Determining the Regional Economic Values of Ethanol Production in Iowa Considering Different Levels of Local Investment

David Swenson
&
Liesl Eathington

Department of Economics
College of Agriculture
Iowa State University

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Executive Summary

As the nation's leading corn producer, Iowa has the majority of the nation's current ethanol production capacity. There are more than two dozen ethanol plants either under construction or planned in Iowa. As the ethanol industry develops and matures it is important to understand the many consequences the industry might have on the whole of the Iowa economy and, in particular, Iowa's rural economy. Reliable and generalizable studies of the economic impact of ethanol plants are, however, lacking not just in Iowa but nationwide. As a consequence, the potential economic benefits of ethanol development are often not well developed or defensible.

This research accomplishes several objectives. First, it clearly and transparently articulates the important economic elements of modern ethanol production. To do that models were built that allow us to flexibly stipulate the major cost assumptions of an ethanol plant along with the production characteristics of such an operation. Second, this study uses that information to compile input-output accounts of regional economies that actually contain the production characteristics of a modern ethanol producing facility. Existing models that are purchased from private vendors or provided by the U.S. Bureau of Economic Analysis do not contain a dry-milling ethyl alcohol sector. As a consequence, reliance on those systems for estimating the regional economic effects of ethanol plants produces distorted results. This research clearly and in detail demonstrates a reliable set of procedures to consider when discerning the net increment to regional economic product that could result from a new facility.

After the basic modeling structure was established and tested, a hypothetical ethanol plant was placed in a three-county region of Iowa that currently does not house such a facility. That input-output model was used to produce baseline statistics on the prototypical economic impact values one might expect from such an operation. The third important objective of this study involved manipulating the flow of returns to investors from that prototypical plant to demonstrate the localized economic impact consequences of different amounts of local investment. A separate, derivative model was developed that allowed us to sensitivity-test the different economic consequences in a region when we manipulated the recipients of and the amounts of investment income payments in our study area. This research demonstrates that there is a discernible boost in local economic impacts associated with higher levels of local investment as compared to a situation where local investment is minimal.

Last, the intelligence gained in this modeling exercise was applied to four different actual ethanol plants in Iowa to simulate their potential industrial output and the regional economic effects of different levels of local ownership.[1]

This study conclusively and convincingly demonstrates that properly specified and applied input-output models produce understandable and reasonable regional economic impact summaries that should help in clarifying the net increment to regional product that can occur from the construction of an ethanol plant. In addition, this research also conclusively and convincingly demonstrates the potential bump to local economic activity that can accrue due to higher levels of local in a plant during a period of historically comparatively high prices received for ethanol, calendar year 2005.

Higher levels of local investment result in higher localized economic impacts. That also means the high local exposure will create negative economic impacts if the profitability of the ethanol industry wanes. Local ownership is a two-sided coin.

Still, in the present boom environment in the biofuels industry and considering the near term profit potentials that are currently driving the rapid expansion of this industry, there is the potential for at least short-term monopoly profits to be gleaned and, along the way, state-benefiting economic outcomes if those profits accumulate to Iowans.

[1] **The findings pertaining to the actual ethanol firms are made anonymous in a companion summary document entitled. A Preview of Findings: Determining the Regional Economic Values of Ethanol Production in Iowa Considering Different Levels of Local Investment.**

Determining the Regional Economic Values of Ethanol Production in Iowa Considering Different Levels of Local Investment

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Introduction

Iowa is the national center of an ethanol plant construction boom. There are 27 plants currently processing corn, mostly for ethanol, and as many more either under construction, planned, or proposed. The state will see its ethanol production capacity increase from 1.3 billion gallons at current count to as much as 3.8 billion gallons in the near future if all of the announced projects are completed.

There are no doubts about the potential economic value of ethanol production to the state of Iowa. First and foremost ethanol plants provide jobs with good incomes. A modern 50 MGY plant will have at least 35 to 40 jobs. A modern 100 MGY plant will have, perhaps, 45 to 60 jobs. Second, an ethanol plant produces more economic product in the region. It is a new production sector, and as a consequence, it yields new payments to workers and to investors, the main components of economic product. Third, ethanol plant corn demand boosts the prices that are received by farmers for their corn or sorghum in the immediate supply area, which are primarily realized as a reduction in gross transport costs relative to the point of demand. Fourth, there is a current construction boom which can be helpful to rural economies in part, although many analysts are very cautious about compiling construction economic impacts beyond their mere description.[2] Last, this industry is highly subsidized at the federal, state, and even local levels. Merely accounting for the lucrative federal flows, we can expect robust net transfers of public funds into the state and to regions.

All of these are important considerations for corn-producing areas, for the state of Iowa, and for persons directly and indirectly affected by this rapidly growing industry.

There is, too, an important concern as to the ownership of Iowa's new industrial capacity. Simple economic logic dictates that local ownership will generate more local economic

[2] Over the past decade the asset value of manufacturing machinery and structures in the U.S. has increased at an annual rate of 3.5 percent. There is to be expected, then, a regular level of capital formation that is part of the U.S.'s natural pattern of growth. Attributing that growth into "construction effects" seems odd in that we measure economic impact and outcomes based on the post-construction potential of an industry as compared to the other uses that investment capital could have been put. Similarly, the development of a plant requires transforming assets from one form of investment into another. In creating a production facility, the returns on those assets from other uses are foregone. Therefore, the net effect of construction is rarely measured adequately.

impacts than instances where ownership is external to the region or the state (provided of course that the industry that is owned is growing and not declining). For farmers and other vested interests in the future of corn-ethanol production, there have been a variety of efforts to organize ethanol production along either traditional agricultural cooperative structures or as an equity drive emphasizing a large amount of local buy-in. The argument is straightforward: industrial payments to local owners are more valuable to a region because local owners are more likely to spend and, possibly, re-invest regionally. In instances where plants are owned externally, the amount of additional economic stimulus in the region is reduced considerably.

The question remains, however, just how beneficial to local economic activity is regional ownership? At the outset, we need to make clear that we are talking about local ownership not just farmer ownership. While cooperative ventures tend to be farmer owned, other ethanol ventures with high local or regional buy-in are not necessarily farmer owned and should not for either practical or rhetorical purposes be represented as such. As a consequence, we are not measuring the potential beneficial outcomes for farmers in local owned configurations, and the results should not be interpreted so.

The potential outcomes are indeed consequential and depend on several factors, to include the overall profitability of the plant in question along with the amount and dispersion of the owners. In order to determine the economic consequences of local ownership, several pieces of information needed to be acquired, developed, or processed. The first and most important piece of information needed involves the production characteristics of modern ethanol plants. These data are not easy to come by, and this analyst relied heavily on research and outreach originating at both the University of Minnesota and at Iowa State University to determine the production characteristics of modern ethanol plants.

Once those data were obtained and modified for our purposes, a simulation modeling system was developed to test the consequences of different ownership configurations. All of that modeling was conducted using a corn-producing area of Iowa that currently does not house an ethanol plant.

Realistic assessments of actual local ownership are measured next in Part B of the study[3]. Four Iowa plants are studied to demonstrate the region-wide economic impact of these plants given their actual local ownership amounts. To determine local ownership, the zip codes and share amounts of investors have been released to allow us to determine the territory of local ownership of our study plants. Our judgment for "local" ownership was based on the overall size of the primary corn market area benefited by the plant in relation, the actual weighted distribution of owner shares, and the counties in which the ethanol plant is believed to have a significant influence.

The findings from the two major parts of this research will be used to assist policy makers and community leaders in understanding the scope and kinds of potential regional economic gains that might be anticipated from the introduction of a bio-fuels manufacturing plant in a region and how those gains change as the types of ownership structure changes.

There will be three very important outcomes form this research:

First, this research will cleanly and transparently identify the production characteristics of a modern ethanol facility,

Second, this research will demonstrate the potential regional economic advantages of local ownership of ethanol facilities as compared with other ownership configurations, and

Third, this research will utilize existing plants to simulate the different expected regional economic outcomes evidenced by current ownership examples in Iowa.

[3] Part B of this research contains detailed estimates of the spatial dimension of ownership characteristics of three ethanol facilities and an assessment of one other that is totally externally owned. The results of this research are summarized in a companion piece to this research in a manner that does not disclose the actual location and the overall distribution of ownership for those plants in detail sufficient to either identify the plant or deduce the actual location of individual investors.

Part A: Developing a Modeling and Measurement Structure

The Production Characteristics of a Modern Ethanol Facility

The very first step in impact assessment involves determining the production characteristics of the industry that we are measuring. The ethanol industry is evolving rapidly, but the industrial basics of the industry are comparatively ancient. There are two types of configurations: wet milling, which can produce a variety of corn based products besides ethyl-alcohol, and dry milling, which is the dominant form of ethanol production and the type of expansion currently underway. In the subsequent analyses, we are referring to dry milling operations exclusively.

There are several standard sources of information about industrial production characteristics. The 2002 U.S. Census of Manufacturing has an ethyl-alcohol sector that allows us to understand some of the basic characteristics of production to include jobs, payroll and benefits, and some of the very basic input amounts employed by the industry. Those data are only useful to a point – they certainly allow us to calibrate our expectations about earnings and employment relative to industrial production nationally, but they give us relatively little information on the scope and amount of production inputs utilized by the industry. Additionally, as those data were collected for 2002, we know that the industry has transformed since then markedly and that the newer production characteristics differ substantially from the old average ones. Newer data are needed.

Data are also compiled in the National Income Product Accounts (NIPA) maintained by the U.S. BEA. These data have a large amount of detail, but they do not isolate ethyl-alcohol production. There is a corn wet milling sector, but that sector produces much more than ethanol, and it does not represent the industrial characteristics of more modern, dry milling operations. There is not a dry milling sector, per se, and characteristics of the overall nonpotable ethyl alcohol industry, where the industry should be properly classified, are buried in the larger “other basic organic chemicals” sector, which includes wood and gum derivatives, other cyclic crude chemical compositions, and literally dozens of common products ranging from acetones to vanilla. These industrial accounts are not helpful either for our purposes.

Commercial and academic input-output modeling systems are normally based in large part on the benchmark input-output data that are derived from the NIPA activity at BEA. Consequently, those accounts also do not contain specific production information that pertains to ethyl alcohol. While the input-output modeling data that are purchased annually for the state of Iowa and maintained by Iowa State University, do contain an organics chemicals sector, it has very few employees and it, as mentioned above, is much more linked to non ethyl alcohol products. The structure of our industrial accounting system does not contain industrial characteristics that pertain specifically to dry mill ethyl alcohol production. Unfortunately, there are analysts in Iowa and in the nation that ignore that fact and continue to produce ostensibly rigorous ethanol economic impact statements, the absence of industrial accounts notwithstanding.[4]

There is therefore a huge gap in the amount of credible information available to national, state, and local level economic impact models for dealing with the ethanol industry. That is not to say, however, that we do not know quite a lot about the production characteristics of a modern, dry milling ethyl alcohol plant. Farm business researchers in several locations have, over the past few years, compiled highly detailed statistics that allow us to identify the major production characteristics of these operations. Tiffany (2003)[5] has documented factors that determine the success of modern ethanol facilities, and Jolly and his students have applied this work to Iowa operations.[6]

Both of these efforts provide very reliable intelligence about the overall operating characteristics of modern ethanol operations and were employed specifically in informing our research. Our contribution to this discipline is that we have absorbed their research and configured it in a manner consistent with input-output accounts for inclusion in our subsequent modeling efforts. A reader might ask why we do not just ask or survey modern ethanol operations and get actual production information. The answer is simple: industries loathe revealing cost and income information, especially in the kind of detail that allows for reliable input-output modeling. As a consequence, we must rely on composite indicators of the kind produced by Tiffany and Jolly in order to get at the most common characteristics of the firms that we are measuring.

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[4] Issues associated with national and small area impact calculations and conclusions are explored in detail in, Swenson, David. Input Outrageous: The Economic Impacts of Modern Biofuels Production. Staff Report, Department of Economics, ISU. June 2006. www.econ.iastate.edu/research/webpapers/paper_12644.pdf . Readers are also invited to read, __________. Model Economic Analyses: An Economic Impact Assessment of an Ethanol Production Facility in Iowa. Staff Report. Department of Economics, Iowa State University. January 2005. www.econ.iastate.edu/research/webpapers/paper_12226.pdf .

[5] Tiffany, Douglas and Vernon R. Eidman. Factors Associated with Success of Fuel Ethanol Producers. Staff Paper PO37. Department of Applied Economics. University of Minnesota. August 2003.

[6] Jolly, Robert. A Look at Ethanol Plant Profitability and Farmers' Investment Portfolios. In-service presentation and materials. Department of Economics. Iowa State University. May 2006. See also, Shunmugavelu, Ramanathan. Investment Analysis of Deferring Farmer Owned Ethanol Plant -- Using Real Options, MS thesis, Iowa State University. 2003.

Transforming the Data Into an Industrial Accounting Structure

The data compiled by Tiffany and Jolly were designed to test different assumptions of prices and levels of production against overall plant profitability. The important aspect of those efforts for our research is that their input assumptions and their output assumptions are stated explicitly. That means that we know how many major commodities the plant consumed and the prices that were paid for those inputs. Similarly, we know the commodities (ethanol and byproducts) the plant produced and the prices received for them. These decision making models also contain explicit assumptions about capital financing, labor and management costs, and expected returns to investors. In short, these models allow us a lot of flexibility in characterizing a modern ethanol dry mill.

The line item characteristics of modern ethanol plants were copied and then updated to reflect commodity use and price averages for 2005, our analysis year for this study. Examples of the basic data and assumptions from the model are displayed below. In Table 1 we identify the basic cost and labor assumptions for our model. In our modeling system, all of the shaded cells can be altered in order to change assumptions. In this instance, we are configuring expected costs associated with a 50 MGY dry mill plant that will cost a total of $73.46 million to construct. We identify the financing sources as to how much comes from borrowing and from actual investors. We identify the terms of the loan and the expected return on investment. We also can specify the number of jobs and the overall direct labor and management costs associated with the plant.

Our next table (Table 2) identifies the major production characteristics of the operation that we are modeling. As indicated ours is rated as a 50 MGY plant. Plants produce more than they are rated, so we also estimate the percentage of their capacity (their nameplate factor) that they will actually use. Depending on the inputs and the processes, the amount of denatured alcohol produced per bushel of corn varies. We have pegged it at 2.75 gallons per bushel. Importantly, ethanol also produces byproducts besides denatured alcohol. Distillers' grains can be dried and marketed, as can CO_2. We can also change the assumptions about the amounts of these two byproducts that are produced.

Table 1. Initial Cost and Labor Assumptions

Total Costs & Labor Assumptions		
Base investment cost ($/gal)	$ 1.45	
Land cost ($/acre)	3000	
Land area required (acres)	320	
Engineering and installation cost	15%	
Overall project cost ($/gal)	1.4692	
Total project cost ($)	$ 73,460,000	
Distribution of cost across years D/E	60%	40%
Interest rate	10%	
Years	10	
Annual Debt Service Costs	$7,173,166	
Investors' return	20%	
Labor		
FTE	35	
Average Wage and Benefits	$67,700	
Management over Labor costs	20%	
Total labor and management	$2,843,400	

It is important to adjust our core assumptions between Table 1 and Table 2 as plant sizes increase or (although unlikely currently) decreases. For example, when plant size increases, the construction costs per rated gallon decreases. Similarly, labor needs do not change proportionate to plant size. A 100 MGY plant may only require from 45 to 50 jobs if not fewer. Modelers employing this system need to be mindful of the expected investment and productivity assumptions underlying different plant size configurations.

Table 2. Production Assumptions

Production Assumptions	**Baseline**	**Ranges**
Rated capacity (gal per year)	50,000,000	20 million to 100 million
Nameplate factor	115%	90% to 120%
Denatured Alcohol (gal per bushel)	2.75	2.5 to 2.9
DDGS yield (lb per bushel)	17.5	15 to 22
CO2 yield (lb per bushel)	17.5	15 to 22

For modeling purposes, the crux of our analysis rests on a definition of the average characteristics of either the firm that we are studying or the entire industry in a region or state. Table 3 itemizes the major inputs that we intend to introduce into our modeling system. It also itemizes the cost assumptions and the basis for those costs. The data are organized around primary inputs – corn, water, and energy – and all other inputs. The data are of sufficient detail to allow us to specify a large fraction of the data elements that we introduce into our modeling structure.

Readers will also notice that in an input-output accounting structure, payments to value added are considered costs as well. Payments in our system are made to the production workers and to management, and would be contained in our modeling system as employee compensation. Value added also consists of payments to investors. In this model our investors are expecting a return on their equity investment of 20 percent. Finally, one expects the plant to make indirect tax payments to federal, state, and local governments associated with their operations, although this industry enjoys huge local government property tax breaks and in fact may not currently be contributing directly significantly to state or local government accounts.[7]

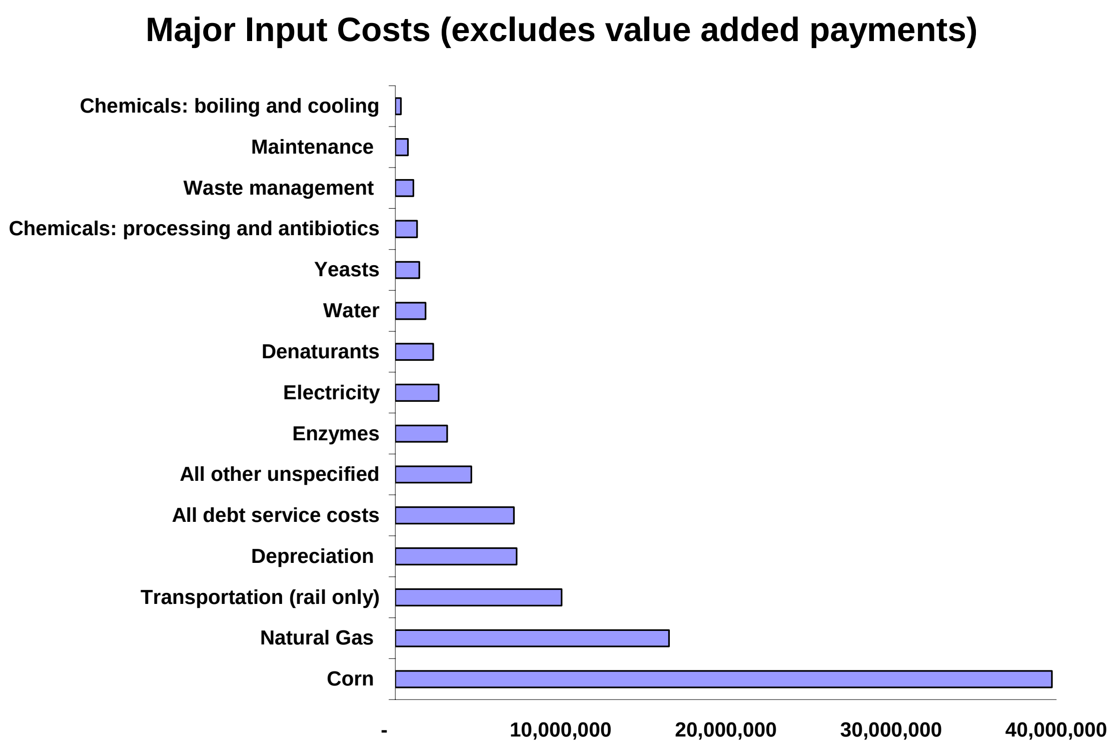
Table 3. Inputs, Prices, and Units

Primary Inputs	**Input Costs**	**Prices / cost**	**Unit/Basis**
Corn (bu)	39,727,273	1.90	Bushel
Water (gal) (plus treatment)	1,819,091	0.01740	Bushel
KwH Electricity	2,618,550	0.04140	KwH
Natural Gas (btu* bushel*alcohol yield)	16,552,813	8.22500	Million BTU
Other energy substitute			
Other Inputs			
Enzymes	3,136,615	0.15001	Bushel
Yeasts	1,438,462	0.06880	Bushel
Chemicals: processing and antibiotics	1,307,487	0.06253	Bushel
Chemicals: boiling and cooling	327,436	0.01566	Bushel
Denaturants	2,287,538	0.10940	Bushel
Waste management	1,089,364	0.05210	Bushel
Maintenance	756,909	0.03620	Bushel
Transportation (rail only)	10,062,500	0.00050	gallon per mile
All debt service costs	7,173,166	0.34306	Bushel
All other unspecified	4,600,000	0.22000	Bushel
Depreciation (Simple - straight 10 years)	7,346,000	0.35133	Bushel
Value Added Costs			
Labor	2,369,500	0.11332	Bushel
Management	473,900	0.02266	Bushel
Expected Return to investors	5,876,800	0.28106	Bushel
Indirect taxes	1,022,795	0.04892	Bushel
Total Costs	109,986,199		

[7] There are no explicit assumptions in our modeling system that addresses government production subsidies or credits that are available to ethanol producers and distributors. The federal value of that credit currently is $.51 per ethyl-alcohol gallon – a 50 MGY plant would generate at least $32 million in payments to the producing industry and its distributors per year. How those subsidies are divided and reflected ultimately in the prices paid for ethanol is not well established according to research on the topic. We assume that the price received for ethanol by the producer already contains implicitly the subsidy effect. We also make no attempt to track the direct federal subsidies received in supplying industries, most notably in the corn production sector.

Figure 1 below demonstrates the dimensions of major payments by kind of input excluding payments to value added. The first 10 payment categories make up over 80 percent of the industry's demand for intermediate inputs, and nearly every one of these inputs operates under a different cost assumption. Accordingly we can vary the amount of payments that the prototypical plant makes to any of the sectors that are involved in our analysis, which in turn allows us to alter our assumptions about our producing firm[8]

Figure 1



Our next set of figures, Table 4, is a statement of the prices that are received for the primary commodity, ethanol, and its byproducts. In this case, assuming last year's average price per gallon of ethanol of $1.80, we have our plant receiving $103.5 million in ethanol sales, $14.1 million in DDG sales, and $1.1 million in CO_2 sales. Readers will note that gross receipts in our model of $118.65 million exceed costs (Table 3) of $109.99 million. The difference is excess profits to be divided among shareholders or for

[8] One must be cautious about introducing too much change in prices into our models. Input-output systems are fixed price models. The modeling systems assume a fixed and stable relationship among industries in terms of units of commodities supplied and prices paid. During periods of relatively stable prices, as has been the case in the U.S. for well over the past dozen years, the models are considered to be relatively stable in their expectations. However, during periods of price instability, one must exercise care when computing inter-industrial relationships. For the purposes of model building and this exercise, we are assuming 2005 prices for all inputs and for prices received from sales. Our baseline data for our modeling system are for the 2003 production year, however.

other uses. In order to rebalance our input-output accounts we add the $8.7 million to the basic value added payments above. This increases our value added amount from $9.74 million to $18.41 million.

Table 4. Income, Prices Received, and Value Added

		Production Income	Price Received	Unit
Denatured alcohol (gal)		103,500,000	1.80	Gallon
DDGS (tons)		14,050,909	76.80	Ton
CO2 (tons)		1,097,727	6.00	Ton
Total		118,648,636		
Sum of Value Added from Costs Table		*9,742,995*		
Surplus Value Added: Profit to be divided among shareholders and other uses		*8,662,438*		
Total Value Added with Profits	*$*	*18,405,433*		

On a summary basis (Table 5) we get two restatements of the characteristics of the plant. The first involves boosting the value added assumption, which generates the second restatement of boosting the total amount of industrial output in the plant. Using 2005 prices, this plant generated $118.7 million in industrial output – the final value of all production. We estimate that it required $100.2 million intermediate inputs, and it made $18.4 million in total value added payments, just 15 percent of which accumulated to labor at the plant.

Table 5. Summary of the Composition of Industrial Output

Industrial Output	$	118,648,636
Intermediate Inputs:		100,243,203
Corn		39,727,273
All Others		60,515,930
Value Added	$	18,405,433
Payments to Workers		2,843,400
Payments to Investors		14,539,238
All Others		1,022,795

<u>Building a Study Region and Determining Local Ownership</u>

The procedures for measuring whether different degrees of local ownership have, in turn, meaningfully different local economic impacts need to be developed systematically.

There are two beneficial yet confounding characteristics of input-output system accounting.[9] First, all of the economic activity is initially counted in the region of the plant's operation. As such, accounting takes place at the location at which the firm makes payments – most notably at the plant level. Second, despite this, we have no way of managing, let alone determining, the physical location of the workforce, proprietors, or investors. In short, we know where the payments to value added get made, their incidence, but we do not know ultimately where they end up, their impact. This is further complicated in an input-output system in that not only do we not know where the payments end up, we also do not know where and how those payments may or may not translate into household spending regionally, another important piece of an economic impact compilation.

It is therefore important to specify a study area that is large enough to capture a significant fraction of a firm's workforce, to maximize regional supply potentials, to the extent that regional commodity supply is important, and to the extent that the data can be manipulated, to maximize payments to local proprietors, partnerships, and investors. This also helps to enhance the modeling system's ability to adequately measure purchases of intermediate inputs, in this case the primary one is corn, and purchases of household goods by workers and investors. We are still left with the problem of not knowing, or being able to cleanly specify in the model, the location of owners and investors, but we address that problem later.

Establishing Our Study Region: TriCo

For the purposes of testing our adjustments to the input-output modeling accounts, we established a three-county region in Iowa as our regional economic laboratory. The three county region (hereafter TriCo) is in a major corn producing area of Iowa, but does not currently house an ethyl alcohol dry milling facility. This allows us to literally create a brand new industry in the area and to, concomitantly, modify our intra-regional transactions so that they accommodate the presence of this new industry.

The industry that we are going to add to the region is the same industry that was specified in Tables 1 through 5. It is a 50 MGY facility that will dry mill corn to produce ethanol, dried distillers' grains (DDGs), and carbon dioxide (CO_2). As specified in this model, it

[9] Implan, an input-output modeling software system was employed for our analysis. That company also provides, for a fee, the detailed county level data that we in part relied on for our study. Many people mistakenly believe that "Implan" does the input-output or impact analysis: that is wrong. There is no such thing as an "Implan study," though people attempting to add credibility to their efforts will sometimes label their work as such. Readers interested in learning more about input-output modeling or economic impact assessment can receive overview material by contacting the authors of this report.

will purchase 85 percent of its corn inputs directly from area farmers and the remaining 15 percent from elevators and other merchants. All of the price data contained in Table 3 are converted into a table of total requirements. Table 6 lists these requirements. They constitute the gross “production recipe” for the firm that we are studying. The newly injected ethanol industrial sector in our model is modified to require these inputs. Most of these input factors come directly from the Tiffany and Jolly research; however, we have included additional costs. First, we have included a significant amount of rail charges. We are assuming that all production is for export, that export is carried on rail tankers, and that the major terminus of sale is 350 miles away.[10] Second all prices reflect published actual prices for 2005, to the extent that they were known, or base prices from the 2003 Tiffany research adjusted for producer price inflation. Third, after all of the specific requirements were entered in the table, the remaining industries that were not manually adjusted absorbed the “all other unspecified” costs of $4.6 million in proportion to their composition of the remainder of all inputs into our industry as determined in the original default accounts in the model.[11] This last distribution of payments to suppliers allows our model to include the highly detailed schedule of industrial interactions that would be expected in light of the national benchmark input-output accounts upon which these models are originally constructed.

Table 6. Table of Total Intermediate Input Requirements

Primary Inputs	Input Costs	Total Requirements
Corn	39,727,273	0.334831
Natural Gas	16,552,813	0.139511
Transportation (rail only)	10,062,500	0.084809
Depreciation	7,346,000	0.061914
All debt service costs	7,173,166	0.060457
All other unspecified	4,600,000	0.038770
Enzymes	3,136,615	0.026436
Electricity	2,618,550	0.022070
Denaturants	2,287,538	0.019280
Water	1,819,091	0.015332
Yeasts	1,438,462	0.012124
Chemicals: processing and antibiotics	1,307,487	0.011020
Waste management	1,089,364	0.009181
Maintenance	756,909	0.006379
Chemicals: boiling and cooling	327,436	0.002760

[10] Someone pays the freight and the price received in our model assumes the seller pays freight. If the buyer pays freight, then we would adjust our ethanol price downward. We assume that the rail handling activity, however, is proximate to the ethanol plant. If we do not have the rail costs specified locally, they end up not being counted in our modeling system.

[11] The industrial accounts for a wet corn mill (a sector specified in the modeling system) were manually placed into the study area as they mimicked a large fraction of the scope of production inputs likely to align with this operation. Those accounts were then modified significantly to reflect the production requirements for our dry mill operation.

Once modified, we can begin modeling our different ownership scenarios. But first we must determine the procedures for differentiating between local and external investors.

Approximating Local Ownership in the Modeling System

The original modeling system typically cannot tell us where the final payments to investors or owners are made without extraordinary effort on the part of analysts. It is however possible for modelers to modify the technical aspects of the system to accommodate different value added payment assumptions. In order to identify how earnings and other value added payments in the region get allocated to households, we first need to extract basic data from the Implan model for our region.

In constructing the foundations for the model, the system creates an industry-by-industry account for all industries, household sectors, and other economic institutions in the model. That account is called a social accounts matrix (SAM), and it was extracted from the modeling system. The SAM is useful for analysis independently of the Implan model and is deployed later in this study in order to conduct a sensitivity analysis of different kinds of investments. Once aggregated into a manageable size, however, the SAM allows us to identify just how all value added payments in the region are made.

The SAM helps determine the likelihood that different types of payments to value added stay in the region that we are studying.[12] The basic data for TriCo are contained in Table 7. Here we see the expected value added payment leakages. Just 13 percent of all earnings (wages and salaries) in the region accumulated to persons outside of the area. Slightly fewer than 5 percent of proprietors' incomes do, but a full 71 percent of investment income value added payments are expected to be made outside of the study area.

This table helps us to see that the likelihood of investment earnings generated in the TriCo economy leaving the region, considering all industries, is large. In fact, the 29 percent accumulating to the region is much higher than the average for most other places in Iowa. This is due perhaps to a higher incidence of land rent payments made to local residents relative to all other investments than would be the case in more urban counties.

[12] Analysts have an obligation to determine the reasonableness of the findings in the modeling system. There are layers of assumptions that are used to determine how different economic values accumulate to a region. Some are based on national averages, and some are based on smaller area assessments. Most analysts perform a "reality check" with their model using other secondary economics data to establish the reasonableness and representativeness of the model that they are deploying.

Table 7: Distribution of Value Added in the TriCo Region

Amounts in Millions	Earnings	Proprietors' Incomes	Investment Incomes
Households < $25,000	52.15	9.11	10.98
Households $25,000 -75,000	310.27	56.60	67.10
Households > $75,000	145.13	27.99	34.81
Total Payments in the Region	507.55	93.70	112.89
Payments Outside of the Region	73.84	4.55	276.20
Total Payments	581.39	98.25	389.08
Percentage Outside	*12.7%*	*4.6%*	*71.0%*

The data in Table 7 give us dimensions upon which to initially configure our model. Recalling that payments to investors from our prototypical plant would have been $14.54 million, the model for TriCo was originally built so that all of those payments accumulated to generic external investors in the same expected portions that already exist in the county (71 percent of payments flowing out of the county). We introduced another step into the modeling procedure where we actually remove that remaining local investment and then recalculated the economic impacts of the plant. This then becomes our baseline model where local ownership is assumed to be zero. Those statistics are part of the next section.

These models are not fixed black boxes. They can, and often should, be modified by the analysts. To study the potential localized economic impact differences, we designed separate scenarios where payments to investors are split among the proprietors' sector and the investment sector in the model in different increments. By manipulating the amount of investment returns put into the model that are divided between these two dimensions, we simulate the potential economic impact differences of local ownership versus external.

Measuring Economic Impacts and Understanding Economic Impact Language

Many people use the term "economic impact" quite loosely, that includes many academics. In this study we reserve the use of the term to instances where it is clear that a change in industrial production in a region either enhances regional economic product (i.e., value added) or reduces regional economic product. An ethanol plant produces net new economic products that are primarily sold for final demand outside of the region of production; hence, ethanol plants would be expected to have a localized and a statewide economic impact in areas where production is concentrated. The true net product, however, would have to be assessed against any local offsets. If the plant's use of corn reduced the grain handling economy elsewhere, one would out of fairness have to gauge those losses. Similarly, if a plant drove regional corn prices up, then other users of corn, like animal feeders, would generate less regional economic product. When we measure regional impacts we must always acknowledge potential offsets.

The economic impacts of national ethanol production must also be assessed in light of the product that it substitutes for, namely gasoline. A gallon of ethanol sold by a distributor offsets a gallon of gasoline purchased by a distributor, all things equal. Stated differently, ethanol producers' gains are offset to a large degree by big oils' losses. Economics at the outset does not express a preference of one over the other – people and policy makers do. There of course is the issue of import substitution, as a large fraction of the nation's energy demand is met by non-domestic supplies, so substituting U.S. produced energy for imported energy can be economically desirable, but it is not automatically so if, for example, U.S. production is heavily subsidized, inefficient, or created external costs that were not acknowledged. No credible research to our knowledge has parsed these values to determine the net national economic product increment attributable to ethanol manufacturing. As a consequence, readers are urged to be skeptical of popular studies claiming to have measured this industry as it is currently configured or as it may be in the future at the national level.

When we study the overall economic activity stimulated by an industry, to include its economic impacts, we look at three major factors: First the accounts that we assess contain estimates of *industrial output*. Industrial output is approximately the sales value of production by an industry in a particular year. The next figure that is determined is *value added*. Value added is a measure of the economic product that an industry or collection of industries produce. It is simply the payments that are made to labor (wages and salaries), business owners (proprietors or simple partnerships), investors (paid as interest, dividends, or rents), and the indirect tax payments made to government that are part of production activity. The last economic value that is determined is jobs. There are more jobs in an economy than employed persons because many people have more than one job. Not all jobs are created equal. Jobs in some sectors, like manufacturing, are considered full-time, year-around jobs. Jobs in other sectors, like retail trade, recreation and entertainment, and agriculture are often considered part-time or part-year jobs.

When we conduct an economic impact analysis we have three additional dimensions of economic activity that are measured:

- **Direct activity**. This is the information that pertains to the firm that we are studying. In this study that is the new ethanol plant in the TriCo region.

- **Indirect activity**. For the ethanol plant to manufacture its products, it must purchase inputs from local suppliers. It needs corn, water, energy, chemicals, and transportation services. These inputs into production are the indirect effects.
- **Induced activity**. Workers in the direct activity (the ethanol plant) and the supplying industries (the indirect activity) convert their paychecks into household spending. Consequently, this induces another round of economic activity in the region

When we sum the direct, indirect, and induced activity, we get the total economic value of an industry to a region; hence,

Direct + Indirect + Induced = Total Economic Activity

The last statistic that is often produced in economic impact assessment studies is called a *multiplier ratio.* A multiplier ratio is simply the ratio of total economic activity to the direct activity. A multiplier ratio can be constructed for industrial output, value added, and for jobs. Its interpretation is straightforward, but will be explained in more detail later in this section. It represents the total change in the economy per unit (dollar of output, dollar of value added, or a job) change in the direct sector. As examples,

Jobs Multiplier = Total Jobs / Direct Jobs
Output Multiplier = Total Output / Direct Output

Many people believe multiplier ratios imply causation, as in an increase of one unit in the direct sector will *cause* a multiplied-through total change in the larger economy. That is wrong. A multiplier simply represents the current measured ratio of total activity in a region to the direct activity. How much of that ratio represents net new economic product given a change in the direct value must be researched further. Many analysts and advocates either do not understand this or do not know how to do this. Readers are urged to never over-interpret the value of a multiplier ratio without critically assessing the source of the analysis, the industry that is being measured, the relationship of that industry to the remaining economy, and, importantly, the likelihood that new jobs are indeed being stimulated in the region.

Compiling the Impacts

An initial baseline model was build for the TriCo region. In building our model several adjustments were made to the standard input-output assumptions in the modeling system. First, we entered all of the production functions that are contained in Table 6. This lets the TriCo economy interact with the new ethanol plant. Then an initial run was conducted where the regional economy was shocked by the full value of the plant's production, the $118.65 million in expected industrial output.

We next made an immediate adjustment to our model. The ethanol plant processes corn that is already produced in surplus in the region; it does not cause more corn production. But our system does not know that, only analysts do. To not create the mistaken impression that our industry is creating more corn production (or more precisely agricultural activity) in our region along with, iteratively, enhancing all of the input suppliers to the corn industry, we immediately remove these values from our analysis. In doing this we have to first add our $118.65 million in ethanol production and simultaneously subtract exactly the amount of corn that the model wanted that plant to stimulate. Once we have calculated the corn offset, we get a better picture of the total value of the plant to the region excluding the already existing corn production.

For the baseline model the direct values are first. The ethanol plant had output of $118.65 million, made value added payments of $18.41 million, and required 35 jobs. Next we look at the indirect amounts. Excluding surplus corn bought regionally, the plant purchased $13.3 million in regionally supplied inputs, which supported $6.01 million in payments to value added in the region and an additional 75 jobs.[13] It should be clear to readers that the job benefits of an ethanol plant are potentially greater in the supplying industries (again, excluding corn production) than they are in the ethanol plant. Finally when the workers in the ethanol plant and the supplying industries spend their paychecks, they generate, under the baseline model, $1.55 million in additional regional output, $942,326 in value added, and 23 jobs. When we add all of these values together, $133.5 million in regional output, $25.4 in payments to value added, and 133 total jobs are associated with this ethanol plant.

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[13] Input-output models mathematically expect there to be average industrial job effects in several important areas for ethanol production: natural gas and electricity supply, water, rail transportation, in area mechanical and electronic equipment repair and maintenance, and in financial services. Phone inquiries were made to different commodity suppliers (gas, electricity, water, and rail) to ascertain the likelihood that the job figures reported in the modeling system would eventuate given the localized demand of our ethanol plant. In all cases, the respondents said that additional labor needs would be from nearly zero to just 30 percent of the amounts reported in the modeling structure, according to our interviews. Consequently, we reduced labor and labor earnings values in natural gas, electricity, water, and rail to 25 percent of the levels reported out of our model to take into account that we are dealing here with significant declining cost industrial structures whose marginal costs differ markedly from their average cost. We also reduced finance sector jobs to 25 percent of the values reported in the model – we do not believe that the financing of a plant will have a durable effect on the region's financial sector; we doubt that the preponderance of debt financing in our firm is local. Area electric and mechanical repair and maintenance jobs, however, were not altered although we believe that those job figures might also be inflated and will require additional research. All other job values were unchanged. These "reality-check" adjustments effectively lower the indirect values and the multipliers that result.

Table 8

TriCo Baseline Economic Impacts

	Direct	Indirect	Induced	Total	Multiplier
Output	118,648,636	13,301,156	1,546,605	133,496,397	1.13
Value Added	18,405,433	6,011,897	942,326	25,359,656	1.38
Jobs	35	75	23	133	3.79

Multipliers are also displayed in Table 8. Under the baseline scenario, the output multiplier is 1.13 (remembering that we have excluded the corn from this analysis – we are not causing more regional agricultural commodity), the value added multiplier is 1.38, and the jobs multiplier is 3.79. In order, these multipliers mean that for every $1 in output, an additional $.13 in (non-corn) purchases were made from the regional economy. For every $1 in value added generated in the plant, $.38 in additional value added were supported in the rest of the economy. And for every job in the plant, 2.79 jobs were sustained in the remaining economy. The jobs multiplier is relatively high compared to other industries because this industry is considered capital intensive relative to its labor demands. It is very atypical of most manufacturing firms in Iowa.

The values in Table 8 were compiled assuming absolutely no local ownership in the plant. Now we need to allocate payments to local investors, but the mechanics of that are not obvious in our standard input-output models.

Let us imagine a local person with a vested interest in an ethanol plant. Let us further assume that an initial investment is $40,000. Finally, let us pay that investor a return of 33 percent, an amount not unheard of if not actually low in 2005. That means that investor would have received $13,333 for his or her investment effort. The question then is how much of that dividend would we expect this investor to spend: all of it, half of it, none of it? First, all of that income would be subject to state and federal income taxes, so it must be reduced to a disposable amount. Next, research on farmer behavior during windfall years in the past concluded that, as a rule, farmers would use approximately a third of their windfall receipts to reduce debt (or to otherwise invest positively), a third to improve capital stock (equipment and buildings), and a third to household spending. If this is the general pattern of spending and investment by farmers, is it the same general pattern for other local investors who might not behave like farmers? I, for example, tend to immediately re-invest all of my dividends or other earnings from investments, but I periodically convert some of my investments into purchases (a down payment on a house or a car, for example). Other recipients of investment income, primarily pensioners, may more readily convert investment receipts into household spending.

So, we are left not knowing just how much of the returns on investment get recycled into the regional economy as household spending. It is reasonable to assume that investors have personal discount rates at which they want to receive a minimum rate of return. It is also reasonable that these same investors will then use the amounts in excess of that return as re-investment capital (locally or externally) or consumption or both. It is simple: these returns are taxed, saved, or consumed. The ratio of which to which is unknown, however, to include the amounts taxed. To try to inject some sensitivity into this analysis we turned to the baseline Social Accounts Matrix (SAM) model mentioned briefly previously for additional analysis.

An Analytical Improvement: Using a SAM Structure to Modify Regional Impacts

A social accounts matrix (SAM) is a complete statement of inter-industrial transactions in our study area, to include purchases of imports and all commodity and service distributions to final demand in our economy.[14] The basic SAM matrix is processed through a series of steps into an economic impact model that is highly transparent and which can be manipulated relatively easily for testing different scenarios.

The TriCo SAM model was constructed assuming that our ethanol plant was already in existence in our region so that we could measure the total economic impact of the industry relative to its production for final demand (export sales). Like above, however, we are not interested so much in the total values, but in the increment to local impacts that accumulate through different levels of local investment. In this model, we captured payments in the model that have accumulated to external investors in the baseline scenario. We manually re-allocated these payments by level of local ownership to the upper income household group into two categories in which value added payments are made to these households in our region: as proprietors' incomes and as investments incomes. We use the upper income bracket in each category to represent our regional investing class. We call the upper income recipients of local proprietor value added payments our *active investor vector* and our upper income recipients of investment incomes our *passive investor vector*, recognizing that both vectors exist simultaneously

[14] There are three major categories of final demand: first, households in our region consume goods and services that are produced in our region; second, governmental institutions are final consumers of locally produced commodities and services; third, the remainder, the amounts not demanded by households or governments or utilized as intermediate production inputs in our economy by local industry are destined for export, which is the final demand category.

within our upper income section of the TriCo economy and that they can not be differentiated further.

The modeling structure is modified to recalculate changes in the regional economy as we shift payments to investors from 100 percent external ownership in increments of 25 percent to a maximum of 75 percent locally owned. Next, we mix this amount between our "active" and our "passive" vectors to see how that type of differentiation also changes our local impacts. This differentiation has a very practical purpose. Passive receipts in our modeling structure are more likely to be converted to household income and spent. Active receipts are likely to be re-invested, like other investment incomes, with comparatively smaller portions converted to household consumption, according to the model mathematics. We are letting the underlying model structure determine the likelihood that these different dimensions find their way into regional spending.

We are pulling investment payments back into our economy by manually transferring them into household incomes. This allows the model to calculate the expected outcomes in the manners in which persons in that region are expected to use their incomes based on how they historically have received their incomes. The outcomes of this exercise are displayed in Table 9.

This table requires some explanation. The column totals represent the degree of local ownership assumed (actually the percentage of investor payments to local households). Next we differentiate between our passive recipients and our active recipients, as described above. Finally, we list the effects by output and value added, like before, but we also add a household income category.[15] While output and value added are important measures, household income accumulates to local residents and is perhaps more of an intuitively useful measure of the localized value of economic change considering one scenario over another.

First, read down the 25 Percent column. We are reallocating 25 percent of the total payments to investors of $14.539 million back into our regional economy as household income. We are next dividing that investment between our passive and active categories from 100 percent of one to zero of another and vice versa in four steps. The model,

[15] Traditional impact models like Implan do not isolate regional household income effects, although payments to households from within the economy and outside of the economy constitute a major portion of regional economic activity. Implan also produces job estimates, but these are not a part of the original SAM – they are econometrically estimated after all of the economic impact calculations have take place. This modeling effort does not attempt to inject job measures as they are superfluous to the exercise, but job estimates are made in the last step where we estimate the different gains to the economy from increased household income (as payments to investors) in our region of study.

considering the type of investment income, then allocates its expectations for local consumption (output), the generation of economic product (value added), and the realized gains to households (household income). At 100 percent active investors, the expected regional household income impact is $3.0 million. Notice, though, that the increment to local output or more precisely regional sales only increases by $1.2 million, and value added from that activity only increases by $800,000. The point is that just a minority of income gains in the region translated into regional spending or, more desirably, value added.

Table 9
Total Regional Economic Activity Change (in Millions)

		Degree of Local Ownership in Ethanol Plant		
Type of Investment	Category	25 Percent	50 Percent	75 Percent
Passive = 0% Active = 0%	Output			
	Value Added			
	Household Income			
Passive = 0% Active = 100%	Output	1.2	2.5	3.8
	Value Added	0.8	1.5	2.3
	Household Income	3.0	5.9	8.9
Passive = 25% Active = 75%	Output	1.6	3.2	4.9
	Value Added	1.0	2.0	3.0
	Household Income	3.7	7.4	11.2
Passive = 50% Active = 50%	Output	2.0	3.9	5.9
	Value Added	1.2	2.4	3.6
	Household Income	4.5	8.9	13.5
Passive = 75% Active = 25%	Output	2.3	4.6	7.0
	Value Added	1.4	2.8	4.3
	Household Income	5.2	10.4	15.7
Passive = 100% Active = 0%	Output	2.7	5.3	8.0
	Value Added	1.6	3.3	4.9
	Household Income	5.9	11.9	17.9

As our mix of passive versus active investor changes in the model, we see that the amount of income in the region increases, as also do output and value added. For the purposes of our remaining comparisons, we are only going to describe the 50 percent passive and 50 percent active (50/50) mix of active/passive investors. We believe that this represents a reasonable assumption about the kind of investor incentives or behaviors relating to our ethanol plant. Half will treat returns like all other investment income, and half of local investors will divert a larger fraction of their returns into household spending.

At a 50/50 allocation of the return to investors and with 25 percent local ownership, there is a regional household income impact of $4.5 million, $2.0 million in additional regional output, and $1.2 million in value added.

Moving over to the 50 percent local ownership column our household income total impacts bump up to $8.9 million in the region, and the area realizes $3.9 million in output impacts and $2.4 million in value added. Last, at 75 percent ownership and a 50/50 mix, regional household income impacts are $13.5 million, which help support $5.9 million in sales impacts and $3.6 million in value added impacts.

In all instances, as we move the investment money from the active to the passive investment vector of the model, the amount of local economic impact increases due entirely to increased local consumption of local provided goods and services. Accordingly, the table demonstrates that our assumptions about the kind of investment received by our upper income households (passive versus active) and the amount of local investment both influence the regional impacts.

Figure 2 displays the values for the 50/50 investment mix by degree of local ownership. Output, our measure of local sales impacts are consistently just about 43 percent of the household income impacts, and value added impacts are about 27 percent of the household income impacts. Stated differently, in the model, per dollar of realized investment income in the household sector, there is a bump of $.27 in value added or regional economic product. The remainder of that dollar is spent on taxes, saved (or reinvested), or buys goods from outside of the region.

There is a last step. We need to merge what we have learned in the SAM model with the baseline values that were generated in Table 8. All of the differential impacts in the SAM modeling system are the result of induced effects – those attributable to different amounts of household spending for goods and services in the region. As a consequence neither the direct nor the indirect values of Table 8 will change, but different levels of local ownership will increase the induced economic activity.

Figure 2

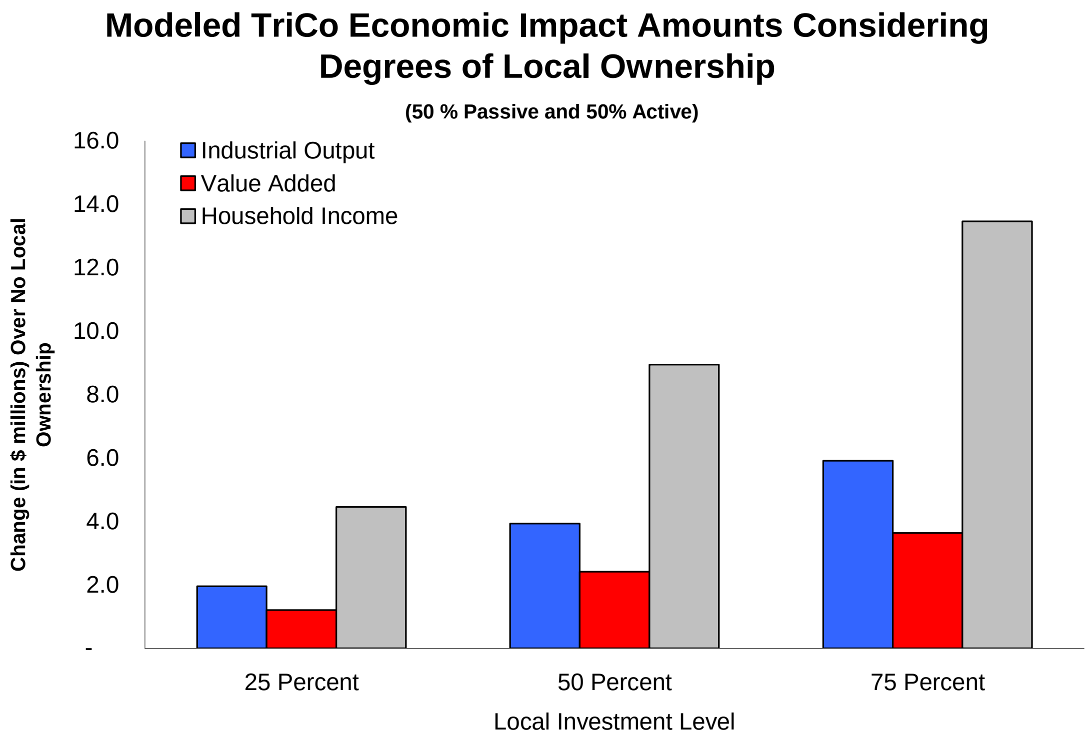

Table 10 combines the baseline model with the SAM model. We chose to use, as before, the 50 percent passive and the 50 percent active values that are in Table 9 to adjust our baseline amounts. The job estimates are driven as fixed ratios from the original baseline model.

Induced output increases from $1.55 million in the baseline (zero local ownership) to $7.5 million in the 75 percent local ownership assumption. Induced value added impacts in the region increase from $942,326 under a situation where there is no local ownership to $4.6 million with 75 percent local ownership. And induced jobs jump from 23 in the baseline to 110 at 75 percent.

Local investment in ethanol plants boosts the total regional economic effects markedly and the resulting multiplier ratios. While total output in the region only grows by 4 percent at the 75 percent local ownership level when compared to the baseline, regional value added grows by 17 percent, and jobs grow by 66 percent. In all, the modeled effects of local ownership are dramatic.

Table 10

TriCo Baseline Economic Impacts Considering Different Levels of Local Ownership (50% Passive & 50% Active)

Direct	Baseline			
Output	118,648,636			
Value Added	18,405,433			
Jobs	35			
Indirect	**Baseline**			
Output	13,301,156			
Value Added	6,011,897			
Jobs	75			
Induced Only (Household Spending)	**Baseline**	**25 percent**	**50 percent**	**75 percent**
Output	1,546,605	3,503,986	5,476,797	7,465,325
Value Added	942,326	2,144,295	3,355,536	4,576,232
Jobs	23	52	81	110
Total Effects (Direct + Indirect + Induced)	**Baseline**	**25 percent**	**50 percent**	**75 percent**
Output	133,496,397	135,453,778	137,426,589	139,415,117
Value Added	25,359,656	26,561,625	27,772,866	28,993,562
Jobs	133	162	191	220
Multipliers (Total / Direct)	**Baseline**	**25 percent**	**50 percent**	**75 percent**
Output	1.13	1.14	1.16	1.18
Value Added	1.38	1.44	1.51	1.58
Jobs	3.79	4.62	5.45	6.28

A Note on Opportunity Costs

The values in Table 10 do not contain an offset for the opportunity cost of channeling local investment resources into the ethanol plant as opposed to how those resources would have been used otherwise in the regional economy. Stated differently, the comparison of this type of investment versus how those same funds could have been used is the *opportunity cost*. If, locally, available investment returns were relatively meager, then the opportunity costs of this investment are in turn low. We can only guess at the aggregate average opportunity cost for area investors. It could be a combination of expected returns on, say land or real estate, mutual funds, and other financial instruments. Generally, during much of the early 21st century, land and real estate performed relatively well and all other investments performed at lower than historical levels.

A true netting of the regional economic impacts would subtract, then, the opportunity cost values of the local investment amounts over the time the resources were committed to the project compared to the returns the project yielded over a similar period of time. As ethanol has had many low return periods and only recently very high periods, the cumulative effects for plants that have been in operation for several years and perhaps much lower than those only recently coming on line. This analysis has been done considering 2005 as a windfall profits year where returns to investors are significantly higher than the historical industrial average.

It is important to remember this. The multipliers implicit in our analyses also work in reverse. If returns remain robust, then those values will be positive and sustaining for the regional economy. If returns to investors begin to lag compared to the 2005 values, then the regional economy will contract in response and the multiplier ratios that result will be much lower.

<u>**Cautions and Conclusions**</u>

There of course are several cautions that need to be made clear. First, all of the preceding analysis is based on models of our region of interest, which in turn depend on data from literally scores of different sources. These are simulations, not reality, but we have endeavored to replicate reality as closely as we can. Second, our models measure expected average effects, that is, as one dimension of our economy changes, we expect all others that are linked to it to change in an average way as well. This is unrealistic in many instances, and analysts are obliged to point out limitations to the results that are generated as a consequence of that assumption.

For example, our modeling system assumes very robust job impacts in the supplying sectors, especially as they relate to repair and maintenance services, regional transportation systems, and regional energy supply facilities. We do not actually know the extent to which a plant will in fact stimulate these sectors of the economy. The plant could be constructed and engineered in a manner that minimizes external repair and maintenance purchases, and the transportation requirements of the plant could very well be identical to those that historically moved corn out of the area for export. Lastly, the region very well might be able to supply all of the plant's additional energy needs with only a minimum of new labor. Were any of these conditions the case, then our model over estimates the indirect effects and, concomitantly, the household effects as they are driven significantly by the supplying sectors (jobs in the supplying sector greatly outnumber the ethanol sector and are generally good-paying jobs). In any case, as we learn more, we can modify our models to better represent reality.

Additionally, if, as is often the case in rural areas, there is employment "slack," as in there are a number of workers in a number of jobs working at less than optimal productivity, then the impacts will not so much be *job producing* as they will be *productivity enhancing*. Were that the case, both returns to owners, investors, and to workers would increase, but the number of jobs will not increase, at least by the amounts assumed in the modeling mathematics. Our modeling efforts describe idealized average effects at a recent point in time. The plausibility of all economic impacts requires additional research and discussion.

Because economic impact assessments for a region do require additional analysis and interpretation beyond the mere statistical outcomes of the modeling effort, citizens and policy makers ought to be skeptical of any results that purport to describe economic boosts to the Iowa economy or to a region that are produced by input-output models. In particular, policy makers need to be mindful of the use of public money in light of declared economic impacts and, importantly, the source of that declaration.

This preparatory research was designed to demonstrate that, given reasonably current statements of costs and incomes for a prototypical ethanol plant, the amount of local ownership had a localized, discernible, and meaningful economic impact. This was a very long way of demonstrating that most folks know: more money realized and re-spent locally is, locally, economically beneficial. That is obvious to nearly everyone who measures economies. How much more beneficial, however, had never been measured to our knowledge; hence, this effort. This research also lets us begin to explore some of the dimensions to impact modeling that need to be addressed as the state of Iowa and the rest of the Midwest gear up for different versions of biofuels production, investment, disinvestment, reinvestment, and transformation over time.