Federal Programs in Conflict: Does Ethanol Plant Location Cause Early Exits in the Conservation Reserve Program?

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* The views expressed are those of the authors and should not be attributed to the Economic Research Service or USDA
1) Introduction:

When farmers sign a Conservation Reserve Program (CRP) contract with the US Department of Agriculture’s (USDA) Farm Service Agency (FSA), they make a long-term commitment (10 or 15 years) to maintain a conservation cover and to not otherwise farm a tract of environmentally sensitive land.

In return for establishing and maintaining an approved conversation cover on retired land, the USDA provides the farmer with a yearly rental payment. The agreed upon length of the contract is fixed, but the farmer does have the option to terminate the contract early, though at a heavy financial cost. The penalty for an early exit includes, at a minimum, repayment of all prior years’ rental payments.

Since peaking in 2008 at 36 million acres, the total acreage enrolled in CRP has declined by over 10 million acres. Most of land had left the program upon contract expiration, the point at which many farmers have chosen to not re-enroll. While exits from the program are not wholly surprising given increasing commodity prices and farm rents over that period, a more concerning development for the design of the program is that many farms have been willing to bear the steep costs for exiting contracts early. From 2007-2013, contracts were terminated early on **13.6% of all acreage exiting the program, for a total of 1,322,286 acres.**

For a farmer to voluntarily enroll in CRP, and then subsequently exit early, some fairly large changes in expected returns to farming would have to have occurred. One likely candidate is the rise of ethanol production, largely in response to federal energy policies. While this has contributed to the increase in commodity prices overall, geographically these changes have not been evenly distributed, in part because of how ethanol production has located. This research examines whether the development of ethanol plants played a role in driving such a large discontinuity in the relative incentives to participate in CRP.

2) Background:

Federal support for ethanol has a long standing history, dating back to the Energy Tax Act of 1978. In 2005, the Energy Policy Act created the Renewable Fuel Standard, which mandated a substantial increase in the amount of biofuel to be blended with gasoline. This act was extended by the Energy Independence and Security Act of 2007, expanding the production target from 4 billion gallons in 2006 to 36 billion gallons by 2022, a change describe as the Renewable Fuel Standard 2 (RFS2).

Even though there is a considerable range in the literature as to the commodity price change as a result of RFS2, virtually all studies have found a positive effect on commodity prices. As commodity prices rise, farmers may alter their cropping decisions to reflect this increase. Since commodities are costly to transport, and since ethanol is currently produced almost exclusively with corn, these changes are not likely to occur evenly across the landscape.
We hypothesize that those farmers with CRP contracts close to a new ethanol plant or a major ethanol plant expansion will be more likely to exit the program than farmers further away from ethanol plants. While there is substantial variation in ethanol plant location over time and across regions, ethanol plant location and expansion decisions may have been made taking into account surrounding land use. An ethanol plant may be more likely to locate in places where CRP land is less marginal and more productive or in places where a large amount of CRP land is potentially suitable for growing corn. If the variation in ethanol capacity is endogenous, estimating the causal impact of ethanol production on early exits from CRP will require controlling for this endogeneity.

3) Data:

CRP contract data were aggregated at the county level due to the difficult of tracking individual contracts over time. Given the county aggregation, we created a panel dataset that covers 2007-2013. We combined this data with information on ethanol capacity, cropland rental rates, other drivers of returns to land (such as oil and gas well production and county population), and controls for 12 states across the Corn Belt region of the United States. The full dataset covers 1,049 counties for a total of 6,294 observations.

Over this time period, there is considerable temporal variation in the early exit rate, even when aggregated to the national level (Fig. 1). From 2007 to 2009, about 150,000 to 200,000 acres per year (or 0.5% to 0.6% of enrolled and non-expiring acres) exited early. This dropped considerably in 2010 before increasing steadily to 2013. In 2013, early exits reached 250,000 acres per year, or 1% of enrolled, non-expiring acres.

I. County Ethanol Capacity

To evaluate the impact of local ethanol refining on early exits, we consider two features of an ethanol plant that may impact a farmer’s contract exit decision:

1) The distance from the farmer to the nearest ethanol plant
2) The plant’s refining capacity

With that in mind, the county ethanol capacity was constructed by making a 125 km kernel density buffer around each ethanol plant, retaining the refining capacity. Overlapping buffers were summed. Next, zonal statistics were employed to create a spatial average for each county in the sample (Fig. 2). For purposes of the econometric model, we evaluate two-year changes in ethanol capacity because we find from an annual cohort analysis that most early exits occur during the second year or third year of a CRP contract. The average 2-year change in local ethanol capacity during this period was 139 million gallons.

To control for the potential endogeneity of ethanol plant location and expansion, we use the soil rental rate and the amount of acres enrolled in the CRP in a given year. This model hypothesizes
that ethanol plants will choose to locate in areas that have the most productive corn acreage and minimizes the input costs. The soil rental rate is based on the land productivity. Due to the high transportation costs involved, ethanol plants need to locate near relatively productive and higher rent land that can produce sufficient corn per acre, but will also want to avoid locating near the most expensive land which may be located near other sources of demand (such as other ethanol plants, major grain elevators, or animal feeding operations) with which the ethanol plant would have to compete for the corn. In other words, we expect that ethanol plants would choose to locate in areas where soil rental rates are neither too low (indicating land with low productivity) nor too high (indicating high local competition). In addition, we hypothesis CRP enrollment will influence ethanol plant expansion potential. We assume that both of these level variables (baseline period enrollment and soil rental rates) are unrelated to the CRP exit decision conditional on the percentage change in soil rental rate and other factors that influence local returns to crop land.

4) Empirical Model:

We begin by developing a theoretical model of the decision to exit as a binary comparison of the expected returns from remaining in the contract for its duration to the expected returns over the same period for some alternative source of revenue taking into account the penalty for exiting early. The return from CRP, through the annual rental payment level, is known from the contract data. In addition, by virtue of signing the contract, farmers have revealed that in the initial year they viewed the returns to CRP as being better than the returns to the alternative source of revenue. Therefore the key determinants of early exits will be factors that lead to large changes in the alternative sources of revenue. Based on observation (from national level program summaries) that farms are most likely to exit early in the first, second and third years, we construct variables of changes in returns on a two-year lag. The exit decision for farmer $i$ then looks as follows:

$$\text{Pr}(\text{exit}_{it} = 1) = \alpha + \beta_0(\text{return}_{it} - \text{return}_{it-2}) + \epsilon_{it}$$

Aggregating this decision over all enrolled and non-expiring acres within a county, gives the following structural form equation, where $Y$ is the proportion of enrolled acres in year $t$ in county $j$ that exit early:

$$Y_{jt} = \alpha + \beta_0(\text{soilrentalrate}_{jt} - \text{soilrentalrate}_{jt-2}) + \beta_1(X_{jt} - X_{jt-2}) + \epsilon_{jt}$$

We estimate this as a grouped logit model. The additional controls ($X_{jt} - X_{jt-2}$) are other factors that may influence the returns to land outside of crop production, including the two year changes in population (as a proxy for residential development) and in oil and gas production (to capture the influence of fracking on CRP exits). We also estimate, separately, the effect of changes in ethanol capacity, population changes, and oil and gas production on the change in soil rental rates, controlling for the potential endogeneity of changes in ethanol capacity as described.
above. The model also uses year fixed effects to control for national-level price and policy changes over this period.

As an alternative, reduced form specification, we proxy for the change in returns with the change in ethanol capacity, embedding the instrumental variables approach within the group logit estimator.

\[ Y_{jt} = \alpha + \beta_0 (\text{capacity}_{jt} - \text{capacity}_{jt-2}) + \beta_1 (X_{jt} - X_{jt-2}) + \varepsilon_{jt} \]

5) Results:

The results presented in Table 1 below demonstrate that the structural and reduced form models return similar estimates. The average two-year change in ethanol capacity of 139 million gallons is estimated to produce an increase in the expected early exit rate of 0.05 to 0.06 percentage points. Note that the period covered in the table below is from 2008-2011 and represents a truncated sample due to the two year lag we utilized in certain variables and an incomplete sample on oil and gas production data.

6) Conclusions:

At the mean 2-year ethanol capacity expansion (139 million gallons), we estimate that about 13% of early exits are due to the ethanol expansion. The estimates from the structural and reduced form models are very close in magnitude, which indicates that there is a two-fold process occurring. Ethanol plants are driving up prices disproportionately (and rapidly) in areas close to these plants, which then lead to relatively more acreage exiting the CRP early nearer the plants. A larger implication of this research is that the stability of CRP enrollments is impacted by factors that lead to large, rapid changes in returns to land during the terms of the contract. Future research could consider whether alternatives to the fixed annual payments specified in current contracts would help to alleviate this instability.
Figure 1: Early Exit CRP Acreage, 2007–2013 (in levels and as a rate of total acreage)
Figure 2: Ethanol Market Difference, 2007–2013 (broken into quintiles)
Table 1: Structural and Reduced Form Model of Attrition

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<thead>
<tr>
<th></th>
<th>Structural Model</th>
<th>Reduced Form Model</th>
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<tbody>
<tr>
<td>( \partial \text{Attrition} )</td>
<td>0.00003***</td>
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<tr>
<td>( \partial \text{Percent SRR} )</td>
<td>22.0454***</td>
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<tr>
<td>( \Delta 139 \text{ Billion Expansion} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \partial \text{Attrition} )</td>
<td>0.0661***</td>
<td>0.0525***</td>
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<tr>
<td>( \Delta 139 \text{ Billion Expansion} )</td>
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</tbody>
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Note: Statistical significance is as follows:

*** \( \alpha = 1\% \), ** \( \alpha = 5\% \), * \( \alpha = 10\% \)