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Forecasting food prices: The case of corn, soybeans and wheat

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ABSTRACT

Given the high correlations observed among food prices, we analyse whether the forecasting accuracies of individual food price models can be improved by considering their cross-dependence. We focus on three strongly correlated food prices: corn, soybeans and wheat. We analyse an unstable forecasting period (2008–2014) and apply robust approaches and recursive schemes. Our results indicate forecast improvements from using models that include price interactions.

1. Introduction

Food prices have shown strong correlations in the past, even before their upward co-movement over recent decades. For instance, the commodities included in the World Bank's food price index for the period 1990–2013 (on a monthly basis) show price correlations of well over 0.60, and even up to 0.85 for some subsets. We therefore explore whether or not the forecast accuracies of a subset of these commodity prices could be improved by taking their cross-dependence into account. Some might think that this is an old question that has already been answered, as simultaneous modelling did not survive after the 1973 oil crisis, due to the poor forecasting performances of macro models relative to naïve forecasts. However, we now have a better understanding of the effects of breaks on forecasting. Various different devices and methods, such as robust transformations and updating, may be useful for forecasting in the presence of breaks, and can also be applied for joint and other models that consider cross-dependence.

We focus on three food prices which are strongly correlated: corn, soybeans and wheat. These are agricultural commodities that, whether directly or indirectly, feed a large part of the world's population. There has been a special interest in understanding the common behaviours of their prices since the 2000s, when their downward trend reversed, as the demand for them started to increase significantly, driven by the unprecedented growth of emerging economies such as China and India. The demand for oilseeds has also increased greatly, due to their competing use as biofuels. Because of these effects, and also due to various macro and financial developments, their prices have experienced a long-term boom, along with many other food, mineral and energy commodities.

We are interested mainly in developing conditional forecasts of food prices in which the out-of-sample values of the weak exogenous variables will come from outside the model; that is, will be provided by the forecaster (e.g., from organizations such as the World Bank, FAO, IMF or USDA). These values should respond to conjectural scenarios about the future behaviours of the regressors, in order to quantify what would happen to corn, soybean and wheat prices if, for example, the economy of China decelerated at a given rate, or the US monetary policy changed. Thus, using the conditional forecasting models should also make it possible to project what might happen to food

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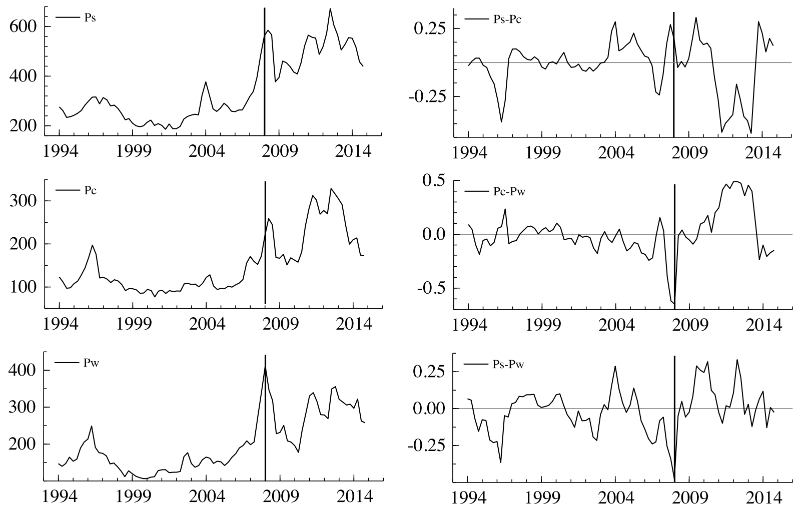

Fig. 1. Nominal absolute and relative prices from 1994 to 2014 (in US dollars). Note: The relative prices are calculated mean-adjusted. The vertical lines indicate the beginning of the out-of-sample period.

prices given a range of assumptions regarding the paths of the explanatory variables employed in the model. To allow for the effects of these variables, a necessary condition is to evaluate the forecasting accuracy of the econometric models over a given pseudo out-of-sample period and forecast horizon.

In this paper, our out-of-sample period includes the 2008–2009 world crisis and its aftermath, together with the recent reversion of the upward trend in commodity prices. As part of model selection, we pay special attention to the cross correlation of prices that motivated the discussion about single vs. joint modelling of these food prices. Forecasts are developed for one and four quarters ahead. For the multi-step forecasts, both iterated and direct approaches are tried. Robust model transformations (which keep the effects of the conditioning variables) and other robust forecast methods are also applied for comparison purposes, due to the unstable behaviour of the food commodity prices studied.

The next section describes the data and briefly reviews the empirical literature. Section 3 presents various different forecasting strategies. Sections 4 and 5 provide the estimation and forecast results, respectively. Section 6 evaluates forecasting biases and pseudo out-of-sample breaks. Finally, Section 7 concludes.

2. Data

This section describes the data used to estimate our forecasting models. Our data set of the nominal prices of corn, soybeans and wheat is quarterly over the period 1994Q3–2014Q4 (82 observations). Since our forecasting period starts in 2008Q1, we can observe what happens to the forecast accuracy of the models as the world crisis evolved and the last super boom seemed to end. Fig. 1 shows the joint behaviours of these three prices over the sample period.

Corn, soybeans and wheat behave similarly over the whole sample period, even before the upward trend that was observed from the early 2000s. In fact, the cross-correlations among them, on a quarterly basis, are higher than 0.9 for the whole sample. However, the relative prices also show instability over the last five years of the sample.

Although our estimations are on a quarterly basis, the production of corn and soybeans enter our model on a yearly basis. For them, we repeated the values of the estimated production published by the U.S. Department of Agriculture (USDA) in the second quarter of each year. The production of soybeans and corn are concentrated geographically, with the leading exporters being the United States, Brazil and Argentina. Because of this, we consider that, by the second quarter, when the southern hemisphere (Brazil and Argentina) is harvesting the bulk of these commodities and the northern hemisphere's (United States) planting season takes place, the USDA will have reliable estimates of the whole year's production. For wheat, the production of which is dispersed more widely geographically, we used the quarterly averages of the monthly estimates of annual production reported by USDA. Doing this not only improved our econometric models, but also allowed us to use the USDA production projections in a multivariate framework in order to obtain conditional forecasts of these prices.

Our information set uses several potential macro-wide and market-driven explanatory variables of commodity prices that are used commonly in the literature. It includes macroeconomic determinants (like the US monetary aggregates or the US exchange rate) as well as commodity-specific variables (such as production and inventories) and demand factors (such as the growth of emerging countries like China).[1] For further data definitions and the sources of the variables included in our models, see Appendix A.

Fig. 2 shows the behaviours of production and inventories of the commodities studied.

[1] Futures prices for explaining (spot) food prices are not included, as they would convey the same information that arises from the economic fundamentals.