.15	57.83
India	4.89	54.80	8.39	65.70	1.29	9.81	0.65	96.59
Japan	0.57	0.84	2.81	23.86	16.60	14.65	0.04	99.65
Philippines	0.85	13.24	9.12	12.72	1.53	87.71	0.31	99.35
Taiwan	4.14	2.60	8.99	20.56	2.78	7.79	0.43	79.04
Turkey	35.70	43.80	20.96	5.15	3.21	6.25	0.19	89.04
Asia	**13.62**	**26.51**	**8.58**	**23.77**	**4.51**	**24.80**	**0.46**	**86.92**
Argentina	19.24	29.14	2.27	10.16	31.95	4.94	0.43	97.87
Brazil	1.53	11.08	0.94	13.05	15.21	9.77	3.84	78.13
Chile	1.06	2.45	0.99	31.65	0.52	79.90	0.93	75.86
Colombia	11.21	31.20	5.10	11.26	5.52	59.24	0.62	80.89
Mexico	0.29	25.30	0.90	10.95	8.56	17.03	0.76	74.90
Peru	2.00	10.88	0.66	71.39	5.07	10.35	6.10	44.18
Uruguay	0.63	0.73	1.59	11.84	1.45	17.81	0.11	99.72
Venezuela	2.21	8.94	5.11	12.60	16.84	5.26	0.52	92.58
South America	**4.77**	**14.97**	**2.20**	**21.61**	**10.64**	**25.54**	**1.66**	**80.52**

Table 5: inflation variance decomposition (%)

	1860-1914		**1915-1959**		**1960-1984**		**1985-2007**	
	W	**R**	**W**	**R**	**W**	**R**	**W**	**R**
Austria	6.47	12.91	1.35	16.89	1.80	94.62	2.88	95.47
Belgium	28.64	4.51	22.77	11.98	4.92	91.61	4.67	91.00
Denmark	0.25	7.29	9.23	42.77	22.49	40.43	5.45	78.51
Finland	0.28	96.16	33.02	4.29	5.73	88.49	21.76	55.09
France	0.64	1.78	76.31	6.16	41.95	43.45	58.69	26.32
Germany	0.39	16.92	0.86	1.92	5.62	84.71	0.50	97.48
Greece	80.94	13.22	30.42	5.37	16.37	31.42	17.57	50.32
Ireland	81.12	13.23	8.71	12.07	4.80	91.75	4.00	41.55
Italy	0.29	13.13	3.98	23.41	45.74	47.32	37.88	55.05
Netherlands	2.94	7.22	26.32	24.96	0.42	98.37	0.31	95.32
Norway	0.23	2.75	6.49	72.81	12.09	69.09	23.11	60.67
Portugal	1.91	94.17	3.58	6.43	12.51	72.89	74.57	19.88
Spain	75.16	18.88	7.25	24.97	11.93	58.32	64.98	19.26
Sweden	0.31	2.64	10.57	81.21	16.11	70.10	67.63	19.67
Switzerland	0.86	1.52	10.68	79.56	8.42	38.23	20.95	73.56
Hungary	80.93	13.14	1.14	11.31	3.89	74.15	3.63	21.46
Poland	3.35	3.09	0.70	22.78	1.59	44.53	1.57	77.23
United Kingdom	0.04	8.50	14.95	64.41	5.46	88.14	69.36	18.40
Europe	**20.26**	**18.39**	**14.91**	**28.52**	**12.32**	**68.20**	**26.64**	**55.35**
Canada	1.68	2.19	43.24	44.64	13.62	77.30	43.02	28.47
United States	2.45	0.37	37.34	47.45	37.64	15.61	28.94	53.65
North America	**2.06**	**1.28**	**40.29**	**46.05**	**25.63**	**46.45**	**35.98**	**41.06**
Australia	0.20	96.30	19.28	33.81	31.49	52.89	8.97	87.95
New Zealand	22.58	69.81	21.68	46.33	21.94	55.74	15.14	73.84
Oceania	**11.39**	**83.06**	**20.48**	**40.07**	**26.72**	**54.32**	**12.05**	**80.90**
China	21.98	65.17	39.35	8.35	4.50	22.07	1.80	88.48
India	0.73	58.10	13.67	48.80	1.53	86.98	1.75	92.70
Japan	1.27	8.12	13.20	10.66	2.14	87.61	7.08	91.05
Philippines	0.20	11.49	2.56	36.71	0.69	32.71	5.48	89.02
Taiwan	0.20	0.52	1.36	3.84	1.18	95.33	2.16	80.75
Turkey	22.14	65.57	0.55	61.38	5.97	20.96	0.58	81.43
Asia	**7.75**	**34.83**	**11.78**	**28.29**	**2.67**	**57.61**	**3.14**	**87.24**
Argentina	0.65	20.27	3.43	53.45	0.58	82.98	1.20	91.01
Brazil	1.18	62.17	3.89	25.52	0.32	81.00	6.45	72.63
Chile	5.60	87.62	1.56	4.57	7.98	12.48	77.82	15.51
Colombia	4.80	73.61	15.59	3.26	36.92	8.22	27.50	26.56
Mexico	0.95	2.96	9.77	0.81	1.98	85.72	3.20	91.35
Peru	0.49	20.39	53.30	4.54	0.36	97.38	3.80	61.53
Uruguay	0.39	1.37	7.79	51.28	2.32	15.38	87.30	3.78
Venezuela	42.54	45.70	45.29	1.04	8.10	55.09	1.12	77.39
South America	**7.08**	**39.26**	**17.58**	**18.06**	**7.32**	**54.78**	**26.05**	**54.97**

Table 6: unconditional correlation between output growth and inflation

	1860-1914	**1915-1959**	**1960-1984**	**1985-2007**
Austria	-0.01	0.10	-0.38	-0.03
Belgium	-0.26	0.20	-0.49	-0.25
Denmark	-0.33	-0.37	-0.66	-0.07
Finland	na	-0.10	-0.57	-0.13
France	-0.10	0.26	-0.76	-0.10
Germany	-0.06	-0.24	-0.52	-0.05
Greece	na	0.22	-0.79	-0.64
Ireland	na	-0.09	-0.17	-0.25
Italy	0.00	-0.46	-0.50	0.35
Netherlands	-0.07	0.00	-0.16	-0.09
Norway	0.29	-0.32	-0.43	-0.27
Portugal	na	0.00	-0.63	0.33
Spain	na	0.09	-0.52	-0.15
Sweden	0.15	-0.42	-0.74	-0.48
Switzerland	-0.22	-0.28	-0.30	-0.03
Hungary	na	0.14	-0.39	-0.73
Poland	na	0.33	-0.31	-0.73
United Kingdom	0.23	0.16	-0.59	-0.46
Europe	**-0.04**	**-0.04**	**-0.49**	**-0.21**
Canada	0.61	0.19	-0.49	-0.36
United States	0.20	0.22	-0.50	-0.23
North America	**0.40**	**0.21**	**-0.50**	**-0.30**
Australia	-0.60	0.27	-0.57	-0.10
New Zealand	na	0.15	-0.29	-0.42
Oceania	**-0.60**	**0.21**	**-0.43**	**-0.26**
China	na	-0.09	-0.54	0.00
India	-0.21	-0.14	0.06	-0.24
Japan	0.29	0.07	-0.40	0.32
Philippines	0.63	-0.01	-0.05	-0.75
Taiwan	na	0.07	-0.69	0.12
Turkey	na	-0.28	-0.57	-0.34
Asia	**0.24**	**-0.06**	**-0.36**	**-0.15**
Argentina	0.18	-0.22	-0.28	-0.37
Brazil	-0.42	0.23	-0.61	-0.29
Chile	na	-0.02	-0.43	0.19
Colombia	0.30	0.00	-0.38	0.01
Mexico	0.37	0.44	-0.72	-0.34
Peru	0.32	0.03	-0.57	-0.63
Uruguay	-0.27	-0.24	0.08	0.09
Venezuela	na	0.25	-0.35	-0.38
South America	**0.08**	**0.06**	**-0.41**	**-0.21**

Table 7: decomposition of the output growth-inflation correlation

	1860-1914		1915-1959		1960-1984		1985-2007	
	W	**R**	**W**	**R**	**W**	**R**	**W**	**R**
Austria	-0.42	0.06	-0.22	0.60	-0.67	-0.30	0.64	-0.35
Belgium	-0.42	-0.05	-0.23	-0.61	-0.68	-0.26	0.33	-0.35
Denmark	-0.41	0.05	0.19	-0.61	-0.68	-0.23	0.56	-0.33
Finland	na	na	-0.26	0.60	-0.68	0.02	-0.64	-0.33
France	-0.42	-0.01	0.26	0.61	-0.68	-0.09	-0.58	-0.26
Germany	-0.41	-0.07	0.20	-0.57	-0.68	-0.30	0.62	-0.35
Greece	na	na	0.26	-0.60	-0.67	-0.15	0.57	0.32
Ireland	na	na	-0.20	-0.58	-0.52	-0.15	-0.60	-0.28
Italy	0.34	-0.03	0.26	-0.58	0.34	0.08	0.56	-0.34
Netherlands	0.36	-0.06	0.26	-0.61	-0.63	-0.28	-0.48	-0.35
Norway	0.34	-0.02	0.26	-0.61	-0.67	0.12	-0.61	0.33
Portugal	na	na	-0.20	-0.60	-0.68	0.23	0.61	-0.29
Spain	na	na	0.20	-0.58	-0.66	0.12	0.49	0.25
Sweden	-0.41	-0.03	0.24	-0.61	-0.68	-0.14	-0.64	-0.28
Switzerland	-0.42	-0.01	0.22	-0.61	-0.67	-0.14	-0.57	-0.34
Hungary	na	na	0.18	-0.61	0.65	0.24	-0.55	0.18
Poland	na	na	0.16	-0.61	-0.43	0.00	-0.54	-0.34
United Kingdom	-0.42	-0.07	-0.23	-0.61	-0.68	-0.31	-0.64	0.35
Europe	**-0.21**	**-0.02**	**0.07**	**-0.40**	**-0.52**	**-0.09**	**-0.08**	**-0.15**
Canada	0.40	0.07	0.26	0.25	-0.68	-0.39	-0.64	-0.25
United States	0.42	0.03	0.26	0.25	-0.68	-0.38	-0.64	0.26
North America	**0.41**	**0.05**	**0.26**	**0.25**	**-0.68**	**-0.39**	**-0.64**	**0.00**
Australia	-0.39	-0.02	-0.21	0.48	-0.68	-0.26	-0.64	-0.09
New Zealand	na	na	0.25	0.47	-0.67	-0.21	-0.64	-0.10
Oceania	**-0.39**	**-0.02**	**0.02**	**0.47**	**-0.68**	**-0.24**	**-0.64**	**-0.09**
China		na	0.18	0.02	0.60	0.22	-0.53	0.12
India	-0.42	-0.40	-0.26	-0.02	0.57	-0.15	-0.63	-0.12
Japan	-0.41	0.31	0.24	0.02	-0.66	0.18	0.60	-0.12
Philippines	-0.37	-0.40	0.25	-0.03	-0.62	0.09	-0.64	-0.13
Taiwan	na	na	0.21	0.02	-0.66	-0.01	0.46	0.03
Turkey	na	na	0.19	-0.03	0.66	-0.07	-0.46	-0.11
Asia	**-0.40**	**-0.16**	**0.14**	**0.00**	**-0.02**	**0.04**	**-0.20**	**-0.05**
Argentina	0.42	0.15	0.25	0.00	0.60	0.21	0.52	-0.02
Brazil	-0.42	-0.15	0.19	0.00	-0.63	-0.45	-0.62	-0.02
Chile	na	na	0.22	0.00	0.59	-0.41	0.56	0.02
Colombia	-0.42	-0.15	0.25	0.01	-0.68	0.19	-0.56	0.02
Mexico	-0.36	-0.12	-0.21	0.00	-0.68	-0.45	-0.60	0.02
Peru	-0.41	-0.15	-0.18	0.00	-0.58	-0.42	-0.62	-0.02
Uruguay	-0.39	-0.01	0.24	0.00	-0.56	0.28	0.57	0.00
Venezuela	na	na	0.26	0.00	-0.68	-0.30	-0.51	-0.02
South America	**-0.26**	**-0.07**	**0.13**	**0.00**	**-0.33**	**-0.17**	**-0.16**	**0.00**