Excessive Food Price Variability Early Warning System

Methodology

Background of the tool and food price variability

Excessive food price volatility (variability) affects farmers, traders, processors and consumers – and it threatens food security. In the aftermath of the 2007-2008 food price crisis and post-crisis commodity price volatility, the Food Security Portal developed the tool presented here.

The Excessive Food Price Variability Early Warning System identifies periods of excessive price variability (i.e. price variability that exceeds a pre-established threshold), and it is updated on a daily basis to identify days that are within periods of high, moderate, and low price variability. The tool is based on a statistical model that formally models the behavior (fluctuations) of commodity price returns (i.e. day-to-day percentage changes of commodity prices) using futures market prices closest to maturity.

The Excessive Food Price Variability tool provides you with a visual representation of historical periods of excessive global price variability from 2000-present, as well as a daily variability status. It serves as an early warning system for timely responses. Alerts produced by this tool can be used to determine appropriate and timely country-level food security responses.

What the tool identifies:

- Periods of excessive price variability
- Days that are within periods of (high, moderate or low) price variability

Commodities Covered by the Tool

The tool currently monitors prices for maize, wheat, soybeans, rice, sugar, cocoa, coffee, cotton, oil, and natural gas.

The tool formally models stochastic (i.e. random) behavior of (log) returns of commodity prices (futures market prices closest to maturity). The first graph on the individual commodity pages identifies abnormalities or excessive price variability (i.e. price volatility that exceeds a pre-established threshold). This can be compared to the price trend of the particular commodity futures, shown in the second graph on the individual commodity pages of this tool.

A time period of excessive price variability is characterized by extreme price variability in which we observe a large number of extreme positive returns. An extreme positive return is defined as a return that exceeds a certain preestablished threshold. This threshold is normally taken to be a high order (95 or 99%) conditional quantile, (i.e. a value of return that is exceeded with low probability: 5 or 1%). In this model we use the 95% and 97.5% quantiles.

Days in variability reflects the number of continuous days in the current level of variability. For example, 20 days of low variability means that since the last instance of moderate or high variability, there have been 20 days of low variability.

How the model works

The probability that we will observe k days of extreme price returns (returns above the 95% quantile as explained in the definition of excessive price variability) in a period of D consecutive days is defined as:

$$P(X = k) = \binom{D}{k}(0.05)^k(0.95)^{D-k}.$$

We implement a one-sided test based on a normal approximation for the binomial distribution. Using a period of 60 consecutive days that precede any date (i.e. D=60), we test whether the probability value obtained from our stochastic model of returns is larger than the chosen 5% or 2.5% probability of observing extreme return.

Thresholds used in the tool to determine excessive price variability

The tool currently uses the Conditional Value-at-Risk (CVaR) of returns as a threshold to identify periods of excessive price variability:

- Standard measure of the risk of loss for investments in financial economics.
- Uses extremely high estimated quantiles of return (95% and 97.5%) as thresholds for "Excessive Variability."

An additional threshold is being added based on conditional expected shortfall (CES): the expected log return above the 95% quantile, which serves as a more rigorous threshold for alerting on excessive variability than the CVaR.

The decision rule embedded in the color system:

RED or Excessive Variability: If the probability value is less than or equal to 2.5%, the null hypothesis that the number of violations (or days of extreme price returns) is consistent with the expected number of violations from the model is highly questionable. This means that we are in a period characterized by an excessive number of days of extreme price returns relative to that expected by the model; therefore we characterize that date as belonging to a period of excessive variability.

ORANGE or Moderate Variability: If the probability value is bigger than 2.5% and less than or equal to 5%, the null hypothesis that the number of violations is consistent with the expected number of violations from the model is questionable at a low level. This means that we are in a period characterized by a moderate number of days of extreme price returns relative to that expected by the model; therefore we characterize that date as belonging to a period of moderate variability.

GREEN or Low Variability: If the probability value is bigger than 5%, we fail to reject the null hypothesis that the number of violations is consistent with the expected number of violations from the model. This means that the number of extreme price returns is not significantly more than what is expected from the model; therefore we characterize that date as belonging to a period of low variability.

For further technical documentation:

- Download technical documentation of this model
- Download a presentation on this model
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