2020 VISION

PROSPECTS FOR GLOBAL FOOD SECURITY: A CRITICAL APPRAISAL OF PAST PROJECTIONS AND PREDICTIONS

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There have always been speculations and forecasts about the world's capacity to feed itself. In the first edition of his *Essay on the Principle of Population* (1798), Thomas Malthus formally framed the debate about whether food resources would be sufficient to feed an increasing world population. Since then, the same basic question has been raised, but from many different perspectives. On one end of the spectrum, people have generated scenarios/predictions based on partial and generally qualitative analysis, while on the other end, projections have relied on quantitative models based on historical data. It would seem plausible that whatever the approach followed, qualitative or quantitative, the credibility of the analysis should depend on the degree of accuracy of the forecasts. In that sense, one would expect an extensive literature evaluating these forecasts. However, to date, few studies have undertaken a comparison of predictions and projections with actual outcomes. As modeling and projecting global food security continues to grow more complex and expensive, revisiting the key predictions and projections of the last half century, and assessing how accurate they were, should provide valuable insights for future exercises.

FIFTY YEARS OF PROJECTIONS

There have been at least 30 quantitative estimates of future world food security in the past 50 years. While the Food and Agriculture Organization of the United Nations (FAO) and United States Department of Agriculture (USDA) have regularly produced forecasts since the 1960s, other agencies, including the Organization for Economic Co-operation and Development (OECD), the International Food Policy Research Institute (IFPRI), and the International Institute of Applied Systems Analysis (IIASA), have also occasionally produced their own forecasts. These forecasts have been based on two types of models: trend projections and world trade models.

Because of differences in such things as data sources, model specifications, time frames, and commodity coverage, consistent cross-model comparisons are virtually impossible at the global level. The heterogeneity in models reduces their usefulness to policymakers in general, even though the models may serve the purposes of their specific agencies. However, even the same organization has often employed different predictive models, preventing model comparisons within agencies. Thus, quantitative comparisons of model performance can only be done a model at a time, comparing the particular model projection to actual data for the projection year.

Comparing food balance projections within three agencies, FAO, USDA, and IFPRI, reveals that (1) global projections are more accurate than those disaggregated by region, (2) the smaller the country or region, the higher the projection error, (3) FAO and USDA seem to consistently underestimate global projections of both production and consumption, and (4) the size of errors in developed-country projections is surprisingly large, given that data problems should not be an issue. The latter problem could indicate the difficulty of incorporating complex domestic policies into analysis.

Across models, projection errors at the global level were found to hide larger errors when disaggregated. For example, even though a set of global projections may be quite close, say ±5 percent of the actual, one component region may be underestimated by 25 percent, while another is overestimated by 30 percent. Whether such global projections can be trusted is an issue to be seriously considered, because in reality they are the net of being wrong twice, once in each direction. Comparing models, the smaller the country or region, the worse the projection seems to be. Data problems are also a major cause of error.

Overall conclusions from analyzing quantitative projection models indicate that global projections with 5- to 10-year horizons are more accurate than for longer periods of 15 to 30 years, because historical trends on which the former projections are based are least likely to change in the short run. Projections are also more accurate for aggregations of components such as regions or commodities, than for the component parts themselves. Yet the most frequent use made of global models appears to be to evaluate countries or regions, not the global outcomes. Differences in model specification seem to explain fewer of the variations in the model performance than do choices about data sources and commodities, for example. Analysis also shows that agencies making projections sequentially do not make more accurate predictions over time, except, to some extent, in the case of FAO's short-term commodity projections.

QUALITATIVE PREDICTIONS VERSUS QUANTITATIVE PROJECTIONS

In terms of qualititative predictions, FAO has produced six World Food Surveys since World War II, with the latest one in 1996. Over the course of these efforts FAO has improved

its methodology and database. Nevertheless, these surveys, together with USDA's World Food Budget of the 1960s, have been criticized for their strong Malthusian bent. Their approach underestimates food availability and overestimates needs.

In the late 1960s, concern about increasing population growth and poverty also resulted in the regular issuance of largely pessimistic predictions. Massive food aid shipments to stave off famine in India in the late 1960s, followed by the Green Revolution gains of the 1970s, and increased focus on natural resource constraints since the 1980s, each fueled its own blend of optimism and pessimism when it came to predicting the global food outlook. Notable among these predictions are works by William and Paul Paddock in the 1960s, and Lester Brown and Paul Ehrlich since the 1970s. While most of these pessimistic predictions have not come true, the goal of the authors may, in fact, have been to move the policy debate in a particular direction by highlighting scenarios and variables of particular concern to them, and thereby reducing the chances of their predictions coming true.

Qualitative predictions of global negative outcomes, such as large-scale famines, have found limited validation. There have been no significant famines induced by persistent supply shortfalls since World War II. Nor is there evidence to indicate that significant increases in real food prices loom on the horizon. Moreover, data to 2000 substantiate neither a rosy picture of increased food availability nor a pessimistic picture that land available for agriculture production is declining.

Quantitative projections, on the other hand, seem to have done a better job than qualitative predictions for a number of reasons. Building a model that can be solved requires consistent and clearly defined relations among all variables, unlike ad hoc qualitative models. Estimating models based on historical trends has the advantage of transferring to the future the structure of the interrelationships among variables that were consistent in the past. This also builds in many complex and not fully specified cross relationships among variables that ad hoc predictions cannot include. Ad hoc approaches also involve extrapolation of particular variables of interest and do not have equilibrating factors such as prices and elasticities built in. As more of these partial, selected components turn negative, there is a tendency to project them individually and see serious problems ahead. In reality, however, these individual variables are part of a much larger complex of tightly interrelated variables, many of which have some degree of substitution among them. Using models rooted in historical trends thus forces a broader and more integrated approach to the problem of predicting food security. Furthermore, widely publicized predictions inevitably bring responses. Early projections of significant long-term food gaps that were made assuming constant prices have never materialized because as shortages emerged, prices rose, producers responded positively, and consumers responded negatively.

CONCLUSION

The limitations identified here for both projections and predictions of the future world food outlook should provide a cautionary tale for researchers and policymakers. Researchers also need to assess conditional ("what if") forecasts of possible future scenarios (based on alternative assumptions about crucial variables). Most of the USDA "projections" explicitly are scenarios based on alternative assumptions about income or trade. People also engage in analyses that explore what would be required to bring about a desired (normative) future result. The first three World Food Surveys by FAO are clearly of this type. In addition, models and ad hoc predictions provide vehicles for exploring the sensitivity of potential outcomes to particular parameters. For example, IFPRI's IMPACT model has productivity growth as a function of research expenditure, thus allowing IFPRI to "explore" (not project) the consequences of significant reductions in research investments.

Quantitative projections are useful in forecasting actual outcomes given a continuation of past trends and should be judged by how close they come to actual numbers. But, if most predictions and many projections are indeed "what if" conditional forecasts of possible future outcomes, then they are by definition normative, not positive, models. Therefore attempting to validate these models by comparing projected outcomes to actual outcomes is inappropriate. A more suitable test is whether the analysis enriched the policy debate. In fact "failure to come true" could be considered a sign of success because an undesirable outcome was avoided. Forecasts about food security may well alert policymakers and citizens to major issues looming on the horizon that need attention.

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"A 2020 Vision for Food, Agriculture, and the Environment" is an initiative of the International Food Policy Research Institute (IFPRI) to develop a shared vision and a consensus for action on how to meet future world food needs while reducing poverty and protecting the environment. Through the 2020 Vision initiative, IFPRI is bringing together divergent schools of thought on these issues, generating research, and identifying recommendations. The *2020 Briefs* present information on various aspects of the issues.