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Who did the ethanol tax credit benefit? An event analysis of subsidy incidence

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ABSTRACT

At the end of 2011, the Volumetric Ethanol Excise Tax Credit (VEETC), which had subsidized the blending of ethanol in gasoline, was allowed to expire. During its tenure, the subsidy was the subject of intense scrutiny concerning who benefited from its existence. Using commodity price data, we estimate the subsidy incidence accruing to corn farmers, ethanol producers, gasoline blenders, and gasoline consumers around the time of expiration. Our empirical approach contributes methodologically to the event studies literature by analyzing futures contract prices (as opposed to spot prices) when possible. Ultimately, we find compelling evidence that, at the date of VEETC expiration, ethanol producers captured about 25¢ of the 45¢ subsidy per gallon of ethanol blended. We find suggestive, albeit inconclusive, evidence that a portion of this benefit (about 5¢ per gallon) was passed further upstream from ethanol producers to corn farmers. Most of the remainder seems most likely to have been captured by the blenders themselves. On the petroleum side, we find no evidence that oil refiners captured any part of the subsidy. We also find no evidence that the subsidy was passed downstream to gasoline consumers in the form of lower gasoline prices.

1. Introduction

> *"It might cost you more to fill up with gas as early as New Year's Day. If all other variables stay the same, gas prices should be higher since the tax credit oil companies have received to blend ethanol with their petroleum won't be available."*
>
> Jeff Scates, Illinois Corn Growers Association President (Illinois Corn, 2011)

> *"As a result, oil companies have been able to set demand and price levels for ethanol, keeping prices low and pocketing much, if not all, of the VEETC as profit."*
>
> Natural Resource Defense Council Policy Fact Sheet (Greene and Lyutse, 2010)

> *"While those who support the program put forth various reasons for their support—that ethanol will reduce greenhouse gases or curb our reliance on foreign oil—in reality, it is merely a wealth transfer program from the general taxpayer to corn producers."*
>
> Washington Examiner Op-Ed Piece (Wolfram, 2011)

The energy sector in the United States is host to a myriad of policies—regulations, taxes, and subsidies—that shift behavior away from a laissez-faire outcome. Such policies are often motivated by the association of different forms of energy use with significant non-market consequences related to the environment and energy reliability. An important question is whether the benefits from these policies exceed the costs, requiring a careful analysis of non-market benefits (National Research Council, 2010).

Often missing from the aggregate benefit-cost analysis are distributional assessments of who pays or, in the case of a subsidy, who benefits. Incidence is not obvious, as burdens and benefits can accrue to both producers and consumers depending on relative elasticities of response, and may be passed up and down a particular supply chain. Moreover, for incentive-based policies, including taxes and subsidies, the distinct consequences for winners and losers can be many times the aggregate net cost or benefit (Burtraw and Palmer, 2008). In many policy debates, it is these consequences for particular stakeholders that

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help determine both enactment and survival, regardless of the aggregate net benefit analysis. For both equity in its own right and equity's link to acceptance, it is important to consider these distributional effects.

Perhaps nowhere is this more evident than ethanol, which was the object of the single most expensive energy subsidy in recent history, the Volumetric Ethanol Excise Tax Credit (VEETC).[1] Regardless of one's stance on whether more ethanol is or is not desirable, or whether the subsidy was effective at encouraging more ethanol, advocates claimed the subsidy lowered motor fuel prices for consumers while critics claimed the subsidy simply enriched ethanol producers. Which view does the evidence support? The answer is relevant not only for the subsidy, but also for understanding the market structure underlying an industry that continues to be the subject of considerable policy intervention through the federal Renewable Fuel Standard.

Policy effects are often difficult to measure because the no-policy counterfactual cannot be observed. Further complicating matters, multiple policies often target the same objective, making it difficult to disentangle the effects of any single policy. This is particularly evident in the case of policies that promoted ethanol, where three different policies were in place from 2005, when both ethanol mandates and an effective ban on MTBE as a fuel additive began, until the end of 2011, when the VEETC was ended.

Nonetheless, the end to the VEETC in December 2011 offers a unique opportunity to observe the incremental consequences of a single policy. In particular, at the time of its termination, was the ethanol subsidy benefiting primarily ethanol producers or consumers? Was the value being passed further up or down the supply chain? By comparing prices along the supply chain immediately before and after the subsidy expired, we can isolate the effect of the subsidy termination holding other influences constant, and thereby determine the subsidy incidence. In concept, our estimation approach is similar to the typical event study, a technique that has spawned a large literature. However, we innovate on the typical event study approach by analyzing futures contract prices rather than spot market prices whenever possible, which allows us to avoid the estimation window issues that often plague event studies.[2]

The results suggest that most—perhaps 25¢—of the 45¢ per gallon of ethanol blended subsidy accrued to ethanol producers at the time the subsidy expired. Moreover, there is some evidence that a portion (about 5¢ per gallon) of the benefits were passed up the supply chain to corn farmers, although data limitations prevent us from making more confident statements on this front.[3] Random variation in prices for petroleum products makes it difficult to estimate the incidence on oil refiners or gasoline consumers precisely, but the point estimates suggest that these stakeholders received very little, if any, benefit from the subsidy. This refutes the notion that the subsidy largely benefited consumers. Based on the evidence, we conclude that most of the remaining third of the subsidy was likely being captured by fuel blenders at the time the subsidy expired.

In order to estimate the ethanol subsidy incidence, we use several data sources and empirical techniques. When possible, we use one-month calendar spreads constructed from the futures markets for ethanol, corn, and gasoline blendstock (petroleum). These spreads, reflecting expected one-month price changes, provide a means to differentiate sharply between the prices of products that could benefit from the tax credit, and those (produced after expiration) that could not. For commodities without exchange-traded futures markets, specifically finished gasoline, we use standard time-series regression techniques on spot price data to analyze whether the subsidy expiration coincided with a significant change in the gasoline blending margin around the time of expiration. To obtain our final estimates and confidence intervals, we implement a simulation procedure that imposes that the total incidence sums up to 45¢.

This paper is organized as follows: Section 2 provides background on the industry structure for gasoline production and biofuels policy in the United States. Section 3 summarizes the related literature on renewable fuel policies and event studies of policy changes. Section 4 lays out the conceptual framework and discusses how the subsidy might manifest in commodity prices. Section 5 presents the empirical approach and model, describes the data, and discusses the results. Section 6 concludes.

2. Gasoline and biofuels policy

Gasoline production in the United States involves the convergence of two supply chains: one for refined petroleum from crude oil and an agricultural supply chain for ethanol from corn. The process can be described by the schematic outlined in Fig. 1 and elaborated below (including how certain producers might be connected at the corporate level).

On the agricultural side, production begins on the farm and ends with blending at the fuel terminal. Corn is harvested, and then shipped to ethanol production facilities for processing.[4] The amount of corn used for fuel production is significant: in 2011, which was the last year for the VEETC, ethanol production accounted for about 40% of corn consumption in the United States (Brester, 2012). The other major input to ethanol production is fuel used to generate electricity for the plant, typically natural gas. The major outputs of the production process are ethanol and distillers grains, which can be sold as animal feed. Once production has occurred, the ethanol is shipped, typically via truck or railcar, to fuel terminals to be blended into gasoline.

Meanwhile, on the petroleum side, production begins with extraction of crude oil and other petroleum liquids and, as with ethanol, ends with blending at the fuel terminal. Crude oil is extracted, possibly shipped, and transported via pipeline to refineries. Refiners process crude oil into several different refined petroleum products, including petroleum blendstock, which is a precursor to finished gasoline. Reformulated blendstock for oxygenated blending (RBOB) and conventional blendstock for oxygenated blending (CBOB) are refined products specifically engineered to be blended with an oxygenate, such as ethanol.[5] These refined petroleum products are then transported, usually via pipeline, to a fuel terminal.

Finished gasoline is the product of combining fuel ethanol, an oxygenate, with gasoline blendstock. From a performance standpoint, oxygenate blending increases the octane of the fuel, which serves the dual purpose of preventing engine "knock" in motor vehicles and also creates a cleaner-burning fuel. However, when used in blends higher than about 5%, ethanol transitions from being a complement to petroleum to a substitute.

Once both products are in storage at the terminal, they are blended in one of two ways. Either both fuels are combined in a designated blending tank, or they are "splash" blended aboard a fuel truck.[6] The proportion of ethanol in a gallon of finished gasoline can vary: the most

[1] The VEETC accounted for $5 billion per year, or roughly one-quarter of all energy related, non-stimulus subsidies in 2007 and 2011 (U.S. Energy Information Administration, 2011).

[2] For a comprehensive discussion of potential sources of bias in event studies and how prediction markets can mitigate them, see Snowberg et al. (2011).

[3] Using a conversion factor of 0.37 bushels per gallon, this translates to 13.5¢ per bushel of corn.

[4] Our focus for this paper is restricted to corn-derived ethanol. The use of other, more advanced biofuel feedstocks is, for the most part, in the research or early commercialization phase, but not yet commercially significant.

[5] RBOB is used in the production of reformulated gasoline, a product blended to burn more cleanly than conventional gasoline (produced from CBOB). The Clean Air Act requires reformulated gasoline to be used in cities with high smog levels, since petroleum combustion contributes to ground-level ozone formation.

[6] A small number of retail stations, primarily located in the Midwest, perform splash blending at the pump.