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An Analysis of the Economic Impact of Biodiesel Production in Illinois

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The production of biodiesel in the United States has expanded greatly in recent years. A factor contributing to the growth of this industry is the perception that renewable fuel production is an economic boon to state and local economies, particularly those of rural areas. This study estimates the economic impact of biodiesel production in the state of Illinois. Through input-output analysis and by simulating the industry using IMPLAN, the impact of a 10 million gallon per year plant using soy oil as its only feedstock is modeled. The estimated effect on output, employment, and other parameters is substantial. However, the results also demonstrate that the magnitude and nature of this impact is heavily reliant on the feedstock used in production and that the choice of feedstock can limit the economic gains in rural localities.

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I. Introduction

"Biodiesel" is the common name for the mono-alkyl esters of fatty acids, a compound produced from a variety of potential feedstocks, including vegetable oil, animal fats such as beef tallow, or even recycled restaurant oil or "trap grease." While biodiesel feedstock can come from many sources, the Illinois Soybean Association (2007) estimates that 90 percent of the biodiesel currently produced in the United States is made from soy oil.

Through a chemical process called transesterification, the feedstock is combined with alcohol (usually methanol) and a catalyst (usually sodium or potassium hydroxide), producing the alkyl esters in addition to a glycerine byproduct. The National Renewable Energy Laboratory (2007) estimates that 100 lbs. of oil and 10 lbs. of ethanol are required to produce 100 lbs. of biodiesel and 10 lbs. of the glycerine byproduct.

With little to no modification, the alkyl ester, or biodiesel, can be used to fuel any traditional diesel engine. To power a diesel engine, biodiesel can be used alone or in combination with petroleum-based fuel in combinations ranging from 100 percent bio-based fuel (known as B100) to 2 percent bio and 98 percent petroleum-based fuel (B2). The byproduct from this process, glycerine, is a commonly used input in soap production, among other uses. (National Biodiesel Board, 2007)

In recent years the popularity of biodiesel as an alternative to traditional diesel fuel has increased, reflected in both an increase in production and in a national energy policy favorable to its expansion as an industry. While not as pervasive a renewable fuel as ethanol, biodiesel consumption in the United States has experienced a steady increase since 1999 and the National Biodiesel Board (2007) estimates current production capacity nationwide to have reached 354 million gallons per year with 53 plants operating in 26 states. In the near future, an additional 44 planned facilities in 24 states are expected to add 329 million gallons per year in production capacity. In Illinois, a leading biodiesel producer, two biodiesel plants are currently in operation, both using soy feedstock with a combined capacity of 53 million gallons annually. Two additional plants with a combined annual production capacity of 35 million gallons are projected to be completed in early 2007. Both plants are to use soy as their only feedstock. As of March 17, 2007, the National Biodiesel Board (2007) estimates 195 biodiesel distributors currently operate in Illinois, marketing the fuel mainly to farmers and fleets. There are approximately 128 retail fueling sites or pumps statewide.

Van Gerpen (2004) lists the primary reason for this expansion. First, relative to petroleum-based diesel, burning biodiesel can reduce the emission of several harmful pollutants, including carbon monoxide. However, because biodiesel is used in a small proportion relative to petroleum diesel, significant environmental impacts will not result from current or projected biodiesel use in the near future. Second, biodiesel is perceived to be part of the solution to U.S. energy dependence. Again, however, due to its relatively small capacity, the impact of biodiesel production on reliance on foreign oil is not expected to be significant but biodiesel could contribute positively to stability in petroleum fuel prices as the latter market is highly sensitive to changes in supply. Finally, biodiesel provides a market for excess vegetable oil, a byproduct from current growth in the production of vegetable meal that cannot be absorbed fully by the market, resulting in a surplus of vegetable oil and downward pressure on its price.

This creation of industrial uses for agricultural products is indicative of how the increased interest in biodiesel is tied to its impact on regional economies, including rural areas, facing a decline in population and economic opportunities. It is not only a discussion about the agricultural sector but also about creating jobs, income, and tax revenue. To make this connection, many states and regions have modeled the economic impact of the biodiesel industry and its effects on employment, output, revenue, and other variables using regional input-output analysis. However, despite the current presence of a biodiesel industry in the state, for Illinois, no similar economic impact study is readily available. By using IMPLAN, a modeling system that can predict the impact from a change in economic activity for a given area, the specific and total effects resulting from the introduction of this industry can be estimated.

II. Literature Review

Chang (1994) uses IMPLAN to estimate the economic impact of biodiesel production on the Kansas City Metropolitan Area, which incorporates 15 counties in Missouri and 14 counties in Kansas. To estimate the impact of producing 100 million gallons of biodiesel, a very large-scale level of production, Chang (1994) assumes biodiesel is substituted for diesel and soy is the only feedstock utilized. Using a final demand approach, it is estimated that this level of production, in addition to direct plant employment, would create an additional 169 jobs at soybean oil mills (crushers), 1,254 jobs in oil bearing crops and 712 jobs in wholesale trade. The model estimates a loss of 40 jobs in petroleum refining. Induced employment is estimated to reach 1,315 jobs in other agricultural products, 271 in food, 2,272 in wholesale and retail trade and a loss of 27 additional jobs in petroleum refining. This level of production would add an additional $9.44 million to the soy mill industry in the area, $8.19 million to the oil bearing crop industry and $29.33 million to the wholesale trade industry. Petroleum refining is estimated to lose $9.95 million. Chang (1994) concludes that biodiesel production would have a significant impact on regional growth and that the new industry would have a positive effect on economic development.

In assessing the impact of a community-based biodiesel operation, Van Dyne, Weber, and Braschler (1996) argue that the "underemployment of resources represents one of the largest problems in agriculture and rural communities today" and the value of biodiesel production lies in its ability to simultaneously employ these resources while creating jobs, income, and revenue. Van Dyne, Weber, and Braschler (1996) study the impact of a community-based plant, common in Europe but not in the United States, using three levels of production. Level 1 is a plant with 500,000 gallon per year capacity, a relatively small-scale operation. This scenario assumes that crushing occurs within the plant, and the initial cost of construction is $1.6 million. Level 2 production estimates the effect if 10% of current farm usage of diesel was replaced with biodiesel and level 3 is similar but with 25% replacement. In a community-based system, farmers raise their own oilseeds and then hire the plant to process it into biodiesel. The farmers then have the option to sell the oil, use it themselves to power their farm vehicles, or trade it for traditional diesel. Through IMPLAN modeling and using a final demand approach, Van Dyne, Weber, and Braschler (1996) find that for each level of production, net job creation in the county is positive, up to 31 direct plant jobs for the largest scale of production, but is offset slightly by a loss of jobs in the fuel, protein meal, and grain handling industries. Temporary jobs would also be created during the construction of the plant. For the largest scale of production, additional income is estimated to be $780,000 annually and for the smallest scale of production, tax revenue is $26,125, most of which accrues in the county. Van Dyne, Weber, and Braschler (1996) conclude their evaluation by emphasizing that permanent jobs gained by the introduction of a biodiesel industry are minimal, but that the impact on regional economies is still significant. Van Dyne, Weber, and Braschler (2006) also find that community-based production has the greatest potential for the revitalization of rural areas relative to larger industrial plants.

In a 2003 feasibility study of a potential biodiesel industry in Georgia, researchers from the Center for Agribusiness and Economic Development at the University of Georgia find biodiesel to be an opportunity for economic growth. Using IMPLAN, the impact of four potential production capacities, 500,000, 3 million, 15 million, and 30 million gallons per year are modeled. Total employment (direct and indirect combined) estimated was 18, 53, 132, and 364 jobs, respectively. Total tax revenue accrued ranged from $205,656 for the small-scale plant to $4,561,222 for the 30 million gallon plant, considered to be a large-scale capacity in the industry. In a more detailed analysis, the researchers focused on the effects of a medium-scaled 15 million gallon plant. A 15 million gallon plant would generate direct output of $17.4 million annually, leading to an additional $16.9 million in direct sales in the Georgia economy and a total economic sales impact of $34.3 million. The initial 14 jobs at the plant are in addition to 119 indirect jobs; state and local tax revenue would increase by about $2 million per year. The analysis concludes that the economic impact of a biodiesel industry in Georgia is positive, but the feasibility of the plant is dependent on the availability and price of feedstock, the largest cost of production when operating a biodiesel plant.

When determining the feasibility of a biodiesel plant in Wisconsin, Fortenbery (2003) assumes two feedstocks, yellow grease (recycled fats and oils) and soy oil, the latter being a more expensive input. Using IMPLAN, Fortenbery (2003) estimates the economic impact of a 4 million gallon and a 10 million gallon per year plant using each feedstock. Fortenbery (2003) does not designate a specific county of analysis but estimates the impact on the Wisconsin economy while remarking that for feasibility, the biodiesel operation must locate close to a rail line to ensure reasonable transportation costs and reasonable access to a feedstock source (all soybean oil feedstock would originate from outside Wisconsin). Using yellow grease, one of the cheapest feedstocks, a 4 million gallon plant capacity would increase total sales in Wisconsin by $11.9 million, $7.9 million of which would come directly from the sale of biodiesel. Direct employment would result in 12 jobs, with an additional 49.7 jobs gained indirectly. Fortenbery (2003) concludes that there is reason to be optimistic about the gains to be made from the development of the biodiesel industry, but that its profitability is vulnerable to feedstock prices that, without public incentives, can make this industry a speculative venture.

III. Model

Similar to the preceding studies, the economic impact of the biodiesel industry in Illinois can be analyzed using an input-output model. Input-output analysis examines economic independence and assesses the change in overall activity that results from a given change in one or several economic activities. Several core assumptions are made in constructing the model. Constant returns to scale assumes a linear production function- a change to all inputs leads to a proportional change in output. With no supply constraints, an economy is assumed to enjoy an unlimited supply of raw materials and output is limited only by demand. Using a fixed commodity input structure, price changes do not lead to a substitution effect into other goods, only a change in output produced by an industry. Homogeneous sector output requires that the proportions of goods or commodities produced in an industry remain constant; the industry technology assumption posits that an industry uses the same technology to produce all its products.[1]

The input-output model was a derivation from conventional economic theory in the 1700s when Francois Quesnay published his *Tableau Economique*. His work demonstrated how a given increase in output results in additional and successive wealth-increasing economic activity. In the 1930s, Wassily Leontief built upon this notion of economic interdependence, using it as a core assumption in his general theory of production. Leontief created the first input-output, or transactions, table allowing for the examination of intra-industry linkages and, given the nature of these linkages, the forecasting of impacts that would result from a change in economic activity. (Miernyk 1965) The input-output table, therefore, is a descriptive and predictive analytical system that can be applied at both the regional and national level.

The transactions table disaggregates sectors and industries to describe how the

[1] Assumptions listed are as described in IMPLAN Manual (2000).

output (or sales) of each industry is distributed across all other industries and sectors. The table also describes the inputs to, or purchases by, each industry from all other individual industries. The level of disaggregation in the model can vary across analyses and a basic transactions table might only include the sales and purchases across sectors, not individual industries.[2]

Table 1 Transaction Table (in dollars)[3]

Sales From	*Sales To*			*Final Demand*		*Total Gross Output*
	Agriculture	*Manufacturing*	*Service*	*Household*	*Exports*	
Agriculture	300	350	300	1,000	700	2,650
Manufacturing	50	150	600	600	1,400	2,800
Service	500	800	800	700	1,050	3,850
Primary Supply:						
Households	1,100	300	100	30	20	2,450
Imports	700	1,200	115	120	0	3,170
Total Gross Outlays	2,650	2,800	3,850	2,450	3,170	14,920

[2] Description of transactions table from Blair (1995).
[3] Table 2 is from Blair (1995, 159).

Table 1 represents a basic transactions table with an economy aggregated across broad sector designations. Each row in the table (from left to right) provides output sold by each sector along the left-hand side of the table to each sector along the top of the table for a given year. For example, within the given year, the manufacturing sector sold $50 of its output to the agricultural sector. Each column (from top to bottom) describes the purchases made by each sector along the top of the table from the sectors along the left-hand side. For example, for the given year, the service sector purchased $600 worth of inputs from the manufacturing sector. From the transactions table it is also clear that the dollar value of total input purchases made by each sector (total gross outlays) is equivalent to the dollar value of total output produced by each sector (total gross output). The combination of the sales and purchases between sectors that form the transactions table provides a basic description of inter-industry linkages within an economy.

Households are included in the table as both a provider of inputs (primarily labor, but also capital, land, and entrepreneurship) purchased by the various sectors and a consumer of output. The aggregate value of output from each sector purchased by households is listed under final demand, along with exports. The final demand, or autonomous, sector in Table 1 is quite simplified. A more aggregated and complex table might also include government purchases and gross private capital formation as elements of this autonomous sector – autonomous in that sense that, within it, changes occur that are transmitted throughout the rest of the transactions table. (Miernyk 1965)

The values of various transactions among sectors and households can be manipulated to provide a more detailed picture of economic interdependence within a particular region or country. Through various derivations, one can gain insight into the direct, indirect, and induced effects that result from an initial change or stimulus in an economy. The aggregation of these iterative effects forms the multiplier, a tool crucial to predictive analysis. The multiplier concept is also related to the principle of final demand. An industry or sector is responding to meet demand either by supplying goods or services directly or (indirectly) to the industry that is responding directly. The industry responding directly is said to be the industry experiencing a final demand change and this response is known as the *direct effect*. In turn, this industry will purchase from other industries. The intra-industry spending increase in this second round of economic activity constitutes the *indirect effect*. As industries continue to buy from each other, an increase in income results and accrues to households. Households then spend this additional income, leading to further economic activity known as the *induced effect*. These effects continue at a successively decreasing magnitude.

To derive a multiplier, information in the transactions table is used to construct a coefficient matrix. This matrix is formed by dividing the total gross output sold by a given sector by each of the sectors from which inputs were purchased to produce this output. For example, in Table 1, the dollar value of total gross output for the agricultural sector is $2,650. The agriculture sector purchased $50 of its inputs from the manufacturing sector. By dividing $50 by $2,650 we derive a coefficient of .019 ($1 worth of output sold by the agricultural sector requires $.019 of inputs from the manufacturing sector). This coefficient expresses the magnitude of the indirect effect that would result from a change in final demand within the manufacturing sector and defines the phase of intra-industry purchasing.

Algebraic manipulation of the coefficient matrix yields different multipliers. A Type I multiplier includes the direct and indirect effect of a change in economic activity; this multiplier measures the intra-industry purchasing that results from the initial change in the industry experiencing the final demand change. A Type II multiplier, known as the income multiplier, measures direct and indirect effects, but also incorporates the induced effects. It includes intra-industry purchases in addition to household expenditures that occur because of the increase in household income that resulted from the indirect effect.[4]

IMPLAN, a computer modeling software, allows for the estimation of these various effects without the tedious and complex derivations that would be necessary if the analysis were performed manually. The software allows a policymaker or researcher to apply a final demand change to a predictive economic input-output model, and then provides a detailed description of the estimated changes in the economy. Along with Type I and Type II multipliers, IMPLAN also includes another multiplier, known as a Type SAM multiplier. This multiplier overcomes a weakness of the Type II multiplier by abandoning the assumption that all labor income is spent within the defined impact area. This assumption can cause the model to overstate the Type II multiplier by overestimating the induced effects of an economic change. IMPLAN is able to construct the type SAM multiplier by generating a model that captures inter-institutional transfers by including both households and other institutions. To incorporate these institutions, IMPLAN relies on social accounting matrix information. Social accounting is a feature of the descriptive portion of input-output analysis and supplements information on intra-industry transactions and final demand by providing data on non-industrial transactions. These transactions include tax payments by businesses and households or any other inter-institutional transaction. Some of the institutions accounted for include commuting, social security tax payments, as well as household income taxes and savings. Labor income,

[4] Description of the multiplier from Miernyk (1965) and Richardson (1972).

therefore, is distributed across these different institutions in addition to being distributed to households within the impact area. Through this approach, the induced effect is not overstated by the model.[5]

IV. Methodology

To estimate the economic impact of the biodiesel industry in Illinois, a final demand change is introduced into IMPLAN as either a single event or a group of events. The impact of a manufacturing plant, for example, is estimated by introducing a specific amount of purchases into the model, sold by that plant to households. The manufacturing sector is experiencing a final demand change. However, this approach cannot be used when analyzing the economic impact of a plant producing biodiesel. As the foundation of its predictive ability, IMPLAN relies upon its capacity to describe the nature of the interdependence that exists between different industries and households within an economy through the application of various multipliers. The software does not include the biodiesel industry as a specific industrial sector and using another type of manufacturing sector (petrochemical manufacturing, for example) as a proxy would lead to inaccurate estimates.[6] Multipliers associated with a proxy industry may not be easily transferable to another industry; it is reasonable to assume that a dollar spent in the petrochemical manufacturing sector and a dollar spent in the biodiesel manufacturing sector will result in very different indirect and induced spending patterns. Instead of initiating a change in economic activity at the plant level, therefore, this analysis will implement a final demand change to those sectors that provide inputs to production for the biodiesel plant.

[5] Discussion of multiplier in this section uses information from the IMPLAN Manual (2000).
[6] IMPLAN relies on North American Industry Classification System (NAICS) codes to categorize and apply changes to industrial sectors; there is no NAICS code specific to the biodiesel industry.

To construct a predictive model using this approach, this study adopts the specifications and corresponding costs associated with the hypothetical biodiesel plant designed by Fortenbery (2003). The plant has a production capacity of 10 million gallons per year, a moderate, but not insignificant, capacity (a 30 million gallon per year plant is considered large for the industry). Soy oil is assumed to be the only feedstock used in the production of biodiesel at the plant. Table 2 lists the expenditures associated with plant construction and operation for each sector, including 12 direct jobs and their corresponding labor costs.

Table 2 Costs Associated with 10 MGY Biodiesel Plant[7]

Category	Cost (in dollars)
CAPITAL COSTS	
Transesterification Machinery	5,500,000.00
Land (7 acres)*	70,000.00
Storage Tanks	680,000.00
Civil and Site Work*	609,840.00
Building	307,500.00
Permits/Miscellaneous	150,000.00
Working Capital	1,503,420.00
Total	8,820,760.00
OPERATING COSTS	
Soybean Oil	24,750,000.00
Transportation (rail)	480,000.00
Methanol	1,176,000.00
Catalyst	320,000.00
Electricity	1,800.00
Natural gas/diesel	539,000.00
Water	11,466.00
Labor (12 total)	
Manager/Operator (1)	65,000.00
Operator (6)	240,000.00
Lab Technician (1)	35,000.00
Sales (1)	35,500.00
Support Staff (1)	18,000.00
Maintenance (2)	60,000.00
Marketing	100,000.00
Insurance	250,000.00

[7] Table 2 from Fortenbery (2003).

Permits	30,000.00
Waste Disposal	21,000.00
Waste Water Treatment	22,000.00
Maintenance	100,000.00
SALES OF BY PRODUCTS	
Glycerin	2,600,000.00
Soap Stock	40,000.00

The expenditures are purchases made by the biodiesel industry from the sectors listed along the left column. Expenditures are divided into capital costs and operating costs and are what is required for the initial construction of the plant in addition to one year of plant activity. From Table 2 it can be seen that the largest cost in plant operation is the purchase of the soy oil feedstock ($24,750,000). The transesterification equipment, which performs the conversion process from feedstock, catalyst, and methanol into alkyl esters, is also costly ($5,500,000). The combined expenditures on the conversion machinery and the soy oil amount to about 82% of total plant costs.

Several sectors listed in Table 2 are not included when estimating the economic impact through IMPLAN. From capital costs – land, working capital, and permits/miscellaneous are not included; there is no individual classification for each of these sectors within the software. Excluding this spending will not cause underestimation of the economic impact from the biodiesel plant because the relatively small expenditure in each would not result in a significant impact in the economy if included. Some categories are combined into one sector; civil and site work and building costs form $917,340 of spending in the manufacturing and industrial buildings sector. No spending is excluded from total operating costs. However, sales of byproducts from biodiesel production are not included in the model. Including the sale of glycerin and soap stock would simulate a final demand change to the detergent and soap manufacturing industry, which is inaccurate as the biodiesel industry, not the former, is being paid for these products.

Given the expenditures in each sector, the economic impact of this 10 million gallon per year plant can be estimated. For the purpose of this analysis, the impact of biodiesel production is divided into three separate categories – the impact resulting from operating expenditures, that resulting from capital expenditures, and the impact of the 12 direct plant jobs. In IMPLAN, each category is entered as a “group.” Within each group are the individual sectors in which spending takes place, known as “events.” Each event is a sector experiencing a final demand change; for example, a $680,000 capital expenditure on storage tanks is a final demand change in that amount to the “plastics plumbing fixtures and all other plastics product” sector. Some final demand changes are applied to that specific industry; soybean oil expenditures are applied to the soybean processing industry, for example. For other purchases, such as the storage tanks, a final demand change is not applied to this very specific sector, but the broader industry that encompasses it. The impact of the plant jobs is simulated by entering each job into the model according to the income paid to that worker. The impact reports generated by IMPLAN are summarized in Table 3 and the aggregated effects of the three expenditure categories are used to estimate the total impact of production. This total impact is divided into the effect on output, employment, indirect business taxes, proprietor’s income, and employee compensation and further segregated by that resulting from the direct, indirect, and induced effects.

V. Estimated Impacts

Table 3 Estimated Economic Impact of 10 MGY Biodiesel Plant in Illinois

	Output (in dollars)	Employment (in jobs)	Indirect Business Taxes (in dollars)	Proprietors Income (in dollars)	Employee compensation (in dollars)
Direct					
Operating costs	27,711,264	19	251,148	47,652	1,303,750
Capital costs	7,097,340	40	22,119	134,043	2,435,578
Plant Employment	234,332	2	15,644	6,876	70,571
Total Direct	35,042,936	61	288,911	188,571	3,809,899
Indirect					
Operating costs	16,609,808	113	1,053,943	741,423	4,297,646
Capital costs	3,008,753	20	146,418	109,082	1,052,135
Plant Employment	80,897	1	3,420	3,701	25,056
Total Indirect	19,699,458	134	1,203,781	854,206	5,374,837
Induced					
Operating costs	5,745,721	54	354,433	195,326	1,784,187
Capital costs	3,338,660	32	205,949	113,498	1,036,738
Plant Employment	95,304	1	5,879	3,240	29,594
Total Induced	9,179,685	87	566,261	312,064	2,850,519
Total Impact by Cost Category					
Operating costs	50,066,793	186	1,659,523	984,401	7,385,583
Capital costs	13,444,753	92	374,486	356,623	4,524,451
Plant Employment	410,533	4	24,943	13,817	125,222
Total Impact	63,922,079	282	2,058,952	1,354,841	12,035,255

The construction and operation of a biodiesel production facility leads to a $63,922,079 increase in total output within the Illinois economy (see Table 3). Output is defined by the model as the value of an industry's total production. (IMPLAN 2000) The direct effect contributes to the greatest proportion of this increased output, followed by the indirect and induced effects. Of the total increase, more than half can be contributed to the direct effect that resulted from the initial final demand change. Expenditures in sectors associated with plant operation are responsible for 78% of the total output impact ($50,066,793). The significant impact of operating expenditures on output growth is a product of the interdependence between the soybean processing sector and the biodiesel production industry. An auxiliary impact report, accounting only for the final demand change to the soybean processing industry (the $24,750,000 expenditure on soybean oil) leads to an increase in output of $44,372,249. When introducing all other operating costs and all capital costs along with this soybean oil expenditure, the estimated increase in output is only an additional $19,549,830.

The total employment impact in Illinois resulting from plant construction and activity is 282 jobs and is in addition to the 12 direct plant jobs. The impact on employment follows a different pattern than that of output. Indirect employment, followed by induced employment, provides the greatest majority of jobs (134 and 87, respectively) than does the direct effect (61). In other words, the effect of intra-industry spending taking place between the sectors in Table 2 and other industries, along with the effect of household spending, has a greater impact on employment than does the direct effect of the initial final demand change. The employment impact of the plant is largely associated with the operating expenditures listed in Table 2. This, also, can be connected to the impact of expenditures on soy oil and the concentration of production costs in the purchase of this feedstock. Referring again to the auxiliary model with just the final demand change to the soy oil processing sector, the total impact on employment is 161 jobs, compared to the 282 jobs generated by including all other expenditures in plant construction and operation. However, the employment impact resulting from capital expenditures, 92, is also significant but it is important to highlight that of this employment impact, some jobs are only temporary, available only during the initial period of plant construction.

The model estimates that $2,058,952 in indirect business taxes accrue to the state of Illinois because of the construction and operation of the biodiesel plant. These taxes include excise taxes, property taxes, fees, licenses, and sales taxes paid by businesses, but not taxes on profit or income. (IMPLAN 2000) Operating expenditures ($1,659,523) are responsible for approximately 81% of tax revenue. Economic activity in the indirect stage generates the most indirect business taxes ($1,203,781) followed by that resulting from the induced and direct effects ($566,261 and $288,911, respectively).

Additional income accruing to proprietors is estimated to reach $1,354,841. Proprietary income includes payments received by self-employed individuals as income, including that received by private business owners, lawyers, and doctors. (IMPLAN 2000) Employee compensation, the total payroll costs (including benefits) of each industry, is approximated at $12,035,255. This category captures payments made by businesses for wages, salaries, as well as health and retirement benefits, life insurance, and non-cash compensation. (IMPLAN 2000)

The total impact on output in various petroleum-related sectors is an interesting digression as it highlights that, although biodiesel itself is a renewable fuel, its production increases economic activity in sectors manufacturing and processing petroleum-based fuel. Proponents supporting the adoption of policy and economic incentives that favor renewable fuel production emphasize the environmental and natural security benefits of using bio-based instead of petroleum-based fuels. However, it should be recognized that this production necessarily requires petroleum fuel for transportation and other uses. For the 10 million gallon plant, the total output impact in the petroleum refining sector is $771,584. The impact on petrochemical manufacturing output is $160,799 and is $5,107 for all other petroleum and coal products. These figures may not be significant enough to refute claims about the potential environmental and natural security benefits of biodiesel, but it is worth acknowledging that the economic interdependence between most any industry and the petroleum sector is a reality for biodiesel production as well.

VI. Conclusion

The construction and operation of the 10 million gallon per year biodiesel plant has a significant impact on the Illinois economy in terms of output, employment, and the other parameters of analysis used in this study. It can also be said that the magnitude and nature of this impact is very much reliant on the chosen feedstock used for the production of biodiesel. The estimated impacts from this hypothetical facility could not be applied to another plant with an identical production capacity, but that used a different feedstock. This is especially true for a plant using recycled restaurant or animal oil or grease as its primary input. The biodiesel plant in this study generates $2,717,736 in output for the oilseed farming industry in Illinois – a substantial increase. If the plant used recycled oil instead, this spending, or a majority of it, may not be transferred to another industry. The impact of biodiesel production, therefore, is very much dependent on the feedstock used.

Similarly, the value of its benefit to rural areas is also likely to be dependent on the choice of feedstock. If agricultural feedstock is not used in the production of biodiesel, it is unlikely that a rural community would benefit as greatly from biodiesel production. If a plant using recycled feedstock were to be located in a rural area, the community would benefit from tax revenue, employment, and other income. It is doubtful that capital expenditures on equipment would benefit a rural community; capital is more likely to have been purchased in an urban area where the concentration of manufacturing is greater relative to rural localities. Therefore, its impact on rural economies is very much related to its ability to create industrial uses for agricultural products, not the plant itself. While this analysis demonstrates the significant economic impact biodiesel production has on the state level, the potential impact across different types of localities, and using different inputs to production, is not as clear.

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