AN ANALYSIS OF THE EFFECTS OF GOVERNMENT SUBSIDIES ON THE FUEL ETHANOL INDUSTRY: A STRUCTURAL ECONOMETRIC MODEL

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Overview

Given that the development of fuel ethanol in the U.S. has been accompanied by government subsidies, it is important to assess the role of government subsidies in the decision-making of ethanol investors and ethanol producers and to determine the appropriate level of the subsidy. The primary ethanol subsidy, the federal volumetric ethanol excise tax credit, was reduced from 51 cents per gallon to 45 cents per gallon in the 2008 Farm Bill and expired on December 31, 2011. Such changes may have affected fuel ethanol plant investment and ethanol production. The lack of subsidies may also affect the industry's ability to reach the Renewable Fuels Standard (RFS) goal of 15 billion gallons of corn-based fuel ethanol to be blended in gasoline by 2022. Although the 2012 total ethanol capacity has almost reached 15 billion gallons, it is still hard to believe that the current capacity is sustainable because there is no subsidy from 2012 onwards. Schmit et al. (2011) used dynamic programming methods to show that without government policies, the recent expansionary periods would have not existed and market conditions in the late-1990s would have led to some plant closure. Lin and Thome (2012) also empirically show that subsidy policies have contributed the development of fuel ethanol plant investment. These above findings, along with current situation that the rate of expansion in ethanol production capacity has decreased to 0.6% per month in 2009 from a 4.6% growth rate between 2005 and the end of 2008 (O'Brien and Woolverton, 2010), emphasize the importance of government support in the development of the ethanol industry.

In this paper, we identify how government subsidies affect fuel ethanol production and determine the optimal subsidy level that maximizes net social welfare.

Methodology

We construct a dynamic strategic model under the framework of industry dynamics developed by Maskin and Tirole (1988) and Ericson and Pakes (1995). Comparing with Schmit et al. (2011) and Lin and Thome (2012), our approach is firmly founded on empirical estimation and carefully represents various strategies for incumbent and new entrant ethanol plants. Another advantage is that we consider the interaction effects between fuel ethanol plants when they make investment or production decisions. Our estimated model is also flexible enough to evaluate different levels of subsidy and the relevant effects on producers, consumers and government.

In our approach, all the plants are assumed to optimize their behavior conditional on the current state variables including other agents' actions and private shocks, which results in a Markov perfect equilibrium (MPE). To estimate the structural econometric model, without imposing any prior structure, we first characterize the policy functions of plants for their decisions regarding entry, capacity expansion and exit, which are functions of state variables. Once we obtain these policy function estimates, we recover the parameters in the value function using semi-parametric methods.

Finally, we exploit the estimated structural model of fuel ethanol industry to simulate the effects of subsidies for fuel ethanol production and subsidies for investment.

Results and Conclusions

We find that a decrease in the subsidies results in a slow-down in the expansion of fuel ethanol production, which is consistent with what we observe currently. We then determine the optimal subsidy level that minimizes government expenditure but enables the desired fuel ethanol supply volume to be satisfied and we report the corresponding social welfare resulting from various subsidy levels. We find that the optimal subsidy level is $0.47/gallon. We also examine the impact of a counterfactual investment subsidy and compare it with a volumetric production subsidy. Such comparison will suggest a cost saving way for government to support the fuel ethanol industry.

References

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