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PPPA 6007 Microeconomics for Public Policy

Elasticity Memo

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### The Effect of Repealing the Renewable Fuel Standard on Agricultural Markets

The Renewable Fuel Standard (RFS) is a federal mandate that requires oil refiners to blend ethanol into gasoline for commercial sale (Davenport 2016). The standard was created in 2005 and expanded in 2007 by the Energy Independence and Security Act (EISA) (Griffin 2013, 1). The RFS is widely supported by those industries that benefit from the mandate, including certain agricultural sectors and the ethanol industry. However, it has since gained many opponents who cite the mandate's failure to achieve its originally stated goals, as well as its negative effects on the global food market (Davenport 2016). This argument is quietly gaining traction in the current Presidential Administration with the EPA reportedly considering a gradual rollback of the quotas for ethanol requirements (Siciliano 2017). The program is a boon to some sectors of agriculture and has had a clear upward effect on the price of certain crops. The following is an analysis of the effect that a complete repeal of the mandate would have on the market for corn, the primary product used for ethanol production. A complete repeal represents the ideal (albeit hypothetical) scenario for opponents of the standard. Repealing the standard would constitute a significant inward shock to demand for corn and in both the short-term and long term, would cause the price of corn to decrease. The effect that repealing the standard would have on global food prices is also explained as the lower demand for corn for fuel purposes would increase supply of land and crops to be used for food and other purposes, driving prices of those goods down.

#### POLICY BACKGROUND

The Renewable Fuel Standard was intended to have a threefold positive impact. The standard was slated to decrease the price that Americans pay for gasoline, reduce dependence on foreign oil, and reduce emissions of carbon dioxide. Opponents argue that not only has the policy failed or had miniscule impact on those three factors, but it has also driven the global cost of food higher by diverting crops away from

the food market and into the fuel market (Griffin 2013, 1-22). The RFS sets a quota for increasing the number of gallons of ethanol between 2007 and 2022 to a maximum of 36 billion gallons. It stipulates a reliance on corn ethanol for the first 15 billion gallons of total production each year (Du et. al 2009, 669).

#### METHODOLOGY

To calculate the effect that the RFS has on the corn market and other agricultural food markets it is necessary to find the elasticity of supply for corn and the proportion of total corn supplied in a given year that is diverted to the fuel market as a result of the mandate. Supply in the corn market is inelastic in both the short- and long-run. It becomes more elastic however, in the long-run, as options for growing different crops (or not growing at all) become viable over multiple growing seasons. The short run elasticity of supply for corn is 0.27 (Du et al. 2009, 674), and in the long run it increases to 0.64 (Babcock 2008, 535). Both of these elasticities suggest that even in the long run, the price of corn will respond very strongly to shifts in demand.

The calculations use a projected 2017/2018 season cost of \$3.60 per bushel of corn and assume a total domestic consumption of 14,235 million bushels (Capehart and Leifert 2017). Fifteen billion gallons of ethanol are produced from corn per year and one bushel of corn can produce 2.8 gallons of ethanol. That suggests that 5,360 million bushels of corn each year are sold to produce ethanol. The remainder of the total annual consumption is used for livestock feed (5,500 million bushels), food (1,300 million bushels), exports (2,000 million bushels) and other industrial and feed purposes (Babcock 2008, 535-536). (See appendix, figures 1 and 2)

In calculating the effect that the RFS has on the price of corn for this paper certain assumptions and exclusions are made.

- Assume that all gasoline sold is at a 10% ethanol level and that the market would naturally support 2.1% ethanol in gasoline because of its properties as an oxygenation booster (Griffin 2013, 4). This means that repealing the ethanol mandate would reduce ethanol consumption by 79%, or 4,235 million bushels. *Note that this paper calculates the market shock to the corn market only, so the national consumption of ethanol is assumed to be a total of 15 billion gallons per year.*

- A portion of ethanol byproducts can be reclaimed and converted into feed for livestock, but this extra consumption is considered to be outside and in addition to the total annual consumption estimates provided here.
- Corn has the capability of being stored beyond its growing season. This ability could serve to stabilize the price of corn in the event of a market shock, but this paper does not consider that as a factor. “Ending stocks” of corn for the growing season and corn stored from previous seasons are not included in the calculations.
- This paper does not consider any other government price regulations on corn or other crops.
- In the long run, some agricultural land previously used for corn production may be retired from growing and returned to pasture, effectively shifting the supply curve for agricultural land inward. This is not considered in the calculations, however. This inward shift of agricultural land would also shift the supply of corn inward, helping to stabilize prices.
- The calculations are made to reflect two conditions. The price of corn with the mandate and without. For the purpose of these calculations, the higher demand with the mandate is considered the ‘ $Q_n$  and  $P_n$ ’ condition and the lower demand without a mandate is considered the ‘ $Q_0$  and  $P_0$ ’ condition. The calculations are framed in this manner because removing the mandate returns the corn market to its original equilibrium point.

#### SUMMARY OF VARIABLES

	Short Run	Long Run
$Q_0$ (no mandate)	10,000 (million bushels)	10,000 (million bushels)
$Q_N$ (with mandate)	14,235 (million bushels)	14,235 (million bushels)
$P_0$ (no mandate)	$P_0$	$P_0$
$P_N$ (with mandate)	\$3.60 per bushel	\$3.60 per bushel
$E^S$	0.27	0.64

*Note: although calculations show that 5,360 million bushels of corn are used to produce ethanol, a reduction of ethanol consumption of 79 percent (E10 to E2.1) represents a 4,235 million bushel decrease. Total domestic consumption is estimated at 14,235 million bushels by Capehart and Leifert (USDA).*

#### CALCULATIONS (continued on next page)

$$E^S = \frac{\% \Delta Q^S}{\% \Delta P} \quad \text{and} \quad E^S = \frac{\frac{Q_n - Q_0}{Q_0}}{\frac{P_n - P_0}{P_0}}$$

Short Run

$$0.27 = \frac{\frac{14,235 - 10,000}{10,000}}{\frac{3.60 - P_0}{P_0}}$$

$$0.27 = 0.4325 * \frac{P_0}{3.60 - P_0}$$

$$0.27 = \frac{0.4235 * P_0}{3.60 - P_0}$$

$$0.27 (3.60 - P_0) = 0.4325P_0$$

$$0.972 - 0.27P_0 = 0.4325P_0$$

$$0.972 = 0.6935P_0$$

$$1.40 = P_0$$

Long Run

$$0.64 = \frac{\frac{14,235 - 10,000}{10,000}}{\frac{3.60 - P_0}{P_0}}$$

$$0.64 = 0.4325 * \frac{P_0}{3.60 - P_0}$$

$$0.64 = \frac{0.4235 * P_0}{3.60 - P_0}$$

$$0.64 (3.60 - P_0) = 0.4325P_0$$

$$2.304 - 0.64P_0 = 0.4325P_0$$

$$2.304 = 1.06P_0$$

$$2.17 = P_0$$

## SUMMARY OF RESULTS

	$E^S$	Total US Consumption (millions of bushels)	Reduction in demand (millions of bushels)	Price with mandate	Price after repeal	$\% \Delta P$
Short Run	0.27	14,235	4,235	\$3.60	\$1.40	-61.00%
Long Run	0.64				\$2.17	-39.70%

(Also see Appendix, Figures 3 and 4)

A dramatic shift in prices occurs in both the short- and long-term when the mandate is repealed. Prices shift down 61 and 39.7 percent respectively; with a 30 percent drop in demand (see Appendix, Figures 3 and 4). These extreme results are due to the inelastic supply for producers. However, it should be noted that it is unlikely that a full repeal of the mandate would occur suddenly or that gasoline blending facilities would drop their consumption of ethanol the full 79 percent immediately as a result. It is similarly unlikely that the cost would vary so dramatically given other government price regulations in the agricultural sector and due to factors such as stock held over from previous growing seasons.

It is important to note that the elasticities given by the literature also may not be appropriate for calculating such a large shift in demand. From these calculations, we can be sure about the direction that prices would move but less sure about the magnitude of that shift.

In the long run the agricultural sector would adjust, likely employing a number of strategies to lessen the effect of the sudden void in demand for their product. Farmers could start transitioning fields and planting higher percentages of other crops or they could stop growing food on a portion of their land in favor of pastures or other land uses. These long-term options would help further stabilize the cost of corn by shifting the supply curve inward (and raising prices) but would also have effects on the prices of other crops.

#### EFFECTS ON GRAIN MARKET AND GLOBAL FOOD PRICES

A study by Michael J Roberts and Wolfram Schlenker places a large responsibility for the rise in global food prices on the United States' Renewable Fuel Standard. They estimate that the mandate may have had the effect of pushing global food prices up 30 percent and increasing the land around the world used for growing crops by up to two percent (Roberts and Schlenker 2013, 2268). The study contends that the mandate consumes an amount of corn equal to approximately five percent of the entire world's caloric intake of the four major grains including corn, soybeans, wheat, and rice (Roberts and Schlenker 2013, 2265). The reason for the upward push on prices is because the US ethanol mandate raised prices for corn, and farmers responded by planting more corn and neglecting to plant alternative grains (pushing the supply curves of those grains inward and raising their prices). If this estimate is accurate, rolling back the mandate and the subsequent drop in corn prices would likely spur a diversification of crops. This would have the effect of shifting the supply curve outward for other grains and pushing their prices down (see Appendix, Figure 5). This lowering of the cost of food could potentially provide relief around the globe, particularly to the citizens of the world's most impoverished countries, where the cost of providing food for a family can amount to more than 40 percent of a household's income (Griffin 2013, 19).

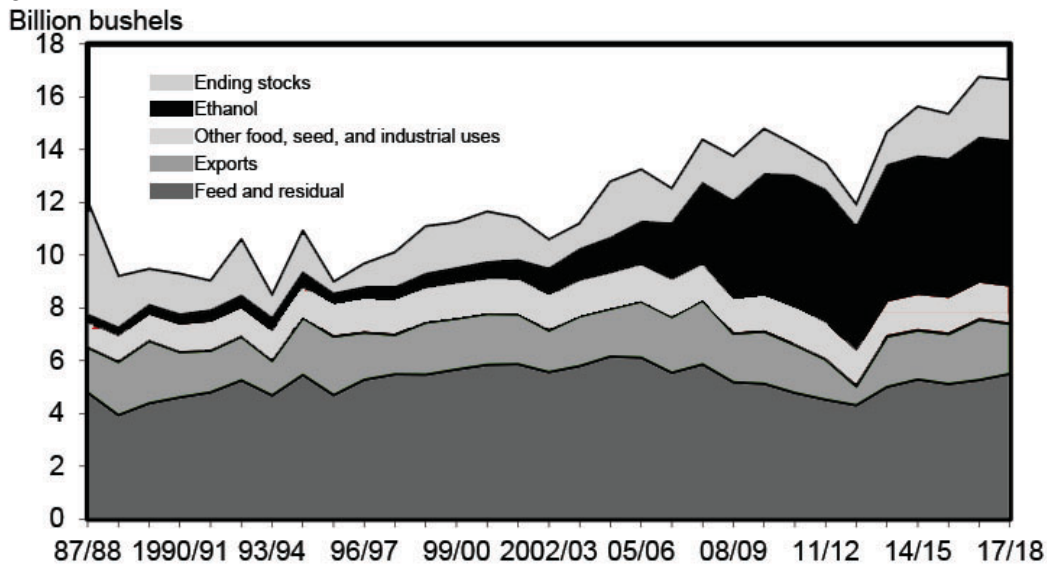
#### CONCLUSION

Opponents of the Renewable Fuel Standard cite its lack of results in terms of gas prices, dependence on foreign oil, and carbon reduction. Many also contend that in diverting such a substantial amount of crop production to fuel, the policy has had the unintended consequence of increasing food insecurity around the globe. In the United States, many agricultural states and communities have come to

depend on the RFS, but increasing pressure from some conservative lawmakers and a new executive administration suspicious of government regulation has opened up the possibility of reevaluating the program (Davenport, 2016). The argument presented in this paper agrees with those who would like to see the mandate rolled back. Indeed, without the mandate, the demand for corn would shift inward and prices would lower to some degree. Global food prices could also experience a relief as supply of other grains rises to fill the void left by the decreasing corn production.

Appendix

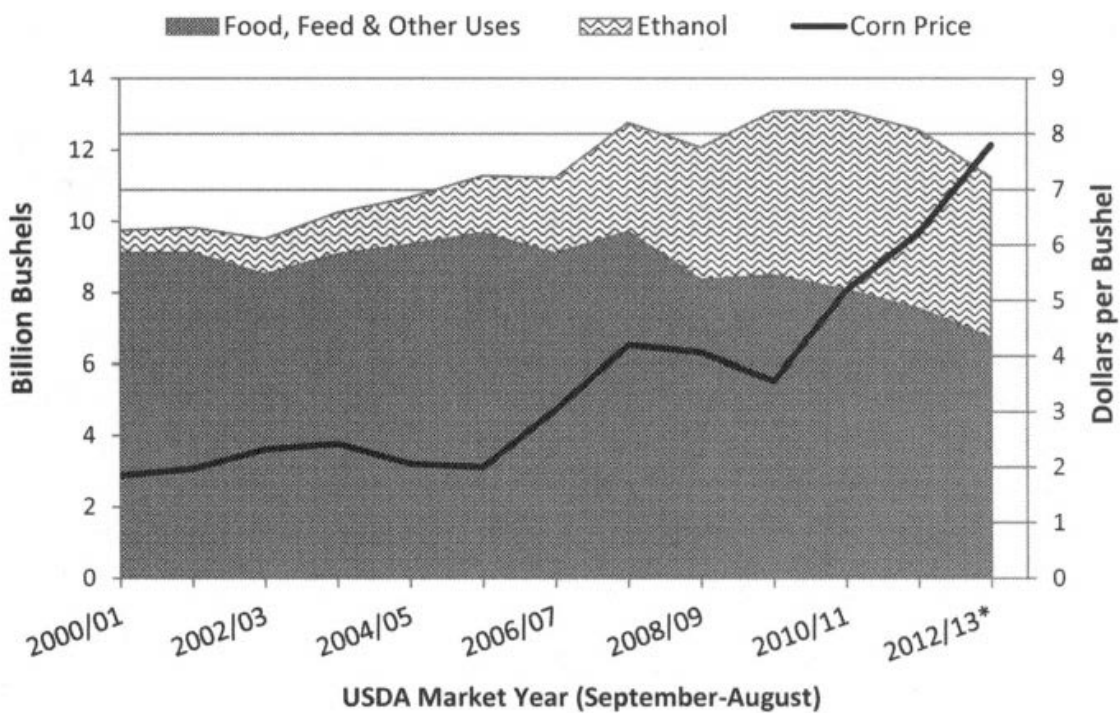
Figure 1: United States Corn Utilization



Note: Marketing year 2017/18 is projected.

Source: USDA, World Agricultural Outlook Board, WASDE

Figure 2: United States Corn Uses and Price History



Source: USDA, Feed Grains Database (2012)

Figure 3: Short Run Effect on Price of Corn

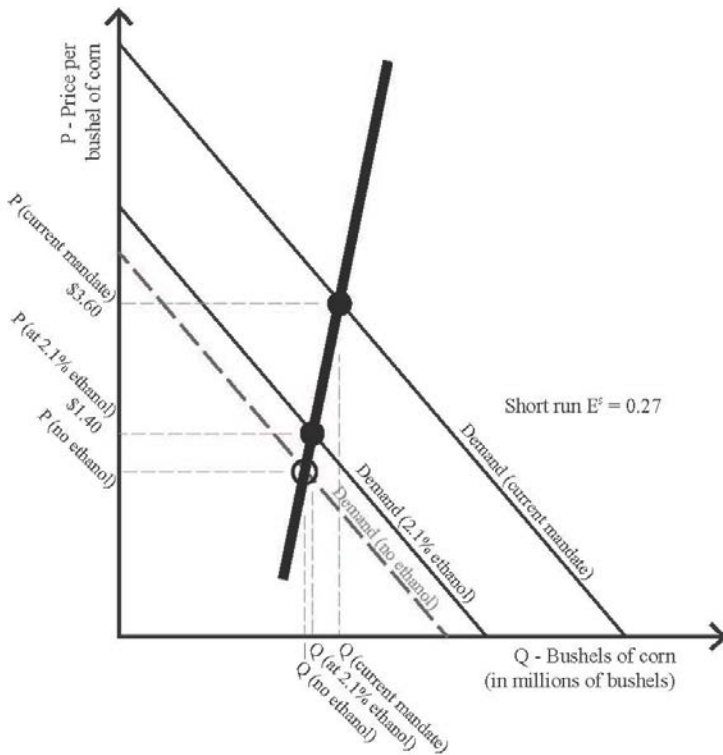


Figure 4: Long Run Effect on Price of Corn

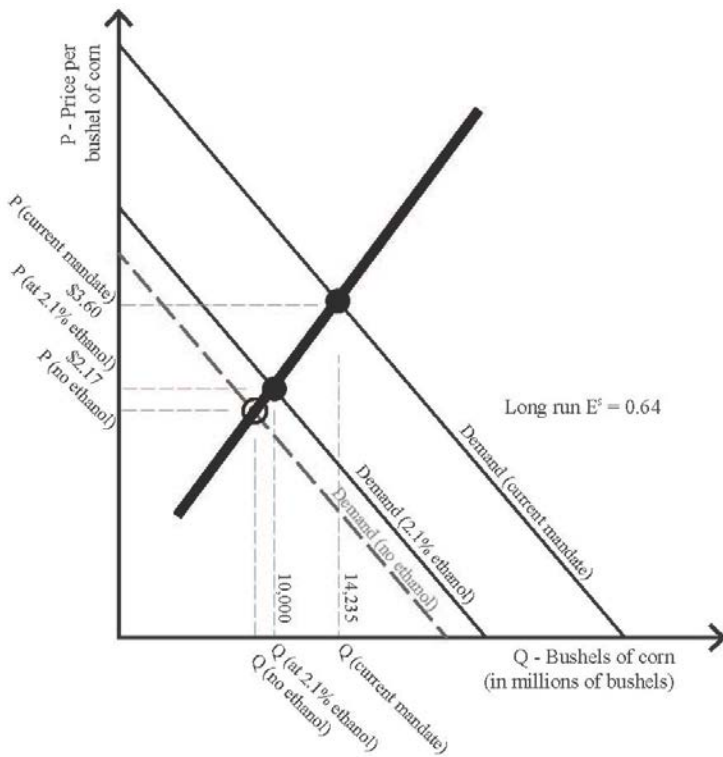
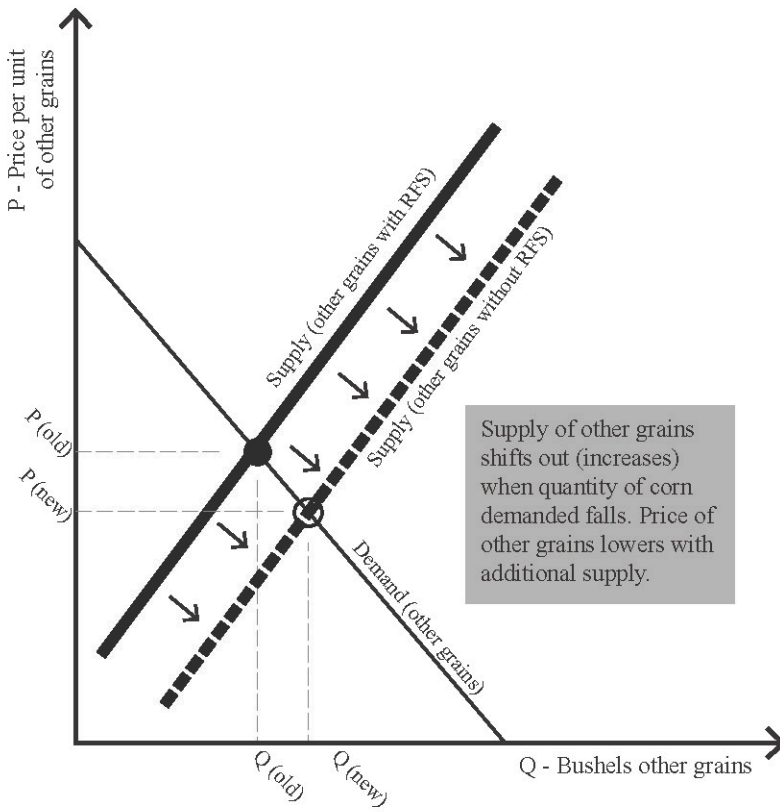




Figure 5: Long Run Effect of Mandate Repeal on Other Grains



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