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INTRODUCTION

The Energy Policy Act of 2005 (EPA 2005) mandates to mix ethanol with gasoline sold in the U.S., which increases the demand for corn. As a result, corn prices rise. In response to high prices, farmers allocate more land to growing corn. However, since arable land is fairly fixed (Hertel 2011), there are reasons to believe that the distribution of corn production takes place from other staple crops. For instance, in the New York Times article “Crop Rotation in the Grain Belt,” Barronewo (2006) points out that Kansas, traditionally known as the Wheat State, to the surprise of all, has added 3% more corn to its acreage. This paper tests if EPA 2005 introduces statistically significant structural changes to the U.S. farm land allocation dynamics. Specifically, it provides the effect of the relative price changes on acreage in corn-specific pairs before and after the introduction of EPA 2005 policies.

DISCUSSION

Energy Policy Act (EPA 2005) was passed by the U.S. Congress in 2005. It mandates blend of gasoline and ethanol with the end goal of at least 10% of ethanol being present in it. The act mandates 7.5 billion US gallons of corn based ethanol to be mixed with the gasoline sold by 2012. The following Energy Independence and Security Act of 2007 (EISA 2007) policy extends the target to 15 billion US gallons by 2022 (EPA 2013, DeGorter and Busby 2014). Ethanol content in gasoline has expanded from 2.9 percent in 2005 to 9.8 percent in 2011 (Figure 2). Already by 2008 the United States has become the largest ethanol producer in the world ahead of Brazil producing 1.56 billion barrels of fuel (Figure 3), comprising 45% of world ethanol production (EIA 2013) that year. Corn stocks diverted to ethanol production have increased significantly from around 206 million barrels in 2006 to an average of 407 million in the last three years (Figure 4). As a consequence, corn prices rise and, in response to the high prices, plantings of corn have increased (Figures 5 and 6). However, additional agricultural land is scarce, there are reasons to believe that corn acreage expands at the expense of other crops. Figure 4 shows the dynamics of shares of acres in corn, soybeans, wheat, after EPA 2005. The study identifies crops and intensities with which they compete for land with each other before and after the enactment of EPA 2005. The model allows to test whether the changes in the land competition dynamics in each crop-specific pair are significant. The model in this study provides crop-pair specific dynamics of competition for land, i.e. the effect of price changes of crops on one's acreage, before and after the ethanol mandate of 2005.

Based on 1960-2012 price and production data for crops, the study identifies specific crops whose acreages respond statistically different to observed other crops price changes before and after 2005. The effect of prices on acreages is expressed as an elasticity measure. The magnitude of changes between two periods is also calculated.

DATA AND METHODOLOGY

The data span years 1960 to 2012 and are collected from National Agricultural Statistical Service (NASS). The data includes annual quantity of produced crops, prices, and acreages for the following crops: corn, cotton, hay, wheat, and soy plus other crops whose quantities are summed to the category "other." This category contains: 1) rice, 2) potatoes, 3) beans, 4) peas, 5) vetch, 6) oats, 7) barley; 8) tobacco; 9) flaxseed; 10) peanuts; 12) sweet potatoes; and 12) sorghum wheat – comprising 5% of U.S. agricultural land.

Rotterdam parameterization model is used to examine the multiproduct U.S. agricultural industry with a quasi-fixed input, land, as developed by Vorotnikova et al. (2013).

The model differentiates from the previous one by including the intensity parameter that distinguishes the year before the year of the policy up to the year after the years 1960-2004 and 2005-2012.

The model allows to test whether the structural changes in the land allocation dynamics due to EPA 2005 are statistically significant. TSP 5.0 software is used to obtain the results.

RESULTS

As a result of Energy Policy Act enacted in 2005 (EPA 2005) that mandates a minimum of 10% ethanol by volume in gasoline, farmers allocate more land to corn. Since additional arable land is scarce (Hertel 2011), there are reasons to believe that acreage expands at the expense of acreages of other crops. By using differential framework we test the hypothesis whether EPA 2005 introduces statistically significant structural changes to the U.S. farm land allocation dynamics. The results confirm that after the enactment of EPA 2005 policy there are statistically significant changes in the allocation dynamics of the U.S. farm land. Specifically, it is the case for corn and soybeans as well as hay and cotton. In Figure 7 the diagram on the left schematically represents the dynamics of land allocation for staple crops before 2005 period, and the diagram on the right – for the period 2005-2012. The representation of output price-land elasticities displayed in Tables 1 and 2, further referred to as price-elasticity. It measures how 1% price change in one crop affects the land that’s being allocated to that crop (for its own production or another) (cross-price-elasticity). The significance of own-price elasticities differences shows up in two crops, soybeans and corn: the 2005-2012 period corn’s own price elasticity has increased by a factor of 4.67 compared for corn. Soybean’s own price elasticity has increased by a higher magnitude than that of corn, 9.4 (Tables 1 and 2).

Next, cross-pairs such as corn-soybeans, hay-cotton, wheat-corn, cotton-other-crops and hay-other-crops have experienced a statistically significant-structurally change due to EPA 2005. Corn-soybeans completion for acreage has intensified by a factor of 5.6 as a result of EPA 2005. Hay’s price change effect on cotton’s acreage is not significant before 2005, but after 2005 for every 1% price on hay’s in-harvested acreage is negatively affected by 0.40 percent. Wheat-corn, cotton-other-crops, and hay-cotton display a statistically significant complimentary behavior in respect to acreage after 2005 whereas their relationship are not significant before 2005. Out of all the marginal land elasticities differences between two periods, only those of cotton and other crops category are significant. Marginal land elasticity measures how responsive is the acreage of a crop to new land made available for agricultural production. After the period 2006-2014 1% increase in soybean land is associated with an increase in cotton’s land by 1.7% and a decrease of cotton’s land by 0.20 percent after 2005, which is a fundamental change.

CONCLUSION

The results confirm that after the enactment of EPA 2005 policy there are statistically significant structural changes in the allocation dynamics of the U.S. farm land especially it is the case for corn and soybeans as well as hay and cotton. In Figure 7 the diagram on the left schematically represents the dynamics of land allocation for staple crops before 2005 period, and the diagram on the right – for after 2005 period. The representation of output price-land elasticities displayed in Tables 1 and 2, further referred as price elasticity. It measures how 1% price change in one crop affects the land that’s being allocated to that crop (for its own production or another) (cross-price-elasticity). The significance of own-price elasticities differences shows up in two crops, soybeans and corn: the 2005-2012 period corn’s own price elasticity has increased by a factor of 4.67 compared for corn. Soybean’s own price elasticity has increased by a higher magnitude than that of corn, 9.4 (Tables 1 and 2).

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