ETHANOL AND RENEWABLE FUEL STANDARD

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EXECUTIVE SUMMARY

This report examines the history and impact of government subsides for the corn ethanol industry on the U.S. economy as a whole and also on specific “corn belt” counties. We are primarily concerned with the impact of the Renewable Fuel Standard (RFS) following its implementation in 2005. By looking at both local and national economies before and after implementation of the RFS we found that not only is the RFS bad for the overall U.S. economy, but also for the very counties expected to benefit most. Understanding the true costs and benefits of ethanol subsidies like the RFS will allow policy makers to better evaluate the structure and necessity of these policies moving forward.

While we do offer a general overview of biofuels and ethanol, highlight the history and state of various ethanol subsidies, and touch on the negative impacts that can arise from policies encouraging corn use in our fuels, this study aims to add a new dimension to the discussion of ethanol policy in the U.S. We look to real world case studies along with historic economic and agricultural data to identify how these policies impact the areas they were designed to benefit the most, the U.S. corn belt. These counties, and those who live and work in them, are often touted as beneficiaries of the RFS mandate. The usual argument is that because the RFS increases the use of corn ethanol, and thereby increases demand for corn production, the economic conditions of those communities that raise, harvest, and come to rely on the production of RFS fuel stock are substantially improved. We test this basic assertion and ultimately find that corn belt counties see higher unemployment rates and lower per capita income than the rest of the U.S. since the implementation of the RFS. These results run counter to the conventional wisdom. Instead, they are indicative of the problems of movements to a single sector economy dominated by large-scale production requirements where the dynamism of competition is replaced with production driven by governmental mandate rather than consumer demand.

These corn belt counties experienced nearly 0.5 percent higher residual unemployment and 20 percent greater loss in per capita income compared to the rest of the U.S. When coupled with the larger economic realities of higher corn, food, and gasoline prices, it becomes clear that the RFS in its current form is undesirable.

Supporters of expanded use of corn ethanol in the U.S. fuel mix claim that it is a performance enhancement in gasoline, a tool for environmental improvement, and critical to increasing our national security. Some of these claims are true, while others are questionable at best. Either way, it is the economic reality of heavy government subsidization, federal mandates, and trade protectionism that we evaluate in this paper.

INTRODUCTION

Commenting on the state of the manipulated ethanol market, Rep. Peter Welch (D-VT) said, “I can’t think of another product in the American economy that really had the trifecta – a tariff barrier, a subsidy, and a mandate.” Despite spending over $57 billion taxpayer dollars on ethanol subsidies since 1980, the U.S. is no better off. While a precious few may benefit greatly from such crony capitalist policies, the rest of the country, and even the world, pays the price.

In response to skyrocketing gasoline prices and environmental concerns relating from lead contamination, the United States took action to find and encourage alternative fuel blends. This led to the blending of corn-based ethanol into the

country’s gasoline supply. The demand for gasoline policy changes to encourage safety and stability resulted in the first major government subsidy for ethanol being written into the Energy Tax Act of 1978.\(^4\)

This law provided a $0.40 payout for each gallon of gasoline blended with ethanol. Since that time, the federal government has propped up the biofuels industry in a variety of ways including tax credits, production mandates, trade protections and other market distorting interventions.

While these various supports continuously change form and structure, they are a major part of our nation’s energy policy and should be evaluated. Today, the major policy supporting the corn ethanol industry is the Renewable Fuel Standard (RFS). This standard mandates that a certain quantity of biofuels are mixed in the U.S. gasoline supply each year. In the U.S. this traditionally means corn-based ethanol.

As with any market intervention by the government, there are inherent ‘winners’ and ‘losers’. With the country spending massive amounts of taxpayer dollars on such policies, it is essential to determine just what is gained or lost by making those expenditures, and who is impacted. In the case of the RFS, the truth is that the costs outweigh the benefits and that the ‘losers’ far outweigh the winners.

While it may seem intuitive that those regions of the U.S. responsible for corn production stand to be the ultimate beneficiaries of the RFS and pro-ethanol policies, the truth is that the economic gain is realized by a relatively small number while the average citizen of the ‘corn belt’ has been negatively impacted.

This report begins with an explanation of biofuels, ethanol, and American agriculture. It goes on to highlight the history of government intervention in the ethanol market and after touching on some problems associated with corn ethanol, relates some case studies of direct and indirect impacts of the RFS. Finally, we aim to add to the greater policy discussion by showing with econometric analysis, how even the states with the most corn production have been negatively impacted with higher unemployment and less per capita income than the U.S. as a whole.

WHAT ARE BIOFUELS?

Biofuels are a segment of a wider category of energy production referred to as “biomass,” or any energy produced from living or recently living organisms, typically plants. Biomass energy is used in a number of ways, ranging from cooking food over an open wood fire to electricity production. Biofuels are the liquid fuel forms of biomass energy. While there are numerous forms of biofuel, the only two with any widespread use as transportation fuels are ethanol and biodiesel.

Ethanol (short for ethyl alcohol) is made via fermentation of plant matter, the same process used to make alcohol for human consumption. Ethanol can be made from a variety of feedstocks, but in the United States the vast majority is made with corn. In Brazil, sugarcane provides the feedstock for most ethanol, and other vegetables such as sugar beets are utilized to make small amounts of ethanol worldwide but do not make up the majority of any major markets. Researchers are currently attempting to find an economical way of making ethanol from cellulose, the material making up the green portion of most plants, which could require far less land per unit of energy production if the technology could be economically scaled.

Biodiesel is made through a process called “transesterification.” Organic oil feedstocks are mixed with a catalyst (typically ethanol or methanol) to create a chemical reaction that allows the separation of methyl esters (the biodiesel) from glycerin, which can be used to make other commercial products such as soap. Commonly used inputs for biodiesel

are more diverse than ethanol. Roughly half of U.S. production is made with soybean oil, the second half are split between plant-based feed stocks (corn, canola, and palm oil), recycled greases and animal fat-based stocks.\(^5\)

Both biodiesel and ethanol are benefactors of government subsidies and regulatory requirements. These policies are sometimes just broad incentives for any type of ethanol, but oftentimes become even more specific, targeting subsections such as cellulosic ethanol or “advanced ethanol,” a term for non-corn starch ethanol.

While government policies mandate an expanded use of biofuels in the U.S. fuel mix, ethanol use did exist in the United States before these policies and would likely continue even after a full repeal, possibly with even more production than from before the mandate. Ethanol is intrinsically useful to boost the octane rating of motor fuels, guaranteeing that it would still have a role in an unregulated market. After MTBE, the traditional chemical used to increase octane by fuel refiners, was found to contaminate groundwater after leaking from underground containers and was banned in many states in the U.S., fuel blenders began replacing MTBE with ethanol as an agent to increase fuel octane.\(^6\)

**WHY DOES THE U.S. USE CORN FOR ETHANOL?**

The most important of U.S. ethanol policies do not actually require ethanol to be made of corn. In fact, the Renewable Fuel Standard provides additional incentive to create ethanol from non-starch (and therefore non-corn) sources. The triumph of corn in the U.S. ethanol market is largely a product of unique American circumstance.

While it is functionally possible to create ethanol from various plant-based sources, the only two technologies that are economical for mass production today require either sucrose- or starch-based feedstocks. Common sucrose feedstocks are sugarcane and sugar beets, common starch feedstocks are corn and sorghum. Between the two, it is more efficient to create ethanol from sucrose, which is why many U.S. ethanol policies show statutory favoritism to sucrose over starch derived ethanol. The reason sucrose makes up such a smaller portion of U.S. ethanol production is a simple matter of crop availability—sugarcane production is limited to Florida, Louisiana, Texas, and Hawaii. Sugar beets are more widely available, but are still only produced in quantities above 100,000 acres in Minnesota, North Dakota, Idaho, and Michigan.\(^7\) In addition to geographic limitations, both sugarcane and sugar beets are far more expensive, due to their higher value as a food source than as an ethanol source.\(^8\) These factors have encouraged ethanol producers to rely on starch-based feedstocks.

Starch-based feedstocks benefit from widespread suitable cropland, and relatively cheap production costs. Corn has managed to outpace sorghum in yield per acre improvements, and has thus championed the largest growth in ethanol production. Other starch sources, such as oats and barley, are not as useful for ethanol production because of their lower ethanol output per acre of harvest.\(^9\)

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HISTORY OF THE RENEWABLE FUEL STANDARD

The most important government intervention benefiting ethanol is the Renewable Fuel Standard (RFS), which mandates that fuel sold in the United States must contain certain volumes of renewable fuels. Originally passed in 2005 under the Energy Policy Act, referred to as RFS1, the mandate was later expanded under the Energy Independence and Security Act of 2007 (EISA), called RFS2. RFS2 volume standards vastly expanded the original mandates set forth by RFS1, which capped out at 7.5 billion required gallons in 2012, and raised the goal to 36 billion gallons of renewable fuel consumption by 2022. These numbers represent a steep increase from the roughly 6.5 billion gallons produced in 2007\textsuperscript{10}, the year the expansion was passed.\textsuperscript{11} There are also a number of key changes made between RFS1 and RFS2:

- A distinction between traditional corn starch ethanol (which maxes out at 15 billion required gallons) and “advanced” biofuels
- An expanded purview that includes almost all forms of transportation fuel, rather than exclusively gasoline
- New requirements for minimum reductions in GHG lifecycle emissions
- Changes to the definition of “renewable biomass” that include land use restrictions.\textsuperscript{12}
- Renewable fuel use mandates as they existed in RFS1 and currently exist in RFS2 are available in the table below.

### RENEWABLE FUEL STANDARD MANDATES (RFS1 & RFS2)¹³

*(in billions of gallons)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Original RFS1 Mandate</th>
<th>Total RFS2 Mandate</th>
<th>&quot;Advanced&quot; Biofuel Requirement</th>
<th>Corn Starch Ethanol Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>4.0</td>
<td>4.00</td>
<td>0.00</td>
<td>4.0</td>
</tr>
<tr>
<td>2007</td>
<td>4.7</td>
<td>4.70</td>
<td>0.00</td>
<td>4.7</td>
</tr>
<tr>
<td>2008</td>
<td>5.4</td>
<td>9.00</td>
<td>0.00</td>
<td>9.0</td>
</tr>
<tr>
<td>2009</td>
<td>6.1</td>
<td>11.10</td>
<td>0.60</td>
<td>10.5</td>
</tr>
<tr>
<td>2010</td>
<td>6.8</td>
<td>12.95</td>
<td>0.95</td>
<td>12.0</td>
</tr>
<tr>
<td>2011</td>
<td>7.4</td>
<td>13.95</td>
<td>1.35</td>
<td>12.6</td>
</tr>
<tr>
<td>2012</td>
<td>7.5</td>
<td>15.20</td>
<td>2.00</td>
<td>13.2</td>
</tr>
<tr>
<td>2013</td>
<td>7.6*</td>
<td>16.55</td>
<td>2.75</td>
<td>13.8</td>
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<tr>
<td>2014</td>
<td>7.7*</td>
<td>18.15</td>
<td>3.75</td>
<td>14.4</td>
</tr>
<tr>
<td>2015</td>
<td>7.8*</td>
<td>20.50</td>
<td>5.50</td>
<td>15.0</td>
</tr>
<tr>
<td>2016</td>
<td>7.9*</td>
<td>22.25</td>
<td>7.25</td>
<td>15.0</td>
</tr>
<tr>
<td>2017</td>
<td>8.1*</td>
<td>24.00</td>
<td>9.00</td>
<td>15.0</td>
</tr>
<tr>
<td>2018</td>
<td>8.2*</td>
<td>26.00</td>
<td>11.00</td>
<td>15.0</td>
</tr>
<tr>
<td>2019</td>
<td>8.3*</td>
<td>28.00</td>
<td>13.00</td>
<td>15.0</td>
</tr>
<tr>
<td>2020</td>
<td>8.4*</td>
<td>30.00</td>
<td>15.00</td>
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<tr>
<td>2021</td>
<td>8.5*</td>
<td>33.00</td>
<td>18.00</td>
<td>15.0</td>
</tr>
<tr>
<td>2022</td>
<td>8.6*</td>
<td>36.00</td>
<td>21.00</td>
<td>15.0</td>
</tr>
</tbody>
</table>

*RFS1 only set standards through 2012—numbers here assume an extension including small, incremental increases in renewable fuel requirements

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The yearly standards set by EISA are not necessarily reflective of the rules that are actually enforced. Congress gave the Environmental Protection Agency (EPA) authority to reduce but not increase the yearly mandates to avoid overly-harsh penalties in the case of unrealistic biofuel production expectations. For example, due to a lack of U.S. production capability for cellulosic ethanol (a subsection of “advanced” biofuels that requires ethanol to be derived from cellulose), the EPA has reduced the mandate specific to cellulosic ethanol every year since 2010.¹⁴

In May of 2015, the EPA finally released its proposed biofuel volume requirements for 2014 through 2016. For corn-based ethanol, the mandate was cut by 3.75 billion gallons over the three-year period.¹⁵ The EPA openly admitted its interventionist role, and its error in being overly optimistic in pushing the biofuels mandates beyond the constraints of market realities. The new rules will even miss targets set in the Clean Air Act. In a fact sheet released with the new mandates, the EPA said:

“Due to constraints in the fuel market to accommodate increasing volumes of ethanol, along with limits on the availability of non-ethanol renewable fuels, the volume targets specified by Congress in the Clean Air Act for 2014, 2015 and 2016 cannot be achieved. However, EPA recognizes that the statutory volume targets were intended to be ambitious; Congress set targets that envisioned growth at a pace that far exceeded historical growth rates. Congress clearly intended the RFS program to incentivize changes that would be unlikely to occur absent the RFS program. Thus while EPA is proposing to use the tools provided by Congress to waive the annual volumes below the statutory levels, we are proposing standards that are directionally consistent with Congress’ clear goal of increasing renewable fuel production and use over time. The proposed volumes would require significant growth in renewable fuel production and use over historical levels. EPA believes the proposed standards to be ambitious but within reach of a responsive marketplace.”¹⁶

This backtracking on ethanol expansion is due to a phenomenon known as the “blend wall” -- the point at which U.S. gasoline becomes saturated with ethanol and can no longer tolerate larger percentages of ethanol without major engine problems relating to corrosion of key components such as gaskets.¹⁷ While most automobile engines can safely use gasoline with up to 10 percent ethanol content, the RFS mandates ethanol blending by total volume into the national gasoline supply, not per gallon of gasoline. This means, that to meet the obligations of the proposed increased RFS, the amount of ethanol in the U.S. gasoline supply would necessitate concentrations of over 10 percent.

While current EPA rules dictate that blends of ethanol up to 10% of gasoline (E10) are safe for all standard vehicles. In 2011, the EPA further allowed the sale of gasoline blends up to 15% ethanol (E15) for vehicles produced in 2001 or later, but only after a gas station navigates a complex regulatory process.¹⁸ The issue with this EPA transition to E15, is that most automobile manufacturers do not warranty their cars and trucks for use with this type of gasoline.¹⁹ An EPA dictate stating otherwise does not override the very real consumer concerns of vehicle reliability and safety.

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A third option, E85, allows gasoline to be made up of up to 85% ethanol, but this fuel is only available to “flex-fuel vehicles” (FFVs), which must be built specifically to handle the larger mix of ethanol. Construction of E85-compatible gas stations has largely been limited to the Corn Belt in the Midwest, a region of corn-growing counties, with additional smaller availability in a few other states.\(^{20}\)

Some scholars have suggested that E85 may hold the potential to break through the blend wall, but only after another round of economic manipulations to push the price of E85 downward.\(^{21}\) For the time being, E85 suffers a lack of widespread market exposure both in number of FFVs and number of E85-compatible fueling stations, as well as a lack of consumer interest in the fuel even when a consumer owns an FFV and has E85 fueling available to them.\(^{22}\) The physical limitations of typical engines and incredibly small market share of FFV vehicles mean that the United States is almost guaranteed to hit the blend wall before RFS has run its course absent some sort of waiver from the EPA.\(^{23}\) In fact, the latest RFS proposal from the EPA would see the blend wall broken in 2016.\(^{24}\)

While the EPA has shown a past willingness to cut statutory requirements that were unrealistically high, the administration has also fallen far behind schedule in announcing these reductions. Final rules for yearly RFS requirements are supposed to be announced on November 30th of the preceding year (i.e. 2014 requirements should have been announced by November 30th, 2013).\(^{25}\) Delaying the creation of a final rule for a compliance period until after that period has already ended has angered many in the fuel blending industry, leading American Fuel & Petrochemical Manufacturers to file an intent to sue the EPA due to the gross mismanagement of regulation.\(^{26}\)

While sentiment has been rising against the RFS, the corn lobby’s clout among high-level politicians means repeal is unlikely.\(^{27}\) Some efforts to repeal the mandate outright have been started, such as Senator Toomey’s (R-PA) “Corn Ethanol Mandate Elimination Act,” but these are very unlikely to find success.\(^{28}\) A litany of smaller-scale changes to the current mandate have been proposed, many of which are explained in great detail in a report by the Bipartisan Policy Center titled “Options for Reforming the Renewable Fuel Standard.”\(^{29}\) Some of these recommendations have made their way into the RFS Reform Act of 2015, introduced by Rep. Goodlatte (R-VA).\(^{30}\) The bill seeks to eliminate the corn starch portion of the mandate and match the remaining advanced biofuels mandate to actual production.\(^{31}\) Even

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these edits to the RFS are unlikely to find popular political favor. For the foreseeable future, the corn ethanol industry will continue to garner multi-million dollar benefits from the government using its vast political connections.32

STATE OF CURRENT SUBSIDIES

Federal and state governments subsidize the ethanol industry in a myriad of ways. It is difficult to determine an exact dollar amount because the nature of many of the subsidies makes that nearly impossible, but the extent of monetary assistance provided to the mature corn ethanol industry is significant. Aside from RFS, the vast majority of corn ethanol incentives come from a few key sources: Department of Agriculture, Department of Transportation, and the Tax Code. Individual states, particularly in the Corn Belt, also provide significant ethanol subsidies.

USDA AND THE FARM BILL

The United States Department of Agriculture (USDA) offers funding support to corn ethanol through various programs. In passing the 2008 Farm Bill, Congress attempted to refocus funding away from corn ethanol due to rising concerns about food competition and instead decided to focus on advanced (i.e. non-corn) sources of ethanol.33 The corn ethanol industry, however, has managed to take advantage of loopholes in these new rules by receiving subsidy dollars for small-scale non-corn ethanol operations in otherwise wholly corn-centric plants. For example, the Bioenergy Program for Advanced Biofuels (BPAB), which specifically bars corn ethanol from receiving financial assistance, has funded several mature corn ethanol facilities that also use milo and sorghum in production, to the amount of $59,618,433.34 Similar misappropriation of funds intended for non-corn ethanol projects have been allocated to the industry via the Biorefinery Assistance and Repowering Assistance Program, with costs in the millions.35 Even worse, the Rural Energy for America Program (REAP), meant to extend renewable energy infrastructure to rural America, awarded $3,335,040 to projects building ethanol blender pumps after corn ethanol industry lobbyists successfully convinced the USDA to include those projects under REAP’s purview. Congress subsequently closed the REAP loophole in the 2014 iteration of the Farm Bill.36

IRS, THE VEETC, AND THE ALTERNATIVE FUEL INFRASTRUCTURE TAX CREDIT

In addition to nonspecific tax breaks and credits for normal business/farming activity, there are a number of tax incentives directed specifically towards corn ethanol nestled within the tax code. The largest of these tax incentives, the Volumetric Ethanol Excise Tax Credit (VEETC), was implemented in 2004 and left to expire in 2011. Regardless, the sheer weight and effect the VEETC had in the ramping up of corn ethanol initiatives means it is still worth consideration.


Ethanol and the Renewable Fuel Standard

The VEETC offered a tax credit of 45 cents per gallon to fuel blenders to include ethanol in their gasoline, along with a 54 cent tariff on imported ethanol to ensure the benefit only applied to American producers. By 2010, yearly expenditure on the VEETC reached $5.68 billion and at its peak in 2011, the credit cost taxpayers $6.3 billion dollars.

The death of the VEETC does not mean that corn ethanol subsidies are now absent from the tax code. Today, the Alternative Fuel Infrastructure Tax Credit offers tax credits to fueling station owners that install fueling equipment for E85, up to 30% of the cost or $30,000, whichever is lower. This incentive was originally supposed to expire at the end of 2013, but was then extended to the end of 2014. It is unclear whether Congress will extend this credit again.

DOT AND CAFE ALLOWANCES

The Department of Transportation (DOT) offers one indirect subsidy to ethanol production. Automakers currently have to abide by Corporate Average Fuel Economy (CAFE) standards, which require an average minimum fuel economy across an automaker’s fleet of vehicles, or else face fines. As an alternative, the law allows automakers to count “flex-fuel” vehicles (vehicles with engines that can accept E85 as a fuel source) as achieving roughly two-thirds better mileage than they actually attain. A government study found that there are now 1.2 million alternative fuel vehicles on U.S. roads, the vast majority of which are E85 flex-fuel vehicles--far more than would exist absent the CAFE allowance. While this subsidy is not direct, it does unnaturally increase the demand for E85 fuel.

INDIVIDUAL STATES

While too numerous to list here in any detail, individual states within the Corn Belt also offer a variety of corn ethanol incentives, from production tax credits, fuel tax exemptions, blender pump tax credits, and alternative fuel vehicle sourcing requirements. For example, Indiana offers up to $3,000,000 in tax credits for corn ethanol producers, tax credits for E85-capable vehicle production, exemptions for certain E85 vehicles from taxes, maintenance, inspection requirements, and publicly-funded E85 education/demonstration programs. While Indiana does offer an above-average amount of subsidies for corn ethanol, it is very comparable to many other corn belt states. Any state’s ethanol laws can be examined in detail at the DOE’s Alternative Fuels Data Center website at http://www.afdc.energy.gov/laws/search.

COST TO DATE OF ETHANOL EXPENDITURES

By the expiration of the VEETC, the program costs reached $21,560,000,000. A proposed extension to the program was estimated to cost of $6.75 billion a year by 2015. From the 1980’s through 2012, the cumulative cost of annual tax

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44 Taxpayers for Common Sense (2011, April 29). The Volumetric Ethanol Excise Tax Credit: History and Current Policy. Retrieved from
Ethanol and the Renewable Fuel Standard

expenditures on ethanol has totaled over $58 billion in subsidies to the industry. The chart below shows the annual tax expenditures on ethanol from the 1980’s through 2010. 

![Annual Tax Expenditures on Ethanol](chart.png)

**EFFECT ON THE CORN BELT**

In the months and years immediately following George W. Bush’s major federal push for domestic ethanol development, local communities throughout the Corn Belt were excited by the potential of a growing, ethanol-based future. This Corn Belt region includes Iowa, Illinois, Indiana, Southern Michigan, Western Ohio, Eastern Nebraska, Eastern Kansas, Southern Minnesota and parts of Missouri, as shown in the map below. Because corn ethanol makes up over 90 percent of all ethanol produced in some states, this area is especially impacted by biofuels and ethanol policies.

Rural towns were told that ethanol would bring huge amounts of economic growth, as well as, to a lesser extent, energy independence, environmental benefits, and national security. These predictions were peddled by not only ethanol companies, but also local governments, small business operators, investors, and large corporate farms.

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Following these pro-ethanol narratives, rural towns began to attempt to woo ethanol refineries into building in their areas. Local governments offered a variety of incentives: tax abatement periods, tax rebates, agreements that local governments would front the costs for required infrastructure improvements, etc. Local residents often lauded attempts to attract refinery operations, but some opposition was common and frequently ignored. When a corn ethanol company decided to build a refinery within a given town, it would often attempt to get local residents to “buy in” to the facility by staging investment drives, which were enormously successful. By the time most refineries had been built, the companies responsible had succeeded in shifting much of the risk onto local communities, by securing their investments and accepting local incentives to shield themselves from large capital costs in infrastructure and taxes.

As demand for corn rose following the construction of these plants, both farmers and refineries felt an economic pinch. Ethanol refineries are reliant on low corn prices to generate profit, and experience losses during times of high corn prices. Following corn price spikes in 2008 and 2012, numerous corn ethanol plants went offline due to an inability to run profitably. While many believed that farmers were making off with huge profits, they too failed to gain substantially due to rising costs of input factors such as fertilizer. Heightened competition bolstered the price for land, driving tenant farmers out of business and contributing to what some called the “production treadmill.” In all, the market structure of ethanol prevented farmers from realizing most of the intended benefit of the ethanol policies.

The uptick in corn price had environmental consequences as well. As farmers attempted to squeeze as much production out of their land as possible, they used huge amounts of nitrogen fertilizer, which can be disruptive to water ecosystems.\(^{57}\) Farmers also began to replant land that had previously been part of the Conservation Reserve Program, a government agreement which pays farmers for leaving marginal land unfarmed as part of a prairie conservation effort.\(^{58}\)

Livestock farmers also experienced reduced profitability as corn is an important input cost for feeding all kinds of livestock.\(^{59}\) The cumulative feed costs to date for chicken, turkey, and hog farmers alone is estimated to be over $100 billion dollars. This does not even account for the impact on other industries like dairy and cattle producers.\(^{60}\) The damage done to livestock farmers has been somewhat mitigated by the increased availability of dried distillers grains with solubles (DDGS), a byproduct of corn ethanol production and an alternative livestock feed source.\(^{61}\) While DDGS are about 15 percent cheaper than corn, they do present some challenges in maintaining nutritional uniformity and avoiding contamination, making them an imperfect substitution for corn itself.\(^{62}\) Because of the costs borne by the livestock industry, the president of the Texas and Southwestern Cattle Raisers, John Parker Jr. argues for a free market perspective in reevaluating the RFS.

“Ranchers understand well-intentioned efforts to move our nation toward energy independence, but those efforts should not consist of government mandates that artificially give one commodity priority at the expense of another,” Parker says. “The cattle industry supports a free market system, and although a full repeal of the RFS standard in today’s political climate may not be possible, we are hopeful that the EPA will help alleviate the current corn crisis by taking the government mandates out of the equation and put corn back on the same playing field as cattle producers.”\(^{63}\)

Even without rising corn prices, refineries often hurt local communities in other ways. Constant trucking to and from the facilities damage local roads paid for by local governments to which many refineries were not required to pay taxes\(^{64}\) while immense water requirements for ethanol production taxed already-scarce water resources. This strain on local communities was many times unaccounted for in initial planning of these facilities and many areas experienced severe hardship in dealing with these realities.

The following case studies illustrate how government intervention into free markets produce negative unintended consequences that result in widely felt repercussions across the whole economy.

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CASE STUDY: VERASUN IN DYERSVILLE, IA

Dyersville, Iowa is an excellent example of how local communities can bear the risk of large ethanol development projects. In the midst of Bush-era ethanol hype, US BioEnergy Corporation planned and began development on an ethanol facility near Dyersville, following a 20-year incentive package offer by the city.65 While some town residents voiced opposition, city officials brushed off their concerns as “premature,” and plant planning continued.66 Meanwhile, the majority of townspeople, the ethanol planners, and city officials all lauded the incoming plant. The mayor, Jim Heavens, likened the groundbreaking event for the plant to a marriage ceremony—a celebration for the marriage of the town’s economic interests to the future of ethanol.67 The marriage was not to be long-lived.

VeraSun, a major nationwide ethanol company, merged with US BioEnergy Corporation, and took over control of the construction of the plant in April 2008.68 A few months behind schedule, the plant was put into full operation in early September 2008, and began bringing in corn that had previously been contracted.69 Less than two months later, rising corn prices impacted VeraSun’s bottom line badly enough to cause them to file for bankruptcy protection.70 Just two months after the opening of the plant, VeraSun shut down Dyersville operations and started failing to fulfill contract obligations to local farmers.71

Within the month, corn farmers hurt by the bankruptcy gathered together to create a group called VeraSun Corn Suppliers for the purposes of collective court representation.72 VeraSun contacted farmers they had previously contracted with and gave them three options, none of which included coming through on previously agreed-upon payments.73 Corn farmers were left to either find a new market for the corn at great economic loss, as corn prices had dropped substantially, or pray for a VeraSun resurrection that would never come.

Bankruptcy litigation and interrupted cash flows plagued Dyersville for years after the VeraSun incident. Even those that had managed to get their corn payments within a 90-day window prior to the Oct. 31 bankruptcy filing had to return 80% of their payment as part of the bankruptcy dealings—a decision that was not made until 2010.74

Before the fiasco, Dyersville praised VeraSun for offering huge economic opportunity. Instead, Dyersville was left footing the bill for VeraSun, who had pegged local economic success to external, highly volatile markets such as oil and corn. Such stories were not uncommon in communities throughout the entire corn belt region.

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CASE STUDY: AMERICA’S RESTAURANT INDUSTRY

Ethanol policies create ripple effects that leave no industry untouched, but one that is particularly damaged by United States’ ethanol subsidies is the restaurant industry. Essentially every raw material used by restaurants including corn, animal products, and other crops are now more expensive because of corn policies.

In 2012, PricewaterhouseCoopers conducted a study to determine the effects of two different scenarios--one in which ethanol policies increase production by 6 billion gallons, and another for which the policies increase production by 1 billion gallons. These numbers are based on a range of predictions made by various scholars on how effective the RFS and similar policies will be in jump-starting ethanol production. In both scenarios, the costs for an average restaurant went up by thousands of dollars. In the 6 billion gallon scenario, costs would rise for quick service restaurants by 10%, and for full service restaurants by 8.9%. The report further explains that in years of market disruptions, such as droughts, the negative effect would be even more pronounced.

These impacts on the United States food industry have led to a public outcry from industry advocate groups. In a letter to the EPA, a coalition of these groups identified rising food costs as the number one threat to the U.S. restaurant industry’s health. The letter also delineated the effect of corn’s ethanol-induced price rise on industries across the food sector, including baking, confectionery, frozen foods, and more.

In 2013, Ed Anderson, a small franchise owner of four Wendy’s locations, testified in front of the Subcommittee on Energy and Power. He told the subcommittee that based on analysis of his business, policies like RFS had resulted in an extra $120,000 of yearly cost for his operations. He pleaded with the subcommittee to repeal the RFS, saying “Our family is not asking Congress for a bailout—we’re asking Congress to dig into the true impact of the RFS and see how it has distorted the market at the expense of small employers like Judy [his wife] and me.”

While many politicians parade the RFS and related policies as an economic triumph for farmers, it is important to remember how other small business owners can be devastated by the very same laws. The RFS and its associated rise in food prices have wreaked havoc on the restaurant industry, and their ability to turn a profit continues to be crippled. In this case, the special interests of the 3.2 million farmers in the U.S. are being favored over those of the 14 million Americans in the restaurant industry.

STATISTICAL ANALYSIS

To better quantify the economic effect of RFS on Corn Belt counties, the researchers of this paper developed a statistical model to isolate the effects of RFS and examine how it affects local economies.

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Ethanol and the Renewable Fuel Standard
The statistical analysis model tests and estimates the impact of the 2007 RFS mandates on almost 1,500 counties across the nation. The model used per capita income and the unemployment rate estimates for the years 1997, 2002, 2007, and 2012. Control variables were included to account for outside influences that may otherwise explain changes in the economic variables.

These counties and those who live and work in them are often touted as beneficiaries of the RFS mandate. The usual argument is that because the RFS increases the use of corn ethanol, and thereby increase demand for corn production the economic conditions of those communities which raise, harvest, and come to rely on the production of RFS fuel stock are substantially improved.

The statistical model found that RFS had a statistically significant relationship with the economic outcomes of Corn Belt counties. The results of the model showed that reductions in unemployment rates were slower for Corn Belt counties after RFS by 0.48 percent. While the rest of the U.S. saw unemployment rates drop 1.89 percent following the RFS, corn belt states saw only a 1.41 percent decrease.

Per capita income was similarly worse off in Corn Belt counties, which experienced an average reduction that was 20 percent greater than non-Corn Belt counties. Corn belt counties experienced a drop in income following RFS of $1942.51 per person, while in the rest of the U.S. the drop was only $1614.32.

These results, which run counter to the conventional wisdom, are representative of the issues that emerge within single sector economic systems. Single sector systems especially those created by governmental mandates and subsidization of particular industries, or in this case a single agricultural crop, often face divergent economic outcomes where increased total production from the subsidized and mandated sector obscure losses in other sectors. We test the conventional wisdom and its story of improved economic outcomes through mandates. We find in the Corn Belt counties of the midwest a single sector economy dominated by large-scale production of a single crop with the dynamism of competition replaced with production driven by governmental mandate rather than consumer demand.

Even after Corn Belt counties received billions of dollars in corn ethanol subsidies, this study finds that these counties did not receive the economic benefits that were expected, at least in a way that materially benefitted the whole region. A detailed explanation of the econometric analysis model can be found in the appendix.
CONCLUSION

The RFS is a prime example of government intervention failing to accomplish its stated objectives, while creating new problems that arise from market inefficiencies. While there will always be those individuals and organizations closely aligned with government officials who realize great gains from the realities of crony capitalism, the vast majority of American families and businesses are left worse off with a higher tax bill.

This report highlights the immense historical costs associated with the RFS and ethanol subsidies, the questionable benefits associated with such policies, and the very real concerns for both U.S. and global citizens. Specifically, we find that even the ‘Corn Belt’ fails to see benefit from such localized and narrow economic supports, and in many cases is left much worse off.

It is clear that the RFS has outlived any usefulness it may have had. The realities of the energy market today are vastly different than the late 1970’s when the government began to prop up the ethanol industry. Instead of further propagating mandates that, in many cases, are technically impossible to implement, the U.S. should support an energy policy free of subsidies, quotas, and trade protections and embrace market based solutions. Such solutions will better allow for the reliability, affordability, and security Americans desire in their energy mix without sacrificing other economic sectors.
APPENDIX: ECONOMETRIC ANALYSIS MODEL

MODEL

We use a differences-in-differences model to test our null hypothesis that “the impact of the 2007 increase in Renewable Fuel Standards is not statistically significant in explaining economic changes in Corn Belt counties.” This model requires data for both before and after RFS, as well as a treatment group and non-treatment group. In our model, the years 2007 and after represent policy change data. Despite the Energy Policy Act of 2005 passing in July of 2005 instituting the Renewable Fuel Standard beginning in 2006, much of the agricultural data gathered is offered in five year sets with the first post-RFS data point being 2007.

Our treatment group is defined by “Corn Belt” counties, characterized by a region with rich soils, warm nights, hot days, and rainfall ideal for growing corn. To identify these counties we looked at nine states distinguishably grouped together as the “Corn Belt” including: Iowa, Illinois, Indiana, southern Michigan, western Ohio, eastern Nebraska, eastern Kansas, southern Minnesota and Missouri. We then classified all “corn counties” within these nine states as those counties where 45 percent or more of their harvested cropland acreage in 2012 produced corn. We include county data from all US states, including Corn Belt states, but excluding territories, as the non-treatment group. We use the unemployment rate and per capita income as economic measurements. We include 5,783 sample observations.

The following model will test and estimate county unemployment rates and per capita income:

\[ \text{Unemployment} = 0 + 1 \text{cornprice} + 2 \text{ethanolprice} + 3 \text{HayHarvested} + 4 \text{SoyHarvested} + 5 \text{CorpFarmOps} + 6 \text{CorpFarmCount} + 7 \text{FamilyFarmOps} + 6 \text{FamilyFarmCount} + 7 \text{rfs} + 8 \text{cb1} + 9 (\text{rfs} \times \text{cb1}) + u \]

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82 Many county data observations were removed due to insufficient data. This may skew our tests and estimations.
The variables are defined as:

unemploy = the unemployment rate of county populations 16 years and over;\textsuperscript{83} \textsuperscript{84} \textsuperscript{85} \textsuperscript{86} \textsuperscript{87}

EstimatePerCapIncome\textsuperscript{88} = per capita income for the total county population, nominal USD;\textsuperscript{89} \textsuperscript{90} \textsuperscript{91}

cornprice = the price of farm corn per bushel received in USD;\textsuperscript{92}

ethanolprice = the US fuel ethanol stock price in USD;\textsuperscript{93}

HayHarvested = the acres of hay harvested in a county;\textsuperscript{94}

SoyHarvested = the acres of soy harvested in a county;\textsuperscript{95}

CorpFarmOps = the total acres operated by an organization in a county that, for tax purposes, is classified as a corporation, excluding family held operations;\textsuperscript{96}

CorpFarmCount = the number of operations in a county that, for tax purposes, is classified as corporation, excluding family held operations;\textsuperscript{97}

\textsuperscript{83} Data was only reported for years 2000, 2005, 2007, and 2012. We converted 2000 and 2005 years to 1997 and 2002 data because we could not find sufficient data for these given years.


\textsuperscript{88} This dependent variable is excluded from the model above for organizational reasons. We estimate the same model, replacing the unemployment rate variable with the estimated per capita income variable.

\textsuperscript{89} Data was only reported for years 2000, 2005, 2007, and 2012. We converted these years to 1997, 2002, 2007 and 2012 data because we could not find sufficient data for these given years.

\textsuperscript{90} U.S. Census Bureau. (2000). \textit{Decennial Census, Census 2000 Summary File (SF 3) - Sample Data, Table P082 - Per Capita Income in 1999 (Dollars) [1], Total Population}. American FactFinder. Retrieved from http://factfinder.census.gov/bkmk/table/1.0/en/DEC/00_SF3/P082/0100000US.05000.003


FamilyFarmOps = the total acres operated by an organization, which is 50 percent or greater ownership held by principal operator and related person;  

FamilyFarmCount = the number of operations in a county that are operated by an organization, which is 50 percent or greater ownership held by principal operator and related person;  

rfs = a dummy variable for the years before and after the 2007 Renewable Fuel Standards was enacted;  

cb1 = a dummy variable for the treatment group, Corn Belt counties;  

rfs*cb1 = interaction term to estimate the marginal impact of RFS and Corn Belt counties.

The variables included in this differences-in-differences model were chosen with the interest of testing if the advent of RFS in Corn Belt counties was statistically correlated with economic changes. We include multiple control variables that would explain changes in our economic measurements, per capita income and unemployment, to avoid bias. The control variables include corn prices, ethanol prices, hay harvested, soy harvested, corporate farms, family farms, Renewable Fuel Standard, Corn Belt counties, and the examined interaction variable, Corn Belt counties interacted with RFS.

We use the unemployment rate as a dependent variable because we believe it appropriately reflects that, even though Corn Belt counties received a bulk of U.S. ethanol subsidies totaling over $50 billion dollars, the jobs were unsustainable and would add to the unemployment rate after RFS. Studies also show that high and persistent unemployment rates increase economic inequality, and have a negative effect on subsequent long-run economic growth. Unemployment rate data includes individuals 16 years and older that are included in the workforce, which comes from the U.S. Census Bureau, American Community Survey 1-Year Estimates data.

Per capita income is our second dependent variable that we use as an economic measurement. Data for this variable was retrieved from Census Summary File Sample data and is calculated as the total county income divided by each person 15 years and older. We use per capita income as a means to gauge the quality of life and living conditions in different counties.

The control variables (corn prices, ethanol prices, acres of soy and hay harvested, corporate and family farm operations) are included to account for trends that may explain economic changes related to the ethanol industry. Each variable’s significance can be seen in Figure 3 and Figure 4.


103 The Summary File 3 Sample Data only reported unemployment data for 2000, 2005, 2007 and 2012. The dates 2000 and 2005 were changed to 1997 and 2002 for merging purposes.
The interaction term in this differences-in-differences model will give us the marginal impact on Corn Belt counties after RFS. We expect to find statistical support for our claim that the interaction term will be negatively correlated with our dependent variables. Case-studies suggest that the jobs that ethanol plants brought into counties were not sustainable and did not benefit Corn Belt counties as a whole. 104

Figure 2 Descriptive Statistics

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<th>Max</th>
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REGRESSION RESULTS

The chart below estimates the changes in the unemployment rate before and after RFS by using differences-in-differences panel regression. Excluding the variable HayHarvested, all of the variables are statistically significant at the 5 percent level.

In Corn Belt counties, after RFS, the unemployment rate decreased by 1.41 percent, while the decrease for the non Corn Belt counties was 1.89 percent; which means, after RFS, the unemployment rate reduction was .48 percent smaller in the Corn Belt counties than the non Corn Belt counties.

The chart below estimates the changes in per capita income before and after RFS by using differences-in-differences panel regression. All of the included variables are statistically significant at the 5 percent level.

After RFS, expected per capita income for Corn Belt counties decreased by $1,942.51, while per capita income for non-Corn Belt counties decreased by $1,614.32 in nominal terms. For the Corn Belt counties, the per capita income decreased by an additional $328.19 after RFS compared to non Corn Belt counties.
CONCLUSION AND ROOM FOR FURTHER STUDY

Even after the government spent billions of taxpayer dollars on ethanol subsidies, we conclude that Corn Belt counties have lower per capita incomes and higher unemployment rates relative to the national average. We can reject our null hypothesis--RFS and Corn Belt counties are statistically significant in explaining changes in economic variables.

Overall, the RFS and the United States economy are complex. Because our data and regressions are based on very specific Corn Belt counties, we can only find some correlation between the RFS policy and US economy instead of strong cause and effect relationship. Further studies can be done to highlight the effects on the farming counties and Corn Belt counties while considering more factors, for example, crude oil prices, demand for corn, and the poverty rate. For now, we can safely conclude that RFS did not significantly help the economic situation of corn belt counties in the way that many politicians intended. 1

1 This paper has examined the current subsidy and regulation structure of U.S. corn policy and the resulting economic impacts. The authors of the paper recognize that the broader ethanol debate is complex and has other issues that are frequently debated and lie outside the immediate scope of this paper. Those issues include the ethical and economic issues of using ‘food (corn) for fuel’ and the energy balance and total emissions of ethanol resulting from the sum of the entire production cycle. There are also supplemental environmental issues to consider such as crop acreage encroaching on land conservation, fertilizer use leading to water pollution, and incentivization of poor land use strategies. Each of these issues has been hotly debated in academic circles and there is a bulk of resources available to the reader to explore these cases further outside the scope of this paper.

Examples of articles discussing these various issues include: