

THE IMPACT OF RISING ETHANOL PRODUCTION ON THE BRAZILIAN MARKET FOR BASIC FOOD COMMODITIES: AN ECONOMETRIC ASSESSMENT

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Overview

The positive (economic, social and environmental) impacts of biofuels, first glorified as a blessing, have become widely debated in the last years. Along with high oil prices, the main drivers behind the sharp increase in biofuel production are government policies (e.g. mandates, targets and subsidies) which aim to achieve higher energy security and to deal with climate-change issues (Janda et al., 2012). As a downside, there has been much debate on the impacts of rising biofuel production on food prices¹. According to the literature (e.g., Mitchell, 2008 and OECD-FAO, 2009), the links between energy and agricultural markets are on the one hand related to the production costs for crops and livestock products, as well as to transportation costs. On the other hand, the links are associated with the increasing biofuel production of first generation as a substitute for liquid fossil fuels used in transportation.²

Economic research on biofuels is an expanding research area which is far from being exhausted. While there is a wide range of theory-based economic studies which make use of partial and general-equilibrium structural models for the assessment of the impacts of biofuels on agricultural markets, there is a lack of econometric assessments³. Furthermore, previous econometric studies⁴ mostly rely on time series data and focus on price variables that are frequently available only on a highly aggregated level. Those estimates are therefore seldomly able to quantify the direct impact of biofuel production on the supply of related agricultural commodities. Thus, the main purpose of this paper is to add to the literature with an explorative econometric analysis by assessing the average impact of rising ethanol production (based on sugarcane) on the Brazilian sugar market and in addition, on the harvested areas for rice, beans, corn, soybeans and manioc, which are essential in the Brazilian diet. The rationale underlying our investigations is as follows: biofuel mandates and/or increasing oil prices encourage biofuel production. Higher biofuel production, in turn, puts more pressure on the fuel and agricultural sectors and might lead to a reduction of the food supply and to higher food prices. This effect might occur due to a reallocation of food crops to fuel production or due to the diversion of agricultural land from food to energy crops. This issue is of great policy relevance in Brazil, as the country is a major global player in sugarcane based ethanol and agricultural markets and households (especially the poor) usually spend the major part of their income on food consumption.

Starting from the presumption that increasing ethanol production puts more pressure on the sugar market, one should expect sugar production to decrease as ethanol production rises.⁵ Nevertheless, contrary to our intuition, we find a positive and significant effect of ethanol production on sugar production for food purposes. Further, our findings show that ethanol and sugar production have (separately and together) a positive and significant impact on the area devoted to sugarcane. This raises the question whether the expansion of the area devoted to sugarcane production is suppressing the availability of land areas which would otherwise be dedicated to the production of other important food commodities. This paper seeks to answer this question.

The paper is structured as follows: After the introduction, Section 2 provides a brief summary of some basic relevant information on the Brazilian ethanol and agricultural markets. Section 3 then presents the data, the empirical methodology, and the results for our first estimations regarding the impacts on the Brazilian sugar market. Subsequently, Section 4 describes our enhanced dataset and the empirical methodology applied in the analysis of the impacts of rising ethanol production on the harvested areas for rice, beans, soybeans, manioc and corn. The section also presents individual estimation results and an overall evaluation. Concluding remarks and some prospects for future research are provided in the final section.

Methods

This paper contributes to the literature with an explorative econometric assessment by applying interaction regression models with entity and time fixed effects using OLS. Our panel dataset comprises annual production/harvested area data for the sugar-alcohol sector and for five other staple commodities (rice, beans, corn, soybeans and manioc) ranging from 1981 to 2009 for 24 Brazilian states.⁶ The analysis proceeds in two steps: we first assess effects on the production/acreages of the agricultural commodities and then make some inferences with respect to prices. This approach allows us to conduct a more robust analysis, since production and acreage data represent real values and are available on a regional level.⁷

¹Several authors claim that the complex and strong linkages among the world's food and energy markets have become more prominent over the last years – especially after the food crisis of 2007-2008 (e.g. Kristoufek et al., 2012).

²Biodiesel and ethanol are the most important biofuels used in the transport sector. Nevertheless, in this paper we will only evaluate the impacts of ethanol production of first generation.

³See Rajagopal et al. (2007) and Janda et al. (2012) for comprehensive reviews of the main economic biofuel models.

⁴See for instance Monteiro et al. (2012), Kristoufek et al. (2012), Hausman et al. (2012) and Hausman (2012).

⁵If sugar production were suppressed due to higher ethanol production, sugar prices would rise (ceteris paribus) signaling scarcity.

⁶We compiled our dataset using data provided by the Brazilian institutions UNICA, IPEA, CEPEA, EMBRAPA, IBGE, MAPA, MME and ANP (see references).

⁷This is in contrast to price data, which are much more volatile and only available on a national level.

Results

Our results indicate the following: (1) contrary to our initial intuition, rising ethanol production has a significant positive impact on sugar production. An explanation for this contra-intuitive outcome is that, on average, increases in ethanol production are ceteris paribus associated with expansions in sugarcane areas attenuating direct competition for land; (2) not all commodities are affected by the developments in the ethanol markets and this might be related to the degree of substitutability among sugarcane and the crops under scrutiny. For example, we could not find any significant impact of rising ethanol production on the harvested areas for corn and manioc; (3) increasing ethanol production exerts a statistically significant (but rather moderate) negative impact on the harvested areas for rice, beans and soybeans.

The effects on the harvested areas for sugarcane, rice, beans and soybeans have implications for the associated prices. Again, the expansion of areas dedicated for the cultivation of a crop leads, ceteris paribus, to higher production of this crop, which in turn leads to lower prices. Conversely, if ethanol production suppresses the area dedicated for food crops, this leads, all other things equal (e.g., productivity, demand, etc.), to lower food production, which in turn leads to higher food prices. Thus, albeit effects are moderate, the prices for rice, beans and soybeans are expected to increase and sugar prices to decrease as a result of rising ethanol production.

Conclusions

The discussion on whether rising ethanol production is driving up food prices is of great policy relevance in Brazil as the country has a history of strong government incentives to develop the ethanol industry and because households (especially the poor) usually spend a large part of their income on food consumption. Our assessment makes several contributions to this issue but is far from being exhaustive. Despite the virtues of our approach (panel estimations with entity and time fixed effects) we are not able to make precise statements regarding the magnitude of the effects of rising ethanol production, since the estimated coefficients are only an average over a number of states and years. Nonetheless, we show in this paper that, ceteris paribus, rising ethanol production does put upward pressure on prices for rice, beans and soybeans (albeit effects are moderate). As the effects of ethanol production on agricultural markets turn out differently across crops and the Brazilian agriculture comprises a wide range of commodities it would be relevant to extend the analysis to other major crops. Moreover, our results raise important environmental issues regarding, for example, deforestation, loss of soil quality or damages to high-biodiversity areas but this was not a topic for our research. The implementation of second and further generation biofuels, which use cellulosic sources for ethanol production, could alleviate these problems related to first-generation biofuels. However, the development of such technologies is still in early stages and further research on the effects of biofuel production of first and further generation remains highly relevant.

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