

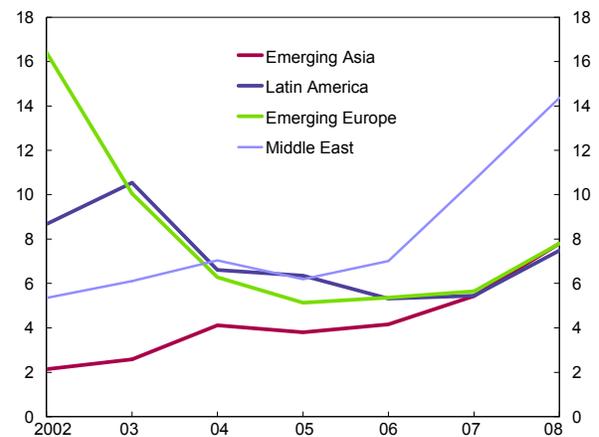
III. Keeping Inflation Under Control

Rising Inflation

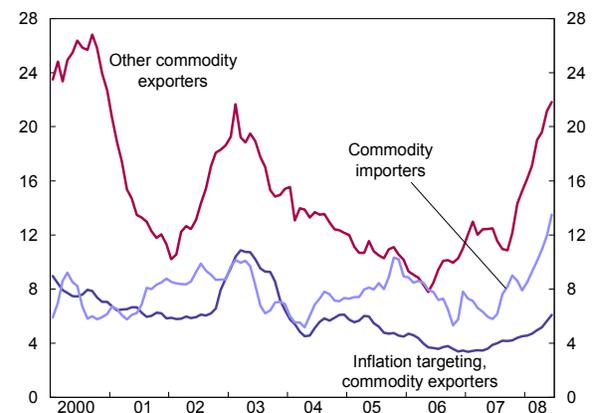
The recent inflationary episode in Latin America and the Caribbean has been the first real test of the region’s commitment to low inflation, especially for the countries with formal inflation-targeting (IT) frameworks. Inflation in the region—which rose to over 8 percent in August 2008—is expected to remain high through end-2008, before beginning to decline gradually in 2009. All other emerging markets have also experienced similar price pressures, with consumer prices rising by over 14 percent a year in the Middle East and by about 8 percent a year in emerging Asia and Europe. Within the region, inflation pressures have been most acute in countries with less flexible exchange rate regimes (including most countries in Central America, Bolivia, Ecuador, and, notably Venezuela, with inflation surpassing 30 percent). In contrast, the IT countries have the lowest inflation in the region, on average. Yet even in these countries headline inflation picked up on average by over 2 percentage points between August 2007 and August 2008, and exceeded the target range in most of the IT countries, often by a wide margin, as of August 2008.

This chapter analyzes the challenges faced by the major IT central banks in the region (Brazil, Chile, Colombia, Mexico, and Peru)⁴ as many of them work to bring inflation back within the target range. The results are based on a new dynamic model (Global Projection Model—GPM) estimated for the United States, Europe, Japan, and the five IT countries for the period 2001 through the first quarter in 2008.⁵ The key behavioral equations for

Inflation on the Rise
Headline Inflation in Emerging Markets (Percent)



Headline Inflation in Latin America by Monetary Framework (Percent)



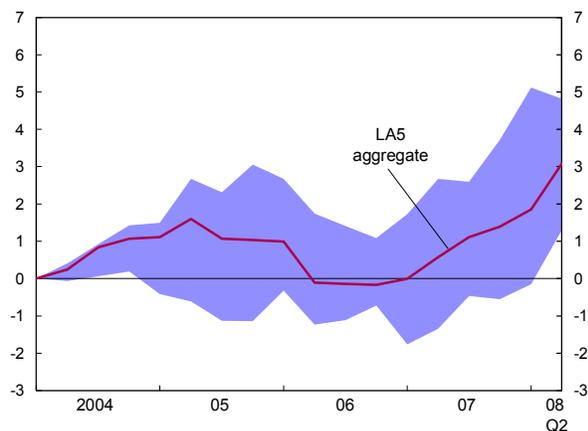
Sources: Haver Analytics; and IMF staff calculations.

Note: This chapter was prepared by Roberto Garcia-Saltos, Jorge Canales-Kriljenko, and Robert Rennhack. The authors acknowledge the support from Douglas Laxton, Ondra Kamenik, Irina Tytell, and Ioan Carabenciov.

⁴ Together these countries account for three-fourths of the LAC region’s GDP.

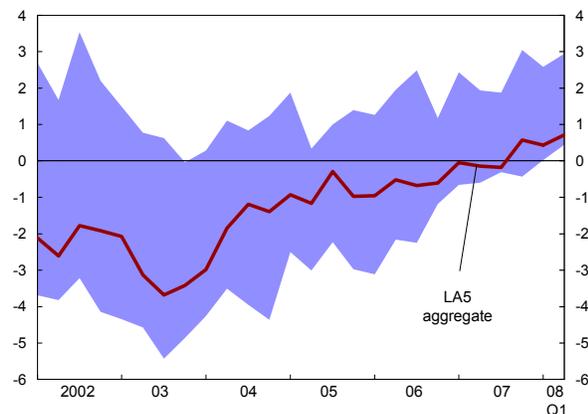
⁵ The model was estimated for an aggregate of the five IT countries as well as for each country individually.

Contribution of Cost-Push to Headline Inflation 1/
(Percentage points)



Source: IMF staff calculations.
1/ Shaded area corresponds to the maximum and minimum contributions from individual countries' GPM's.

Output Gap in Selected Latin American Countries 1/
(Percent of potential GDP)



Source: IMF staff calculations.
1/ Shaded area corresponds to the maximum and minimum of the output gap estimates from individual countries' GPMs. LA5 includes Brazil, Chile, Colombia, Mexico, and Peru.

each country block include (1) a neo-Keynesian Phillips curve that explains inflation in terms of expected as well as past inflation, the real exchange rate, and the domestic output gap; (2) an equation that explains the domestic output gap in terms of the domestic interest rate, the real exchange rate, expected future and past domestic output gaps, and the output gaps of the trading partners; (3) a Taylor rule to explain how the central banks adjusted their policy interest rates over this period; and (4) an equation that explains the real exchange rate in terms of the real interest differential. Further details of the model are presented in Appendix 3.1.

Much of the literature in this area focuses on the gains from adopting IT frameworks. For example, Goretto and Laxton (2005) find that IT has helped anchor long-term inflation expectations and support growth by reducing long-term interest rates. Goncalves and Salles (2008) conclude that inflation targeting has helped not only lower inflation but also reduce output volatility. Another strand of the literature analyzes the relationship between policy interest rates and inflation in the context of small macroeconomic models. This includes Berg, Karam, and Laxton (2006); Castillo, Montoro, and Tuesta (2006); Gouvea and others (2008); McDermott and McMenamin (2008); and Medina, Munro, and Soto (2008). The GPM model extends this second strand of the literature in several ways, including by allowing for a clear decomposition of the sources of inflation and the estimation of Taylor rules in a consistent framework. With links across countries, it also allows for an analysis of the effect of foreign demand on growth and output in these five countries, and includes a measure of bank lending conditions in the United States.

Supply shocks hit when economies near capacity . . .

The leading source of inflation over the period 2001–2008:Q1 came from rising costs, most likely stemming from the sharp rise in world food and fuel prices as well as the effects in some countries of adverse weather on domestic food prices. The analysis based on the GPM finds that cost-push

shocks accounted for a significant share of the rise in inflation since 2006 and by early 2008 explained about 2 percentage points of headline inflation, which averaged 6 percent for these five countries in this period. The results also show that these cost pressures were very persistent, starting in late 2006 and building steadily through early 2008. Chile in early 2008 appears to have been most affected by supply factors, most likely reflecting the recurrence of domestic supply shocks. Peru also appears to have been affected by sharp increases in the cost of food, which accounts for a large share of the CPI basket. The effects of these supply shocks were much less in Mexico, where food accounts for a lower share of the consumption basket.

The supply shocks hit when capacity constraints were tightening after years of steady growth. The estimates based on the GPM show that in 2003–04, these economies were operating well below potential, helping curb inflation. However this gap had closed by late 2006 and, for the past year, many of these five countries have been operating above potential. Through the first quarter of 2008, the excess demand pressures appear to have been the largest in Brazil, Peru, and Colombia, while Mexico and Chile seem to have been operating near capacity. Estimates suggest that—if the output gap had stayed at its level of end-2004—inflation would have been about 1½ percentage points lower in the first quarter of 2008. Of course, the extent of excess demand pressures can be difficult to measure. For example, over the past few years, real private investment has grown significantly in several countries in the region. For this reason, some countries have recently raised their estimates of potential output growth, suggesting that excess demand pressures could have been less than estimated.

Growth in major trading partners seems to have had little effect on demand conditions, on average, in these five countries. Following the outbreak of the financial crisis in the United States and other advanced economies in mid-2007, there was a question as to whether a slowdown in global growth would ease inflation pressures throughout the world

by lowering demand for exports and world prices of commodities. The GPM-based estimates show that the slowdown in growth in the United States since mid-2007 curbed inflation by 0.3 percentage point in the first quarter of 2008 on average for these countries. Brazil, Chile, Peru, and, to a lesser extent, Colombia sell a large share of their exports to Europe and Asia, and their exports to the United States amount to a relatively low share of GDP. Of course, Mexico is much more influenced by developments in the United States, given the close trade and financial linkages between these two countries.

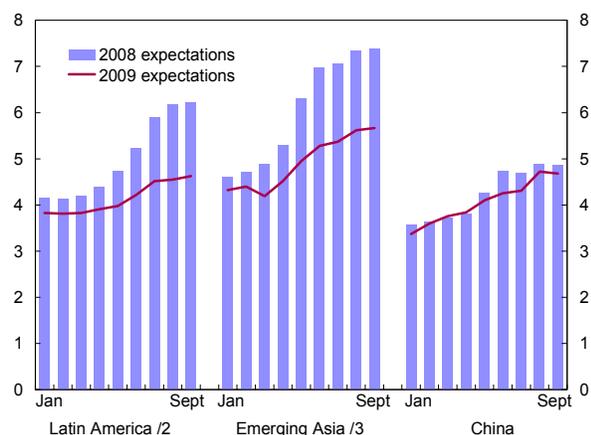
... and spread to other prices

The initial surge in inflation has been spilling over to core inflation (inflation excluding fuel and volatile prices) as well as to non-traded goods inflation. Expected inflation has been increasing not only at a one-year horizon but at longer horizons as well. Also, nominal wage growth has picked up in a few of these countries.

This spread of inflationary pressures is consistent with the finding that inflation in these countries is still persistent. That is, inflation takes a long time to return to trend, because of inertia in wage and price setting due to rigidities in contracts as well as more backward-looking inflation expectations. Several studies, such as Barkbu, Batini, and Garcia-Saltos (2006) and Capistrán and Ramos-Francia (2007), show that inflation in these countries has become less persistent after the adoption of IT. The analysis based on the GPM also confirms that current inflation has become increasingly linked to expected future inflation as opposed to past inflation in the 2001–08 period. However, these results also indicate that inflation in these five countries is considerably more persistent than in the United States, Europe, and Japan. In these five countries, inflation returns to trend 12 quarters after a shock, compared with 6 quarters for the United States and 4 quarters for Europe. This is consistent with García and Valdés (2005), who find that inflation persistence is considerably lower in the United Kingdom, Canada, and Norway than in Colombia and Mexico.

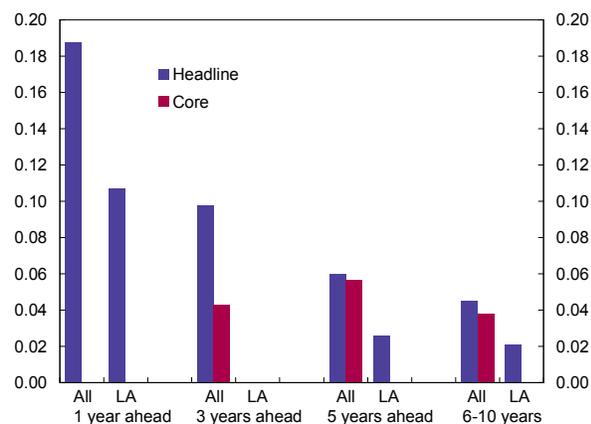
Inflation Expectations

Expected Inflation for End-2008 vs. End-2009 1/
(January - July 2008, in percent)



Changes in Expected Inflation in Response to Changes in Actual Inflation 4/

(Expected inflation 1, 3, 5, and 6-10 years ahead; percentage point responses to a 1 percent point change in actual inflation)



Sources: Consensus Economics, *Consensus Forecast*; IMF, *World Economic Outlook*, October 2008; and IMF staff calculations.

1/ Chart compares updated inflation expectations for years 2008 and 2009 as they are reported each month for the period January to July 2008.

2/ PPP-weighted average for Brazil, Chile, Colombia, Mexico, and Peru.

3/ PPP-weighted average for Indonesia, Singapore, and Taiwan.

4/ Based on statistically significant coefficients from panel regressions with fixed effects, using semi-annual data since 2003. "All" includes 26 emerging market countries; "LA" includes Brazil, Chile, Colombia, Mexico, and Peru.

Also, there is evidence that inflation expectations could be more firmly anchored. To look at this, we estimated a cross-country model of the effect of headline inflation on expected inflation for emerging market countries, including Latin America and other emerging market countries with IT.⁶ In Latin America, expected inflation at a one-year horizon would rise by 10 basis points for every 100 basis point increase in headline inflation, and at a five-year horizon, the effect is significant but quite small. However, expectations appear more firmly anchored in the other emerging market IT countries, which include the Czech Republic, Hungary, Korea, Poland, and Thailand. This suggests that inflation expectations in the five IT countries in Latin America are reasonably well anchored, but there is room for further progress. In addition, large increases in headline inflation can still spill over onto expected inflation.

Monetary Policy Has Been Tightened

The central banks in these five countries have been tightening monetary policy, especially during 2008 as inflation continued to rise. In the first eight months of 2008, these central banks raised their policy interest rate by at least 50 basis points and in some cases much more. Other emerging market IT countries are also tightening monetary policy.

The results of the estimated Taylor rules show that the policy reaction of the IT central banks in the region is very similar to that of the central banks in the United States, Europe, and Japan.⁷ According to this estimated rule, these central banks tended to adjust their policy interest rates by about 220 basis points for every 100 basis point increase in expected headline inflation, similar to the response estimated for Europe and more than the response estimated

⁶ See IMF (2008c, Appendix 3.1) for details.

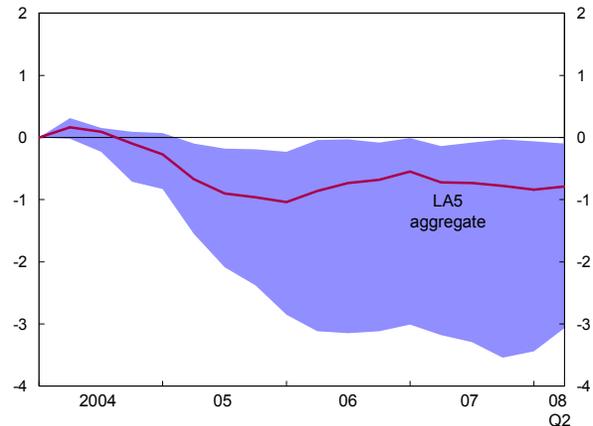
⁷ This policy rule estimated how much each central bank adjusted its policy interest rate each quarter to the deviations of forecast inflation from the target and the output gap. The rule also included the policy interest rate in the previous quarter to gauge how quickly these central banks adjusted their policy rate.

for the United States and Japan. On the other dimensions of the Taylor rule, the LA5 central banks behaved the same as in the United States, Europe, and Japan: they adjusted their policy interest rate by just 20 basis points for every 100 basis point increase in the gap between actual and potential output; preferred to gradually return their policy interest rates to a neutral stance; and sought to bring inflation back on target over a horizon of six to eight quarters. These results suggest that the IT central banks in the region have raised the policy interest rate in real terms in response to rising expected inflation. Yet they have proceeded cautiously to avoid an overreaction that might unduly slow growth.

Exchange rate flexibility and fiscal policy have supported monetary policy. For net commodity exporters, the rise in world food and fuel prices boosted their terms of trade, contributing to a significant appreciation in the nominal exchange rate and limiting the rise in traded goods inflation. The GPM-based analysis finds that currency appreciation reduced annual inflation pressures by 0.7 percent on average between 2005 and the first quarter of 2008. The effect of the currency appreciation was the most pronounced in Brazil, reflecting the large weight of traded goods in the CPI basket as well as the sizable appreciation of the real between 2004 and 2007. In recent years, these countries have sustained primary fiscal surpluses of about 3 percent of GDP on average, ranging from 9.5 percent of GDP in Chile to 1 percent of GDP in Mexico in 2007, and the overall fiscal deficit declined to 1 percent of GDP. In 2008, both Brazil and Peru have raised their targets for the primary fiscal surplus significantly. However, the growth in primary current spending in relation to GDP does pose some fiscal risks.

Contribution of Currency Appreciation to Headline Inflation 1/

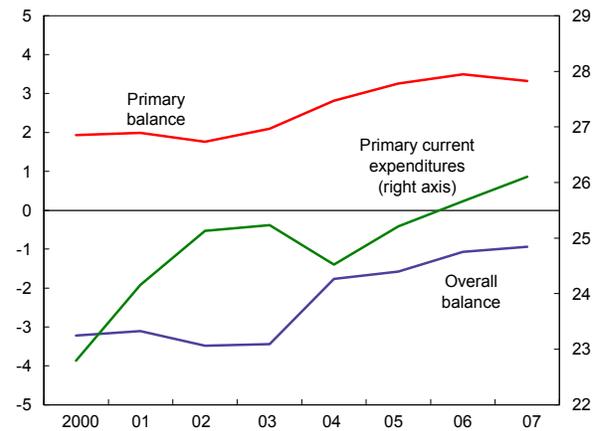
(Percentage points)



Source: IMF staff calculations.
1/ Shaded area corresponds to the maximum and minimum contributions from individual countries' GPM's.

Fiscal Indicators in Inflation Targeting Countries 1/

(In percent of GDP)



Source: IMF staff calculations.
1/ PPP-GDP weighted average.

Conclusions

This chapter finds that the most important factor behind the rise in inflation since 2006 was supply shocks—most likely coming from higher food and fuel prices—that hit when excess demand pressures were building in most of these countries. The moderate slowdown in growth in advanced economies, through the first quarter of 2008 appears to have had only a modest effect on inflation in these five countries through early 2008.

Interestingly, the results of the Taylor rules suggest that the central banks in these five countries raise the policy interest rate firmly in response to higher inflation, as in Europe, which over time should help build credibility further. Also, monetary policy has been supported by exchange rate flexibility and a strong fiscal position.

Monetary policy continues to face a challenging environment. In many of the IT countries, headline inflation is still above target, with the economies operating above potential, yet the current global environment is full of uncertainty. It will be important to stand ready to adapt monetary policy as needed to bring headline inflation comfortably within the target range. An important lesson of this recent episode is that, while monetary policy has become more credible since the adoption of IT, there is still room to anchor inflation expectations even more firmly, which would help reduce the persistence of inflation.

Appendix 3.1

This technical appendix provides a brief overview of the structure of the IMF's newly developed Global Projection Model (GPM). The full explanation of the results is presented in Canales-Kriljenko and others (2008). The appendix also presents the methodology used to estimate the determinants of inflation expectations.

Global Projection Model⁸

The GPM is a multicountry open-economy dynamic macroeconomic model developed by the IMF's Research Department designed to illustrate the effects and importance of cross-border real and financial shocks (Carabenciov and others, 2008a and 2008b). Conceptually, it embraces the spirit of the New Keynesian synthesis, which blends the emphasis on nominal and real rigidities with the real business cycle tradition of dynamic stochastic general equilibrium modeling with rational expectations. The GPM also incorporates a financial variable in the United States, geared to identify directly the linkages between the real and financial sectors in the U.S. economy and the rest of the world. One of the virtues of this type of modeling framework is to produce model-consistent measures of key, yet unobservable, variables such as the output gap or the unemployment gap.

Behavioral Equations

The GPM contains a few critical behavioral equations, namely an IS curve, a Phillips curve, a natural rate of unemployment equation, a monetary policy reaction function, and an uncovered interest rate parity equation. Below we present a summary of the specification of the model for a single country i .

The dynamic IS curve tracks the evolution of the domestic output gap:

$$y_{it} = \beta_{i,1}y_{it-1} + \beta_{i,2}y_{it+1} - \beta_{i,3}r_{it-1} + \beta_{i,4} \sum_j w_{i,j4} z_{i,j,t-1} + \beta_{i,5} \sum_j w_{i,j5} y_{j,t-1} + \varepsilon_{i,t}^y. \quad (1)$$

Domestic output gap (y) depends on the real interest rate gap (r), the effective real exchange rate gap (z), the foreign output (y_j), and a disturbance term (ε). A dynamic structure to account for real rigidities and to permit shocks to have persistent effects results from introducing a lagged term.

⁸ For more details of the GPM see Carabenciov and others (2008).

Forward-looking elements in the aggregate demand are captured by a lead term. The foreign output gap is defined as a weighted average of the lagged foreign output gaps, where the weights (ω_{ij}) are the ratios of exports from country i to j . The effective real exchange rate gap variable is computed as weighted average of the real exchange rate gaps of the foreign countries to which economy i exports. For the U.S. output gap equation, we take the original specification of the GPM, which includes a financial variable (Bank Lending Tightening, BLT) among its determinants.⁹

The unemployment gap (u) is

$$u_{it} = \alpha_{i,1}u_{it-1} + \alpha_{i,2}y_{it-1} + \varepsilon_{i,t}^u \quad (2)$$

This is a dynamic version of Okun's law, in which the unemployment gap is a function of its lagged value, the contemporaneous output gap, and a disturbance term (ε^u).

The dynamic Phillips curve tracks the evolution of inflation:

$$\begin{aligned} \pi_{it} = & \lambda_{i,1}\pi_{i,t+4} + (1 - \lambda_{i,1})\pi_{i,t-1} \\ & + \lambda_{i,2}y_{i,t-1} + \lambda_{i,3} \sum_j w_{i,j,3} \Delta z_{i,j,t} \\ & + \varepsilon_{i,t}^\pi \end{aligned} \quad (3)$$

Inflation depends on the expected and lagged inflation, the output gap, the change in the effective exchange rate of country i , and a disturbance term (ε^π). The size of λ_i measures the relative weight of forward- versus backward-looking components in the inflation process. The backward-looking elements include direct and indirect indexation schemes to past inflation as well as the proportion of price setters who base their expectations of future inflation on past inflation. A high proportion of

price setters who adjust their expectations based on past inflation is associated with low credibility. As in the case of the output gap equation, exchange rate movements also affect domestic inflation by changing the cost of the imported component of the consumer price index. The effects of exchange rate changes for country i are defined as the change of currency i relative to the U.S. dollar minus the change in currency j relative to the U.S. dollar. The weights on the changes in the bilateral real exchange rates are based on imports of country i from country j .

The monetary policy reaction function, a Taylor-type rule, determines the nominal interest rate:

$$I_{it} = (1 - \gamma_{i,1}) \left[\begin{aligned} & \bar{R}_{i,t} + \pi_{i,t+3} + \gamma_{i,2} \\ & (\pi_{i,t+3} - \pi_i^{tar}) + \gamma_{i,4}y_{i,t} \end{aligned} \right] + \gamma_{i,1}I_{it-1} + \varepsilon_{i,t}^I \quad (4)$$

The policy rate depends on its own lag, which characterizes well-known smoothing attributes of policy responses, the central bank's responses to output gap, and deviations of inflation from its target. The rate implied by this equation characterizes the inflation-targeting framework as an inflation-forecast-based target, as the central bank reacts to expected inflation three quarters ahead rather than to observed inflation. Over the long run, with no output gap and inflation at its target, the central bank aims at setting the interest rate at its "neutral" level (the equilibrium real interest rate plus the inflation target).

The uncovered interest rate parity (UIP):

$$\begin{aligned} 4(Z_{i,t+1}^e - Z_{it}) = & (R_{it} - R_{us,t}) \\ & - (\bar{R}_{i,t} - \bar{R}_{us,t}) + \varepsilon_{i,t}^{Z-Z^e} \end{aligned} \quad (5)$$

This version of the UIP expressed in real terms indicates that the difference between the real exchange rate of currency i (Z_i) and its expected value the following quarter is equal to the difference between the real rate (R) in country i and its counterpart in the United States, less the difference

⁹ The BLT is constructed as the average of the responses to four questions with respect to tightening terms and conditions in the Federal Reserve Board's quarterly Senior Loan Officer Survey of Bank Lending Practices.

in the equilibrium real interest rates (\bar{R}) in the two countries.

These behavioral equations plus the stochastic process for potential output, real GDP growth, unemployment, real interest rates, and real exchange rates complement the specification of the model.

Estimation

The GPM has been estimated with Bayesian techniques for an aggregate of the IT countries in Latin America (LA5), plus the United States, Euro area, and Japan; the estimation covers the period 2001:Q4–2008:Q1.¹⁰ The model is estimated with information from five observable variables. These are real GDP, the unemployment rate, CPI inflation, a short-term interest rate, and the exchange rate vis-à-vis the U.S. dollar.

As explained in Carabenciov and others (2008a and 2008b), Bayesian estimation techniques provide a middle ground between classical econometric methods and the calibration approach used in macroeconomic models. In this sense, the Bayesian approach has the benefit of putting some weight on the priors of the researchers (defined by a subjective model) and some weight on the data. These methods are a very efficient way of imposing cross-equation restrictions to produce both plausible dynamics and sensible forecasting properties, which are especially useful for small samples.

Determinants of Inflation Expectations

The responses of expectations to actual inflation shown in the chart of the main text are based on a semiannual panel data set for 21 emerging economies that covers the period starting in 2003. The exercise builds from an identical exercise discussed in the IMF's (2008b) *World Economic Outlook*. The exercise links changes in expected inflation to changes in actual headline inflation and core inflation.¹¹

$$\Delta\pi_{i,t}^e = \lambda_i + \theta\Delta\pi_{i,t}^{headline} + \varepsilon_{i,t}$$

$$\Delta\pi_{i,t}^e = \mu_i + \alpha\Delta\pi_{i,t}^{core} + \nu_{i,t}$$

In these equations, $\Delta\pi$ denotes first differences in expected inflation at various horizons (1, 3, 5, and 6–10 years ahead) and actual inflation (headline and core inflation) in percentage points. The data on inflation expectations are obtained from Consensus Economics and are based on surveys of professional forecasters published twice yearly in March/April and September/October. To correspond to these frequencies, the data on actual inflation refer to the first and third quarter of each year and are measured in year-on-year terms. The equations also include country- and year-fixed effects, and a dummy variable representing the IT countries in Latin America. The reported results include only the coefficients that are statistically significant at the 10 percent level.

¹⁰ This LA5 aggregate represents 7.5 percent of world output and covers 73 percent of the region's output.

¹¹ See Goretti and Laxton (2005) for similar analyses.