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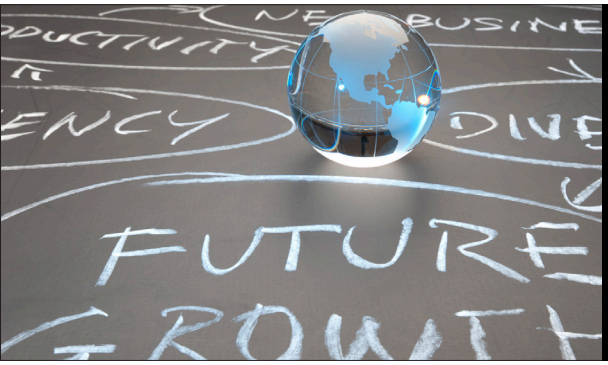


Economic Letter

Risk, Uncertainty Separately Cloud Global Growth Forecasting

by Alexander Chudik, Enrique Martínez-García and Valerie Grossman

ABSTRACT: Forecasts of global growth have historically been imprecise, punctuated by periods of optimism and pessimism. Inaccuracy in forecasting partly reflects quantifiable risks to the global outlook as well as economic uncertainty.

The reliability of global economic forecasts is an increasingly pressing concern for households, firms and policymakers. The possibility of greater trade and foreign investment opportunity can affect households' income potential and factor into current consumption and savings decisions.

Firms can raise prices, expand their workforces and invest in new productive capacity based on expected strength in world demand rather than just domestic activity.

Thus, how households and firms assess global prospects has major implications for economic activity and ultimately for central bank policymaking.

Growth estimates have been imprecise over the past quarter century, based on a review of the accuracy of forecasts of next-year annual gross domestic product (GDP) growth for 40 advanced and emerging economies.[1] Forecasts for these countries are obtained from Consensus Economics' Consensus Forecasts and the International Monetary Fund (IMF). The nations' collective output represents more than 80 percent of the world's GDP in purchasing power parity-adjusted terms (allowing cross-country comparisons) from 1991 to 2014.[2]

Resulting forecasting errors—the difference between actual growth and the predictions—appear to arise from a mix of risks to the global outlook and underlying economic uncertainty.

Forecasting Accuracy and Biases

The estimated mean of forecasting errors in the sample is slightly negative but statistically indistinguishable from zero, suggesting that forecasters are systematically neither pessimistic nor optimistic about predictions, on average (*Table 1*).

Estimates of the standard deviation of the forecast errors—a measure of how widely distributed the errors are—in the table imply a 90 percent probability that actual global GDP growth will be within a 4.9 percentage-point range for IMF forecasts and a similar range for Consensus Forecasts.[3]

Put another way, there is a 1-in-10 chance that 2016 world GDP growth will be below roughly 1 percent or above about 6 percent, based on the spring 2015 World Economic Outlook from the IMF and the April 2015 release of Consensus Forecasts. It is worth noting, however, that the short time dimension of the sample precludes a statistically meaningful comparison of the two forecasts' performance.[4]

Individual Country Data

Estimates in Table 1 are aggregates based on a limited sample of 24 annual

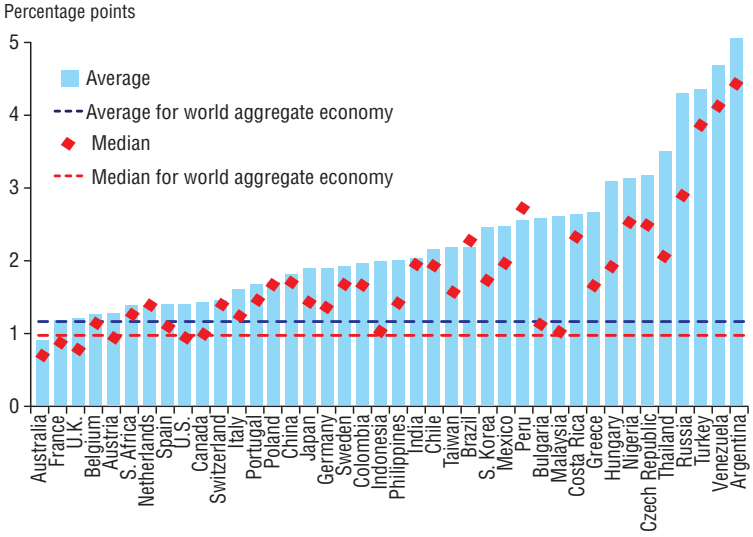
Table 1 Mean Global Forecasts Appear Unbiased; Standard Deviation of Forecasting Errors Is Wide

	Consensus Forecasts	IMF
Mean	–0.27	–0.19
Standard deviation	1.47	1.48
Mean absolute error	1.17	1.15

NOTES: Forecasting errors are defined as the actual gross domestic product growth aggregate minus the aggregated forecast. Mean absolute error is the average absolute value of forecasting errors. Entries are calculated by trimming the IMF sample so its coverage matches that of Consensus Forecasts.

SOURCES: International Monetary Fund's World Economic Outlook; Consensus Forecasts; authors' calculations.

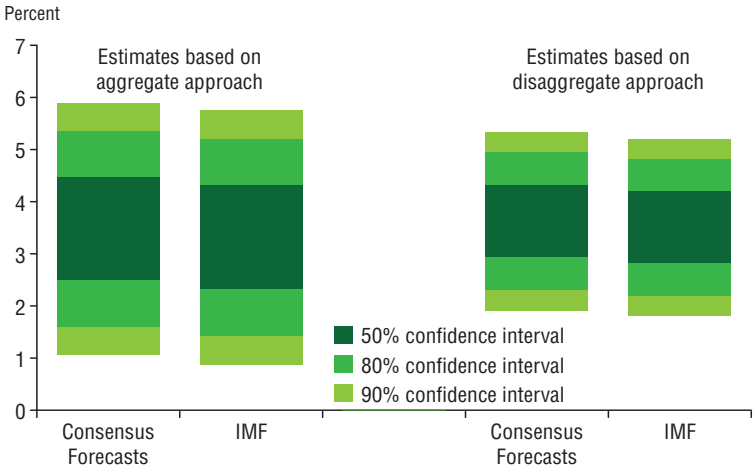
Chart 1 Magnitude of Forecasting Errors Varies Widely Across Countries



NOTES: Forecast errors are based on IMF forecasts. Sample includes countries for which Consensus Forecasts are also available at a given point in time. The blue bars are country-specific averages of historically observed absolute values of next-year forecast errors (based on each year's April releases). Similarly the red diamonds are country-specific medians of the historically observed forecast errors' magnitude.

SOURCES: International Monetary Fund's World Economic Outlook; authors' calculations.

Chart 2 Confidence Intervals Tighten Using Country Data for 2016 Global Growth Forecast



SOURCES: International Monetary Fund's World Economic Outlook; Consensus Forecasts; authors' calculations.

observations. Alternatively, forecasting errors can be obtained for each of the 40 countries included in the world figures—depicted in Chart 1 with IMF country forecasts.

The largest forecasting errors occur in emerging economies—particularly Venezuela and Argentina—which tend to be more volatile. Greece is one of the most difficult of the advanced economies to forecast, perhaps understandably given its debt crisis. Forecasts for Germany, somewhat surprisingly, are also imprecise.

The median magnitude of forecasting errors in almost all countries is less than the corresponding simple average, suggesting that large surprise events (outliers) occur frequently.[5] Moreover, the forecasting performance of the world aggregate exceeds that of any single economy except Australia. Large forecasting errors in individual countries partly disappear when aggregated. The forecasting performance of global GDP generally exceeds that of individual countries in much the same way that investors diversify assets in their portfolios to improve performance by offsetting the idiosyncratic risk of any single investment.

Nevertheless, country-level forecasting errors can be used to obtain an alternative estimate of forecasting accuracy for world GDP growth. Statistical estimates based on such a disaggregate (or bottom-up) approach likely underestimate the extent of forecast error volatility. This provides a lower bound on global growth forecasts' imprecision.[6]

For illustration, Chart 2 provides the estimated confidence intervals around the April 2015 forecasts for 2016 annual growth from Consensus Forecasts and the IMF using the aggregate estimates of forecasting performance data in Table 1 and the estimates obtained using individual country data. The chart shows 9-in-10, 8-in-10 and 1-in-2 chances that actual global GDP growth for 2016 will fall within that interval. The confidence bounds remain quite large using estimates based on disaggregated data even though these estimates likely underestimate the precision of the forecasts.

Roles of Uncertainty, Risk

What can explain the magnitude of these forecasting errors? Two economic

concepts help provide an answer—uncertainty, arising when the probabilities of outcomes cannot be accurately measured or are simply unknown, and risk, related to outcomes whose odds are known or can be learned.[7] The distinction is relevant because people are generally more comfortable making decisions that involve risk instead of uncertainty.[8]

An example illustrates the impact of risk and uncertainty on forecast precision and economic decisions. Consider a farmer who owns a vineyard and must predict the quantity of the annual grape harvest. The farmer knows that grape clusters will average 0.4 pounds with good weather.[9] He can assess the weather risk beforehand and can describe the odds of various outcomes. Suppose the farmer anticipates the chances are 30 percent that the average cluster will weigh 0.3 pounds due to adverse weather, 30 percent that it will weigh 0.5 pounds given benign weather and 40 percent that it will weigh 0.4 pounds in normal weather.

Without weather risk, the farmer gets an average cluster weight of 0.4 pounds with certainty. With weather risk involved, the farmer forecasts a cluster weight of 0.4 pounds based on the given distribution over weather outcomes, but this will result in forecasting errors because 60 percent of the time, the cluster weight will be above or below the predicted 0.4 pounds. Hence, weather risks—and risky events in general—contribute to the imprecision of forecasts.

Consider an alternative scenario in which the distribution of cluster weight outcomes depends on whether an irrigation channel is expanded to bring in water from elsewhere. The crucial aspect of uncertainty in this case is that—unlike risk—the farmer is unsure about the odds of each possible event.

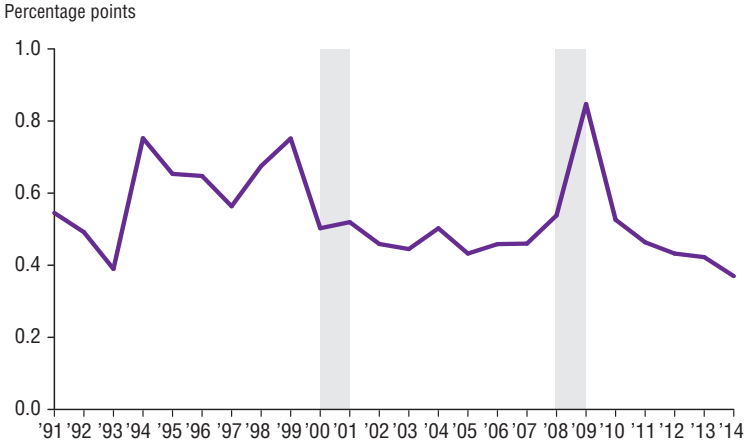
When dealing with the uncertainty of outcomes and their distribution, different farmers may well arrive at different forecasts depending on the views they form about the likelihood of the irrigation channel expansion. In other words, uncertainty leads to disagreements among forecasters and makes it more difficult to forecast events with precision.

In this sense, we can get an idea of the importance of uncertainty surrounding the global growth forecasts by measuring forecasters' disagreements. This is imperfectly captured by the standard deviation of Consensus Forecasts panelists' prognostications for each country's anticipated growth result (*Chart 3*).

Forecasting disagreements were low before the 2008 global recession; forecasters were in close agreement then—and yet wrong, too. Disagreement among forecasters almost doubled in 2009, suggesting heightened uncertainty as the global economy struggled from the effects of the global recession. Forecasting disagreements returned to their prerecession levels by 2010–11—coinciding with several years of unrealized optimism about the strength of the global recovery.

Grappling with uncertainty is complicated because it can change over time. However, low uncertainty does not necessarily mean that forecasting errors will also be small because the world economy still faces many risks.

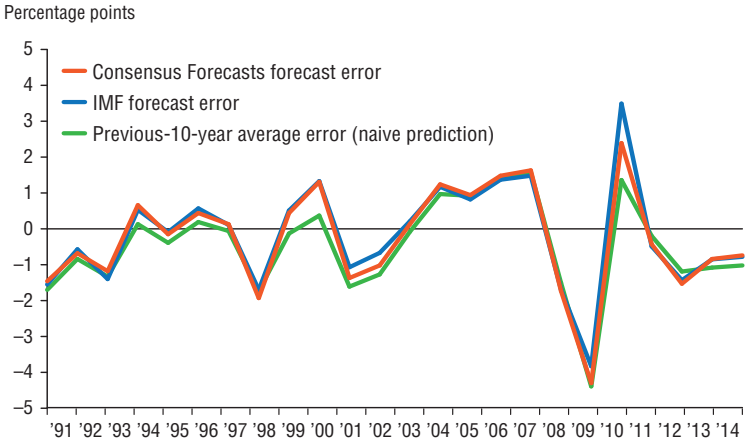
Chart 3 Next-Year Forecast Disagreements Recede from 2008 Global Recession Highs
(Aggregated country-specific standard deviations of real GDP growth)



NOTES: Austria, Belgium, Greece, Portugal, Costa Rica, South Africa and Nigeria are excluded due to lack of data. The standard deviations of the forecasts are aggregated using purchasing power parity-adjusted gross domestic product weights for the remaining 40 countries (see note 1), entering the sample as their data become available in Consensus Forecasts. Shaded bars indicate global recessions.

SOURCES: Consensus Forecasts; International Monetary Fund; authors' calculations.

Chart 4 Forecasting Errors Resemble Those from Backward-Looking Benchmark



NOTES: Forecast errors are defined as actual global gross domestic product growth minus the forecast. Availability of Consensus Forecasts determines which countries are included in the sample.

SOURCES: International Monetary Fund's World Economic Outlook; Consensus Forecasts; authors' calculations.

Lessons for the Future

Global growth forecasting performance helps provide insight into the inherent risks and uncertainty surrounding the global outlook. Periods of sizable forecasting errors have regularly emerged since the 1990s, and it is unclear whether consistently better forecasts can be obtained. Thus, the accuracy of forecasts from Consensus Forecasts and the IMF can be closely matched with that of a naïve prediction of next year's global growth obtained by averaging observed global GDP growth over the past 10 years (*Chart 4*).[10]

These results in some respects mirror the Chinese philosopher Lao Tzu's axiom on prediction: "He who knows does not predict. He who predicts does not know." More pragmatically, improved forecasting accuracy can perhaps still be achieved (at least to some extent) from ongoing research that deepens the understanding of globalization and the interconnectedness of world economies.

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Notes

The authors thank Bradley Graves and Kuhu Parasrampuria for research assistance. Martínez-García grew up among vineyards, seeing his father weigh the risks for the harvest at every turn—constantly making predictions regarding the price of grapes, based on global demand and supply, on which his yearly income ultimately depended. He dedicates this *Economic Letter* to him.

[1] Due to a lack of real-time data for all countries, GDP from the April 2015 data vintage of the IMF World Economic Outlook is used. The 40 countries in the Dallas Fed's Database of Global Economic Indicators are the U.S., U.K, Austria, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, Canada, Japan, Greece, Portugal, Spain, Turkey, Australia, South Africa, Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Venezuela, Taiwan Province of China, India, Indonesia, Korea, Malaysia, Philippines, Thailand, Nigeria, Bulgaria, Russia, China, Czech Republic, Hungary and Poland. The global growth aggregate is defined as the purchasing power parity-weighted average of the 40 countries. Weights are time invariant based on IMF data for 2010–15.

[2] Country forecasts for annual GDP growth from Consensus Forecasts and the IMF are collected in April, coinciding with the spring release of the IMF's World Economic Outlook. Consensus Forecasts represents the mean of its panelists. Data for some economies are missing at the beginning of the sample; end-of-sample coverage is complete.

[3] A standard deviation is a statistical measure that quantifies the amount of variation present in the data. The width of the 90 percent confidence interval is calculated as (2 x 1.645 x standard deviation) under the assumption that forecasting errors are normally distributed.

[4] Notwithstanding limitations due to the short time dimension, Consensus Forecasts and IMF forecasts are not exactly comparable because the timing of forecast releases does not exactly coincide. For consistency, Consensus Forecasts availability determines which countries are included in the IMF sample.

[5] The median is a number separating the higher half of data in the sample from the lower half. A median gives less importance to outliers than a simple average.

[6] Country-level forecast errors can be correlated across countries. Therefore, the key to estimating the precision of global growth forecasts with disaggregated country-level forecast errors is the estimation of their covariance matrix. This article employs a Ledoit and Wolf (2004) shrinkage estimator, which favors forecasters by shrinking the covariance matrix toward the diagonal. See "A Well-Conditioned Estimator for Large-Dimensional Covariance Matrices," by Olivier Ledoit and Michael Wolf, *Journal of Multivariate Analysis*, vol. 88, no. 2, 2004, pp. 365–411.

[7] Uncertainty goes beyond situations in which we cannot measure the odds of events, as in this example, and includes cases for which we don't know all possible outcomes. The distinction between risk and uncertainty is thought to be first articulated in economics by Frank Knight in his 1921 treatise *Risk, Uncertainty, and Profit.*

[8] The preference to act on known rather than unknown probabilities is called the Ellsberg paradox. See "Risk, Ambiguity, and the Savage Axioms," by Daniel Ellsberg, *Quarterly Journal of Economics*, vol. 75, no. 4, 1961, pp. 643–69.

[9] Each annual harvest depends primarily on the actual number of vines per acre, the number of clusters per vine and the cluster weights. Cluster weight is the key for forecasting because this is the component that varies the most over the years due to environmental conditions, grape variety characteristics, changes in farming practices (for example, irrigation and fertilizers) and diseases, among others.

[10] The average magnitude of these forecasting errors is: IMF (1.2 percentage points), Consensus Forecasts (1.2) and the naïve benchmark (1.1). However, the small history of available forecasts precludes a reliable ranking of these forecasting models at conventional statistical significance levels.

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