View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Research Papers in Economics

Research Division
Federal Reserve Bank of St. Louis
Working Paper Series

International Comovements in Inflation Rates and Country Characteristics

Christopher J. Neely
and
David E. Rapach

Working Paper 2008-025F
http://research.stlouisfed.org/wp/2008/2008-025.pdf

August 2008
Revised June 2011

FEDERAL RESERVE BANK OF ST. LOUIS
Research Division
P.O. Box 442
St. Louis, MO 63166

The views expressed are those of the individual authors and do not necessarily reflect official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve System, or the Board of Governors.

Federal Reserve Bank of St. Louis Working Papers are preliminary materials circulated to stimulate discussion and critical comment. References in publications to Federal Reserve Bank of St. Louis Working Papers (other than an acknowledgment that the writer has had access to unpublished material) should be cleared with the author or authors.

International Comovements in Inflation Rates and Country Characteristics

Christopher J. Neely*
Research Division
Federal Reserve Bank of St. Louis
neely@stls.frb.org

David E. Rapach
Department of Economics
Saint Louis University
rapachde@slu.edu

June 13, 2011

*Corresponding author. Send correspondence to Christopher J. Neely, Research Division, Federal Reserve Bank of St. Louis, P.O. Box 442, St. Louis, MO 63166-0442; phone: 314-444-8568; fax: 314-444-8731.

International Comovements in Inflation Rates and Country Characteristics

Abstract

Common shocks, similarities in central bank reaction functions, and international trade potentially produce common components in international inflation rates. This paper characterizes such links in international inflation rates with a dynamic latent factor model that decomposes 64 national inflation rates into world, regional, and idiosyncratic components. The world and regional components account for 35% and 16%, respectively, of annual inflation variability on average across countries, so that international influences together explain just over half of inflation variability. The importance of the world and regional components, however, differs substantially across countries. Economic policy choices and development measures strongly explain the cross-sectional variation in the relative importance of international influences. A subsample analysis reveals that the regional (world) factor increases in importance for a number of North American and European (Latin American and Asian) countries since 1980.

JEL classification: C32, E31, E52, F42

Keywords: Inflation; Dynamic latent factor model; Bayesian estimation; Policy choices; Development

1. Introduction

This paper investigates the extent to which international inflation rates move together and what factors influence regional and global comovements.[1] A variety of channels potentially link inflation rates in different countries. A fixed exchange rate system—for example, a unilateral peg, the Bretton Woods system, or the European Economic and Monetary Union (EMU)—requires participating countries to adopt similar monetary policies. Even in the absence of a *de jure* fixed exchange rate regime, a desire to stabilize exchanges rates can prompt central banks to mirror each other's policy shifts (Canzoneri and Gray, 1985; Calvo and Reinhart, 2002; Devereux and Engel, 2007). Common macroeconomic shocks, such as oil price shocks, also potentially link international inflation rates. The fact that central banks may respond similarly to common shocks amplifies such comovements (e.g., Henriksen et al., 2011). Even a macroeconomic shock that clearly originates in a particular country can spill over to other countries' inflation rates through international trade in goods and services and assets. In summary, a variety of macroeconomic shocks, as well as economic and political pressures for central banks to respond similarly to shocks, are capable of producing comovements in inflation rates across countries.

While such factors potentially create common fluctuations in national inflation rates, a given country's inflation rate can behave in a highly idiosyncratic manner if its central bank pursues monetary policies that substantially differ from those of the rest of the world. For example, countries that rely on seignorage to finance fiscal outlays will see domestic needs swamp foreign influences on inflation. Furthermore, political, cultural, demographic, and technological factors affect a country's openness and therefore the degree to which trade channels link its inflation rate to foreign rates.

Although theory suggests transmission channels for shocks to inflation rates, the extent to which countries' inflation rates move together is ultimately an empirical issue. We tackle this issue by applying a dynamic latent factor model to 64 national inflation rates over the postwar era (1951–2009). This approach models covariation among many variables in a unified framework, as a function of a small number of latent factors, rather than using pair-wise correlations and related techniques that are difficult to summarize. Kose et al. (2003, 2008), among others, have recently used dynamic latent factor models to study international comovements in real macroeconomic variables. We follow Kose et al. (2003, 2008) by estimating the model with Bayesian techniques.

[1] Economists widely accept Milton Friedman's famous dictum that "inflation is always and everywhere a monetary phenomenon." The maxim does not preclude non-monetary factors from having transitory effects on inflation (McCallum, 1990) or any factors from indirectly influencing inflation.

Our dynamic latent factor model relates national inflation rates to one world, seven regional, and 64 country-specific factors. The variance decompositions measure the extent to which world, regional, and country-specific components explain the variation in national inflation rates. The extent to which the world and regional factors explain a high proportion of inflation variability in many countries indicates the importance of international influences on national inflation rates.

Previewing our results, we find that international components significantly influence national inflation rates. The world factor explains 35% of annual inflation variability on average across the 64 countries, the regional factor explains 16% of inflation variability on average, and the country-specific component explains 49%. To put these figures in context, we also estimate a dynamic latent factor model for inflation rates in 18 U.S. metropolitan areas and find that the national factor explains 92% of inflation volatility on average across the 18 areas, while the regional and metropolitan-area components explain only 1% and 6%, respectively. Because the United States is a currency union, with very similar fiscal and regulatory environments, it is much more integrated than one could expect the global economic environment to be in the foreseeable future. Therefore, the importance of the U.S. national factor in metropolitan inflation rates provides an upper-bound benchmark against which to measure the maximal possible effect of global influences on national inflation rates.

While the world factor explains about a third of inflation variability on average across countries, its importance within that group varies substantially. For example, the world factor explains 83% of inflation variability in Canada but less than 10% of inflation volatility in a number of countries. Cross-sectional regression results imply that the world inflation factor more strongly influences developed economies with strong institutions, developed financial markets, low average inflation, and independent central banks.

To examine whether changes such as the end of the Bretton Woods system and/or monetary integration in Europe have affected the relative importance of world, regional, and country-specific factors in determining national inflation rates, we compare estimated factor models for the 1951–1979 and 1980–2009 subsamples. The relative importance of the factors is fairly stable over the two subsamples, although the regional (world) factor clearly increases in importance for a number of North American and European (Latin American and Asian) countries during the second subsample.

Our findings on the stability of sensitivity to international inflation influences contrast with those of Heathcote and Perri (2004) on real variables. Those authors document that real components—

employment, investment, consumption, output—of the U.S. business cycle became less correlated with those of the rest of the developed world over their 1972–1986 and 1986–2000 subsamples, despite increasing global financial integration. Heathcote and Perri (2004) create a model in which financial frictions limit risk sharing and rising country-specific risk increases financial integration. The authors conclude that a combination of increasing country-specific shocks and the endogenous response of financial globalization can explain the decline in real correlations. In contrast, the sensitivity of national inflation rates to international factors is broadly stable over our subsamples.

In characterizing and explaining countries' sensitivity to international factors, this paper has a very different goal than four other approximately contemporaneous papers that analyze factors in international inflation rates. Ciccarelli and Mojon (2010) look for a global component in 22 OECD inflation rates, finding a global factor that is useful for forecasting national inflation rates. Mumtaz and Surico (2011) consider inflation rates from eleven industrialized countries, concluding that inflation rates have become more similar and less predictable since the 1960s but that there has been no common trend in inflation persistence. Monacelli and Sala (2009) investigate factors in disaggregated price data for four OECD countries. Beck et al. (2009) investigate euro area and national factors in disaggregated price data and find that euro area effects account for approximately half of monthly price variation.

We emphasize that we are interested in measuring and explaining common fluctuations in international inflation rates around their long-run averages, but not in explaining the cross-sectional variation in the national long-run averages themselves. A sizable literature does explain long-run average inflation rates with country characteristics (e.g., Grilli et al., 1991; Cukierman et al., 1992; Romer, 1993; Lane, 1995; Campillo and Miron, 1997). Our paper complements this literature by measuring the sensitivity of fluctuations in national inflation rates to international influences. Further, we explain the cross-sectional variation in such sensitivities with national characteristics.

The rest of the paper is organized as follows. Section 2 describes the dynamic latent factor model and outlines how we estimate it. Section 3 presents factor model estimation results, including the variance decompositions. Section 4 reports cross-sectional regression results relating the variance decompositions to country characteristics. Section 5 reports results for a subsample analysis. Section 6 concludes.

2. Econometric methodology

The dynamic latent factor model is given by

$$y_{i,t} = \beta_i^w f_t^w + \beta_i^r f_{j,t}^r + \varepsilon_{i,t}, \tag{1}$$

where $y_{i,t}$ is the demeaned CPI inflation rate for country i ($i = 1,\ldots,N$) from year $t-1$ to t ($t = 1,\ldots,T$). The first factor, f_t^w, is common across all of the $N = 64$ national inflation rates we consider. The regional factors, $f_{j,t}^r$ ($j = 1,\ldots,J$), are common to the countries in each of $J = 7$ specific regions. The loadings, β_i^w and β_i^r, measure the responses of an individual country's inflation rate to changes in the world and regional factors, respectively. A higher β_i^w, for example, means that country i's inflation rate responds more strongly to the world inflation factor. Finally, $\varepsilon_{i,t}$ is the country-specific or idiosyncratic component of nation i's inflation rate, which captures purely national influences on inflation.

Because $\varepsilon_{i,t}$, f_t^w, and $f_{j,t}^r$ follow autoregressive (AR) processes, (1) is a *dynamic* latent factor model. Each idiosyncratic component follows an AR(p) process:

$$\varepsilon_{i,t} = \rho_{i,1}\varepsilon_{i,t-1} + \cdots + \rho_{i,p}\varepsilon_{i,t-p} + u_{i,t}, \tag{2}$$

where $u_{i,t} \sim N(0,\sigma_i^2)$ and $E(u_{i,t}u_{i,t-s}) = 0$ for $s \neq 0$. Similarly, AR(q) processes generate the world and regional factors:

$$f_t^w = \rho_1^w f_{t-1}^w + \cdots + \rho_q^w f_{t-q}^w + u_t^w, \tag{3}$$

$$f_{j,t}^r = \rho_{j,1}^r f_{j,t-1}^r + \cdots + \rho_{j,q}^r f_{j,t-q}^r + u_{j,t}^r \quad (j = 1,\ldots,J), \tag{4}$$

where $u_t^w \sim N(0,\sigma_w^2)$, $u_{j,t}^r \sim N(0,\sigma_{j,r}^2)$, and $E(u_t^w u_{t-s}^w) = E(u_{j,t}^r u_{j,t-s}^r) = 0$ for $s \neq 0$. As is standard in the literature, we assume that the shocks in (2)–(4) are uncorrelated contemporaneously and at all leads and lags, so that the world, regional, and country-specific factors are orthogonal. We set the orders of the AR processes, p and q, equal to two when estimating the dynamic factor model. Other non-zero values for p and q produce similar results.

We reiterate that the dynamic factor model attributes all of the comovements in national inflation rates to the world and regional factors, f_t^w and $f_{j,t}^r$, via the factor loadings, β_i^w and β_i^r. In the extreme, a country with $\beta_i^w = \beta_i^r = 0$ will thus have an inflation rate that is completely idiosyncratic ($y_{i,t} = \varepsilon_{i,t}$), displaying no covariation with other countries' inflation rates.

Neither the signs nor scales of the factors and factor loadings are separately identified in (1). For example, multiplying the world factor by -2 and the loadings on that factor by $-1/2$ would produce exactly the same model. To normalize the signs of the factors/loadings, we follow a strategy similar to Kose et al. (2003) and restrict the loading on the world factor for Barbados and the loadings on the regional factors for Barbados, Argentina, Austria, the Republic of the Congo, Hong Kong, Egypt, and Australia to be positive. We choose these representatives from the world and each of the seven regions—North America, Latin America, Europe, Africa, Asia, the Middle East, and Australasia—arbitrarily, as these countries are the first (alphabetically) in each group. To normalize the scales, we assume that each of the factor shock variances, σ_w^2 and $\sigma_{j,r}^2$ ($j = 1, \ldots, J$), is equal to one (Sargent and Sims, 1977; Stock and Watson, 1989, 1993). The sign and scale normalizations do not have any economic content and do not affect any economic inference. For example, the variance decompositions at the center of our analysis are invariant to these normalizations. The sign normalizations happen to provide convenient interpretations, however, as they make most of the means of the loading posterior distributions in Section 3 positive—62 of 64 and 47 of 64 for the world and regional loadings, respectively—implying that inflation rates are generally positively related to the factors.

The latent nature of the factors in (1) precludes the use of common regression methods to estimate the model. Instead, we follow Otrok and Whiteman (1998) and Kose et al. (2003, 2008) and use Bayesian techniques with data augmentation to estimate the model (Tanner and Wong, 1987). As pointed out by Kose et al. (2003), Bayesian procedures efficiently handle large cross sections of data and a large number of factors in dynamic factor models. Bayesian estimation entails simulating draws from the complete posterior distribution for the model parameters and factors by successively drawing from a series of conditional distributions using a Markov chain Monte Carlo (MCMC) procedure. Posterior distribution properties for the model parameters and factors are based on 200,000 MCMC replications after 20,000 burn-in replications.[2]

To implement Bayesian analysis, we use the following conjugate priors, which are similar to

[2]Otrok and Whiteman (1998) and Kose et al. (2003) detail the estimation procedure. In the MCMC algorithm, we enforce the sign normalizations described above by discarding draws of the factor loadings that do not satisfy the restrictions. In practice, inadmissible factor loadings are rarely drawn after the burn-in replications.

those used in Kose et al. (2003):

$$(\beta_i^w, \beta_i^r)' \sim N(0, I_2) \;\; (i = 1, \ldots, N), \tag{5}$$

$$(\rho_{i,1}, \ldots, \rho_{i,p})' \sim N[0, \text{diag}(1, 0.5, \ldots, 0.5^{p-1})] \;\; (i = 1, \ldots, N), \tag{6}$$

$$(\rho_1^w, \ldots, \rho_q^w)' \sim N[0, \text{diag}(1, 0.5, \ldots, 0.5^{q-1})], \tag{7}$$

$$(\rho_{j,1}^r, \ldots, \rho_{j,q}^r)' \sim N[0, \text{diag}(1, 0.5, \ldots, 0.5^{q-1})] \;\; (j = 1, \ldots, J), \tag{8}$$

$$\sigma_i^2 \sim IG(6, 0.001) \;\; (i = 1, \ldots, N), \tag{9}$$

where IG denotes the inverse-gamma distribution. These are relatively agnostic priors, and our results are not sensitive to reasonable perturbations of them. Equations (6)–(8) imply that the prior distributions for the AR parameters become more tightly centered on zero as the lag length increases, similar to the treatment of lagged coefficients in the "Minnesota Prior." The prior for the idiosyncratic shock variances is very diffuse [see (9)]; Otrok and Whiteman (1998) observe that the third and higher-order moments do not exist for this proper prior. Our prior information also assumes that the AR processes in (2)–(4) are stationary, implying that inflation rates are $I(0)$ processes. Ng and Perron (2001) unit root tests generally support this $I(0)$ assumption.[3]

We can measure the extent of global influences on domestic inflation by computing the world factor's contribution to the total variability in a country's inflation rate. This variance decomposition is straightforward to compute for orthogonal factors:

$$\theta_i^w = (\beta_i^w)^2 \text{var}(f_t^w)/\text{var}(y_{i,t}) \;\; (i = 1, \ldots, N), \tag{10}$$

where

$$\text{var}(y_{i,t}) = (\beta_i^w)^2 \text{var}(f_t^w) + (\beta_i^r)^2 \text{var}(f_{j,t}^r) + \text{var}(\varepsilon_{i,t}) \;\; (i = 1, \ldots, N), \tag{11}$$

and θ_i^w is the proportion of the total variability in country i's inflation rate attributable to the world factor. The relative magnitudes of θ_i^w and θ_j^w depend on both the factor loadings and relative inflation volatility in countries i and j. θ_i^r and θ_i^c (the proportions of the total variability in country i's inflation rate attributable to the regional factor and country factor, respectively) are defined similarly. Because θ_i^w, θ_i^r, and θ_i^c are functions of the model's parameters and data, the MCMC algorithm draws from the respective posterior distributions on each statistic for each replication for each country.[4]

[3]Complete unit root test results are available upon request from the authors. As with the sign normalizations, we enforce the stationarity restrictions by discarding draws of the AR parameters that do not satisfy the restrictions. Inadmissible AR parameters are again rarely drawn.

[4]As discussed in Kose et al. (2003, footnote 21), while the factors are uncorrelated in the dynamic latent factor

3. Dynamic latent factor model estimation results

This section summarizes the inflation data and presents results from Bayesian estimation of the dynamic latent factor model. We discuss the patterns in the time series of the world and regional factors, as well as the extent to which each of the factors explains national inflation rates through variance decompositions (θ_i^w, θ_i^r, and θ_i^c).[5]

3.1. Data

We use annual CPI data from Global Financial Data for 64 countries—all of the countries for which CPI data are continuously available for 1950–2009. We measure annual inflation as first differences in the log-levels of the CPI, which produces 59 inflation rate observations (1951–2009) for each country. The summary statistics in Table 1 show that Latin American countries as a group experienced the greatest inflation volatility, as well as the highest average inflation—by sizable margins—followed by Middle Eastern, African, and Asian countries.

We note that any regional grouping is, to some extent, subjective. For example, we group Barbados and Trinidad and Tobago with North America, rather than Latin America, because those countries are English-speaking. Likewise, we divide Africa at the Sahara, putting Arabic-speaking countries like Egypt and Tunisia in the Middle East group, rather than with sub-Saharan Africa. We observe two facts about our chosen regional grouping. First, given that the world and regional factors are orthogonal in the dynamic factor model, inferences concerning the world factor do not depend on the regional grouping; that is, we obtain the same f_t^w, β_i^w, and θ_i^w estimates for any regional grouping.[6] Second, we obtain similar results concerning the regional and country-specific factors for reasonable perturbations of the regional grouping.

While it is natural to define world and regional factors when analyzing international comovements in national macroeconomic variables, it would be, of course, also possible to consider additional factors relating to, for example, culture, fixed exchange rates, or trading blocs. To keep the model tractable, we do not consider additional factors in this version. As discussed above, in-

model, samples taken at each step of the Markov chain will not necessarily be uncorrelated due to sampling error. To ensure that θ_i^w, θ_i^r, and θ_i^c sum to one, we follow Kose et al. (2003) and orthogonalize the factors (using the world-region-country factor ordering) when computing the variance decompositions at each replication. Since the sample correlations are small, this has little influence on the results.

[5]The MATLAB code used to generate the Bayesian estimation results is available through David Rapach's website (http://pages.slu.edu/faculty/rapachde). The MATLAB code is based on GAUSS code kindly provided by Christopher Otrok through his website (http://people.virginia.edu/ cmo3h/code.html).

[6]This is subject to the caveat in footnote 4. We experimented with alternative groupings and confirmed that world factor inferences are nearly identical.

cluding these additional factors would not affect our inferences concerning the world and regional factors because all of the factors are orthogonal in the dynamic factor model.[7]

3.2. World and regional factors and loadings

Figure 1 depicts means and 0.05 and 0.95 quantiles for the posterior distributions for the world and regional factors, while Figures 2 and 3 show posterior properties for the loadings on the world and regional factors, respectively. The estimated world factor series in Figure 1, Panel A is naturally interpreted as a normalized index of global inflation. Observe that 62 of 64 posterior means of the loadings on the world factor are positive in Figure 2, so that the world factor is positively related to national inflation in nearly all countries. World inflation is low for most of the 1950s and 1960s, rises substantially in the early 1970s, stays high during the early 1980s, then decreases markedly in the late 1980s, and remains low thereafter. The world factor thus clearly supports a world-wide Great Inflation beginning in the 1970s and subsequent Great Disinflation during the 1980s. Ciccarelli and Mojon (2010) and Mumtaz and Surico (2011) use much smaller samples of industrialized countries and different estimation techniques to discover a similar pattern.[8] Panel A also shows a downturn in global inflation at the end of the sample, presumably due to the Global Financial Crisis and corresponding Great Recession.

Researchers have widely studied and debated the origins of the Great Inflation and the subsequent Great Disinflation, and they broadly agree that changing ideas on the objectives and scope of monetary policy were critical to the development of the episode. This literature has disproportionately emphasized the U.S. experience, despite the fact that the Great Inflation was a world-wide phenomenon. There is little doubt that the Federal Reserve failed to respond sufficiently to inflation in the 1960s and 1970s (e.g., Taylor, 1999), but there is disagreement over why the Fed failed to act. DeLong (1997) believes that the Great Depression left the Federal Reserve with no mandate to control inflation at the expense of unemployment. In contrast, Romer and Romer (2002) implicitly argue that the Fed used a fairly sophisticated but deeply flawed model that claimed to offer an exploitable inflation-unemployment tradeoff. Nelson (2005a, 2005b) and Nelson and Nikolov (2004) argue that "monetary neglect"—emphasis on non-monetary factors in inflation—largely explains the Great Inflation not only in the United States but also in Canada, Australia, New Zealand, and the United Kingdom.

[7]We leave a consideration of additional factors to future research. It would also be interesting to explore selecting regions endogenously, although this would substantially complicate estimation.

[8]Ciccarelli and Mojon (2010) and Mumtaz and Surico (2011) do not estimate regional factors.

Panels B–H of Figure 1 display the estimated regional factors.[9] Figure 3 shows that the loadings on the regional factor are positive for the North American countries, so that increases in the North America factor (Figure 1, Panel B) signal increases in regional inflation, above and beyond any changes due to the world factor. There is a notable uptick in the North America factor in the late 1960s—consistent with an attempt to exploit an inflation-unemployment tradeoff—and two more in the 1970s, which are coincident with oil shocks and the January 1978 appointment of G. William Miller as Federal Reserve Chair, who had strongly Keynesian expansionist views. It appears that central bank ideas strongly manifested themselves in North America.

The Latin America factor displays a strong upward trend during the 1980s, culminating in a substantial spike in 1990 (Figure 1, Panel C). The loadings on the regional factor in Latin America are positive for nearly all of the countries in this region (Figure 3), so that the increase in the Latin America factor from approximately 1980–1990 represents higher regional inflation (again apart from any changes due to the world factor). Panel A of Figure 4 depicts the inflation rate for the four Latin American countries—Argentina, Bolivia, Brazil, and Peru—-with the highest inflation rates during 1980–1995. (Note that the scale of Figure 4 is such that an inflation rate of 2 indicates 200% inflation.) The increase in the Latin America factor in the early 1980s primarily captures large increases in inflation in Bolivia, Argentina, and Brazil, while the very sharp increase in the factor in the late 1980s is chiefly driven by hyperinflation in Peru, Argentina, and Brazil.

It is interesting that Latin American inflation increased substantially in the 1980s, just as much of the world was disinflating. Conventional wisdom attributes the sharp increase in inflation to governments' reactions to the U.S. disinflation of the early 1980s. The disinflation produced high real dollar interest rates and thus an increasing burden in servicing U.S. dollar-denominated debt for many Latin American countries. This greatly increased the demand for seignorage revenue, as governments monetized the growing debt, generating inflation.[10] Expecting higher inflation, agents began substituting U.S. dollars for the local currency, further fueling inflation (Sargent et al., 2009). The popularity of "structuralist" economic philosophy also freed central banks from the belief that they ought to stabilize prices (Bernanke, 2005). Various "heterodox" disinflationary strategies in the mid 1980s failed to correct the underlying fiscal problems and were ultimately unsuccessful (Acemoglu et al., 2008). More successful measures—which often included fixed exchange rates and/or dollarization—did bring inflation down sharply from its 1990 peak in a

[9]Note that the scales for the panels in Figure 1 depend on the normalization and thus are not comparable across the factors.

[10]Cardoso (1989) clearly explains the usual problems and illustrates them by relating the Bolivian hyperinflation of the 1980s to the 1982 election of a leftist government.

number of Latin American countries. The estimated Latin America factor in Figure 1 displays the effects of these hyperinflationary episodes and subsequent reforms.

The Europe factor decreases from about the mid 1970s to the mid 1980s (Figure 1, Panel D), but the regional factor loadings in Figure 3 are inconsistently signed: positive for some European countries, such as Germany and France—Old Europe? (Rumsfeld, 2003)—and negative for many others. The decrease in the Europe factor from approximately 1973–1985 is thus associated with lower inflation in countries such as Germany and France but higher inflation in others. This suggests some differences in central bank behavior and responses to oil price shocks across groups of European countries during this period, despite exchange rate target zones such as the Snake and European Monetary System.

The Asia factor's most obvious feature is a big upward spike in the early 1970s, followed by a fairly substantial decrease (Figure 1, Panel F). Positive Asian regional factor loadings (Figure 3) indicate that the sharp rise and fall in the Asia factor unambiguously corresponds to a rise and fall in regional inflation. Panel B of Figure 4 depicts inflation in Indonesia, the Philippines, South Korea, and Thailand for 1970–1985. The behavior of these inflation rates is representative of that in other Asian countries during 1970–1985, indicating that the increase in inflation in the early 1970s was consistent and sizable throughout the region, with inflation increases in Indonesia and the Philippines especially prominent. While it is tempting to blame the Asian inflation of this period entirely on the first oil shock, the inflation appears to have started in 1971–1972, before the first oil price rise in the summer of 1973 and the bigger rise in late 1973.[11] In any case, the oil shock was a global phenomenon, but—if it was responsible for the uptick in the Asia factor—it apparently had an unusual effect in Asia. Monetary policy almost surely played a role, especially via exchange rate arrangements. For example, the 20% dollar depreciation from 1969–1973 likely exported some inflation to Asia through the fixed exchange rates of the Philippines, Indonesia, South Korea, Thailand, Sri Lanka (until 1972), and Singapore (until 1971). Contemporaneous writings on the Asian inflation of the early 1970s emphasize "structuralist" and supply-side explanations but are remarkably dismissive of the role of monetary policy in creating or restraining inflation.[12] Like Sherlock Holmes's dog-that-did-not-bark, the lack of attention to monetary factors helps to explain the inflationary episode.

[11]The Arab oil embargo began on October 17, 1973, in the wake of the Yom Kippur War.

[12]For example, Bautista (1974, p. 221) writes, "[T]here is very limited scope for the effectiveness of either monetary or wage restraint in remedying the current inflation problem. Indeed, it would be risking more harm than good...to adopt a general contractionary monetary policy which might only prejudice the need to accommodate structural readjustments in slowing down the inflation."

The Africa, Middle East, and Australasia factors in Panels E, G, and H, respectively, in Figure 1 do not display significant fluctuations. The dynamic latent factor model thus generally fails to detect significant comovements across inflation rates in the regions of Africa, the Middle East, and Australasia (after accounting for world-wide comovements in inflation).[13]

3.3. Variance decompositions

We turn next to the estimates of the variance decompositions, our key metric for assessing the strength of international comovements in national inflation rates. Figure 5 presents means and 0.05 and 0.95 quantiles for the posterior distributions for θ_i^w, θ_i^r, and θ_i^c. The 0.05 and 0.95 quantiles for the posterior distributions given by the black bars in Figure 5 show that θ_i^w is usually estimated fairly precisely, which gives us some confidence in our results. The fact that the dark and light gray bars in Figure 5 are usually longer than the black bars indicates that θ_i^r and θ_i^c are generally less precisely estimated than θ_i^w, but these decompositions are still reasonably precisely estimated for many countries. To summarize the results in Figure 5, Table 2 reports averages across various country groups of the means and quantiles portrayed in Figure 5. Table 2 shows that the average θ_i^w estimate across the 64 countries is 0.35, while the average θ_i^r (θ_i^c) estimate is 0.16 (0.49). World and regional shocks together thus account for just over half of inflation rate fluctuations in individual countries on average during 1951–2009, while country-specific shocks account for just under half.

Table 2 and Figure 5 reveal that the θ_i^w estimates vary substantially across regions and sometimes even within regions. North American countries have relatively high θ_i^w estimates, with an average of 0.65, indicating that the world factor plays a leading role in explaining North American inflation variability. Canada has the highest θ_i^w estimate, 0.83, in both North America and the 64 countries in the world-wide sample. The world factor accounts for 59% of inflation volatility across European countries, and this average is only below that of North America. Belgium, France, the United Kingdom, Ireland, Italy, and Sweden all have θ_i^w estimates above 0.70, while Greece, Malta, and the Netherlands have relatively low θ_i^w estimates, below 0.40. Similar to North America and Europe, the world factor accounts for a majority of inflation variability on average for the small, open economies of Australasia. The average of the θ_i^w estimates across the countries

[13] We omit complete results for the AR parameters in (2)–(4) for brevity. They are available upon request from the authors. The averages across all countries of the point estimates of $\rho_{i,1}$ and $\rho_{i,2}$ in (2) are 0.34 and 0.08, respectively. The world factor is estimated to be only moderately persistent, with ρ_1^w and ρ_2^w estimates of 0.16 and -0.06, respectively, while the Latin America and Europe factors display the most persistence among the regional factors.

of Australasia is 0.59, led by Australia with a value of 0.70.

The world factor only modestly influences inflation rates in most Latin American countries, where the average of the θ_i^w estimates is 0.10. Among Latin American countries, Chile has the highest θ_i^w estimate (0.35), while the other θ_i^w estimates are all equal to or less than 0.21, often substantially so. Chile's relatively long-standing monetary reforms might boost its sensitivity to the world factor. The world factor fails to account for most inflation variability in any African, Asian, or Middle Eastern nation, and the averages of the θ_i^w estimates for these regions are 0.25, 0.25, and 0.16, respectively. While these averages are relatively low, they vary substantially across countries. Indonesia, Iran, and Turkey all have very low θ_i^w estimates equal to or less than 0.01, while Mauritius, Hong Kong, Japan, Malaysia, and Singapore have much higher estimates above 0.40. Overall, the world factor explains a much lower portion of Latin American, Asian, African, and Middle Eastern inflation than it does for North America, Europe, and Australasia.

As we have observed, on average the regional factors explain only 16% of inflation volatility across all countries; 43 of the 64 θ_i^r estimates are less than or equal to 0.20, and 34 are less than or equal to 0.10. Some countries, however, exhibit sizable θ_i^r estimates. For example, the Latin America factor explains nearly half or more of inflation volatility in Argentina, Brazil, the Dominican Republic, Guatemala, and Peru. The high explanatory power for the Latin American regional factor contrasts with the low explanatory power of the global factor for that region. Among the Asian countries, the regional factor is most important for India, Malaysia, and Singapore, accounting for 35%–44% of inflation volatility. Given the efforts toward economic integration in Europe over the postwar period, culminating in the EMU, it is somewhat surprising that the average θ_i^r estimate across European countries is only 0.08; we discuss the importance of the Europe factor in more detail in Section 5.

The inflation variance decompositions in Table 2 and Figure 5 suggest that national inflation rates have reasonably strong international influences, with the world and regional factors explaining 35% and 16%, respectively, of the variability in a country's inflation rate on average. Global influences on inflation appear to be especially important for industrialized countries: The world factor alone explains nearly two-thirds or more of inflation variability for Canada, the United States, Belgium, France, the United Kingdom, Ireland, Italy, Luxembourg, Sweden, and Australia.[14]

[14]To allow for variation in the unconditional means of national inflation rates, we also estimated the dynamic latent factor model with HP-filtered inflation rates (with a smoothing parameter of ten for annual data) replacing demeaned inflation rates. We obtain qualitatively similar results, although the idiosyncratic factor becomes somewhat more important on average in explaining inflation variability at the expense of the world factor. Complete results are available upon request from the authors.

3.4. A benchmark for the variance decompositions

To construct a benchmark for the magnitudes of the θ_i^w estimates, we estimate a dynamic latent factor model for U.S. metropolitan area inflation rates that includes national, regional, and area-specific factors. As a common currency area with factor mobility, low internal barriers to trade, and similar legal systems and institutions across the country, U.S. metropolitan areas will exhibit strong common inflation trends, even with the geographical expanse of the United States. The explanatory power of a national factor for U.S. metropolitan area inflation rates provides an upper-bound benchmark for assessing the maximal values that one could reasonably expect for the θ_i^w estimates in Table 2 and Figure 5.

The dynamic latent factor model for U.S. metropolitan areas is similar to that for the international system:

$$y_{i,t}^{US} = \beta_i^{n,US} f_t^{n,US} + \beta_i^{r,US} f_{j,t}^{r,US} + \varepsilon_{i,t}^{US}, \tag{12}$$

where $y_{i,t}^{US}$ is the demeaned inflation rate for U.S. metropolitan area i in year t, $f_t^{n,US}$ is a national factor, $f_{j,t}^{r,US}$ is a regional factor common for one of four U.S. regions (Northeast, South, Midwest, and West), and $\varepsilon_{i,t}^{US}$ is an idiosyncratic shock. We again assume that the factors are mutually independent and follow AR processes. Section 2 describes how we estimate the model.

We use CPI data for 1950–2009 for 18 U.S. metropolitan areas—all available areas—from the U.S. Bureau of Labor Statistics, and inflation for 1951–2009 is computed as log-differences in the CPI. Each metropolitan area is associated with its U.S. Census Bureau region.[15] To conserve space, we omit complete estimation results for the U.S. metropolitan area model.[16] Most relevant for our purposes, the U.S. national factor explains a very high proportion of inflation variability for all metropolitan areas: The $\theta_i^{n,US}$ estimates range from 0.86–0.97, with an average of 0.92. These proportions are estimated very precisely according to the 0.05 and 0.95 quantiles, within one or two percentage points. The regional and area factors play limited roles, accounting for only 1% and 6%, respectively, of inflation variability on average across the metropolitan areas.

Comparing the $\theta_i^{n,US}$ estimates to the θ_i^w estimates in Figure 5, the $\theta_i^{n,US}$ estimates are, as expected, consistently higher. Nevertheless, the largest θ_i^w estimates for the international dynamic

[15]The 18 metropolitan areas and their regions are: New York-Northern New Jersey-Long Island, Philadelphia-Wilmington-Atlantic City, Boston-Brockton-Nashua, Pittsburgh (Northeast); Chicago-Gary-Kenosha, Cincinnati-Hamilton, Cleveland-Akron, Detroit-Ann Arbor-Flint, Kansas City, Milwaukee-Racine, Minneapolis-St. Paul, St. Louis (Midwest); Atlanta, Houston-Galveston-Brazoria (South); Los Angeles-Riverside-Orange County, Portland-Salem, San Francisco-Oakland-San Jose, Seattle-Tacoma-Bremerton (West).

[16]They are available upon request from the authors.

latent factor model (e.g., for Canada, Belgium, France, Italy, the United Kingdom, and Sweden) are not much less than the lowest of the $\theta_i^{n,US}$ estimates, and the world factor clearly explains most variability in North American, European, and Australasian inflation rates. The average θ_i^w estimate of 0.35, however, is far below the benchmark average estimate of $\theta_i^{n,US}$, which equals 0.92. As one would expect, global influences on inflation are much less important in an international context on average than are national influences in the U.S. domestic context.

4. Country characteristics

What characteristics explain a country's sensitivity to global or regional influences on inflation? We examine this systematically by relating the θ_i^w, θ_i^r, and θ_i^c estimates presented in Section 3 to a variety of country characteristics. Data limitations preclude us from exhaustively investigating the relation between country characteristics and international inflation influences. Nevertheless, we examine a number of potentially important characteristics that determine the extent to which world, regional, and country-specific factors affect a nation's inflation rate.

We consider eight explanatory variables that potentially influence a country's sensitivity to world, regional, and idiosyncratic inflation factors: (1) Sachs and Warner (1995) openness index; (2) Sachs and Warner (1997) index of institutional quality; (3) Beck et al. (2000) measure of liquid liabilities (financial development); (4) Penn World Tables government share of output; (5) Penn World Tables average real GDP per capita; (6) average inflation rate; (7) inflation volatility; (8) Cukierman et al. (1992) index of central bank independence. The appendix details these variables.

We expect openness, institutional quality, financial development, and real GDP per capita to be positively associated with the variance explained by the world factor, as countries with these characteristics tend to respond similarly to common shocks. In contrast, average inflation and inflation volatility are likely to be negatively associated with the world factor, because these characteristics signal a greater reliance on seignorage to finance fiscal needs. The signs of the theoretical relationships are less obvious for the government share and central bank independence. A greater government share could reflect a higher level of development or uncontrolled government spending, funded by monetization. An independent central bank might be associated with good institutions and high commonality with other central bank reaction functions, or it could mean that the central bank is concerned solely with maintaining domestic inflation, which could produce an inflation rate that covaries only weakly with international inflation trends.

To investigate the ability of country characteristics to explain sensitivity to international inflation influences, we regress the proportion of inflation variance explained by the world, regional, and idiosyncratic factors on the eight explanatory variables, both individually and jointly. The bivariate regression models are given by

$$\bar{\theta}_i^w = b_0 + b_k X_{k,i} + e_i^w, \tag{13}$$

where $\bar{\theta}_i^w$ is the point estimate (given by the posterior mean) of the proportion of the variance of country i ($i = 1, \ldots, 64$) that the world factor explains and $X_{k,i}$ is the value for characteristic k ($k = 1, \ldots, 8$) in country i. The multiple regression model is given by

$$\bar{\theta}_i^w = b_0 + \sum_{k=1}^{8} b_k X_{k,i} + e_i^w. \tag{14}$$

Similar regressions explain $\bar{\theta}_i^r$ and $\bar{\theta}_i^c$. Of course, given that $\bar{\theta}_i^w$, $\bar{\theta}_i^r$, and $\bar{\theta}_i^c$ sum to one, the coefficients from one of the trio of regressions [for (13) or (14)] with $\bar{\theta}_i^w$, $\bar{\theta}_i^r$, and $\bar{\theta}_i^c$ serving as regressands will be redundant. We nevertheless provide results from all three regressions for clarity. We estimate (13) and (14) using OLS with White (1980) heteroskedasticity-consistent standard errors.[17]

The cross-sectional regressions have limitations. Each observation on each of the regressors consists of a national average of the variable in question over a large portion of the postwar period or its value at a point in time. The explanatory variables, however, will not just vary across countries but also over time. For example, the relative wealth of countries in the sample will change over time. Nevertheless, we think that such intertemporal variation is of distinctly secondary importance compared to the cross-sectional variation; that is, countries that are relatively open, wealthy, or have good institutions in one part of the sample will also tend to exhibit these relative qualities in the rest of the sample.

Table 3 presents the cross-sectional regression results.[18] The bivariate regression results in Panel A show that openness, institutional quality, financial development, and real GDP per capita all have a significantly positive relation with $\bar{\theta}_i^w$ at the 1% level. Average inflation, inflation volatility, and central bank independence are significantly negatively related to $\bar{\theta}_i^w$ at the 1% level. Because a higher value for the central bank independence index denotes less independence, the world

[17]Note that data on country characteristics are not always available for all of the 64 countries appearing in our dynamic latent factor model, so that the number of usable observations in (13) can be less than 64 in a particular cross-sectional regression. We drop the last country characteristic, central bank independence, from (14), as its inclusion would significantly decrease the number of usable observations in (14).

[18]We recognize that we are being somewhat philosophically inconsistent in evaluating the cross-sectional regressions using a frequentist approach while evaluating the dynamic latent factor model in Section 3 using Bayesian techniques. As we discussed in Section 2, Bayesian techniques are especially useful for estimating dynamic latent factor models. The literature commonly combines Bayesian and frequentist approaches (e.g., Kose et al., 2003).

factor more strongly influences inflation in countries with greater central bank independence. The signs of the estimated coefficients in the bivariate regression models accord with our prior beliefs.

The country characteristics often substantially explain the variation in $\bar{\theta}_i^w$ in the bivariate regressions, as evidenced by the adjusted R^2 statistics in Table 3, Panel A. Institutional quality has an adjusted R^2 of 0.71, and openness, real GDP per capita, and central bank independence all have adjusted R^2 statistics greater than 0.50. The estimated coefficients in Table 3, Panel A also imply sizable economic effects for several of the country characteristics in the bivariate regressions; for example, the estimated coefficient on log(average real GDP per capita) means that a doubling of a country's average living standard corresponds to an increase in $\bar{\theta}_i^w$ of 0.24.

The bivariate regression results for $\bar{\theta}_i^r$ and $\bar{\theta}_i^c$ in Panels B and C, respectively, of Table 3 produce coefficients that are opposite in sign to those in the $\bar{\theta}_i^w$ regressions in Panel A (with the exception of government share in Panel B) and usually statistically significant. Examination of scatterplots—omitted for brevity—suggests that the bivariate regression results are robust to outliers.

With multiple regressors, institutional quality, financial development, and real GDP per capita remain significantly positively related to $\bar{\theta}_i^w$ at the 1% level (see Table 3, Panel A). Average inflation is also still negatively related to θ_i^w in the multiple regression, but the relationship is now only significant at the 10% level. The other country characteristics are no longer significantly related to $\bar{\theta}_i^w$ in the multiple regression, presumably due in part to multicollinearity. The multiple regression model for $\bar{\theta}_i^w$ has an adjusted R^2 of 0.75 (and the F-statistic rejects the null hypotheses that the slope coefficients are jointly zero at the 1% level), so that the country characteristics together explain three-quarters of the variation in $\bar{\theta}_i^w$ across countries. Characteristics such as real GDP per capita continue to have economically important effects in the multiple regression model for $\bar{\theta}_i^w$.

The multiple regression results in Table 3, Panel B indicate that the country characteristics jointly explain 32% of the cross-sectional variation in $\bar{\theta}_i^r$, and the F-statistic rejects the null that the slope coefficients are jointly zero at the 1% level; however, none of the characteristics are individually significant according to the t-statistics, again presumably due in part to multicollinearity. Panel C of Table 3 shows that the characteristics jointly account for 39% of the cross-country variation in $\bar{\theta}_i^c$ (and the F-statistic again signals rejection of the null that the slope coefficients are jointly zero at the 1% level), with institutional quality and financial development individually significant predictors at the 1% level.

In summary, Table 3 supports the notion that wealthy economies with strong institutions, developed financial markets, low average inflation, and independent central banks are most influenced by global trends in inflation. These country characteristics likely reduce idiosyncratic influences exerted on inflation by the vicissitudes of local political business cycles and fiscal financing.

5. Subsample analysis

As a final exercise, we divide the full 1951–2009 sample in half and estimate the dynamic factor model, (1), separately over the 1951–1979 and 1980–2009 subsamples. Events such as the dissolution of the Bretton Woods system, monetary integration in Europe, and the emergence of a "new" era of globalization might have changed countries' sensitivity to international influences on inflation.

While the selection of any particular partition to form subsamples is somewhat arbitrary, dividing the 1951–2009 sample at the middle seems reasonable from an economic perspective. The 1951–1979 subsample covers the Bretton Woods era and the volatile macroeconomic conditions of the 1970s, while the 1979–2009 subsample corresponds with the move toward monetary integration in Europe and renewed globalization efforts starting in the 1980s.[19] This subsample division should capture a number of potentially important changes in the international economy over the postwar period and provide a good sense of the robustness of our results over time.[20]

Figure 6 illustrates the means of the posterior distributions for θ_i^w, θ_i^r, and θ_i^c for each country over the 1951–1979 (black bars) and 1980–2009 (gray bars) subsamples. The variance decompositions generally appear stable across the subsamples. Figure 7, which reports the average point estimates of θ_i^w, θ_i^r, and θ_i^c across all countries and each regional country group, confirms this.

While the variance decompositions appear reasonably stable overall across the subsamples, some interesting patterns emerge. The importance of the world (regional) factor decreases (increases) across North American countries during the second subsample, perhaps due to the renewed commitment to price stability by North American central banks in the second subsample. While the share of inflation variability accounted for by the world factor generally declines across

[19]Kose et al. (2008) estimate a dynamic factor model for G-7 real output, consumption, and investment quarterly growth rates over three subsamples: 1960:1–1972:2, Bretton Woods period; 1972:3–1986:2, period of common shocks; and 1986:3–2003:4, globalization period. We experimented with three similar subsamples for our annual inflation data for 64 countries, but the shorter subsamples prevented the factors and model parameters from being reasonably accurately estimated.

[20]Del Negro and Otrok (2008) model time variation in a dynamic factor model using a time-varying parameter (TVP) approach. Their method, however, is less amenable to models (such as ours) with a large number of cross-sectional units (N) and a relatively large number of factors.

Latin American countries during the second subsample, it increases markedly in Chile, consistent with the implementation of substantial economic reforms in Chile near 1980.

Monetary integration in Europe, including the creation of the European Monetary System, increased the importance of the regional factor, which explains a greater proportion of inflation variability on average across European countries during the second subsample. Such increases are particularly notable for Belgium, Denmark, Finland, France, Ireland, Iceland, Italy, Luxembourg, the Netherlands, and Norway. The world factor decreases in importance for the African countries during the second subsample. For African countries such as Kenya and Senegal, these decreases are likely due in part to political instabilities, which often resulted in more inward-oriented policies. While the relative importance of the world factor is essentially constant on average across Asian countries over the subsamples, the world factor becomes substantially more important for Japan and South Korea during the second subsample, consistent with increasing emphases on export-led growth strategies. Similar to North American countries, the importance of the world (regional) factor decreases (increases) on average across Australasian countries during the second subsample.

6. Conclusion

This paper characterizes international inflation rates with a dynamic latent factor model that decomposes 64 national inflation rates into world, regional, and idiosyncratic components. Common shocks, similar policy reactions, international trade, and financial links can produce significant common components in international inflation rates. World and regional factors explain 35% and 16%, respectively, of inflation variability on average across the 64 countries. While international factors significantly influence national inflation rates, results from a benchmark model of U.S. metropolitan inflation rates indicates that global influences are much less important in an international context on average than are national influences in the U.S. domestic context.

Our results also show that the importance of the world factor in accounting for inflation variability varies markedly across countries. In bivariate cross-sectional regressions, seven variables—openness to trade, institutional quality, financial development, average real GDP per capita, average inflation, inflation volatility, and central bank independence—strongly explain the cross-sectional variation in the proportion of inflation variance accounted for by the world factor. These results indicate that idiosyncratic factors less strongly affect wealthier countries and those with more advanced institutions and developed financial markets.

Finally, we check the stability of the variance decompositions by estimating the dynamic latent factor model for the 1951–1979 and 1980–2009 subsamples. The relative importance of the world, regional, and idiosyncratic factors is generally stable across the two subsamples. Nevertheless, the regional factor typically increases in importance for North American and European countries during the second subsample, likely as the result of increased efforts toward economic integration in these regions. Furthermore, the importance of the world factor increases markedly in some Latin American and Asian countries during the latter period, in line with an emphasis on outward-oriented policies.

Appendix

This appendix describes the data for the country characteristics used in Section 4.

- *Openness*. Openness is measured as the fraction of years during 1965–1990 in which the Sachs and Warner (1995) criteria rate a country as open. A country is rated as open if it satisfies four conditions: (1) average tariff rates below 40%; (2) average quota and licensing coverage of imports of less than 40%; (3) a black market exchange rate premium averaging less than 20% for 1970–1989; (4) no extreme controls (i.e., taxes, quotas, state monopolies) on exports.

- *Institutional quality*. Sachs and Warner (1997) provide data for institutional quality. The institutional quality index is an average of five sub-indices: rule of law, bureaucratic quality, corruption, risk of expropriation, and government repudiation of contracts. A higher value for the average index represents better institutional quality.

- *Financial development*. Financial development is measured using the liquid liabilities variable from Beck et al. (2000). The variable is the 1960–1995 average of currency plus demand and interest-bearing liabilities of financial intermediaries and nonbank financial intermediaries divided by GDP. Liquid liabilities are a common measure of financial development (see Beck et al., 2000).

- *Government share*. Government share is the sample average of real government purchases divided by real GDP. Real government purchases and real GDP are both from the Penn World Tables.[21]

- *Average real GDP per capita*. This is the sample average of real GDP per capita.

- *Average inflation*. This is the mean of the inflation rate for 1951–2009.

- *Inflation volatility*. This is the standard deviation of the inflation rate for 1951–2009.

- *Central bank independence*. Overall central bank independence is measured using Cukierman et al.'s (1992) index, which is based on such things as the tenure of the central bank chair, limitations of lending in practice, resolution of conflicts, financial independence, intermediate policy targets, and actual priority given to price stability. The index ranges from zero to one, with a lower value indicating greater central bank independence.

[21] The maximal span of Penn World Tables data is 1950–2007, but not all countries have the maximal span available.

Acknowledgements

The authors thank Paul McNelis (Co-Editor) and seminar and session participants at the Federal Reserve Bank of St. Louis, University of Goethe Center for Financial Studies/ECB-Deutsche Bundesbank, West Virginia University, 2008 Midwest Econometric Group Meetings, 2009 Missouri Economics Conference, and 2009 Federal Reserve System Committee Meetings on Macroeconomics, especially Marta Banbura, Günter Beck, Michael Binder, Gabriel Fagan, Jonathan Heathcote, Kirstin Hubrich, Óscar Jordá, Bartosz Maćkowiak, Mike McCracken, Benoît Mojon, Jim Nason, Ed Nelson, Chris Otrok, Mike Owyang, George Selgin, Frank Smets, John Williams, and Tao Wu for helpful comments. The authors also thank Brett Fawley and Ariel Weinberger for research assistance. The views expressed in this paper are those of the authors and do not reflect those of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

References

Acemoglu, D., Johnson, S., Querubin, P., Robinson, J.A., 2008. When does policy reform work? The case of central bank independence. Brookings Papers on Economic Activity 1, 351–418.

Bautista, R.M., 1974. Perspective on the recent Philippine inflation. Philippine Economic Journal 13, 214–224.

Beck, G.W., Hubrich, K., Marcellino, M.M., 2009. Regional inflation dynamics within and across Euro Area countries and a comparison with the United States. Economic Policy 24 (57), 141–184.

Beck, T., Levine, R., Loayza, N.V., 2000. Finance and the sources of growth. Journal of Financial Economics 58 (1–2), 147–180.

Bernanke, B.S., 2005. Inflation in Latin America: a new era? Remarks at the Stanford Institute for Economic Policy Research Economic Summit, Stanford, California, February 11, 2005.

Calvo, G.A., Reinhart, C.M., 2002. Fear of floating. Quarterly Journal of Economics 117 (2), 379–408.

Campillo, M., Miron, J.A., 1997. Why does inflation differ across countries? In: Romer, C.D., Romer, D.H. (Eds.), Reducing Inflation. University of Chicago Press, Chicago.

Canzoneri, M.B., Gray, J., 1985. Monetary policy games and the consequences of non-cooperative behavior. International Economic Review 26 (3), 547–564.

Cardoso, E.A., 1989. Hyperinflation in Latin America. Challenge 32 (1), 11–19.

Ciccarelli, M., Mojon, B., 2010. Global inflation. Review of Economics and Statistics 92 (3), 524–535.

Cukierman, A., Webb, S.B., Neyapti, B., 1992. Measuring the independence of central banks and its effect on policy outcomes. World Bank Economic Review 6 (3), 353–398.

Del Negro, M., Otrok, C., 2008. Dynamic factor models with time-varying parameters: measuring changes in international business cycles. Federal Reserve Bank of New York Staff Report No. 326.

DeLong, J.B., 1997. America's peacetime inflation: the 1970s. In: Romer, C.D., Romer, D.H. (Eds.), Reducing Inflation. University of Chicago Press, Chicago.

Devereux, M.B., Engel, C., 2007. Expenditure switching vs. real exchange rate stabilization: competing objectives for exchange rate policy. Journal of Monetary Economics 54 (8), 2346–2374.

Grilli, V., Masciandaro, D., Tabellini, G., 1991. Political and monetary institutions and public financial policies in the industrial countries. Economic Policy 6 (13), 341–392.

Heathcote, J., Perri, F. 2004. Financial globalization and real regionalization. Journal of Economic Theory 119 (1), 207–243.

Henriksen, E.R., Kydland, F.E., Šustek, R., 2011. The high cross-country correlations of prices and interest rates. Discussion Paper 11/01, University of Nottingham, Centre for Finance, Credit, and Macroeconomics.

Kose, M.A., Otrok, C., Whiteman, C.H., 2003. International business cycles: world, region, and country-specific factors. American Economic Review 93 (4), 1216–1239.

Kose, M.A., Otrok, C., Whiteman, C.H., 2008. Understanding the evolution of world business cycles. Journal of International Economics 75 (1), 110–130.

Lane, P.R., 1995. Inflation in open economies. Journal of International Economics 42 (3–4), 327–346.

McCallum, B.T., 1990. Inflation: theory and evidence. In: Friedman, B.M., Hahn, F.H. (Eds.), Handbook of Monetary Economics. North Holland, New York.

Monacelli, T., Sala, L., 2009. The international dimension of inflation: evidence from disaggregated consumer price data. Journal of Money, Credit, and Banking 41 (s1), 101–120.

Mumtaz, H., Surico, P., 2011. Evolving international inflation dynamics: world and country-specific factors. Journal of the European Economic Association, forthcoming.

Nelson, E., 2005a. The Great Inflation of the Seventies: what really happened? B.E. Journal of Macroeconomics: Advances in Macroeconomics 5, 1–50.

Nelson, E., 2005b. Monetary policy neglect and the Great Inflation in Canada, Australia, and New Zealand. International Journal of Central Banking 1 (1), 133–179.

Nelson, E., Nikolov, K., 2004. Monetary policy and stagflation in the U.K. Journal of Money, Credit, and Banking 36 (3, Part 1), 293–318.

Ng, S., Perron, P., 2001. Lag length selection and the construction of unit root tests with good size and power. Econometrica 69 (6), 1519–1554.

Otrok, C., Whiteman, C.H., 1998. Bayesian leading indicators: measuring and predicting economic conditions in Iowa. International Economic Review 39 (4), 997–1014.

Romer, C.D., Romer, D.H., 2002. A rehabilitation of monetary policy in the 1950s. American Economic Review 92 (2), 121–127.

Romer, D.H., 1993. Openness and inflation: theory and evidence. Quarterly Journal of Economics 107 (4), 869–903.

Rumsfeld, D.H., 2003. Remarks at a press conference, January 22, 2003 (http://news.bbc.co.uk/2/hi/europe/2687403.stm).

Sachs, J.D., Warner, A.M., 1995. Economic reform and the process of global integration. Brookings Papers on Economic Activity 1, 1–95.

Sachs, J.D., Warner, A.M., 1997. Fundamental sources of long-run growth. American Economic Review 87 (2), 184–188.

Sargent, T.J., Sims, C.A., 1977. Business cycle modeling without pretending to have too much a priori economic theory. In: Sims, C.A. (Ed.), New Methods in Business Cycle Research. Federal Reserve Bank of Minneapolis, Minneapolis.

Sargent, T.J., Williams, N., Zha, T., 2009. The conquest of South American inflation. Journal of Political Economy 117 (2), 211–256.

Stock, J.H., Watson, M.W., 1989. New indexes of coincident and leading economic indicators. In: Blanchard, O.J., Fischer, S. (Eds.), NBER Macroeconomics Annual 1989. MIT Press, Cambridge, Mass.

Stock, J.H., Watson, M.W., 1993. A procedure for predicting recessions with leading indicators: econometric issues and recent experience. In: Stock, J.H., Watson, M.W. (Eds.), Business Cycles, Indicators, and Forecasting. University of Chicago Press, Chicago.

Tanner, M.A., Wong, W.H., 1987. The calculation of posterior distributions by data augmentation. Journal of the American Statistical Association 82 (398), 528–840.

Taylor, J.B., 1999. A historical analysis of monetary policy rules. In: Taylor, J.B. (Ed.), Monetary Policy Rules. University of Chicago Press, Chicago.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48 (4), 817–838.

Table 1
Summary statistics for country inflation rates (differences in CPI log-levels), 1951–2009

Country	Mean	Std. dev.	Minimum	Maximum	Country	Mean	Std. dev.	Minimum	Maximum
A. North America									
Barbados	0.055	0.059	−0.010	0.312	Trinidad & Tobago	0.068	0.047	0.004	0.218
Canada	0.037	0.031	−0.012	0.116	United States	0.037	0.028	−0.007	0.125
B. Latin America									
Argentina	0.529	0.737	−0.018	3.917	Guatemala	0.067	0.083	−0.049	0.469
Bolivia	0.337	0.748	−0.146	4.415	Guyana	0.084	0.104	−0.011	0.600
Brazil	0.594	0.813	0.025	3.249	Jamaica	0.120	0.110	−0.008	0.589
Chile	0.288	0.369	−0.015	1.805	Mexico	0.165	0.199	−0.049	0.952
Colombia	0.136	0.081	−0.031	0.282	Peru	0.417	1.014	−0.001	6.653
Costa Rica	0.103	0.110	−0.032	0.597	Paraguay	0.136	0.141	−0.003	0.966
Dominican Republic	0.093	0.122	−0.087	0.587	Uruguay	0.315	0.224	0.035	0.858
Ecuador	0.156	0.160	−0.029	0.647	Venezuela	0.146	0.159	−0.016	0.709
C. Europe									
Austria	0.036	0.038	−0.005	0.276	Greece	0.084	0.072	−0.013	0.267
Belgium	0.034	0.028	−0.009	0.146	Ireland	0.057	0.051	−0.051	0.210
Switzerland	0.026	0.023	−0.006	0.113	Iceland	0.140	0.142	−0.082	0.570
Cyprus	0.043	0.036	−0.013	0.155	Italy	0.058	0.052	0.004	0.220
Germany	0.028	0.022	−0.028	0.120	Luxembourg	0.032	0.027	−0.014	0.107
Denmark	0.047	0.036	−0.008	0.144	Malta	0.031	0.034	−0.036	0.138
Spain	0.068	0.051	−0.016	0.234	Netherlands	0.035	0.027	−0.020	0.103
Finland	0.050	0.044	−0.039	0.166	Norway	0.047	0.034	−0.004	0.129
France	0.047	0.041	−0.021	0.197	Portugal	0.076	0.076	−0.010	0.292
United Kingdom	0.052	0.045	0.000	0.223	Sweden	0.048	0.037	−0.011	0.176
D. Africa									
Republic of the Congo	0.061	0.072	−0.068	0.252	Senegal	0.052	0.068	−0.053	0.319
Kenya	0.088	0.078	−0.005	0.420	South Africa	0.074	0.047	0.003	0.170
Mauritius	0.063	0.065	−0.016	0.326					
E. Asia									
Hong Kong	0.043	0.052	−0.083	0.173	Sri Lanka	0.073	0.062	−0.015	0.221
Indonesia	0.254	0.449	−0.112	2.995	Malaysia	0.027	0.039	−0.063	0.167
India	0.064	0.058	−0.083	0.228	Philippines	0.075	0.081	−0.077	0.411
Japan	0.034	0.041	−0.017	0.190	Singapore	0.022	0.046	−0.063	0.242
South Korea	0.136	0.233	−0.064	1.618	Thailand	0.046	0.050	−0.075	0.184
F. Middle East									
Egypt	0.074	0.072	−0.108	0.250	Pakistan	0.070	0.060	−0.094	0.321
Iran	0.123	0.088	−0.030	0.415	Tunisia	0.046	0.036	−0.086	0.140
Israel	0.216	0.326	−0.019	1.695	Turkey	0.262	0.209	0.019	0.813
G. Australasia									
Australia	0.052	0.043	−0.002	0.223	New Zealand	0.057	0.048	0.004	0.167
Fiji	0.051	0.043	−0.018	0.200					
H. Average across country group									
All	0.109	0.135	−0.031	0.690	Africa	0.067	0.066	−0.028	0.297
North America	0.049	0.041	−0.006	0.193	Asia	0.077	0.111	−0.065	0.643
Latin America	0.230	0.323	−0.027	1.706	Middle East	0.132	0.132	−0.053	0.606
Europe	0.052	0.046	−0.019	0.199	Australasia	0.053	0.045	−0.006	0.197

Table 2
Averages across country groups, variance decompositions for country inflation rates, 1951–2009

Country group	Average point estimate across country group	Average 0.05 quantile across country group	Average 0.95 quantile across country group
A. World factor (θ_i^w)			
All (64 countries)	0.35	0.30	0.40
North America (4 countries)	0.65	0.59	0.70
Latin America (16 countries)	0.10	0.07	0.13
Europe (20 countries)	0.59	0.52	0.65
Africa (5 countries)	0.25	0.21	0.29
Asia (10 countries)	0.25	0.21	0.29
Middle East (6 countries)	0.16	0.13	0.20
Australasia (3 countries)	0.59	0.54	0.63
B. Regional factor (θ_i^r)			
All (64 countries)	0.16	0.08	0.27
North America (4 countries)	0.09	0.01	0.20
Latin America (16 countries)	0.28	0.22	0.35
Europe (20 countries)	0.08	0.02	0.16
Africa (5 countries)	0.14	0.00	0.41
Asia (10 countries)	0.18	0.11	0.27
Middle East (6 countries)	0.15	0.00	0.42
Australasia (3 countries)	0.08	0.00	0.23
C. Country factor (θ_i^c)			
All (64 countries)	0.49	0.39	0.57
North America (4 countries)	0.26	0.17	0.33
Latin America (16 countries)	0.62	0.55	0.68
Europe (20 countries)	0.33	0.28	0.38
Africa (5 countries)	0.61	0.34	0.77
Asia (10 countries)	0.57	0.49	0.64
Middle East (6 countries)	0.69	0.42	0.85
Australasia (3 countries)	0.34	0.18	0.43

Table 3
Cross-sectional regression results, variance decompositions for country inflation rates

Country characteristic	Bivariate regressions: Slope	t-statistic	N	$\bar{R}^2$	Multiple regressions: Slope	t-statistic	N	$\bar{R}^2$	F-statistic
A. World factor ($\bar{\theta}_i^w$)									
Openness	0.407	8.83**	60	0.50	0.069	1.14	50	0.75	60.74**
Institutional quality	0.093	12.42**	55	0.71	0.047	3.96**			
Financial development	0.005	2.91**	55	0.21	0.1×10^{-4}	2.92**			
Government share	−0.007	−1.26	64	0.001	−0.001	−0.36			
Log(avg. real GDP per capita)	0.245	11.03**	64	0.60	0.098	2.63**			
Average inflation	−1.119	−5.17**	64	0.25	−0.490	−1.78†			
Inflation volatility	−0.597	−5.91**	64	0.21	0.061	0.50			
Central bank independence	−2.191	−6.10**	47	0.54					
B. Regional factor ($\bar{\theta}_i^r$)									
Openness	−0.150	−3.38**	60	0.15	−0.115	−1.34	50	0.32	8.89**
Institutional quality	−0.026	−2.80**	55	0.12	0.014	0.66			
Financial development	−0.002	−2.91**	55	0.12	0.7×10^{-5}	1.13			
Government share	−0.001	−0.20	64	−0.02	−0.005	−1.33			
Log(avg. real GDP per capita)	−0.059	−2.87**	64	0.07	−0.051	−0.92			
Average inflation	0.661	3.22**	64	0.21	−0.036	−0.07			
Inflation volatility	0.399	2.73**	64	0.23	0.421	1.22			
Central bank independence	0.959	3.35**	47	0.24					
C. Country factor ($\bar{\theta}_i^c$)									
Openness	−0.257	−4.92**	60	0.23	0.046	0.52	50	0.39	32.49**
Institutional quality	−0.067	−6.21**	55	0.42	−0.062	−2.61**			
Financial development	−0.002	−1.60	55	0.05	-0.2×10^{-4}	−2.58**			
Government share	0.008	1.56	64	0.01	0.007	1.22			
Log(avg. real GDP per capita)	−0.185	−6.99**	64	0.41	−0.047	−0.76			
Average inflation	0.458	1.37	64	0.04	0.526	0.94			
Inflation volatility	0.199	0.93	64	0.01	−0.482	−1.33			
Central bank independence	1.232	2.90**	47	0.19					

Notes: The table reports cross-sectional regression results for models with $\bar{\theta}_i^w$, $\bar{\theta}_i^r$, and $\bar{\theta}_i^c$ serving as the regressand in Panels A, B, and C, respectively. The bivariate regressions include each country characteristic in turn as a regressor. The multiple regressions include all of the country characteristics (with the exception of central bank independence) jointly as regressors. All regression models include an intercept term. N is the number of countries in the regression. The t-statistics are based on White (1980) heteroskedasticity-consistent standard errors. $\bar{R}^2$ is the adjusted R^2 statistic. F-statistic is for a test of the null hypothesis that the slope coefficients are jointly zero; the F-statistic is based on the White (1980) heteroskedasticity-consistent covariance matrix. †, *, and ** indicate significance at the 10%, 5%, and 1% levels, respectively.

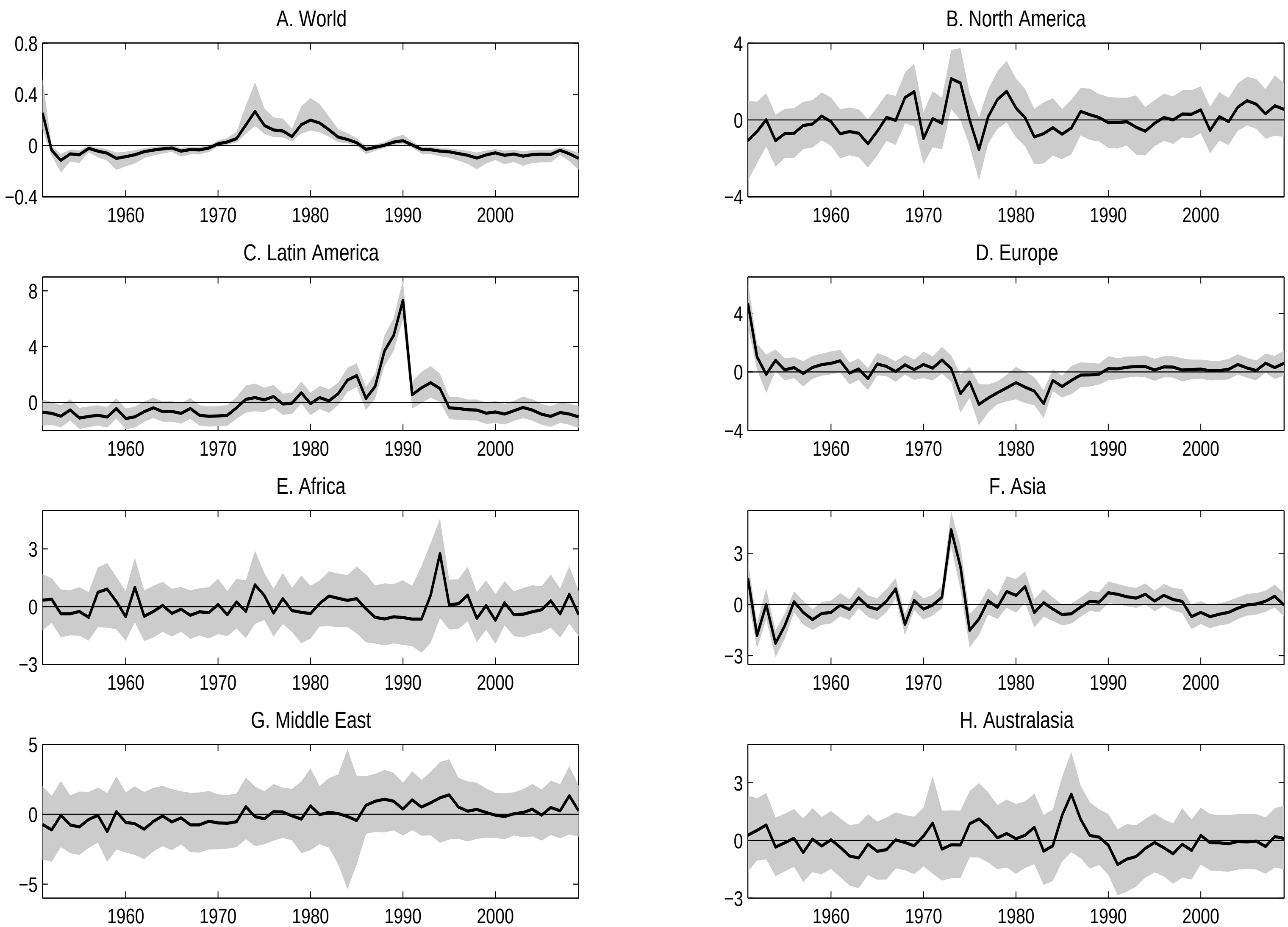

Fig. 1. World and regional factors, 1951–2009. The solid lines depict the mean and shaded regions delineate 0.05 and 0.95 quantiles for the posterior distributions for the world and regional factors.

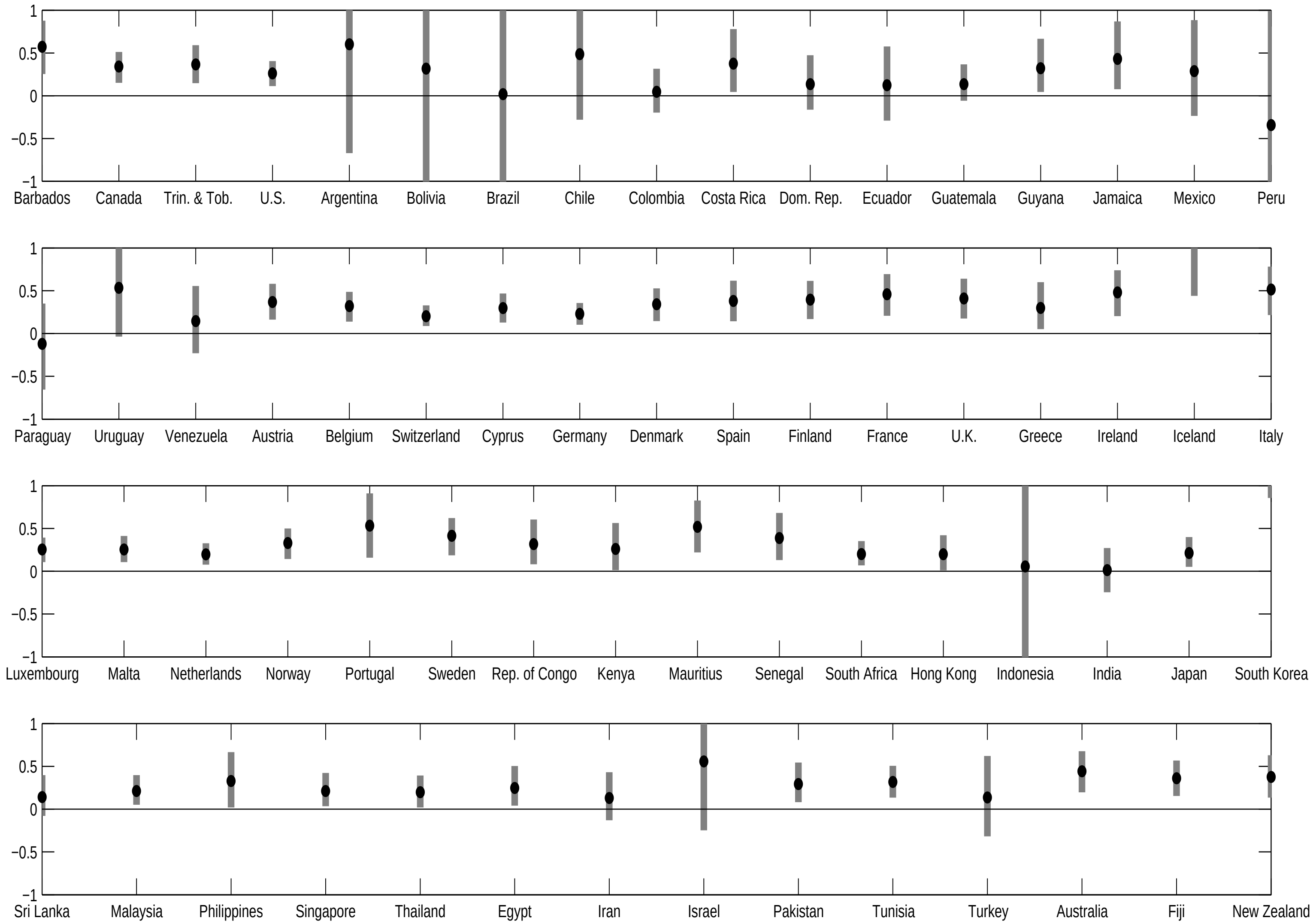

Fig. 2. Loadings on the world factor for country inflation rates, 1951–2009. Circles indicate the means and vertical bars delineate 0.05 and 0.95 quantiles for the posterior distributions for β_i^w.

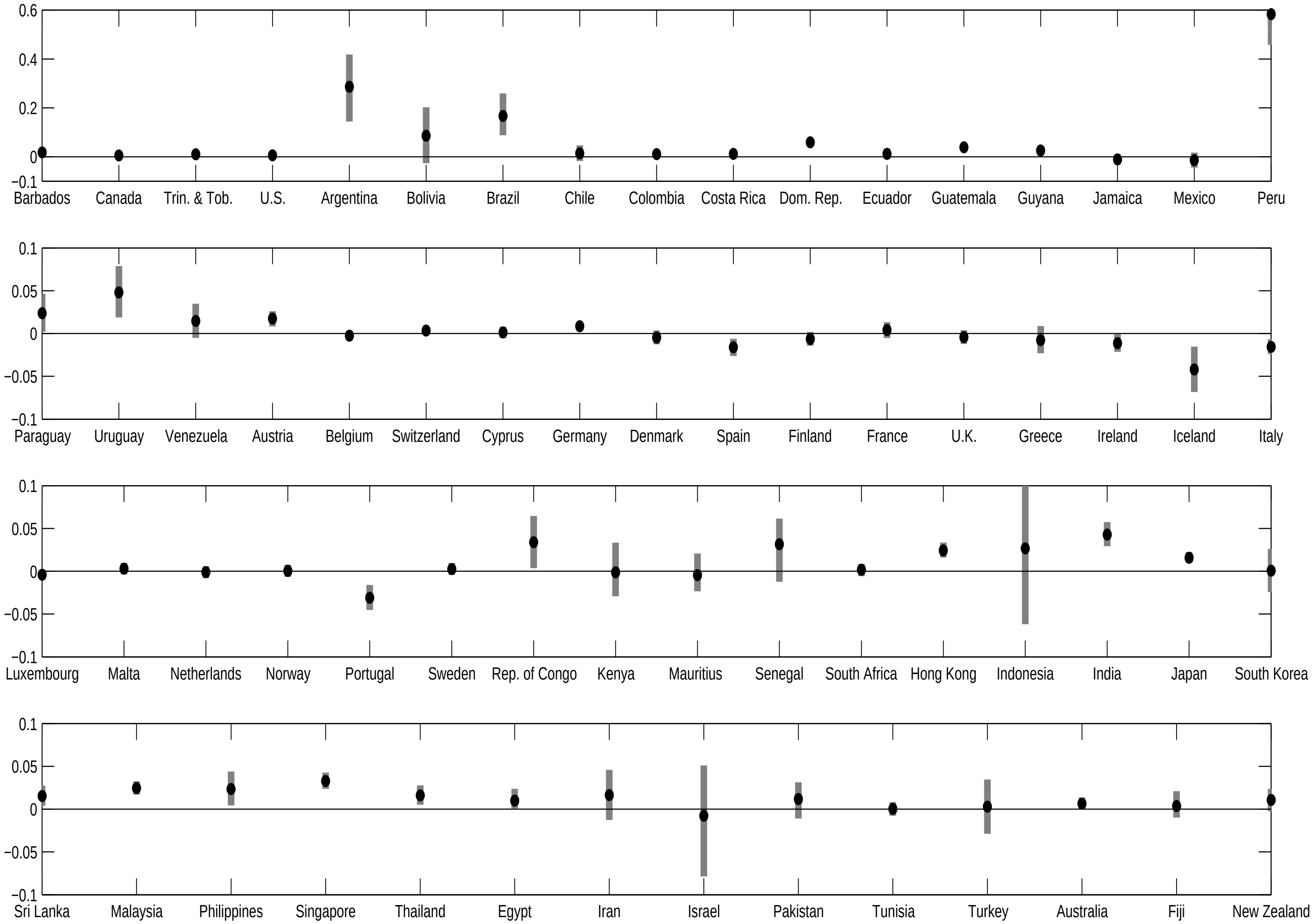

Fig. 3. Loadings on the regional factors for country inflation rates, 1951–2009. Circles indicate the means and vertical bars delineate 0.05 and 0.95 quantiles for the posterior distributions for β_i^r.

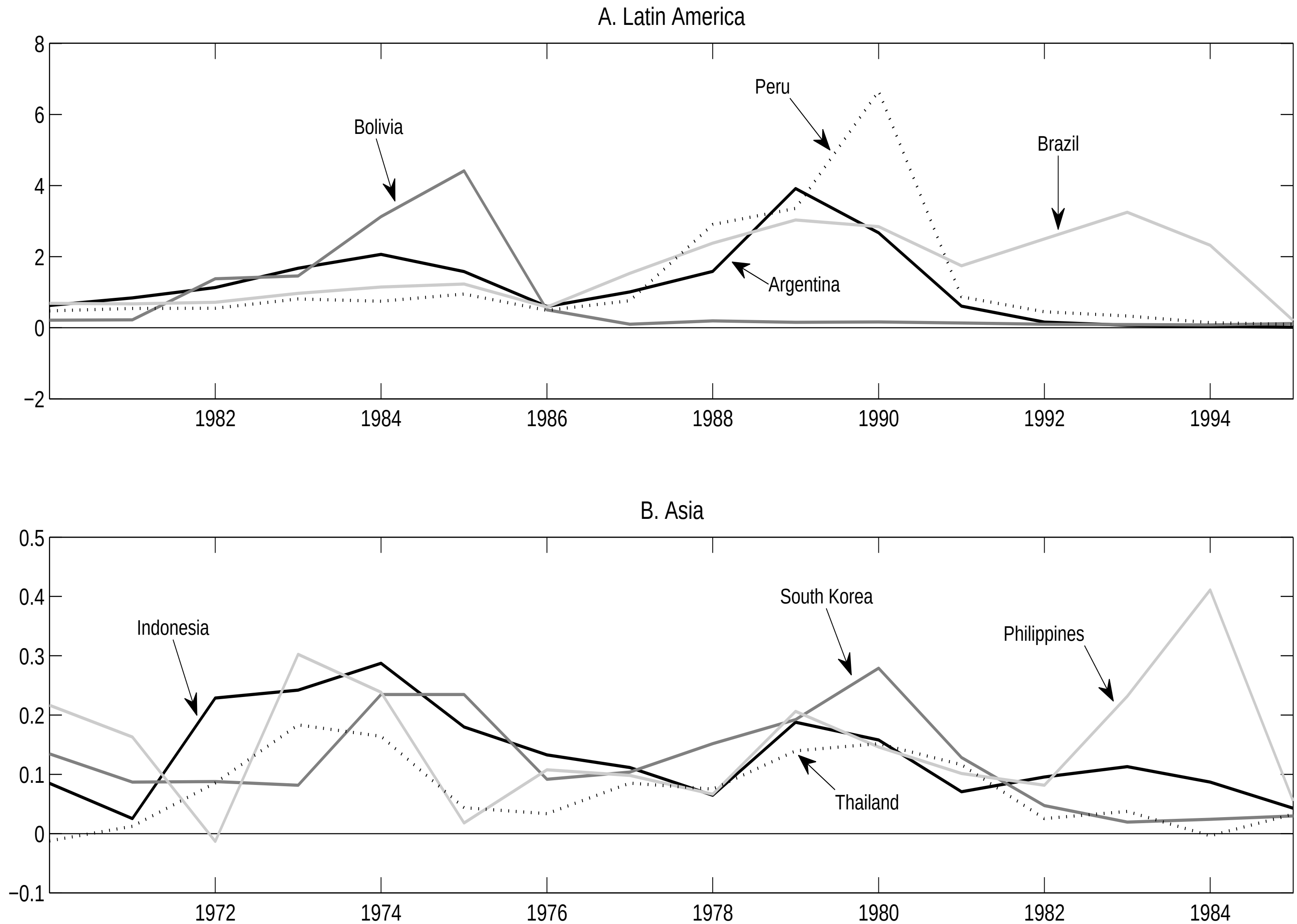

Fig. 4. Latin American and Asian country inflation rates (differences in CPI log-levels). Panel A shows inflation rates for four Latin American countries for 1980–1995; Panel B shows inflation rates for four Asian countries for 1970–1985. The scale of the figure is such that, for example, an inflation rate of 2 indicates an inflation rate of 200%.

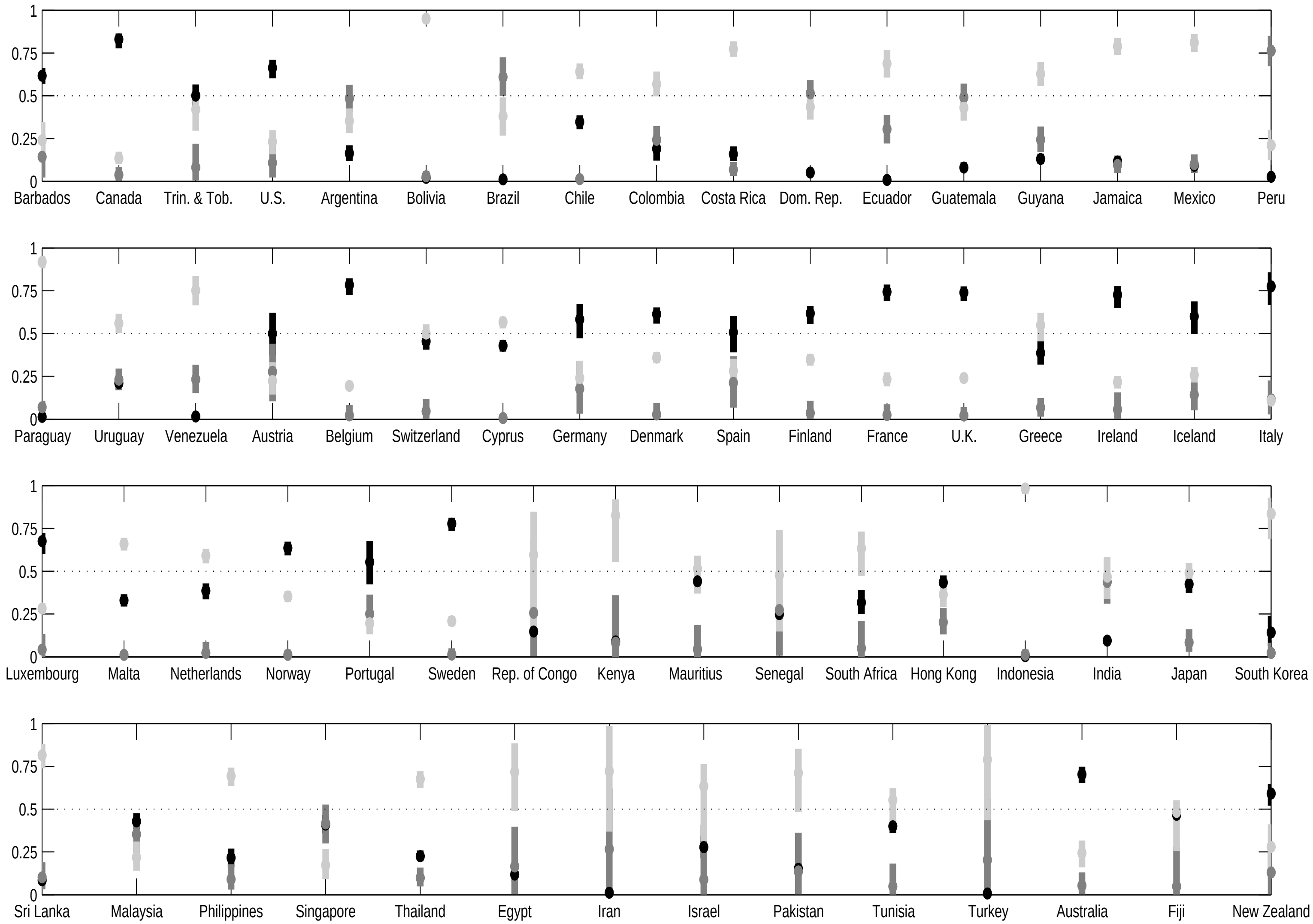

Fig. 5. Variance decompositions for country inflation rates, 1951–2009. Circles indicate the means and vertical bars delineate 0.05 and 0.95 quantiles for the posterior distributions. Black, dark gray, and light gray correspond to posterior coverage regions for θ_i^w, θ_i^r, and θ_i^c, respectively.

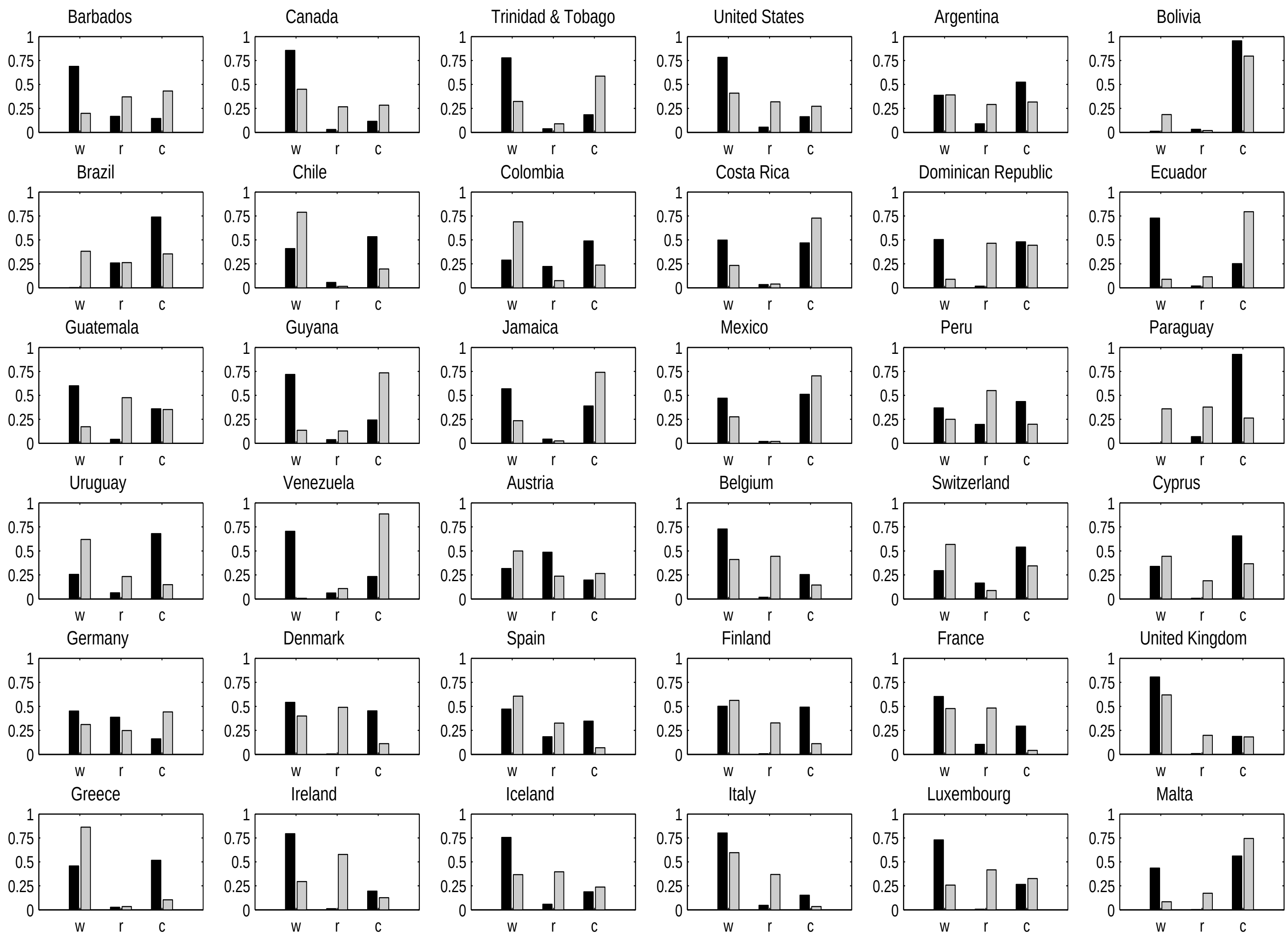

Fig. 6. Variance decompositions for country inflation rates, 1951–1979 and 1980–2009 subsamples. Black and gray bars indicate the means for the posterior distributions for the 1951–1979 and 1980–2009 subsamples, respectively; w, r, and c correspond to θ_i^w, θ_i^r, and θ_i^c, respectively.

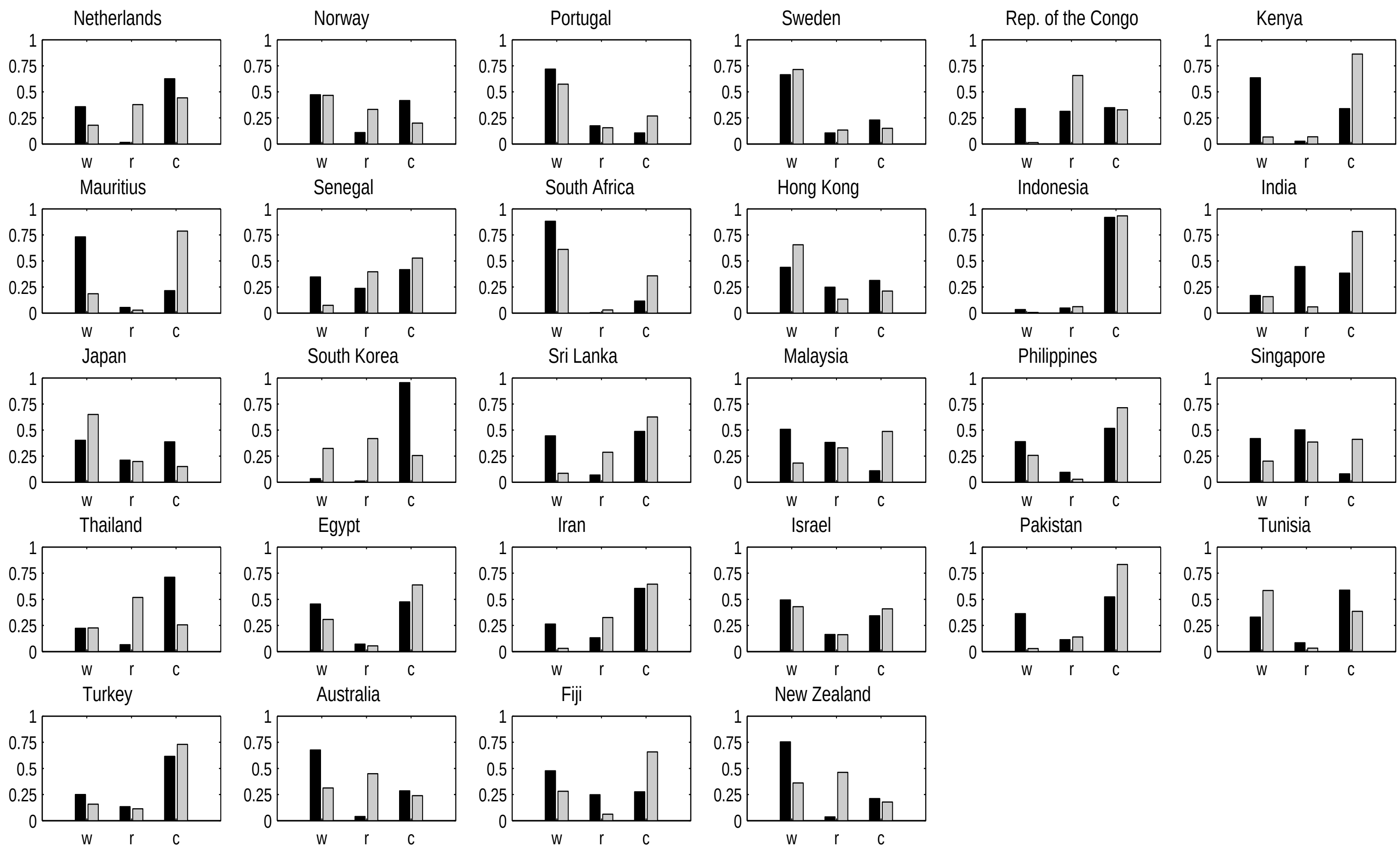

Fig. 6. Continued.

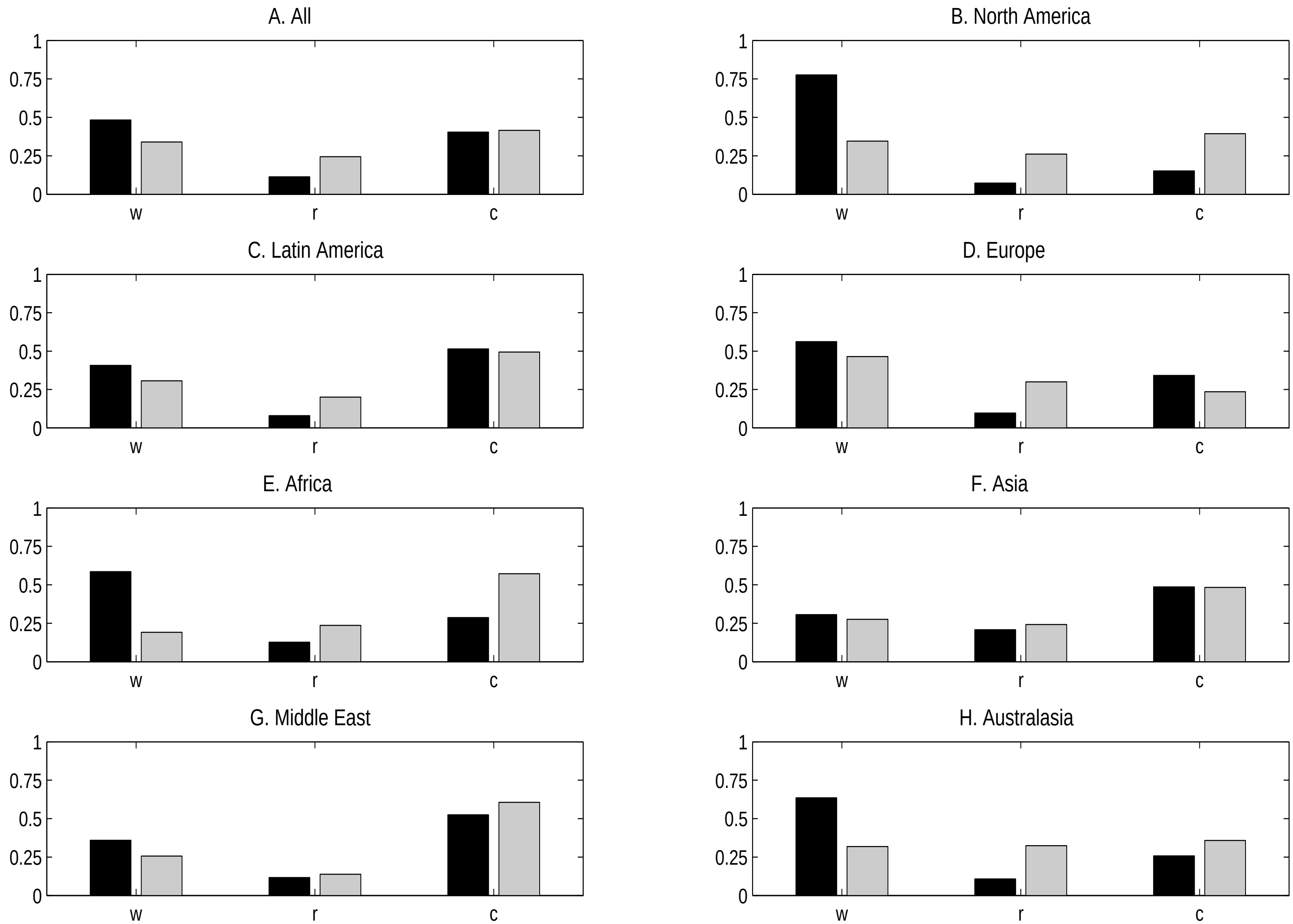

Fig. 7. Averages across country groups, variance decompositions for country inflation rates, 1951–1979 and 1980–2009 subsamples. Black and gray bars indicate the average point estimates across country groups for the 1951–1979 and 1980–2009 subsamples, respectively; w, r, and c correspond to θ_i^w, θ_i^r, and θ_i^c, respectively.