



New Study Shows that Corn Acreage and Total Crop Acreage are not very Responsive to Local Ethanol Production and Crop Prices

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Land-use change is in the forefront of human-nature interaction and is the nexus of food security, farm economy, greenhouse gas emission, and ecosystem services. How the development of corn-based biofuel affects land-use change, particularly at the extensive margin, has been the focus of the debate regarding the environmental and economic impact of U.S. biofuel policies since the ethanol boom about one decade ago. Many studies have investigated the question; however, no consensus has been reached.

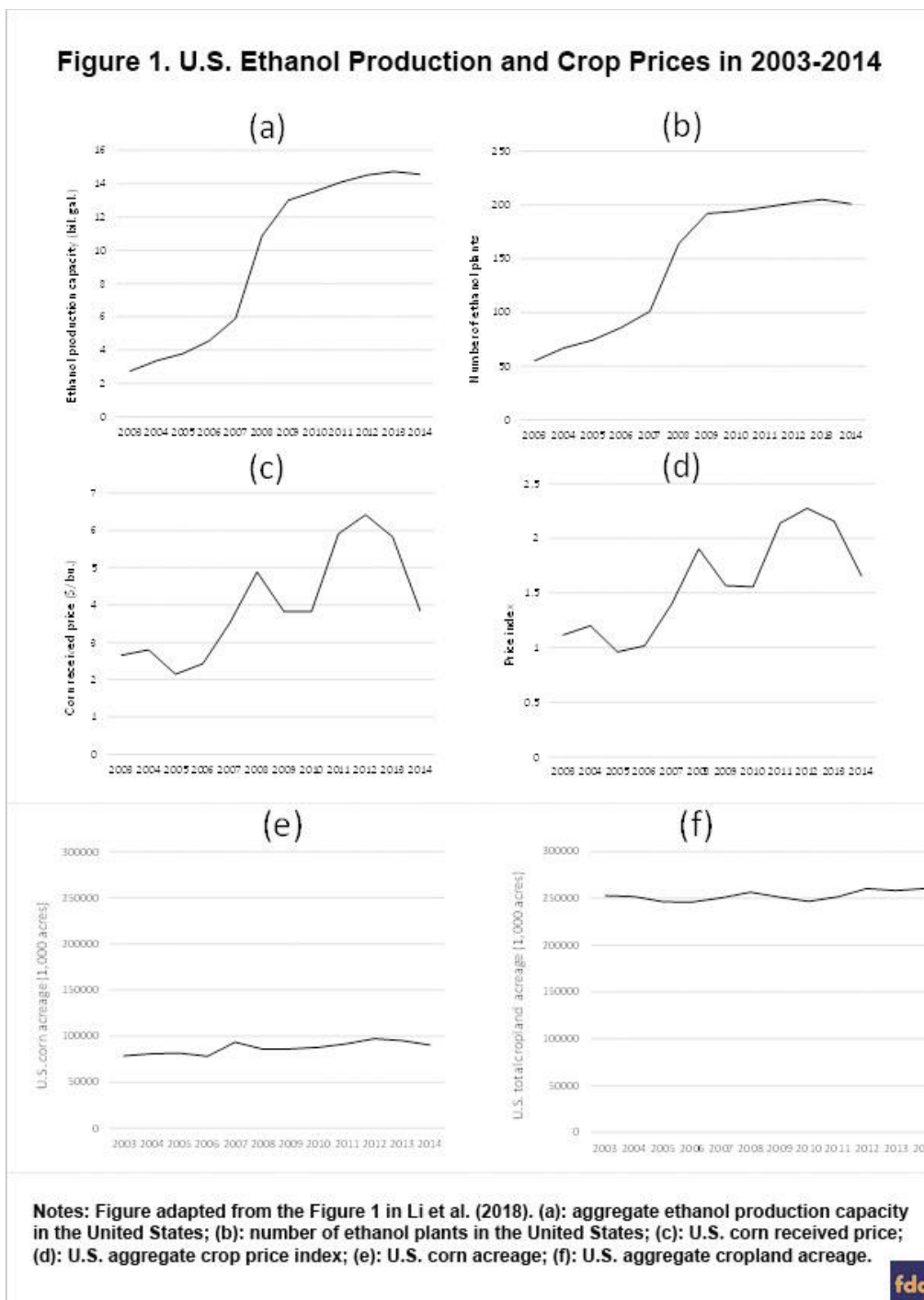
It is well understood that land-use is largely determined by economic drivers. Ethanol production affects land-use via influencing these economic drivers, such as crop prices. However, the challenge of quantifying the effect of ethanol production on land-use is that the effect of ethanol production on the economic drivers is commingled with numerous other factors (e.g., international trade, weather shocks, and even taste changes) to be reflected altogether in crop prices. Previous studies largely ignored crop prices as a confounding factor for ethanol production and crop acreage.

We recently published [a study in *American Journal of Agricultural Economics*](#) to further examine the responsiveness of land-use to local ethanol production while addressing the aforementioned challenge by simultaneously considering the effect of both ethanol production and crop prices on land-use change. Doing so allows us to disentangle the land-use effect of local ethanol production and that of crop prices. The study covers the entire contiguous United States over 2003-2014 when U.S. ethanol production initially increased exponentially and then plateaued whereas crop prices fluctuated substantially. To

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explain, we will first briefly describe the industrial background of U.S. ethanol and agricultural commodities.

Incentivized by the Energy Policy Act of 2005 and the U.S. Energy Independence and Security Act of 2007, the corn-based ethanol industry in the United States expanded exponentially in the studied period (2003-2014). For instance, the number of corn-based ethanol plants increased from 55 in 2003 to 201 in 2014, almost quadrupled. The total ethanol production capacity increased from 2.8 billion gallons in 2003 to 14.6 billion gallons in 2014. Graphs (a) and (b) in Figure 1 (adapted from Li et al. 2018) depict the ethanol production capacity and the number of ethanol plants over 2003-2014, from which we can see that ethanol production plateaued around 2009. On the other hand, crop prices over 2003-2014 experienced roughly two distinct cycles (see Graphs (c) and (d) in Figure 1). Land uses (corn acreage and total cropland) did not fluctuate significantly during the same period (see Graphs (e) and (f) in the figure).



Based on the data that include significant increase in ethanol production and fluctuation of crop prices, the study finds that corn acreage and aggregate crop acreage are insensitive to local ethanol production and crop prices. On average, when ethanol production capacity within a county increase by 1%, then corn acreage in the county will only increase by 0.03%-0.1% and the total crop acreage in the county will increase even less, by 0.02%-0.03%. This finding indicates that ethanol production's effect on local land-use change mainly occur at the intensive margin, that is, ethanol production increases corn acreage mainly via converting land originally under other crops to corn. Its effect on incentivizing a net increase in total cropland acreage is quite small.

The study also shows that when corn price increases by 1%, however, corn acreage will increase by 0.18%-0.29%. Total crop acreage has only negligible responsiveness to corn price. When aggregate crop price increases by 1%, then total crop acreage will increase by 0.07%-0.08%. By comparing the responsiveness of land-use to local ethanol production with that to crop prices, we find that crop acreage is more sensitive to crop prices than to local ethanol production. Furthermore, we find that if crop prices are ignored in the analysis, then the land-use effect of ethanol production will be significantly overestimated.

Based on the results discussed above, we further predict land-use changes caused by local ethanol production and by crop prices over 2003-2014 period. We find that everything else equal, about 6 million acres (about 7.6%) of corn can be attributed to the increase in corn price and about 9 million acres (about 11%) can be attributed to ethanol production over this period. Between 2008 and 2014, however, our model predicts that land-use change caused by corn price is negligible because in 2014 corn price regressed to the 2008 level. The effect of ethanol production on land-use sustained during 2008-2014 as ethanol capacity had been growing in this period. These findings show that the land-use effect of ethanol production was relatively steady over 2003-2014 whereas the effect of crop prices was transitory as crop prices were much more volatile than ethanol production was. For total crop acreage, about 7 million acres (2.8%) was increased due to crop price increase and additional 7 million acres was increased due to ethanol production increase.

This study contributes to our understanding of land-use changes by showing that the land-use changes caused either by ethanol production and by crop prices mainly occur at the intensive margin. These changes are in modest magnitude. If crop prices are not considered then the land-use effect of ethanol production will be likely overestimated significantly. Moreover, our analysis show that the land-use change caused by ethanol production was relatively steady but that caused by crop price was transitory, indicating the dynamic nature of land-use change as well as the importance of examining its responsiveness to time-varying factors.

Complete citation for the study discussed here is:

Li, Yijia, Ruiqing Miao, and Madhu Khanna. 2018. "Effects of Ethanol Plant Proximity and Crop Prices on Land-Use Change in the United States." *American Journal of Agricultural Economics* (<https://academic.oup.com/ajae/advance-article/doi/10.1093/ajae/aay080/5231793>)