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An Ethanol Policy That Benefits All Americans

By Frank A. Wolak

In a carbon-constrained world, ethanol should assume a larger role in America's energy portfolio. It can displace fossil fuels in the transportation sector, where few financially viable low-carbon alternatives exist. The Energy Policy Act (EPAct) of 2005 calls for up to 7.5 billion gallons of renewable fuel to be used in gasoline by 2012. President George W. Bush devoted a substantial portion of his January 2007 State of the Union address to laying out a plan for the United States to increase its production of ethanol. He urged the U.S. government to mandate greater ethanol use in motor fuels and set a floor for alternative and renewable fuel use in 2017 equal to seven times current U.S. ethanol output. Despite general agreement among policymakers on the need for a larger share for ethanol in the U.S. energy portfolio, there is substantial disagreement over how to achieve this goal.

Under current U.S. policy, domestic producers receive substantial subsidies for ethanol used in the transportation sector and sizable tariff protection from imports. Because ethanol currently accounts for a small share of U.S. energy consumption, the aggregate cost to consumers from these policies is modest. However, if the domestic ethanol production envisioned by the EPAct 2005 and President Bush's proposals materializes, these policies could become extremely expensive for U.S. consumers.

Because corn is the primary input used to produce ethanol in the United States, the global

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About The Author

Frank A. Wolak received his Ph.D. and S.M. from Harvard University. He is a Professor of Economics at Stanford University, and the Chairman of the Market Surveillance Committee of the California Independent System Operator (ISO), an independent market monitoring entity for state's electricity supply industry. He has been a visiting scholar at University of California Energy Institute (UCEI), is a Research Associate of the National Bureau of Economic Research (NBER), and a Senior Fellow at SIEPR. Wolak's fields of specialization are industrial organization and econometric theory. His recent work studies methods for introducing competition into formerly regulated infrastructure industries—telecommunications, electricity, water delivery and postal delivery services—and on assessing the impacts of these competition policies on consumer and producer welfare.

environmental benefits of domestic ethanol production with existing technology are small. Corn cultivation in the United States requires substantial fossil-fuel consumption, and processing and distilling the corn into ethanol is an energy-intensive process that often consumes fossil fuel. Furthermore, the use of ethanol as a transportation fuel produces higher levels of local pollutants that cause smog than gasoline.

Consequently, current U.S. policy toward ethanol will become increasingly expensive to U.S. consumers and is likely to provide limited global environmental benefits. Fortunately, there are policies that the United States can pursue with much bigger economic and environmental payoffs, but these require a broader view of the economic and environmental benefits to U.S. consumers.

Current U.S. ethanol policy and corn-based ethanol production in the United States have a number of economic and environmental shortcomings. Brazilian sugarcane is a more environmentally friendly and lower-cost source of ethanol. Therefore, the United States should eliminate all market barriers that disadvantage foreign ethanol producers. The tax dollars currently used to subsidize corn-based ethanol production should instead be spent on research and development of low-cost, large-scale technologies for producing ethanol from non-food feedstocks. These policies will provide far greater economic and environmental benefits to U.S. consumers than current ethanol policies and will enhance U.S. energy security goals.

The Trouble With Corn-Based Ethanol

There is considerable academic debate over the extent to which corn-based ethanol replaces fossil fuels. Corn production and agricultural production in general in the United States is extremely energy intensive. Farm vehicles to prepare, plant and harvest crops consume gasoline and diesel fuel at high rates. A major determinant of increasing crop yields per acre in the United States is the application of ammonia fertilizers that consume natural gas as a major feedstock. In many locations, some or all of the water for the crops is provided by irrigation or groundwater, which requires electric pumps to move the water where it is needed when it is needed. These pumps consume significant amounts of electricity, some of which is produced using fossil fuels.

There are a number of studies measuring the fossil-fuel ratio for corn-based ethanol – the amount of energy in one gallon of ethanol divided by the amount of fossil-fuel energy necessary to produce it. Some studies argue that the fossil-fuel ratio is less than one for corn-based ethanol, meaning that it takes more fossil-fuel energy to produce the amount of energy in one gallon of ethanol. Other studies that include the energy content of all consumable energy products from the ethanol production process find a fossil-fuel energy ratio between 1.2 and 1.4, meaning that at most 40 percent more energy is contained in the gallon of ethanol than is in the fossil fuel consumed to produce it. For comparison, the fossil-fuel ratio for Brazilian ethanol from sugarcane is 8.3, a six to seven times more efficient use of fossil fuels per gallon of ethanol produced.

Corn-based ethanol currently has two sources of government-mandated financial assistance. The first is a tax credit for ethanol refiners of $0.51/gallon for ethanol used as a transportation fuel. The second is a tariff on ethanol imported from Brazil of $0.54/gallon. Together, they provide American producers with a more than $1/gallon price advantage relative to Brazilian imports.

Increasing use of U.S. corn to produce ethanol has also bid up the price of corn, a basic food source in many developing

countries. For example, Mexico recently increased its subsidies for corn consumption citing the increasing use of corn to produce ethanol as an important factor driving this decision.

A fossil-fuel intensive production process, substantial financial assistance to domestic corn and ethanol producers, and the use of corn an essential food source in many countries of the world combine to make the economics and environmental benefits of corn-based ethanol dramatically inferior to sugarcane ethanol and ethanol from other biomass sources. To understand the economic and environmental advantages of Brazilian ethanol, it is useful to review the economics of the Brazilian sugarcane industry.

The Saudi Arabia of Ethanol

Brazil produces more ethanol than any other country in the world at an average production cost that is less than 65 percent of average U.S. production costs. Brazilian ethanol is cost competitive with current gasoline prices, even after accounting for the fact that the energy content per gallon is roughly 70 percent of that of a gallon of gasoline. This logic implies that a retail price per gallon of ethanol less than 0.70 times the price of gasoline makes ethanol a better buy for consumers able to use either fuel in their vehicles. Currently, the cheapest producers in Brazil can sell ethanol at $0.80/gallon, which implies that it is cost competitive with wholesale gasoline selling at $1.15/gallon, a price far below the current wholesale price in the United States.

Brazil's significant cost advantage in producing ethanol can be traced to a number of unique factors. First, Brazil's temperature and seasonal rainfall patterns provide almost three times more tons of biomass per acre than the United States. Second, Brazil produces ethanol from sugarcane, which is a much less energy-intensive and costly process. Corn-based ethanol requires the additional step of transforming the starch in corn into sugar before it is distilled into ethanol, a process that can be skipped by starting with sugarcane. Third, Brazil has been producing sugarcane for hundreds of years and has engaged in extensive research and development to optimize crop yields for the Brazilian climate and soils. Finally, the ownership of productive capacity in both the sugarcane production and distilling sectors is unconcentrated. There are more than 60,000 sugarcane producers and more than 300 ethanol distilleries in Brazil.

Brazil also has the ability to scale up its productive capacity to a barrel of oil-equivalent volume of ethanol equal to Saudi Arabia's annual oil production. There are 925 million acres of land suitable for agriculture in Brazil without using rainforests or other protected environmental areas. Currently, approximately 697 million acres are in use, with only 14 million acres devoted to sugarcane. Approximately 280 million acres are suitable for sugarcane production. None of this additional land used to produce sugarcane needs to displace the production of primary food crops. This additional production is likely to replace soybean production and pasture land and make use of presently uncultivated land. With this amount of land in sugarcane production, Brazil would produce roughly 9.6 million barrels of oil equivalent per day, which is close to Saudi Arabia's current daily output of oil.

Brazil could further increase its ethanol production by taking advantage of the cellulosic ethanol production process, which uses the bark and leaves of any biomass as a feedstock to produce ethanol. Currently, only the sugarcane syrup, which accounts for just one-third of the energy in the sugarcane biomass, is converted to ethanol

through fermentation. There is a substantial amount of biomass remaining (called bagasse) that is usually burned to produce heat, which boils water that spins a turbine to produce electricity. Recently, combined ethanol production and bagasse electricity generation facilities have become cost competitive with natural gas-fired and hydroelectric facilities in Brazil. Currently, there is almost 3.000 megawatts of installed generation capacity that jointly produces ethanol and electricity.

Using the cellulosic conversion process, a bagasse feedstock could also be used to produce ethanol. Although this process is technically feasible, it has yet to be developed on a large scale because of the significantly increased cost of production relative to corn-based ethanol. Cellulosic ethanol holds substantial promise to reduce fossil-fuel consumption and total greenhouse gas emissions. The cellulosic ethanol process is estimated to have a fossil-fuel energy ratio that is more than 25 percent higher than sugarcane ethanol and almost ten times higher than corn-based ethanol.

Focus on What You're Good At

The best available technologies for the production of ethanol in the United States and Brazil clearly argue for Brazil producing ethanol and exporting it to the United States. There should be little, if any, corn-based ethanol production in this country. This outcome can easily be implemented by eliminating the subsidy for domestic ethanol production and the tariff on imports of Brazilian ethanol. As a result of this policy change, U.S. consumers would pay less for ethanol and the supply of ethanol to the United States would also increase because Brazilian producers no longer need to pay a tariff to sell in the U.S. market. This policy is also likely to have the additional benefit of reducing the price of corn to U.S. consumers and consumers in developing countries around the world.

If the United States adopted a non-discriminatory access policy for imported ethanol, what other steps should it take to support domestic ethanol production? As noted above, the cellulosic ethanol production process requires substantial research and development to make it cost competitive with sugarcane ethanol from Brazil. The United States is a world leader in biotechnology research. Instead of spending money on something the United States has no comparative advantage in – producing ethanol from corn – the United States should instead spend this money on something the United States has a substantial comparative advantage in-biotechnology research to improve the efficiency and cost-effectiveness of the cellulosic ethanol production process.

Subsidizing the production of corn-based ethanol clearly benefits corn farmers and ethanol refineries, but this policy is extremely costly to U.S. consumers and even more so as U.S. consumption of ethanol increases. Eliminating these subsidies and the import tariffs on ethanol from Brazil and transferring any remaining money to fund research on cellulosic ethanol has the potential to create a cost-effective source of ethanol than significantly reduces U.S. greenhouse gas emissions from the transportation sector, a very laudable goal because so few renewable sources of energy can be used in this sector of the economy.

Increase the Diversity of Energy Sources and Suppliers

At first glance, the recommendation that the United States increase its consumption of Brazilian ethanol and decrease U.S. corn-based ethanol production runs counter to a major motivation often given for subsidizing

domestic ethanol production – reducing U.S. dependence on foreign energy sources. Although one cannot deny this policy will increase the dependence of the United States on foreign sources of energy, a strong case can be made that it will increase supply security for transportation fuels and reduce the transportation fuel price volatility faced by U.S. consumers.

The experience of Brazil provides a valuable lesson. As a result of the development of a significant ethanol industry, the Brazilian government mandated the production of flexible-fuel (flex-fuel) vehicles that could consume either gasoline or ethanol in any combination. Currently, more than 70 percent of new cars sold in Brazil are flex-fuel. A consumer with a flex-fuel car can significantly limit his exposure to fossil-fuel price volatility caused by events in the Middle East, Nigeria or other oil-producing regions of the world. If the retail price of gasoline times 0.70 is greater than the price of ethanol, the consumer fills up his tank with ethanol and avoids the higher gasoline price; otherwise, he fills his tank with gasoline. An additional sign of the economic benefits consumers derive from the ability to exploit differences in the price of gasoline and ethanol is that the used-car market in Brazil currently attaches a price premium to flex-fuel vehicles.

Besides this fuel price risk benefit, there is also a fuel supply security benefit from allowing Brazilian ethanol to compete on equal footing with domestically produced ethanol. The United States would have an additional source of transportation fuel not subject to the supply interruptions and other turmoil that plague oil-producing regions. Moreover, there are a number of other countries in the world with climates similar to Brazil that could ramp up their production of sugarcane ethanol. For example, several Caribbean countries and African countries could become significant ethanol producers. Non-discriminatory access of Brazilian ethanol to the U.S. market would signal that investments in sugarcane ethanol facilities in these countries would be financially viable because of equal access to the U.S. market. This would further increase the set of countries supplying ethanol to the U.S. market, which would further increase transportation fuel supply security.

Consequently, a policy that provides non-discriminatory access of Brazilian ethanol to the U.S. market increases both the number of transportation fuel energy sources and the number of countries that supply transportation fuels and in this way addresses U.S. concerns about energy supply security. This policy also shares the benefits of low-cost Brazil ethanol and government expenditures on research and development on cellulosic ethanol with all U.S. consumers.

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