Improving Macroeconomic Predictions for the ERS Baseline Projections

Wendy Zeng, USDA, Economic Research Service, and James Davis, University of Georgia

Abstract

Every year, the USDA, Economic Research Service (ERS) generates and publishes 10-year projections on key macroeconomic indicators.[1] An econometric approach offers potential improvements to the existing ERS projection methodology by addressing three critical shortcomings.

- First, developing an in-house projection model would allow ERS to provide further transparency behind the generation of forecast numbers for researchers and policymakers alike.
- Second, ERS relies on subject matter expert revisions for their final projections, which are subject to potential biases and often vary by expert. Forecasts from an in-house model would be free of such biases and variation of biases.
- Finally, ERS does not compare the accuracy of their forecasts sourced from proprietary data to benchmark time series models to assess any information gains.

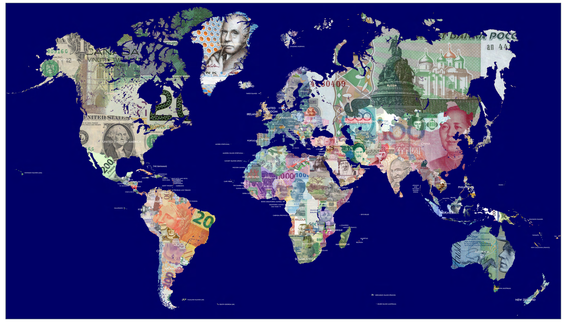
Implications: ERS should consider an in-house projection model alongside its traditional forecasting method derived from proprietary sources and expert revision.

Research Question

How does the performance of forecasts generated from an auto-regressive integrated moving average (ARIMA) model compare to those of past ERS forecasts?

Background

- ERS compiles their 10-year projections from multiple sources, including forecasting services such as Oxford Economics and IHS Global. The forecasts are combined with historical series from the World Bank or International Monetary Fund (IMF) to create a complete series of realized and projected values.
- ERS projects Real Gross Domestic Product (Real GDP), Gross Domestic Product Deflator, Consumer Price Index (CPI). Real Exchange Rates, Population, and Real Gross Domestic Product per Capita (Real GDPPC).



- These six indicators provide a general economic snapshot for each country as well as tor larger geographic regions (e.g., North America), income aggregates (e.g., developing vs. developed countries), and the world.
- ERS publishes these projections in the Intemational Macroeconomic Baseline Report, which is used by policymakers for budget allocation and resource planning. Most importantly, these macroeconomic projections provide the fundamental inputs into the development of the World Agricultural Supply and Demand Estimates (WASDE) published by ERS.

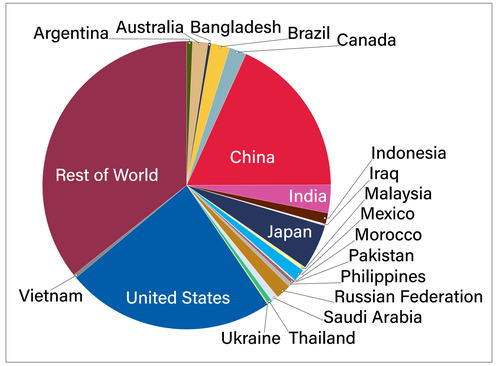
Table 1

Selected countries for ARIMA analysis

Country	Code
Argentina	ARG
Australia	AUS
Bangladesh	BGD
Brazil	BRA
Canada	CAN
India	IND
Indonesia	IDN
Iraq	IRQ
Japan	JPN
Malaysia	MYS
Mexico	Mex
Morocco	MAR
Pakistan	PAK
Philippines	PHL
Saudi Arabia	SAU
Thailand	THA
Ukraine	UKR
United States	USA
Vietnam	VNM

Figure 1

2021 Real GDP of selected 21 countries and rest of world



Source: World Bank GDP Series and author's calculations.

ARIMA Model

We utilize an algorithm for optimal model selection that minimizes information loss. This approach determines the appropriate number of lags, differencing, and moving average terms in a generalized ARIMA (p,d,q) equation:

$$\left(1-\sum_{i=1}^{p}\alpha_i L^i\right)(1-L^d)X_t=\left(1-\sum_{j=1}^{q}\theta_j L^j\right)\epsilon_t$$

where X is the forecasted variable, p is the number of lags, d is the order of differencing, and q is the number of moving average terms. The estimated parameters include α, the coefficient for the autoregressive term lag order L^i, θ, the coefficient for the moving average term lag order L^j, and ϵ_t, the error term at time t.

We train our ARIMA model of GDP using annual historical World Bank (WB) GDP data for 21 countries. The final model for each country is selected according to the Akaike Information Criterion with a correction for small sample sizes (AICc). Once the model is fitted, we then predict 11 steps ahead so that the set of projection we produce correspond to the projection window of past ERS baselines of the given year plus 10 years forward. Then, we calculate accuracy measures for ARIMA and ERS projections from 2000 to 2020 relative to the historical WB data, using the root-mean-squared error (RMSE) and mean absolute error (MAE) statistics for each country and projection year.

Results

Table 2

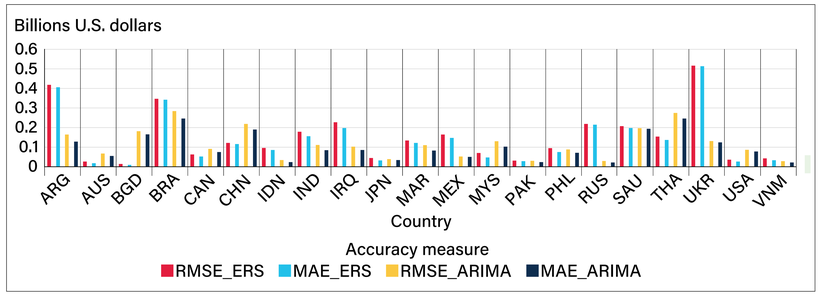
Accuracy measures over all countries and all base year forecasts

Years	RMSE ERS	RMSE ARIMA	MAE ERS	MAE ARIMA
Full 10	0.088	0.115	0.077	0.102
First 5	0.064	0.081	0.057	0.074
Last 5	0.116	0.155	0.111	0.150

Source: World Bank GDP Series, USDA Agricultural Projections, and author's calculations.

Figure 2

Accuracy measures by country for base year 2011



Note: ERS VS ARIMA accuracy, 2012–2021.

Source: World Bank GDP Series, USDA Agricultural Projections, and author's calculations.

References

[1] U.S. Department of Agriculture, Economic Research Service. International Macroeconomic Data Set.

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE

Contact Information:
Wendy Zeng: wendy.zeng@usda.gov
James Davis: james.davis1@uga.edu

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