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The effect of ethanol policies on the vertical price transmission in corn and food markets☆

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ABSTRACT

This paper analyzes the impact of ethanol policies on price transmission along the food supply chain. We consider the US corn sector and its vertical links with food and ethanol (energy) markets. We find that ethanol is a source of imperfect price transmission in the food supply chain. Ethanol, however, alters price transmission only under a binding blender's tax credit and only from food to corn (not vice versa). Our results indicate that ethanol weakens the response of corn and food prices in terms of their level changes to shocks occurring in agricultural (corn and food) markets. The results are robust to different assumptions on the model parameters. Although market power has previously been identified as a source of imperfect price transmission in the food supply chain, our findings show that in the presence of ethanol, the imperfect price transmission may occur even if markets are perfectly competitive. This warrants careful evaluation of markets before any policy intervention.

1. Introduction

A renewed interest in the issue of price transmission among researchers and policy makers stems from two sources. First, the recent structural changes in the food and retail sectors have led to their higher concentration. Second, the global agricultural and energy sectors became more interdependent due to the surge in biofuel production in the last two decades, with both sectors exhibiting high price volatility. The pass-through of the price shocks from world to domestic markets and from agricultural commodities to food prices can have significant income distributional and welfare implications for farmers and consumers; this makes the issue of price transmission very relevant from the political economy perspective.

The pass-through of price changes along the food supply chain is commonly found to be imperfect, meaning that a price change at the producer (consumer) level is not fully transmitted to consumers (producers). Literature often finds price transmission to be asymmetric, that is, a price decrease at the producer level is slowly and not fully transmitted to consumers while a price increase at the producer level is transmitted more quickly and fully to consumers prices. Two main causes of imperfect price transmission were identified in the theoretical literature: the market power (e.g., McCorriston et al., 1998) and the existence of adjustment or menu costs (e.g., Ball and Mankiw, 1994). Other causes of imperfect price transmission include, among others, agricultural policies (Gardner, 1975; Serra and Goodwin, 2003), inventory behavior (Reagan and Weitzman, 1982; Wohlgenant, 1985), dynamics (Azzam, 1999), the share of commodity costs in the final product (Bettendorf and Verboven, 2000), and accounting methods (Balke et al., 1998).

Besides theoretical studies, there is a large empirical literature investigating the price transmission in the food supply chain (e.g., Goodwin and Harper, 2000; Mohanty et al., 1995; Miller and Hayenga, 2001; Rezitis and

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Reziti, 2011; Bakucs et al., 2012, 2014; Rajcaniova and Pokrivcak, 2013; Pokrivcak and Rajcaniova, 2014). Although the studies significantly differ in their estimation methodology and regional and commodity coverage, they tend to confirm imperfect price transmission. The main shortcoming of the empirical studies, however, is their failure to provide theoretical underpinnings and a plausible interpretation of the estimated results.

A flourishing empirical literature has analyzed the effects of biofuels on the price transmission between biofuels and feedstock prices. An extensive literature review by Serra and Zilberman et al. (2013) concludes that energy prices drive long-run agricultural price levels and that instability in energy markets is transferred to food markets. Kristoufek et al. (2014) study price transmission between biofuel markets and related commodities. They find that both ethanol and biodiesel prices are responsive to their production factors (ethanol to corn and biodiesel to diesel). The strength of transmission between both significant pairs increased remarkably during the food crisis of 2007–2008.

This paper contributes to the previous literature by developing a stylized structural theoretical model for the corn sector and its vertical linkages with food and ethanol markets to analyze the impact of ethanol and ethanol policies on price transmission in the food supply chain (and not only between ethanol and corn prices) (Fig. 1).

This topic is of high importance given the significant impact of biofuels' expansion on the world agricultural commodity markets (e.g., de Gorter and Just, 2008, 2009a; Ciaian and Kancs, 2011a, 2011b; Drabik, 2011; Serra et al., 2011; Yano et al., 2010; Zilberman et al., 2013; de Gorter et al., 2013). In the period 2007–2010, world ethanol production almost doubled but leveled-off after that, reaching 21.8 to 24.6 billion gallons in the period 2011–2014 (US Department of Energy, 2015). A significant share of corn and sugarcane production is used to produce fuel. Several studies have shown that the surge in biofuel production due to biofuel policies was the major cause of the recent spikes in the global grains and oilseed prices and that a strong and direct link between energy and commodity prices has been created (e.g., Wright, 2011; Mallory et al., 2012; de Gorter et al., 2015).

This paper provides an answer to a question on whether the introduction of corn ethanol has affected the price transmission between the agricultural commodity (corn) and food markets. Because the biofuel production is policy-driven, we also analyze how different policy regimes affect the price transmission. More precisely, we analyze the US corn sector and its vertical links to food and ethanol markets. We consider two policy regimes: (1) a blend mandate and (2) a blender's tax credit. We compare these policy regimes to the no biofuel production benchmark. The blend mandate and the blender's tax credit are historically the most relevant policies used in the United States, and other countries alike, to support biofuel production. We evaluate the price transmission both from corn to food and from food to corn.

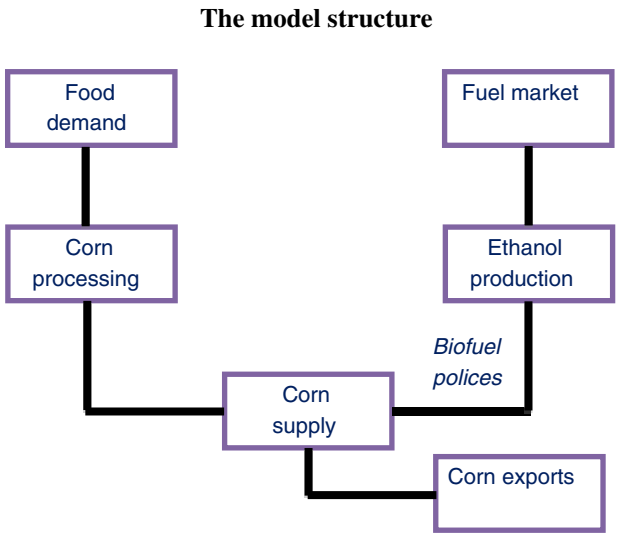

Fig. 1. The model structure.

We build a tractable partial equilibrium model where corn is used to produce food (and feed) and ethanol by competitive firms, and is also exported abroad. We are aware that the US food processing industry exhibits a significant concentration; however, by assuming a competitive market environment, we can better identify the effects of ethanol (and the role of different policy regimes) on price transmission in the food chain. More importantly, however, it appears that the assumption of a competitive industry is inconsequential to the question whether ethanol has affected the price transmission, as long as the same market structure exists before and after the introduction of ethanol.

In our model, the corn market is vertically linked to a food industry that produces final goods for consumers. When ethanol production is introduced, corn prices become linked to ethanol prices through a zero-profit condition following the models of de Gorter and Just (2008), and Mallory et al. (2012).

The key finding from our simulation results based on the 2009 data is that when ethanol production is due to a blender's tax credit, a price shock originating in the food market transmits to the corn market at a smaller rate compared to a situation without ethanol production (i.e., the transmission becomes more imperfect). However, when the ethanol production is due to a blend mandate, or the price shock originates in the corn market (regardless of the biofuel policy), the price transmission does not change. These differences stem from different effects biofuel policies have on the corn price formation. Importantly, our results also show that the response of corn and food prices (in absolute terms) to shocks in the corn or food markets is lower in the presence of biofuels.

The public media and policy documents often claim that the imperfect price transmission is caused by market failures, such as market power. This argument is often used to justify policy intervention in the agricultural markets (Meyer and von Cramon-Taubadel, 2004). The results of our paper show that such arguments need to be evaluated with caution and that the market environment needs to be understood well before a policy intervention. It is because, as we showed earlier, the imperfect price transmission can occur even if markets are perfectly competitive. The presence of biofuels may thus result in an imperfect adjustment of farm gate prices to shocks occurring in the food sector.

2. The theoretical model

In order to better identify the direct impact of biofuels on the price transmission, we abstract from modeling the linkages of the fuel market with the food sector (e.g., through higher transportation costs) and with the corn sector in the form of changing input costs for corn production. Furthermore, we also abstract from other issues already investigated in the literature, such as market power, adjustment costs, inventory behavior, size of commodity costs in the final product, or accounting method. However, because biofuels production has historically heavily depended on governmental interventions, we consider a policy dimension in our model.

In our benchmark scenario, entitled *no biofuel*, only the corn–food market supply chain is considered and corn and ethanol markets are delinked. The food market is represented by a competitive processing sector that buys and processes corn and sells corn-based food. We then analyze how biofuels affect the benchmark price transmission by creating a direct link between corn and ethanol prices and quantities. The ethanol production and the price links are primarily determined by biofuel policies. Therefore, we consider two policy regimes: (1) a binding blend mandate and (2) a binding blender's tax credit. These biofuel policies have historically been used in the United States. We follow the approach developed by de Gorter and Just (2008), Drabik (2011),