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Has Greater Globalization Made Forecasting Inflation More Difficult?

by Mark A. Wynne and Patrick Roy

U.S. inflation and real economic activity became more difficult to forecast during the Great Moderation.

Monetary policy affects real economic activity and the price level with long and variable lags. Consequently, forecasts of inflation and real economic activity are key inputs to central banks' decisionmaking.

Research and experience have shown, however, that forecasting is fraught with difficulty. Rarely, if ever, do forecasts turn out exactly correct. Errors occur because of our limited understanding of modern economies, our inability to anticipate the shocks that regularly buffet the economy and our failure to fully anticipate ongoing structural changes.

Evidence suggests that U.S. inflation and real economic activity became more difficult to forecast during the Great Moderation, the two-decade period of relatively mild inflation and stable growth that preceded the current financial crisis.[1]

Even for advanced economies, estimates of slack are subject to considerable uncertainty.

The explanation often centers on improved monetary policy. With central banks more focused on price stability, the predictive power has ebbed for such indicators of inflation pressures as capacity utilization, unemployment rates or output gaps. In the past, central banks might have allowed price pressures generated by tighter labor or product markets to be transmitted to higher inflation. Today, they adjust policies in response to these pressures, preventing a move to higher inflation.

We investigate an alternative possibility—that the decline in the ability to forecast inflation may instead be due to greater globalization. As countries become more integrated through trade and financial flows, domestic inflation has a larger foreign component that is determined by variables typically excluded from forecasts.

Forecasts Go Astray

To measure the accuracy of inflation forecasts, we compare annual forecasts since 1991, taken from the monthly publication *Consensus Forecasts*, with year-over-year changes in the U.S. Consumer Price Index (CPI). The forecast values are from 18 months in advance. For the forecast of 2008 inflation, for example, we use the projections made in June 2007.

In that survey, *Consensus Forecasts* participants projected a 2008 inflation rate of 2.4 percent. The CPI actually increased 3.8 percent. Over the entire sample, actual inflation rarely matches the rate forecast 18 months in advance. In the early 1990s, inflation was consistently below the *Consensus Forecasts* rates; after 2000, it was usually above the forecast rates (*Chart 1*). Indeed, the mean absolute forecast error rose from 0.6 in the 1990s to 0.8 in the 2000s, a noticeable increase in an already large number.

Understanding this dismal track record starts with the Phillips curve—a well-documented, empirical relationship between measures of slack in labor or product markets and inflation. Greater slack seems to be followed by lower inflation; tighter labor and product markets seem linked to higher inflation.

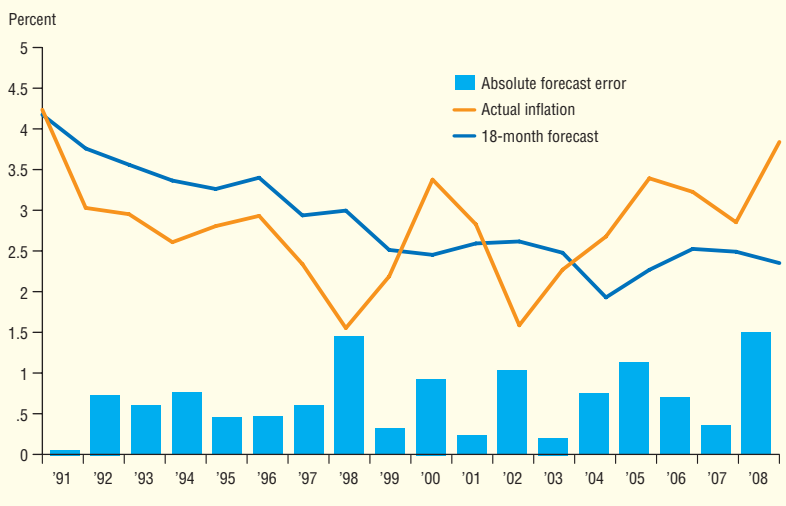
Economists have long used Phillips curve-type relationships in making inflation forecasts.[2] However, the relationship between slack measures and inflation seems to have changed over time. Specifically, inflation seems less responsive to domestic slack in recent years.

Some economists have argued that the reduced responsiveness reflects greater globalization. With the ability to source inputs from anywhere in the world, home market factors of production matter less for domestic inflation. If we know that global slack is what matters for inflation determination, then surely doing a better job of forecasting inflation is simply a matter of replacing our conventional measures of domestic slack with measures of global slack.

Unfortunately, things aren't so simple. Measuring resource utilization or slack is a challenging task under the best of circumstances. Even for advanced economies—for which we have abundant and timely data on output, labor and capital—estimates of slack are subject to considerable uncertainty.

If we try to measure these indicators on a global scale, the problems of

Chart 1
Forecast Errors for U.S. Inflation Fluctuate



SOURCE: *Consensus Forecasts*; Haver Analytics.

accurate measurement increase. Poor measurement of the key driving variable of inflation might be expected to lead to a decline in our ability to forecast inflation.[3]

Our objective is to ask whether there is any evidence that inflation has become more difficult to forecast as a result of globalization.

Our primary data sources are the inflation forecasts reported each month by London-based Consensus Economics. Each month, it polls professional forecasters at a variety of institutions for their latest forecasts for GDP growth, inflation and a variety of other macroeconomic indicators. Consensus publishes four surveys: *Consensus Forecasts*, *Asia Pacific Consensus Forecasts*, *Latin American Consensus Forecasts* and *Eastern Europe Consensus Forecasts*.

In all cases, forecasts are reported in terms of year-over-year average changes.[4] The list of countries covered by each publication has evolved over time. We chose to focus on 26 countries for which forecasts were available in 1991 to ensure a broad sample (*Table 1*).

In examining globalization's role in the deterioration of our ability to accurately forecast inflation, using survey-based forecasts is something of a departure from standard practice. Most of the existing work in this area has looked at econometric models of varying degrees of complexity, often gauging their inflation-forecasting performance relative to simple, naïve benchmarks.

When it comes to forecasting inflation, however, evidence suggests that survey averages of forecasts tend to do a lot better than individual forecasts.[5] The exact reason for the superior performance isn't entirely clear, but it may be due to the greater diversity of models and data that go into survey forecasts.

Forecasting Inflation

We begin our analysis by looking at the accuracy of the forecasts of year-over-year average annual inflation at a variety of horizons. We define the forecast horizon as the number of months between the date of the particular issue of *Consensus Forecasts* and December of the year being forecast.

The nine-month forecast for inflation in 2008 is reported in the March 2008 *Consensus Forecasts*. Each issue of *Consensus Forecasts* includes forecasts not only for the current year, but also for at least one future year. So the 18-month forecast for 2009 inflation comes from the June 2008 issue.

For each country, we plot the forecast error for time horizons ranging from 23 to 0 months (*Chart 2*).[6] The results show that inflation becomes a lot easier to forecast as one proceeds through the year: The forecast errors fall dramatically as we go from a 23-month horizon to a 0-month horizon.

Survey averages of forecasts tend to do a lot better than individual forecasts.

Table 1
Consensus Economics Publications

Publication	Countries covered	Start date	Frequency
Consensus Forecasts	**U.S., U.K., Japan, Canada, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, Austria, Belgium,Denmark, Finland, Ireland, Portugal,** Egypt, euro zone, Greece, Israel, Nigeria, Saudi Arabia and South Africa	October 1989	Monthly
Asia Pacific Consensus Forecasts	**Australia, New Zealand, South Korea, Taiwan, Hong Kong, Malaysia, Singapore, Thailand,** Indonesia, Bangladesh, Pakistan, Philippines, Sri Lanka and Vietnam	November 1990	Monthly
Latin American Consensus Forecasts	Argentina, Brazil, Chile, Mexico, Venezuela, Colombia, Peru, Bolivia, Costa Rica, Dominican Republic, Ecuador, Panama, Paraguay and Uruguay	March 1993	Bimonthly (monthly beginning April 2001)
Eastern Europe Consensus Forecasts	Czech Republic, Hungary, Poland, Russia, Turkey, Bulgaria, Croatia, Estonia, Latvia, Lithuania, Romania, Slovakia, Slovenia and Ukraine	January 1995	Bimonthly (monthly beginning January 2008)

NOTE: Bold type indicates the 26 countries included in our analysis.

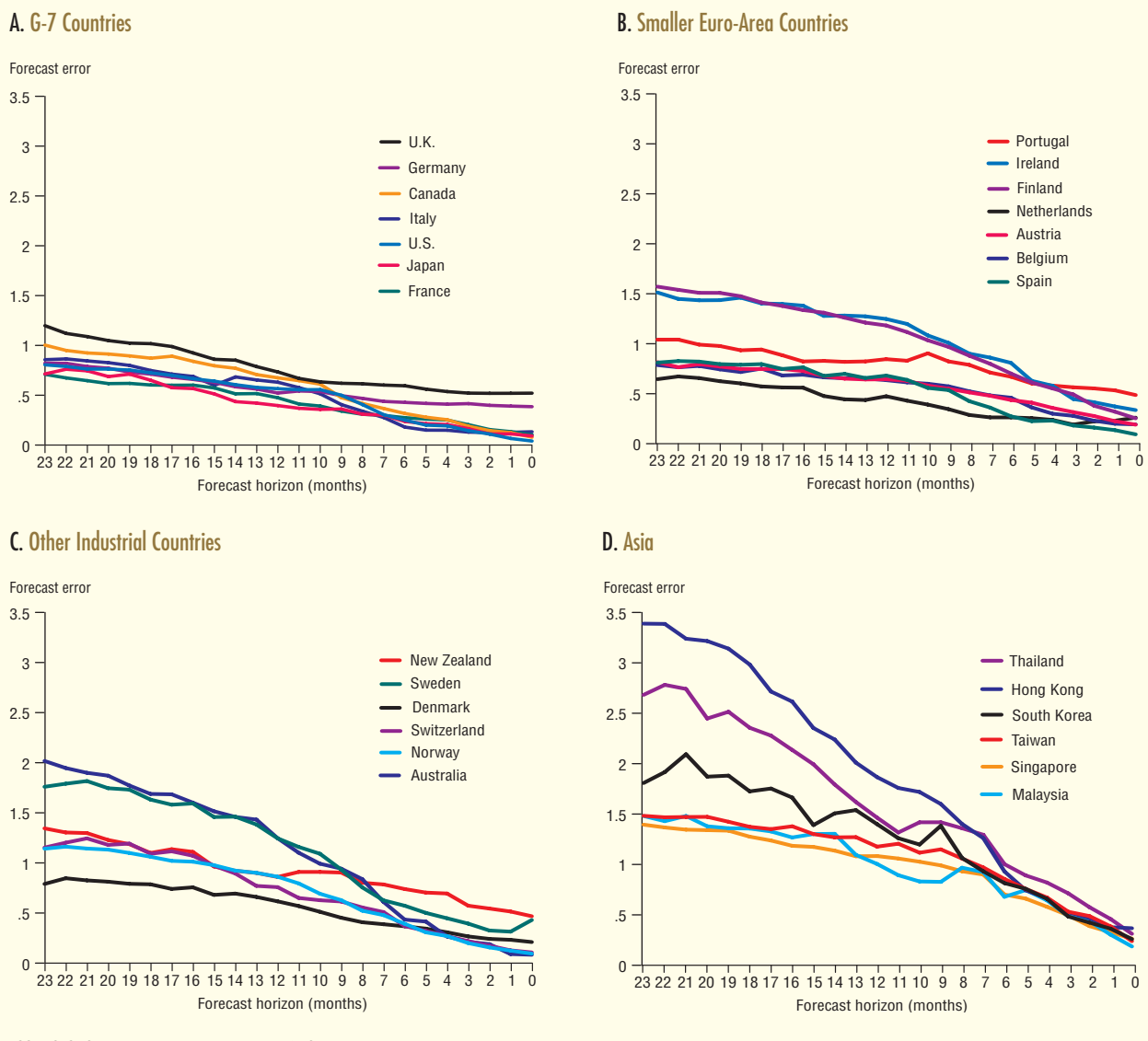
Even at the 0-month horizon—that is, December of the year being forecast—the forecast error is still positive, indicating at least some error remains. This isn't as odd as it may seem. At the time December forecasts are made, analysts still don't have complete information about price developments during the year. In most countries, the December CPI isn't reported until the middle of January of the following year.

A number of other points are worth noting. First, the G-7 countries show about a 0.5 percentage point variation at the 23-month horizon and at 0 months as well (*Chart 2A*). While accuracy improves as we get closer to the end of the year being forecast, the gains are a lot smaller for the U.K. and Germany than for other G-7 countries.

Second, smaller euro-area countries have greater variation in forecast accuracy at longer horizons, but that variation diminishes significantly as the forecast horizon shortens (*Chart 2B*). A similar pattern is evident among smaller industrial countries (*Chart 2C*).

Finally, we find a huge variation in forecast accuracy among Asian countries (*Chart 2D*). At the longest

Chart 2
Inflation Forecast Errors Decline at Shorter Horizons



SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Haver Analytics.

horizon, Asian forecast errors are higher than for all the G-7 countries. As the forecast horizon shrinks, accuracy increases until the range at 0 months converges with the G-7.

Plotting each country's forecast error at the 18-month horizon against average real per capita GDP yields an inverse relationship, suggesting that inflation is harder to forecast in low-income countries (*Chart 3*).

If we remove Hong Kong, an outlier, this proposition gains strength, with the sample correlation going from −0.32 to −0.58. One explanation would be that data used for forecasts are more readily available in high-income countries. Another possibility is that lower-income countries may be more susceptible to unexpected inflationary shocks.

For the rest of this article we will focus on the 18-month horizon. The choice isn't entirely arbitrary because 18 months reflects a consensus for the lags between monetary policy actions and their impact on the economy.[7]

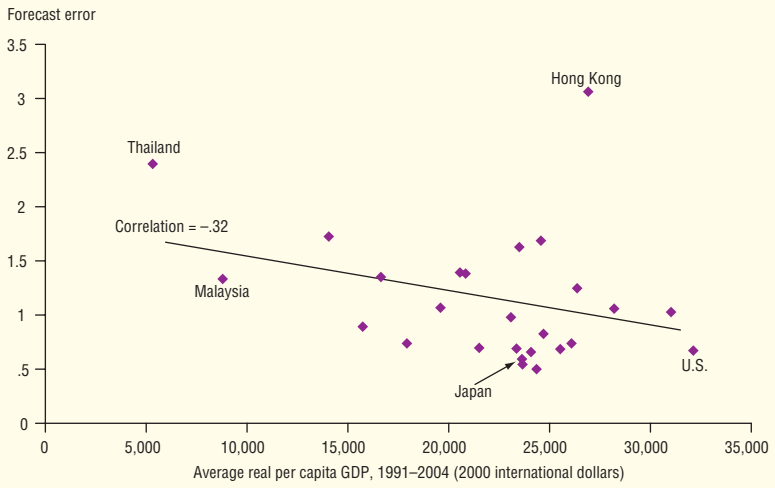
We can summarize how forecasting accuracy at this horizon has changed over time by plotting the forecast errors during the 1990s on the horizontal axis and those in the 2000s on the vertical axis (*Chart 4*). For points above the 45-degree line, the forecast errors increased between the 1990s and the 2000s—that is, inflation became more difficult to forecast. For points below the 45-degree line, the forecast errors decreased—that is, inflation became easier to forecast.

Inflation has become easier to forecast over time for almost all the countries—in some cases by a significant amount. The exceptions are the U.S., Ireland, Netherlands, Spain, Taiwan and Malaysia.

Globalization and Inflation

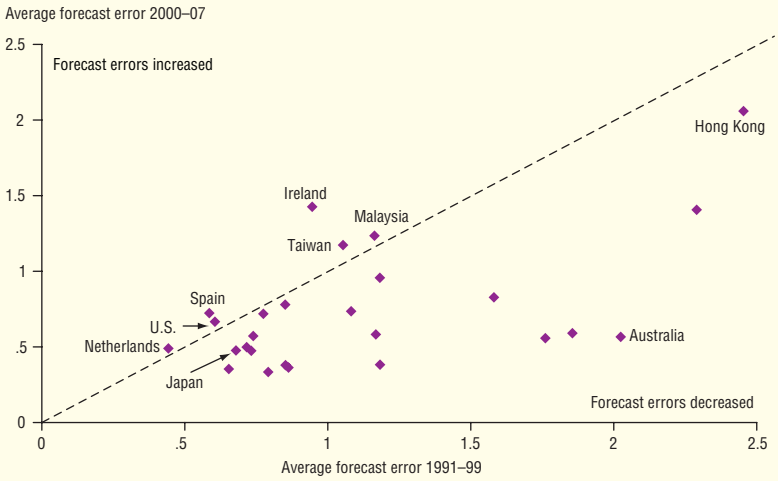
To determine whether globalization has contributed to changes in inflation predictability, we first look for evidence that inflation is more difficult to forecast in more globalized economies.

Chart 3
Inflation Harder to Forecast in Low-Income Countries



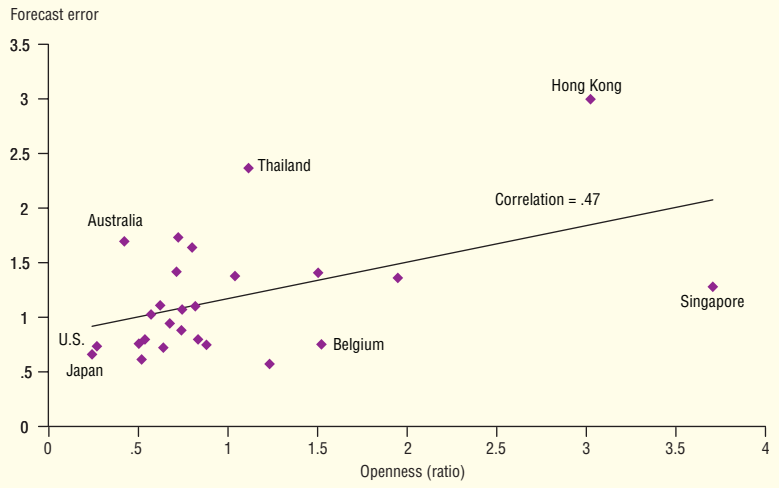
SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Penn World Table; Haver Analytics.

Chart 4
Inflation Easier to Forecast Since 2000



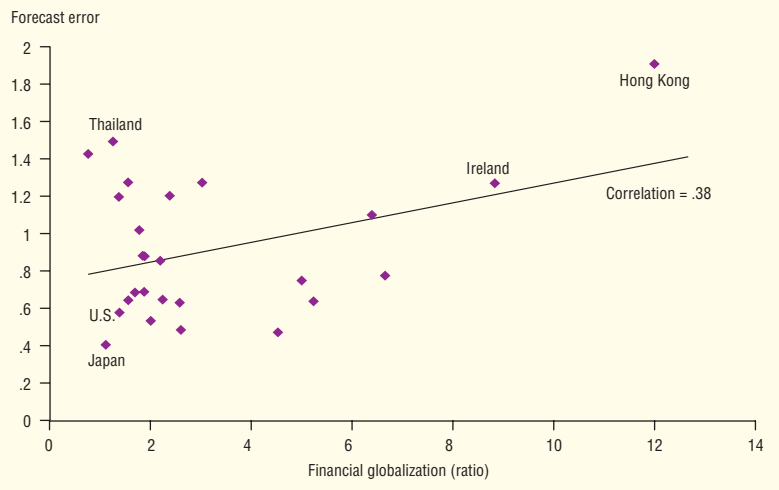
SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Haver Analytics.

Chart 5
Inflation Harder to Forecast in Open Economies?



SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Haver Analytics.

Chart 6
Inflation Harder to Forecast in Financially Globalized Economies?



SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Haver Analytics; financial globalization data from "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," by Philip R. Lane and Gian Maria Milesi-Ferretti, Institute for International Integration Studies Discussion Paper no. 126, March 2006.

Measuring globalization is difficult. Ideally, we'd look at differences between prices in domestic and world markets. Isolated countries would tend to have large gaps. In more globalized economies, foreign competition would bring domestic and international prices into closer alignment.

In practice, it's virtually impossible to obtain the data needed for a price-based measure of globalization. Instead, researchers typically rely on quantity-based measures to assess the extent of globalization. One of the common indicators of real (as opposed to financial) globalization is the ratio of international trade to GDP. Our first measure of each country's openness uses the sum of nominal imports and exports relative to GDP, averaged over the sample period.

A scatter plot of the 18-month forecast error and trade openness suggests that inflation is harder to forecast in more-open economies, with a pairwise correlation of 0.47 (*Chart 5*).

It's hard to know how much weight to put on this finding. The relationship is driven by two outliers, Hong Kong and Singapore, both very open economies by almost any measure. If we drop them, the correlation falls to 0.25.

What about more financially globalized economies? Measuring financial openness as the ratio of foreign assets and liabilities to GDP, we see a positive correlation at the 18-month horizon, with a correlation of 0.38 (*Chart 6*).[8] Once again, globalization appears associated with greater difficulty in forecasting inflation.

Like the trade-based measure, the relationship for financial globalization seems heavily driven by outliers—in this case, Hong Kong and Ireland. Dropping them reduces the correlation to –0.17. That is, if we omit the outliers, inflation appears to be *easier* to forecast in economies that are more financially globalized.

Perhaps the story of globalization is fundamentally one of change rather than a steady exposure to international

developments. Even with a constant overall level of trade flows, a change in the composition of imports and exports may make it more difficult to forecast inflation.

To see how trade composition relates to the decline in the ability to forecast inflation, we used data on bilateral flows of imports and exports to construct a simple measure of how each country's trading patterns changed between the 1990s and the 2000s.[9]

We see a positive correlation with the forecast errors, with outliers still important but not as influential as they were for the other two measures of globalization (*Chart 7*). Dropping Hong Kong and Korea, the correlation falls from 0.41 to 0.35.

The Challenge Ahead

The structural change that poses a perennial challenge to forecasters has been turbocharged with the integration of China, India and other emerging giants into the global economy. We asked whether this surge in globalization over the past two decades has made it more difficult to forecast inflation.

We addressed the question from two angles. First, we looked for evidence of deterioration in our ability to forecast inflation as countries have become more integrated with each other. Second, we looked for evidence that forecast errors were greater on average in countries that rank higher on conventional globalization indicators.

U.S. inflation does appear to have become more difficult to forecast as we moved from the 1990s to the 2000s; however, the opposite seems true in almost every other country we looked at. Our prior belief, based on U.S. experience, that globalization has made inflation harder to forecast doesn't appear to be borne out.

Nevertheless, we do find some evidence of greater difficulty in forecasting inflation in economies that are more open to international developments, although the relationships seem heavily influenced by outliers.

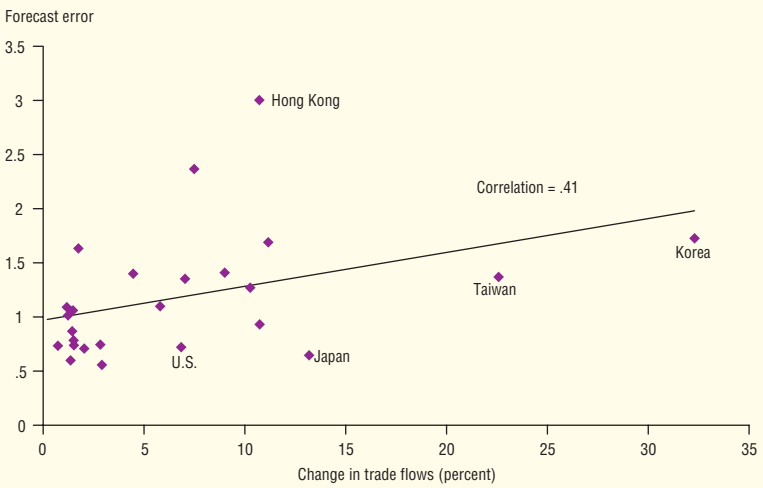
The relationships documented here are worthy of further research. Given the importance some explanations of the decline in inflation predictability attach to better monetary policy, it would be interesting to try controlling for monetary policy regime—specifically, the introduction of inflation targeting or the presence of currency board arrangements or currency unions.

It would also be interesting to extend the sample period back in time. China's accession to the World Trade Organization in 2001 was pivotal to globalization in the recent decade, but some would argue that the fundamental forces have been in place a lot longer. Perhaps since the start of Chinese policy reforms of 1978. Perhaps since the fall of the Berlin Wall in 1989. A longer-term perspective might better identify the effects of globalization on the predictability of inflation.

U.S. inflation does appear to have become more difficult to forecast as we moved from the 1990s to the 2000s; however, the opposite seems true in almost every other country we looked at.

Chart 7

Changing Trade Flows Make Inflation Harder to Forecast



SOURCES: *Consensus Forecasts* and *Asia Pacific Consensus Forecasts*; Haver Analytics.

Wynne, a Federal Reserve Bank of Dallas vice president, is director of the Bank's Globalization and Monetary Policy Institute, and Roy is a research assistant in the institute.

Notes

[1] Specifically, D'Agostino, Giannone and Surico document a decline in the ability to forecast inflation and real economic activity in the U.S. associated with the Great Moderation. They show that since the mid-1980s, the forecast performance of the Green Book and the Survey of Professional Forecasters has declined relative to naïve, random-walk forecasting models. See "(Un)predictability and Macroeconomic Stability," by Antonello D'Agostino, Domenico Giannone and Paolo Surico, ECB Working Paper Series no. 605, April 2006. Stock and Watson have looked for relationships that provide the best forecasts of inflation and examined the factors that underlie the instability of these forecasting relationships. See "Forecasting Inflation," by James H. Stock and Mark W. Watson, *Journal of Monetary Economics*, vol. 44, no. 2, 1999, pp. 293–335; "Why Has U.S. Inflation Become Harder to Forecast?" by James H. Stock and Mark W. Watson, *Journal of Money, Credit and Banking*, vol. 39, supplement, 2007, pp. 3–33; and "Phillips Curve Inflation Forecasts," by James H. Stock and Mark W. Watson, unpublished paper, 2008.

[2] For example, see note 1, Stock and Watson (2008).

[3] The difficulties associated with measuring global output gaps are discussed in "Obstacles to Measuring Global Output Gaps," by Mark A. Wynne and Genevieve R. Solomon, Federal Reserve Bank of Dallas *Economic Letter*, no. 3, March 2007.

[4] For a subset of the more advanced countries, each quarter Consensus Economics also reports forecasts of four-quarter changes in GDP, consumer spending and consumer prices at a quarterly frequency. Unfortunately these data are not included in the historical archive that we use for this study.

[5] See, for example, "Do Macro Variables, Asset Markets, or Surveys Forecast Inflation Better?" by Andrew Ang, Geert Bekaert and Min Wei, *Journal of Monetary Economics*, vol. 54, no. 4, 2007, pp. 1163–1212.

[6] A commonly used measure of forecast accuracy, the RMSFE penalizes equally forecasts that are too high and too low. It also imposes greater penalties on forecasts that are far from the actual outcome. The RMSFE is formally defined as the square root of the mean squared forecast error.

$$RMSFE = \sqrt{\sum_{t=1}^{n} (\pi_t - \pi_t^f)^2 / n}$$

where π_t is actual inflation at period t and π_t^f is the inflation forecasted for period t as of some earlier period.

[7] A 12-month horizon was also tested, yielding very similar results.

[8] The asset and liability data come from "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," by Philip R. Lane and Gian Maria Milesi-Ferretti, Institute for International Integration Studies Discussion Paper no. 126, March 2006.

[9] Let s_{ijt} denote the share of country i's overall trade that is conducted with country j at date t, as measured either by the share of country i imports that come from country j at date t, or the share of total trade (imports plus exports) of country i that is with country j at date t. Using data from the International Monetary Fund's annual Direction of Trade database, we measure the change in the composition of country i trade between dates t_0 and t_1 as

$$\sum_{j=1}^{N_i} (s_{ijt_1} - s_{ijt_0})^2 / N_i$$

where N_i denotes the number of country i's trading partners.

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