Moody's ANALYTICS

ANALYSIS

# About the Moody's Analytics Global Macroeconomic Model


## Prepared by

Mark Hopkins
Mark.Hopkins@moodys.com
Director

## Contact Us

Email
help@economy.com

U.S./Canada
+1.866.275.3266

EMEA
+44.20.7772.5454 (London)
+420.224.222.929 (Prague)

Asia/Pacific
+852.3551.3077

All Others
+1.610.235.5299

Web
www.economy.com
www.moodysanalytics.com


## Introduction

The Moody's Analytics global macroeconomic model produces forecasts for more than 10,000 time series across 64 countries that collectively constitute more than 95% of global GDP. The model consists of a single, simultaneous system of structural economic equations that allow for a variety of cross-country interactions through demand, price and financial market linkages. The model equations are all specified according to established macroeconomic theory, with parameters estimated econometrically using historical data. A baseline and a number of alternative scenario forecasts are produced at a quarterly frequency, extending over a 30-year time horizon. These forecasts are updated each month to retain consistency with the most recent available economic data, and are used as inputs to a range of additional Moody's Analytics products, including subnational, housing and credit market forecasts.

THIS DOCUMENT PROVIDES A HIGH-LEVEL VIEW OF OUR MODEL METHODOLOGY. PLEASE CONTACT US TO VIEW THE FULL DOCUMENT.

# About the Moody's Analytics Global Macroeconomic Model

BY MARK HOPKINS

The Moody's Analytics global macroeconomic model produces forecasts for more than 10,000 time series across 64 countries that collectively constitute more than 95% of global GDP (see Chart 1). The model consists of a single, simultaneous system of structural economic equations that allow for a variety of cross-country interactions through demand, price and financial market linkages. The model equations are all specified according to established macroeconomic theory, with parameters estimated econometrically using historical data. A baseline and a number of alternative scenario forecasts are produced at a quarterly frequency, extending over a 30-year time horizon. These forecasts are updated each month to retain consistency with the most recent available economic data, and are used as inputs to a range of additional Moody's Analytics products, including subnational, housing and credit market forecasts (see Chart 2).

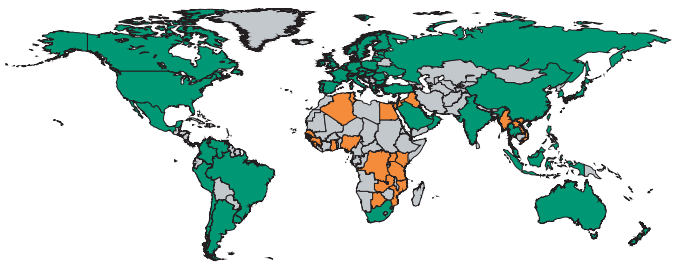
The historical data series forecast in the model are sourced directly from national statistical offices wherever possible, to ensure that the forecasts reflect the most accurate and timely information available. Data from third party aggregators such as the World Bank and International Monetary Fund are used to supplement these sources when primary sources are not available, or to improve cross-country consistency. Often, to maximize the quality, methodological consistency and cross-country comparability of forecasts, historical data are sourced from proprietary estimated series.[1]

In addition to producing forecasts for individual countries, the model reports a number of aggregated forecasts. These provide breakdowns by geographical region (for example, South America, Europe) and by income (developing versus developed Asia, for instance), as well as groupings reflecting major institutional arrangements such as the EU and the euro zone. Throughout the model, Moody's Analytics employs a "top-down, bottom-up" methodology to forecasting, meaning global growth projections are constructed from a large array of forecasts for consumption spending, investment and trade across individual countries. These building blocks, however, depend in turn on a set of global drivers and various "high level targets" that can be adjusted by the model user to produce alternative forecast paths across thousands of global series quickly and efficiently.

The model consists of separate blocks of equations capturing relationships across series within each national economy, interacting together through a range of cross-country linkages (see Chart 3). These various channels allow the propagation of simulated shocks throughout the domestic economy

## Chart 1: Global Forecast Coverage

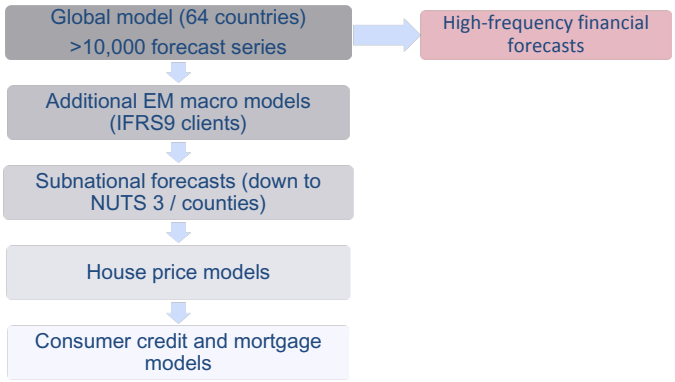
Mar 2018



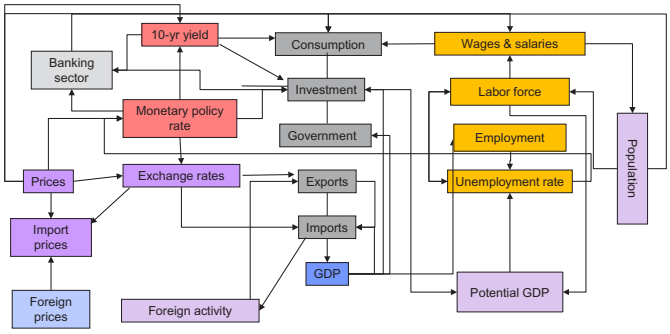

Source: Moody's Analytics

1 Standard examples include wages, disposable income and house prices, which are often reported on an inconsistent basis by national sources, but which often serve as the basis for cross-country comparisons. NIPA variables such as GDP are reported on a standardized, seasonally adjusted annualized basis, both in local currencies and in three comparable currencies: U.S. dollars, euros and PPP (purchasing power adjusted U.S. dollars).

## Chart 2: Global Forecasting Architecture




## Chart 3: Sample Country Model Structure




as well as into global markets, influencing the forecasts in other countries as well. The cross-country linkages in the model include:

- **Trade**: Exports are tied to a trade-weighted average of the imports of the exporter's five largest export markets. Exports also depend on the real effective exchange rate, which depends on foreign prices and exchange rates.
- **Finance**: Among those countries with liberal current accounts and convertible currencies, global financial arbitrage activity exercises a strong impact on domestic interest rates, equity prices and exchange rates. In particular, while short-maturity interest rates are driven largely by central bank policy, longer-maturity bond yields in convertible currencies are linked through uncovered interest rate parity to a global benchmark rate, proxied by the U.S. Treasury yield. Within the euro zone, the German 10-year is used as the benchmark for other member countries.
- **Prices**: Generally speaking, the inflation rate in economies with a fixed exchange rate is anchored by the growth rate of foreign prices. Inflation in countries with a floating exchange rate is anchored by inflation expectations, but influenced by a number of global factors, including commodity prices (particularly oil prices), exchange rates, and the price of foreign goods.
- **Balance of Payments**: Direct and portfolio investment flows are modeled as part of the financial account of the Balance of Payments. Direct investment flowing into and out of the country depends largely on investors' expectations of growth and a country's competitiveness, defined by its real effective exchange rate. Portfolio capital flows are forecast on a net basis, with a specification motivated by the Balance of Payments identity that the current, capital and financial accounts must sum to zero.
- **Investment**: FDI inflows act as a driver of domestic investment, and thus GDP. In practice, this effect tends to be weak. Frequently psychology plays a more important role in explaining cross-country contagion patterns in investment. To capture this effect, expectations of future domestic GDP growth, which affect investor decision-making in both the goods and financial markets, are specified to include the concurrent economic performance of the large engines of global growth: the U.S., the euro zone, China, and Japan.

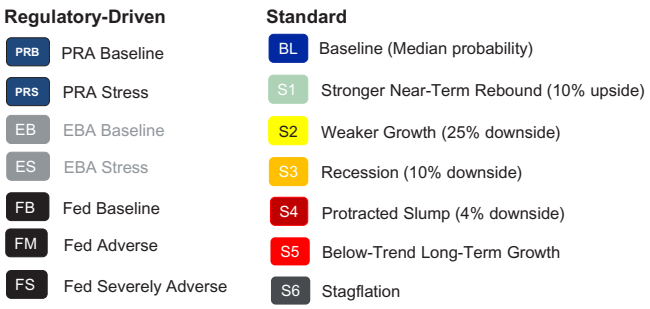
Roughly speaking, macroeconomic models are employed for three main purposes—forecasting, insight and shock evaluation—and the model serves as a valuable tool for each of these. Clients can use the model to predict future values of key economic time series such as output, interest rates and inflation; to produce counterfactual scenario projections of those variables under varying sets of assumptions; and to facilitate their economic understanding of these outcomes by tracing the path of "cause and effect" as shocks propagate throughout the global economy.

At the heart of the Moody's Analytics forecasting methodology is a recognition that while a bespoke, purpose-built model may be the optimal tool to answer any specific question, no model can be superior in all cases. Nevertheless, modeling costs, clients' desire for consistency and transparency in our analysis and results, and regulators' desire for methodological clarity, uniformity and process governance all demand the ability to make predictions from a single, flexible, transparent and heavily vetted macroeconomic forecasting model.

With this in mind, the model was constructed to accommodate and balance a wide array of objectives and competing trade-offs, including forecast accuracy, consistency of forecasts across concepts, model stability, a solid theoretical foundation, and flexibility and efficiency across multiple client use cases, including baseline forecasting, policy evaluation, regulatory stress-testing, and expected loss accounting.

Scenario solutions can be implemented in a number of ways. Moody's Analytics publishes an array of standard scenarios covering a range of possible risks and forecast probabilities, as well as all the major regulatory scenarios conducted by regulators in the U.S. and Europe (see Chart 4). These off-the-shelf scenarios include downside and upside scenarios with severities specially calibrated to specified benchmark probabilities, which can

## Chart 4: Example Global Scenarios




be used to generate expected loss calculations under IFRS9 rules.

Alternative scenarios can also be generated by model users themselves, via the Moody's Analytics new, cutting-edge collaborative forecasting platform. This web-based application puts users in the driver's seat, allowing them to alter inputs to the model, individually or in globally distributed teams working together in real time through the platform, to produce customized baseline outlooks and alternative scenario paths, all with the rigorous forecast governance necessary to satisfy regulatory requirements.

## About the Author

Mark Hopkins is a director at Moody's Analytics, with responsibilities for international macroeconomic research and global forecasting, including the design and maintenance of the Moody's Analytics suite of country forecast models. Dr. Hopkins has also been responsible for forecasting Canada's economy and U.S. federal fiscal policy. Previously, he taught macroeconomics at Gettysburg College and served as international economist on the staff of the President's Council of Economic Advisers. He has published in the areas of international economics, economic growth, and foreign policy. He received his PhD in economics from the University of Wisconsin-Madison, an MSc from the London School of Economics, and a BA from Wesleyan University.

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Moody's Analytics added the economic forecasting firm Economy.com to its portfolio in 2005. This unit is based in West Chester PA, a suburb of Philadelphia, with offices in London, Prague and Sydney. More information is available at www.economy.com.

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