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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

Empirical Analysis of Agricultural Commodity Prices: A Viewpoint

by

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EMPIRICAL ANALYSIS OF AGRICULTURAL COMMODITY PRICES: A VIEWPOINT

An Extended Abstract

William G. Tomek and Robert J. Myers*

Empirical price analyses should be judged relative to their intended applications. The four general purposes are description of markets, generation of hypotheses, forecasting, and policy analysis. Of these, price analysts have emphasized forecasting and policy simulations using structural models, but results are often fragile implying poor forecasts and raising doubts about the usefulness of simulations. Price analysts have, however, proposed many innovative models which are plausible descriptions of market behavior. Typically these models must be treated as hypotheses deserving further testing, and unfortunately results are rarely subjected to additional evaluation and winnowing.

We review contributions to structural and time-series analyses of commodity markets, identify sources of problems in price analyses, and suggest ways of improving future analyses (Review of Agricultural Economics, January 1993 and Cornell University Agricultural Economics Working Paper 93-1). With respect to structural models, the published article emphasizes models of supply, demand, and the price determination process. The Working Paper adds brief discussions of models of commodity characteristics, marketing margins, and storage and seasonal price behavior.

Our review indicates that individual pieces of research are innovative, but that modelers face a vast array of difficult choices. There are, for example, many potential sources of dynamic behavior in commodity prices, and different specifications are often broadly consistent with observed behavior. This raises the question of whether different analysts, facing precisely the same set of problems, would make the same choices. We think not, at least as research has been done in the past. One goal is to move toward a set of principles which would help guide modeling choices.

At present, relatively little has been done to discriminate among competing structural models which purport to describe the same phenomenon. Useful comparisons of models probably require confirming results, but the accumulating evidence suggests that it is difficult--sometimes impossible--to confirm published research. Even when models can be confirmed, results are typically not robust to small changes in the sample, such as data revisions or updating, nor to minor changes in the model specification.

The reasons for fragility of results include the quality and quantity of data relative to the research problem, the propensity for structural change, and possible use of inappropriate estimators and inference procedures. There is a paradox that on the one hand, agricultural economists have used many of the latest econometric techniques but on the other hand, have been relatively less interested in appraising and comparing the quality of results, including testing

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whether exogenous variables are indeed exogenous, whether overidentifying restrictions are valid, and whether results are robust to small changes in data or model specification.

With respect to time-series analyses, the article first examines what we know about the time-series properties of commodity prices. Existing evidence suggests that high frequency data (data sampled at daily, weekly, or even monthly intervals) contain stochastic trends (unit roots); have time-varying volatility (conditional heteroscedasticity); and are not normally or lognormally distributed (due to asymmetries and excess kurtosis). However, as one moves to lower frequency (annual) data, the evidence for each of these characteristics diminishes for reasons that are not yet well understood. Commodity prices and other commodity market variables may also contain common stochastic trends (i.e., be cointegrated), so that they move together in some form of long-run equilibrium relationship.

These time-series characteristics have potentially important implications for structural econometric modeling of commodity markets. In particular, if prices have stochastic trends and are cointegrated with other commodity market variables, then many estimated supply and demand equations are cointegrating regressions. In this case, ordinary least squares is a consistent estimator of the supply or demand coefficients, despite the existence of simultaneous equations bias in small samples. Furthermore, both ordinary least squares and traditional instrumental variables estimators, such as two-stage least squares, generally have non-standard limiting distributions when models are characterized by stochastic trends and cointegration. This means conventional normal distribution theory cannot be used in hypothesis testing, *even when relying on large sample results*, which casts doubt on standard hypothesis tests. Some approaches to correcting this problem are discussed in the article. Time-varying volatility and excess kurtosis also reduce estimation efficiency and can cause problems in maximum likelihood estimation.

Structural and multivariate time-series models are often contrasted, one as founded in economic theory and the other as largely atheoretical. Yet several methods for imposing "structural" identification schemes in time-series models have been developed and are discussed in the article. The difference between identification in time-series models and traditional identification in structural simultaneous equations models lies in the number and type of identification restrictions used. Structural models opt for extensive sets of overidentifying restrictions (which are rarely tested) while time-series models focus on minimal just identifying restrictions, in order to be consistent with a broader set of theories about how the market or economy actually works. In between these extremes lies a continuum of alternative identification schemes. In our view, each of these approaches is valid and the preferred alternative should be application specific, depending on the nature of the problem, the quality of the data, and the confidence one has about knowledge of the underlying data generating process.

At the end of the article, suggestions are made for moving towards improved price analyses. The first suggestion is for a renewed interest in data and data quality. While this is hardly controversial, it bears repeating because, as a profession, we seem to pay a lot more attention to the latest econometric techniques than to the quality and quantity of data. Second, we argue for more emphasis on preliminary analyses to determine the time-series and distributional

properties of the data series being used. This should facilitate a more appropriate choice of estimation and hypothesis testing framework. The third suggestion is that identification schemes be more problem specific. Since the true model generating the observed data is usually uncertain, the historical predisposition of price analysts to employ highly restricted models is, in our view, often unwarranted, especially if the restrictions are not clearly justified by the research problem. Legitimate alternative approaches to identification exist and imposing a particular identification scheme does not make it the truth, particularly when the chosen scheme is the result of extensive pre-testing. Fourth, we suggest that analysts provide more information on tests of model adequacy. These would include tests of assumptions, tests of model restrictions, and tests of model robustness. The fifth and final suggestion is that confirmation and replication of key prior results be done before further research is undertaken. Confirmation is a basis for demonstrating that new results improve upon the old.

It is increasingly apparent that it is very difficult to generate useful structural information on agricultural commodity prices and markets from observational data. Yet, we will continue to try, because questions surrounding economic structure and cause and effect are what interest price analysts most, and also represent their greatest potential contribution. It is clear that useful analyses require a depth of scholarship and work that is rarely evident in past research. Our hope is that the issues and suggestions raised in our article will help move us forward.