Food versus fuel: What do prices tell us?

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Abstract

Sorting out the impacts of biofuels on global agricultural commodity prices is impossible without turning to data and distinguishing between the short-run versus the long-run impacts. Using time-series prices on fuels and agricultural commodities, the aim is to investigate the long-run co-integration of these prices simultaneously with their multivariate short-run interactions. Results indicate no direct long-run price relations between fuel and agricultural commodity prices, and limited if any direct short-run relationships. In terms of short-run price movements, sugar prices are influencing all the other agricultural commodity prices except rice. With sugar the number one world input for ethanol, results indicate increased ethanol production is potentially influencing short-run agricultural commodity prices. Overall, results support the effect of agricultural commodity prices as market signals which restore commodity markets to their equilibria after a demand or supply shock.

1. Introduction

As early as 1983, research indicated the potential of fuel ethanol over the next decades to be very disruptive to global agricultural commodity prices (Barnard, 1983). Biofuel may compete for renewable and nonrenewable resources and thus impact its sustainability and that of food (von Ulf, 2007). Over time, an expanding biofuel market will provide commodity producers a choice of producing food for people or feed for automobiles. Economics suggests they will produce whichever is more profitable (Brown, 1980). This food versus fuel trade-off emerged on a global scale with the 2007-2008 world agricultural commodity price crisis (Moen, 2008). The crisis in price spikes was due to a number of mutually reinforcing factors in global agricultural markets: a sharp increase in biofuel demand, rapid economic growth, droughts in key grain-producing regions, high oil prices, a weak US dollar, speculation, and export restrictions (Coffins and Duffield, 2005; Dewbre et al., 2008; Headley and Fan, 2008; Muhannad and Kebebe, 2008; Rajagopal et al., 2007; Seresin, 2008).

Research into this food versus fuel issue is generally investigated by employing economic models including computable general equilibrium (CGE) models and incorporating mathematical simulation. However, in many cases such relationships are established exogenously based on economic theory and expert options with assumed elasticities and parameters. This leaves the models determining agricultural commodity price impacts with no account of their short-run dynamics, but often exclude the interaction between fuel and food prices (Mitchell, 2008). As an example, long-run studies indicate that fuel-price shocks govern agricultural commodity prices (Kinnear et al., 2010; Rosenzweig et al., 2010). Differences in the estimated impact of agricultural commodity prices depend on how the food basket is defined and why the interaction between fuel and food prices is measured. Economic Advisors estimate that the US had only around 3% in 2007 due to ethanol. In contrast, investigations have concluded that biofuel production in the United States is responsible for no more than 4% (Mitchell, 2008), and could result in increased net import of food as opposed to an export push (Palsen, 2007).

Sorting out the impacts of biofuel on agricultural commodity prices is naturally an example with a clear cost. For instance, the sugar-ethanol nexus in Brazil is the long-run drivers of ethanol and sugar prices, with the former-causing sugar prices and the latter-causing two price pairs to be co-integrated, the equilibrium differs. Their work suggests...
Food vs. Fuel History

- As early as 1983, research indicated the potential of fuel ethanol over the next decades to be very disruptive to global agricultural commodity prices.
- This food vs. fuel trade-off emerged on a global scale with the 2007-2008 world agricultural commodity price crisis.
- This crisis in price spikes was due to:
  - Sharp increases in biofuel demand
  - Rapid economic growth
  - Droughts
  - High oil prices
  - Weak dollar
  - Speculation
  - Export restrictions
Food vs. Fuel Research

- Employs economic models
  - Computable general equilibrium models
  - Mathematical simulations
- The models determine the magnitude of long-run agricultural commodity price impacts of fuel-price shocks
- The models generally do not capture short-run price dynamics
- Detailed studies of specific crops may include the short-run dynamics, but often exclude the impacts of other markets
- As an example, long-run analysis using CGE indicates that fuel-price shocks govern rising food prices
- Some studies have even suggested U.S. could become a net importer of food as opposed to an importer of oil
An Empirical Question

- Sorting out the impact of biofuels on global agricultural commodity prices is naturally an empirical one.
- It is simply impossible to determine the impacts of biofuels on agricultural commodity prices without turning to data.
  - Distinguish between the short-run versus the long-run
Projections conclude food prices would remain relatively high for many years to come because of expanded biofuel production, high oil prices, and increased international demand.

Other projections were correct in stating a short-run bubble in food prices existed in early 2008 which deflated toward the year’s end.

In the long-run, productivity gains and acreage response to prices can mitigate the volatility in agricultural commodity prices.
Hypothesis

- Short-run fuel and agricultural commodity market volatilities are a consequence of a different set of factors than long-run market volatilities.
- Such a hypothesis would explain some of the shortcomings of previous results by not distinguishing between short- and long-run price volatility.
Time Series Prices

- Fuels
  - Ethanol
  - Gasoline
  - Oil
- Agricultural Commodities
  - Corn
  - Rice
  - Soybeans
  - Sugar
  - Wheat
- The long-run cointegration of these prices is investigated simultaneously with their multivariate short-run interactions
Results

- No direct long-run relation between fuel and agricultural commodity prices
- Limited if any direct short-run relations
- Consistent with the hypothesis, short- versus long-run price adjustments do differ
  - Short-run: Sugar prices are influencing all the other agricultural commodities prices except rice
Sugar

- Number one world input for ethanol
  - Increased ethanol production is potentially influencing short-run agricultural commodity prices through its impact on sugar prices
- Possibly more plausible, sugar prices as a leading indicator of economic growth are serving as a growth surrogate
  - Sugar contributes 20% of GDP and employs 30% of the workforce in African, Caribbean and Pacific Group of States
- Economic growth, in general, is then the driver of short-run agricultural commodity price fluctuations
Policy Implications

- Results support the effect of agricultural commodity prices as market signals which restore commodity markets to their equilibria after a demand or supply event (shock)

- Such shocks may in the short-run lead to agricultural commodity price inflation, but decentralized freely operating markets will mitigate the persistence of these shocks

- Consideration may then be directed toward shifting agricultural policy for mitigating such short-run commodity-price inflation with commodity buffers for supplementing supplies in years of insufficient harvest

- Such commodity buffers could blunt food price spikes caused not only by possible biofuel stocks but also shocks associated with weather, conflicts, and terrorism
Data

- The Jarque-Bera test statistics reject the hypothesis of normality at the 1% level for all but four of the series
- Dickey-Fuller and augmented Dickey-Fuller unit root tests indicate first differencing the logarithm of the price series results in generally a 99% confidence level of each series being stationary
Cointegration Estimation

- Price series are cointegrated if they move together in the long-run. Although there may be short-run shocks causing price series deviation, if they are cointegrated there is a long-run linear relation which ties the prices together.

- Johansen trace tests were applied in a stepwise procedure for indicating the long-run relations among the eight price series.
Cointegration Results

\[ lnP_o = -1.181 + 1.018lnP_g \]
\[ \quad (0.051) \quad (0.012) \]
\[ lnP_e = -1.887 + 0.511lnP_g \]
\[ \quad (0.175) \quad (0.041) \]
\[ lnP_b = 1.941 - 0.347lnP_s + 0.766lnP_r \]
\[ \quad (0.713) \quad (0.096) \quad (0.143) \]
\[ lnP_w = 2.639 + 0.270lnP_s + 0.313lnP_r \]
\[ \quad (0.769) \quad (0.081) \quad (0.148) \]
\[ lnP_s = -12.391 + 6.490lnP_c - 2.830lnP_r \]
\[ \quad (4.738) \quad (0.828) \quad (0.964) \]

where \( P_o, P_g, P_e, P_b, P_s, P_r, P_w, \) and \( P_c \) are the level prices of oil, gasoline, ethanol, soybeans, sugar, rice, wheat and corn, respectively.
Vector Error Corrections Model

- Vector error corrections specifies the short-run dynamics of each price series in a framework that anchors the dynamics to long-run equilibrium relationships (cointegrates)
- Granger causality tests: Lack of both long- and short-run causality between fuel and agricultural commodity prices
- The exception is the short-run positive influence of sugar prices on oil prices
U.S. production of ethanol from corn is not elucidating an ethanol and corn price relation and corn prices are not influencing other agricultural commodity prices. On the contrary, the direction points to the influence of soybean, sugar, and rice prices on corn price trends.
Fuel Prices

- In the long-run, as the global economy expands or contracts, oil prices are affected which then influence gasoline and ethanol prices.
- However, a funneling of this world activity directly through fuel prices to agricultural commodity prices is not apparent.
- Commodity prices are affected by global economic activity, but not through fuel prices.
Impulse Response

- One possible reason for this food vs. fuel price disconnection is the lack of any persistence in the agricultural commodity prices given a price shock.
- Impulse response analysis indicates after 10-15 months most if not all of the price shocks are dissipated.
- This lack of price persistence to a shock indicates a rapid market response mitigating a shock’s effect.
- Such a response supports the theory indicating decentralized perfectly competitive markets are efficient in responding to price signals.
Economic Modeling Implications

- Results suggest a possible modification in the CGE models and other numerical models which may assume a direct long-run link between fuel prices and agricultural commodity prices.
- The resulting forecasting of high agricultural commodity prices precipitating from high fuel prices may be misleading.
Results have implications far beyond suggesting modifications in modeling

Spikes in agricultural commodity prices whether caused by biofuels, climate, conflicts, or just human mistakes cause irreparable harm to the global poor

Policies including agricultural commodity buffers, designed to blunt these short-run price spikes should be developed and implemented


Research Team

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Recent Research

Food versus Fuel: What do Prices Tell Us?

- Sorting out the impacts of biofuels on commodity prices is impossible without turning to data

- Time-series on prices
  - Long-run cointegration
  - Short-run interactions

- Results: No direct long-run price relations between fuel and commodity prices

- Limited if any short-run relationships

- Prices are market signals which restore market equilibria after event shocks
Variance-Decomposition Results

- Variance-decomposition results provide information on the relative magnitude of the causation influence of one price series on another.
- Results indicate oil accounts for 78% of gasoline prices, where sugar variability contributes only 8% and 11% of variance for corn and soybeans.