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Drought, ethanol, and livestock

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ABSTRACT

The 2012 drought in the U.S. Midwest resulted in volatile crop prices. With field crops constituting a major input in livestock production, livestock producers sought a waiver to Renewable Fuel Standard biofuel mandates. They believed such a waiver would mitigate crop-price volatility; given crops are major inputs in biofuel production. The U.S. Environmental Protection Agency (EPA) denied the waiver under the belief that the waiver would have minimal if any impact on mitigating price volatility. Employing a VECM, the objective is to investigate if it was prudent for the EPA to reject the waiver. Results generally support EPA's conclusion that the waiver relaxing the biofuel mandate would have minimal impact.

1. Introduction

Despite advances in crop varieties, irrigation technologies, and weather forecasting, drought remains one of the most catastrophic supply shocks in modern agriculture. Although globalization of agricultural commodities improves the ability to blunt localized impacts of crop losses, the linkages of commodity, livestock, and nascent biofuel markets leave multiple markets vulnerable to drought. The emergence of a substantial U.S. corn-based ethanol market has created a growing conflict between the ethanol and livestock industries over corn supplies, particularly in times of negative corn supply shocks.[1]

The recent 2012 Midwest U.S. drought that severely impacted corn supplies and corn prices highlights this conflict as well as the government policies which help support the U.S. ethanol industry. Despite a 75 year record for the number of acres planted (USDA, 2013a), the historic drought conditions affecting the U.S. Corn Belt resulted in a 13% decline in corn yields from 2011. In 2012, the weighted-average farm price for corn was $7.10 per bushel compared with $6.22 in 2011 (USDA, 2013b). Such price spikes have a marked impact on the profitability and production decisions of livestock producers (Lawrence et al., 2008). The diversion of corn to ethanol production coupled with the drought was blamed by the popular press and the livestock industry for this corn-price spike and the hardships faced by livestock producers (Carter and Miller, 2012; Fletcher, 2012; NCBA, 2012a).

In response, ten state governors and major livestock groups (including the National Cattlemen's Beef Association and the National Chicken Council) requested in July 2012 that the Environmental Protection Agency (EPA) grant a short-term partial waiver of the Renewable Fuel Standard (RFS) mandates (EPA, 2012; Yacobucci, 2014). The underlying rationale for the waiver was based upon the assertion that a relaxation of the ethanol-fuel mandate would lower corn prices for livestock producers by reducing the amount of corn flowing into ethanol. This would ultimately mitigate some of the economic hardship suffered by livestock producers. Such short-run relief would stabilize herd size, yielding long-run positive impacts on livestock prices. The EPA denied the waiver in November 2012 based upon analysis indicating, with a high probability, that a one-year relaxation of the mandate would have minimal (if any) impact

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[1] Prior to 2000, approximately 75% of U.S. corn production was consumed as livestock feed. This percentage has dropped to 40% in 2012 as corn is increasingly being used for ethanol production (Capehart, 2013; Tejeda, 2012).

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on corn prices because the RFS mandate is not binding. Specifically, the EPA concluded that a one-year waiver would have minimal impact on the short-run supply and demand for ethanol, and hence corn prices and the quantity of corn used for ethanol production. This denial was based on price forecasts during the 2012 drought, which projected the waiver would have minimal impact on corn prices (Babcock, 2012; Thompson et al., 2012; Tyner et al., 2012). The foundations for the projections were: (1) carryover of blending credits (RINs) from previous years, (2) inelastic short-run demand and supply of ethanol, and (3) short-run production difficulties in adjusting ethanol production. This ruling was not well received by livestock groups who argued that the failure to provide short-term relief to the livestock industry in the face of record drought will have a long-run negative impact on livestock prices due to reductions in herds (NCBA, 2012b). In terms of long-run projections, Whistance et al. (2013) further makes projections on waiver options for 2014 and beyond.

The conflict between the two primary end-users of corn during the drought of 2012 highlights the interrelation of food and energy markets and the importance of government policy for addressing short- and long-run price volatility and food, energy, and environmental goals. Surprisingly, despite a substantial literature assessing the relationship between U.S. corn and ethanol markets, significantly less attention has been directed toward the relationship with the livestock market. Previous research has not explicitly modeled the market relations, which evaluate the general impact of drought and the intensity of drought on corn, ethanol, and livestock markets. Given the evolving linkage between food and energy markets, understanding the impact of drought is particularly important under the specter of potentially increased temperatures and duration between rainfall events in the U.S. Corn Belt (Karl et al., 2009).

As a first attempt at addressing these impacts, the price linkages and transmission patterns in the U.S. corn, soybean, ethanol, and livestock industry are investigated, with special attention to the impact of drought conditions. Employing a vector error correction model (VECM) and a detailed drought severity classification developed by the U.S. Drought Monitor, this article presents the first evidence on the impact of drought across the corn, soybean, ethanol, and livestock markets. Through this analysis, several insights on potential policy solutions to supply shocks caused by drought are revealed. Critically, the analysis supports the short-run conclusions of the EPA that policies such as a RFS waiver will not provide significant relief to the livestock industry from volatile corn prices. Instead, results indicate that corn-supply policies may be a superior avenue for aiding the livestock industry when faced with corn-supply shocks. Policies directly augmenting supply may dominate policies providing incentives to reduce demand. Understanding the economic relations among markets will provide the direction that such policies should follow.

2. Literature review

The literature concerning ethanol-related transmission impacts is rapidly expanding (Campiche et al., 2010; Chang and Su, 2010; McPhail et al., 2012; Serra and Zilberman, 2013; Zhang et al., 2010). For a review of the literature see Qiu et al. (2011). Recent literature employing a VECM, vector autoregressive (VAR) model, or other models assessing volatility generally concludes that energy markets have a short-run impact on the food market, but no long-run impacts (McPhail, 2011; McPhail et al., 2012; Nazlioglu et al., 2013; Qiu et al., 2012; Saghaian, 2010). Exceptions are Serra et al. (2011) who find both a short- and long-run relations between ethanol and corn prices and the conclusion by Serra and Zilberman (2013) inferring that the literature indicates a long-run relation between energy and agricultural commodity prices. Nazlioglu et al. (2013) indicate that in general this causal link remains unclear. Omitted variable bias may explain some of this inconsistency. As hypothesized, climatic environmental conditions play a role in agricultural commodity prices and failure to consider these conditions may affect the commodity/biofuel price relations. Although there is research introducing climate impacts into corn markets, climate impacts on biofuel and livestock markets are far from fully considered (Diffenbaugh et al., 2012).

Diffenbaugh et al. (2012) project 21st century changes in temperature and precipitation, simulate the response of U.S. corn yields, and use a GTAP model to simulate the volatility in corn prices. Their research concludes that U.S. corn-price volatility will increase sharply in response to global warming projected over the next three decades. However, their analysis is limited in terms of only investigating the impact of climate (indexed by temperature and precipitation) on corn-price volatility. The possible spillover effects to the livestock market are not addressed. Their analysis could be extended by investigating the mechanisms of how climate affects livestock and biofuel markets. The time-series model developed below is an attempt to extend this investigation.

In contrast to extensive literature on ethanol-market effects on crop-commodity prices, their effects on livestock markets have not been as widely investigated. Tejeda (2012) employed a multivariate regime-switching model, and found significant positive dynamic correlations among weekly price changes of distiller grains, corn, and soybean meal. Various time-series models are employed to investigate the dynamic interaction among grains and livestock prices (Anderson et al., 2008; Pozo and Schroeder, 2012; Tejeda and Goodwin, 2009, 2011). Miljkovic et al. (2012) employ a simultaneous equation model and determine that ethanol policy may indirectly impact cattle production through the RFS's influence on corn quantity. Bhattacharya et al. (2009) and Elobeid et al. (2006) employ a multi-market equilibrium displacement model to account for interdependence. Six markets are considered: beef, pork, poultry, corn, ethanol, and ethanol byproducts.

However, the literature is void of accounting for drought and its impacts on agricultural and biofuel markets. The relation of drought, biofuel, and livestock is still elusive. Without knowing their relation it is not possible to fully assess the impacts of a RFS waiver. As a first attempt to fill this void, the transmission effects among the markets, by including drought effects and ethanol prices, are investigated. With such a model, the policy of adopting the RFS waiver can then be evaluated.

3. Methodology

When time-series data are nonstationary, a vector autoregressive (VAR) model can be represented by the following VECM with exogenous variables:

$$\Delta y_t = \mu_t + \alpha\beta' y_{t-1} + \Gamma \Delta y_{t-1} + \sum\nolimits_{k=1}^{10} \delta_k x_{k,t} + \varepsilon_t, \tag{1}$$

where Δy is a vector of first-differenced log-transformed ethanol, corn, soybean, beef, and poultry real prices, adjusted by the CPI, and x_{kt} is the k^{th} exogenous variable representing the drought indicator, seasonal dummies, interaction terms of drought with seasonal dummies, speculation prices of corn and soybeans, and dollar prices. Associated with the exogenous variables is the coefficient vector δ_k representing the impact of the exogenous variable x_k on the first-differenced logarithm price series. Vector μ comprises the intercept terms and the coefficient vectors α and β contain the adjustment and cointegration parameters, respectively. The coefficient vector represents the short-run effects with a lag length of two weeks, where the lag length is selected based on the model selection criteria Akaike information criterion (AIC) and Schwarz Bayesian information criterion (SBC). The model selection methods, AIC and SBC are also employed to determine rank number.

The drought variable is acquired from the U.S. Drought Monitor, a synthesis of multiple indices and impacts, which represent a consensus of federal and academic scientists. The Drought Monitor concept was developed (jointly by the National Weather Service, the National Drought Mitigation Center, and the U.S. Department of Agriculture's