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Abstract

This report compares and contrasts two methods of discerning industrial importance: (1) evaluating industrial information as conventionally reported by government agencies, and (2) using input-output techniques to allocate all indirect economic activity into industries producing for final demand. The advantage of the final demand apportioning procedure is that it allows for a determination of total job linkages to Iowa's key industries like agriculture, ag-related manufacturing, all other manufacturing, and to banking and finance.

Keywords

economic impact, manufacturing, agriculture, finance, input-output analysis, banking, Leontief

Disciplines

Growth and Development | Industrial Organization | Labor Economics | Public Economics | Regional Economics

The Economic Impact of Iowa's Major Industries in 2014

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Introduction

Iowa is chiefly known for its agricultural productivity, its manufacturing strengths, and its banking and insurance sectors. These are the major industries that produce goods and services that are consumed in large part by persons or industries located outside of Iowa. Accordingly, these industries export sales to the rest of the country and the rest of the world – our goods and services go out to external buyers, and their money comes back into Iowa. One way to measure the importance of these export-producing sectors is to look at the degree to which jobs in other industries depend on or link to those that are producing for export sales. In so doing, one adopts a “but for” the export-producing jobs, these other jobs would not exist. This short report looks at Iowa’s industrial structure as it is typically reported, and then reanalyzes those same data to isolate the total number of jobs and other economic factors that are linked to the state’s export-producing industries.

The data used for this analysis come from the 2014 IMPLAN data base for the state of Iowa. IMPLAN is an input-output processing utility that is populated with data supplied by the firm. ISU procures data annually from IMPLAN to conduct assessments and economic impact studies for the state. For the most part, the IMPLAN data set accurately reflects the Iowa economy, but it does allow for modifications if other data exist. For example, the data set used for the subsequent analysis has been modified to more accurately reflect the structure and value of Iowa’s ethanol producing industries.¹

The Initial Data

The IMPLAN data set is populated with job and income information with industry-specific values that are derived in large part from the Quarterly Census of Employment and Wages (QCEW) maintained by the Bureau of Labor Statistics (BLS). Those data are supplemented with estimates of self-employment from the U.S. Bureau of Economic Analysis (BEA), and for the farm sector, information from the quinquennial agricultural censuses and annual survey estimates from the USDA. Additional characteristics of industrial sectors, along with the relationships of industries with one-another – the sets of supply-chain

¹ In IMPLAN, the ethanol industry is initially allocated to the “organic chemicals” sector of the model. The model uses national production averages for that sector that link organic chemical production to the petrochemical industry. In this analysis, a separate ethanol industry sector was inserted that instead linked to the major inputs into ethanol production (i.e., corn, transportation, natural gas supply, electricity, etc.).

linkages that are expected— are derived in large measure from the national benchmark input-output accounts maintained by the BEA.

The basic data set contains information for 536 industrial sectors at the national level, 460 of which are in evidence in the Iowa economy. There are four major economic indicators reported for each sector:

- Industrial output: the value of goods and services produced by each industry on an annual basis.
- Labor income: this is composed of payments to wage and salary workers, their employer-provided benefits, and the payments to management that proprietors receive.
- Value added: labor income (described above), returns to investors (dividends interest payments), plus indirect tax payments. Value added is the equivalent of Gross Domestic Product (GDP).
- Jobs: an annualized count of the number of full-time and part-time jobs in each industry. As people can have more than one job, there are always more jobs in an economy than employed persons.

Table 1 tells us the size and basic characteristics of the state’s economy. With \$382.9 billion in total industrial output, Iowa’s industries and governments produced \$177.3 billion in value added (or GDP), of which \$104.18 billion was labor income to 2.04 million jobholders.

Table 1

Basic Indicators of the Iowa Economy, 2014

Financial Amounts in \$Millions

	Industrial Output	Labor Income	Value Added	Total Jobs
All Iowa Industries	\$ 382,856	\$ 104,177	\$ 177,307	2,037,609

These are the direct and total amounts of the Iowa economy, and categorical summaries are contained in Table 2 and

Table 3. The tables summarize the direct amounts by major agricultural and manufacturing group, as well as a set of other important industrial categories. As is readily evident, the largest sectors in terms of value added production (or GDP) are manufacturing, all agriculture, trade, governments, and banking and insurance. Together, they directly account for 58 percent of the state’s value added and 48.3 percent of all jobs. The most jobs are in the trade sector at 287,246 (14.1 percent), followed by manufacturing at 229,887 (11.2 percent), and health and hospital care related jobs at 152,231 jobs (7.5 percent). Next, there were 136,956 (6.7 percent) accommodation, dining, and drinking related jobs, and there were 109,892 ag sector jobs (5.5 percent).

These amounts and fractions tell us what the aggregated sectors contribute to the Iowa economy in a manner that reflects each industry’s actual annual production. This is the conventional manner in which industrial production values are produced and reported. There is, however, another way to express the

data – a way that transforms each sector’s economic indicators such that it reflects the entire supply chain required for that industry to produce goods and services for final demand (primarily export sales) or for industries to contribute to other industries that, in fact, do produce goods and services for final demand.

Table 2

Direct Indicators of the Iowa Economy by Major Sector, 2014

	<i>Financial Amounts in \$Millions</i>			
	Total Industrial Output	Labor Income	Value Added	Total Jobs
Ag Animals	19,255	6,548	13,195	78,547
Grain and Oilseed Farming	12,662	1,786	4,715	15,722
All Other Ag	1,087	583	792	15,623
Ag Related Manufacturing	65,236	3,427	12,298	69,880
All Other Nondurable Manufacturing	18,433	8,632	5,832	36,878
All Other Durable Manufacturing	48,585	4,289	13,266	123,129
Construction	20,088	6,421	7,990	117,999
Retail & Wholesale	30,638	11,456	18,406	287,246
Banking and Insurance	27,059	8,040	16,403	99,845
Professional Services	3,523	1,867	2,231	29,222
Health & Hospitals	16,093	8,677	9,972	152,231
Entertainment & Recreation	2,457	504	1,285	34,454
Accommodations & Dining/Drinking	7,450	2,499	3,781	136,956
Governments	20,142	15,071	17,903	257,714
All Other Sectors	90,148	24,380	49,239	582,162
Total	\$ 382,856	\$ 104,177	\$ 177,307	2,037,609

Table 3

Direct Indicators of the Iowa Economy by Major Sector, 2014

As Proportions of Totals

	Total Industrial Output	Labor Income	Value Added	Total Jobs
Ag Animals	5.0%	6.3%	7.4%	3.9%
Grain and Oilseed Farming	3.3%	1.7%	2.7%	0.8%
All Other Ag	0.3%	0.6%	0.4%	0.8%
Ag Related Manufacturing	17.0%	3.3%	6.9%	3.4%
All Other Nondurable Manufacturing	4.8%	8.3%	3.3%	1.8%
All Other Durable Manufacturing	12.7%	4.1%	7.5%	6.0%
Construction	5.2%	6.2%	4.5%	5.8%
Retail & Wholesale	8.0%	11.0%	10.4%	14.1%
Banking and Insurance	7.1%	7.7%	9.3%	4.9%
Professional Services	0.9%	1.8%	1.3%	1.4%
Health & Hospitals	4.2%	8.3%	5.6%	7.5%
Entertainment & Recreation	0.6%	0.5%	0.7%	1.7%
Accommodations & Dining/Drinking	1.9%	2.4%	2.1%	6.7%
Governments	5.3%	14.5%	10.1%	12.6%
All Other Sectors	23.5%	23.4%	27.8%	28.6%
Total	100.0%	100.0%	100.0%	100.0%

Final Demand Accounting and Terminology

The previous section described the direct activity in the Iowa industries scrutinized. All industries are evaluated as to their annual output, labor income, value added production, and job requirements. Industries' outputs, however, can be partitioned into that which flows to intermediate uses within the economy and that which flows to final demand. For example, Iowa's insurance industry sells insurance instruments that manage risk for Iowa companies. In this instance, those insurance sales constitute an

intermediate input into production for the other firms. In other cases, insurance sales are external to the Iowa economy; accordingly, they are satisfying final demand because the sale constitutes an export sale. Final demand accounting allows us to track the flow of economic resources by each industry in Iowa in terms of their respective contributions to final demand sales. This gives us a type of economic impact summary for different industries in so far as those industries contribute to final demand versus intermediate consumption.

Here are two examples:

1. Iowa prominently produces corn and soybeans. In Table 2, that sector produced \$4.72 million in value added and supported 15,722 jobs. Some of what Iowa farmers produce goes to final demand in the form of exports outside of Iowa. Another very large fraction goes to Iowa's ethanol producers. Other amounts flow into the manufacturing sector and become corn syrup or soybean oil and soybean meal. And so on. When Iowa farm crop output flows into other Iowa industries as inputs into their production for final demand sales, we count those amounts in those final-demand manufacturing industries, not the farm sector. Those manufacturing firms are adding value to the agricultural inputs and preparing them for, in large part, an export sale.
2. Now, let's go back to our export sale of corn and soybeans – the value of crop farming going to that component of final demand. In final demand accounting, we would count all of the inputs that it took to create that export sale. That means we would first count the sales amount, plus all inputs like farm machinery, energy, seeds and chemicals, finance, transportation, so on required to produce the portion of the crop sold for export. The final demand value added calculation in that instance would be that produced on the farm plus that produced by all supplying sectors in supporting those farm commodity exports.

This iterative process of accounting is much more complicated than just described in Table 2 and

Table 3. It deduces the total industrial requirements needed to make a commodity for final demand sale, so it sums the value of all inputs and all of the input-suppliers' inputs, and so on, and so on, to arrive at a final determination of economic activity. This process of accounting is called the Leontief transformation and is at the core of input-output modeling systems. The accounting yields an $N \times N$ matrix of coefficients for each industry in a model (in Iowa's case it was 460 sectors) that reveals the total contribution of every industry in the model towards each industry's production for final demand. These are called the total requirements multipliers, and they are often used by economists to measure the expected incremental expected gain or loss to an economy from industrial expansion or reduction.

For final demand accounting, however, we add one more step: the total requirements matrix is multiplied times the total final demand sales reported for each industry in the model. This results in a complete re-accounting of values found in Table 2 into industries producing for final demand. In so doing, we can evaluate the magnitude of dependence Iowa has on different economic sectors as they relate to final demand sales. The value of this exercise is that the totals for all economic columns are

the same in the direct accounting table as well as in the final demand table. The process simply tracks the value of economic linkages in the Iowa economy as it produces for final demand sales.

Before proceeding to the findings, there are several types of final demand transactions. Already mentioned are sales to entities outside of Iowa, either domestic or foreign, which are called exports. Other final demand transactions involve sales to governments, net additions to capital stock, and changes in inventory. The bulk of final demand transactions accrue to export sectors and to capital additions. For example, food products exported from Iowa or sold to an Iowa governmental entity would both be considered final demand transactions. In the case of the export, the product has left the state and no further value is added to it in Iowa. In the case of the sale to government entities, by definition they do not add value to products; hence they are the final user of that product in the Iowa economy. Some durable goods, like machinery and a very large fraction of constructed structures and infrastructure additions are considered final demands for capital.²

Figure 1 illustrates final demand transactions in Iowa for 2014. Exports plus capital and inventory additions accounted for 70 percent, and sales to governments and other enterprises accounted for 30 percent.

Iowa Final Demand Flows, 2014

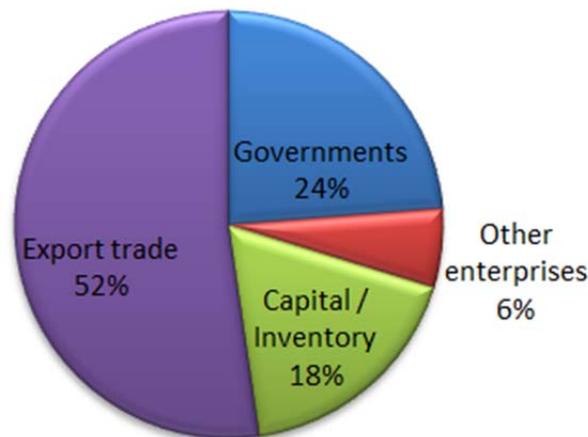


Figure 1

While there are a multitude of factors affecting overall economic growth, economies grow in the short run in terms of their abilities to satisfy exogenous demands for goods and services. Endogenous suppliers, those satisfying within-Iowa demand in the main, are therefore dependent on firms that are

² All sales in an economy to Iowa households are also considered final demand transactions. In this modeling exercise, however, households were included as a sector in the model in such a manner as to capture their wages, salaries, and other returns from working and investment as they contribute towards the production of final demand transactions. This allows for a complete accounting that includes the direct amounts (the final demand initial sales), the indirect amounts (all supply sector transactions, and the induced amounts (workers in all affected industries converting their incomes into household spending).

producing primarily for final demand sales. Stated simply, but for the final demand sale, the intermediate activity would not exist. There are, of course, industries satisfying both, as in the crop production example earlier, but this simplifying description helps us to determine at one point in time the degrees to which and the sectors upon which Iowa jobs depend for final demand industrial sales.

Final Demand Results

Table 4 and Table 5 contain the final demand results. It is immediately clear that the individual row and column totals are different than those in the previous two tables, but the totals are the same. This method of assessment allows us to re-evaluate our economy in terms of its final demand production. In so doing, some sectors' values increase markedly, others stay about the same, and some decline sharply.

For example, combined manufacturing in

Table 3 was 11.2 percent of direct jobs, but in Table 5 that fraction had grown to 29.4 percent. The first instance reported the jobs at the factories required to make manufacturing's direct output; the second instance reports manufacturing jobs plus all supplying and labor-stimulated jobs supporting manufacturing's production for external demand. Conversely, retail and wholesale explained 14.1 percent of jobs in the direct accounting table, but a mere 3.7 percent of jobs when production for final demand is considered. This is because the vast majority of retail and wholesale trade activity in the state either supplies households or other commercial interests with goods. There are very little export-related retail or wholesale sales.

Chief Final Demand Sectors: Agriculture and Manufacturing

Two industries weigh-in heavily when Iowa's economy is described: agriculture and manufacturing. Iowa's agriculture sector has very strong backwards linkages to an intricate supply sector. It also has very strong forward linkages to the manufacturing sector; there are manufacturing firms that exist precisely because of the state's agricultural output. There are also manufacturing firms that exist solely to supply inputs to Iowa's agricultural sector. For this exercise, manufacturing that has either a supplying relationship to agriculture or those that depend on agricultural inputs is intentionally segregated and called ag-related manufacturing. It denotes the strong economic symbiosis between the two larger sectors. It contains food and feed production, ethanol, agricultural chemicals and fertilizers, and farm machinery manufacturing.

Agriculture economy boosters frequently count ag-related manufacturing as part of the agriculture sector. That of course comes at the consternation to some manufacturing advocates who believe that is poaching on their overall sector's importance. Given the symbiosis between ag and manufacturing in Iowa, however, there is nothing wrong with allowing both sectors to trumpet the importance of ag-related manufacturing: one can argue with certainty that but-for Iowa's agricultural output, the state would not have a significant fraction of its manufacturing sector. One can also argue that Iowa's manufacturing prominence in agriculture-related durable and nondurable inputs creates profitability opportunities for Iowa agriculture that are largely unrivaled in the rest of the U.S.

Table 4

Final Demand Indicators of the Iowa Economy by Major Sector, 2014

	<i>Financial Amounts in \$Millions</i>			
	Industrial Output	Labor Income	Value Added	Total Jobs
Ag Animals	16,553	5,776	11,147	84,992
Grain and Oilseed Farming	14,976	2,952	6,589	47,800
All Other Ag	299	114	200	2,590
Ag Related Manufacturing	94,501	14,314	29,489	254,576
All Other Nondurable Manufacturing	24,138	6,299	9,434	89,476
All Other Durable Manufacturing	65,473	14,537	23,205	255,320
Construction	29,137	9,354	13,377	199,420
Retail & Wholesale	9,753	3,381	5,752	75,459
Banking and Insurance	19,100	4,907	11,354	79,763
Professional Services	1,092	480	634	8,312
Health & Hospitals	2,201	968	1,307	24,590
Entertainment & Recreation	553	132	301	6,321
Accommodations & Dining/Drinking	2,518	774	1,406	27,205
Governments	29,376	16,907	22,330	316,723
All Other Sectors	73,188	23,283	40,782	565,063
Total	\$ 382,856	\$ 104,177	\$ 177,307	2,037,609

Table 5

Final Demand Indicators of the Iowa Economy by Major Sector, 2014

As Proportions of Totals

	Total Industrial Output	Labor Income	Value Added	Total Jobs
Ag Animals	4.3%	5.5%	6.3%	4.2%
Grain and Oilseed Farming	3.9%	2.8%	3.7%	2.3%
All Other Ag	0.1%	0.1%	0.1%	0.1%
Ag Related Manufacturing	24.7%	13.7%	16.6%	12.5%
All Other Nondurable Manufacturing	6.3%	6.0%	5.3%	4.4%
All Other Durable Manufacturing	17.1%	14.0%	13.1%	12.5%
Construction	7.6%	9.0%	7.5%	9.8%
Retail & Wholesale	2.5%	3.2%	3.2%	3.7%
Banking and Insurance	5.0%	4.7%	6.4%	3.9%
Professional Services	0.3%	0.5%	0.4%	0.4%
Health & Hospitals	0.6%	0.9%	0.7%	1.2%
Entertainment & Recreation	0.1%	0.1%	0.2%	0.3%
Accommodations & Dining/Drinking	0.7%	0.7%	0.8%	1.3%
Governments	7.7%	16.2%	12.6%	15.5%
All Other Sectors	19.1%	22.3%	23.0%	27.7%
Total	100.0%	100.0%	100.0%	100.0%

Figure 2 and Figure 3 show the value added and the job contributions of agriculture, ag-related manufacturing, and all remaining manufacturing in Iowa comparing the direct method of accounting industrial size with the final demand accounting.³

- Agriculture alone explained 10.5 percent of direct state value added, but that value declines slightly to 10.1 percent using the final demand method because such a large fraction of ag products are actually raw materials for manufacturing. Direct ag jobs are 5.4 percent of the state total and grow to 6.6 percent under final demand accounting.
- Much larger differences between the accounting methods are found in ag-related manufacturing. That sector was just 6.9 percent of direct value added, but grew to 16.6 percent using the final demand method that considers all inputs into production. Direct Iowa jobs were only 3.4 percent but blossomed to a final demand level of 12.5 percent.
- All other durable and nondurable manufacturing in Iowa also shows sharp changes. Direct value added was 10.8 percent but grew to 18.4 percent with final demand measures. Direct jobs were 7.9 percent but more than doubled to 16.9 percent using the final demand method.

We can describe these two powerhouses of the Iowa economy thus using final demand apportioning:

- Iowa agriculture *plus* all ag-related manufacturing accounts for 26.7 percent of all value added produced in the state and 19.1 percent of all jobs.
- Iowa manufacturing, *to include all* ag-related manufacturing, accounts for 35.0 percent of all value added production in Iowa and 29.4 percent of all jobs.
- Finally, all agriculture plus all manufacturing in Iowa sums to 45.1 percent of the state's value added generation and 36.0 percent of its jobs.

Again, as a reminder, final demand accounting takes into consideration jobs producing for final demand (exports, capital, or sales to governments) plus all of the supplying sector jobs that link indirectly to producing those sales. The final job figure in the last bullet point above includes farmers, farm employees, and manufacturing workers as the direct components, but it also contains accountants, truck drivers, lawyers, warehouse workers, doctors, insurance agents, and shopkeepers and their help, just to name a few. It sums the total number of jobs (or value added or, referring back to Figure 2 and Figure 3, labor income) required in the entire economy to produce the final demand sale.

³ Readers will note that I do not summarize industrial output. We derive value added (of which labor income is a component) and jobs from the process of generating industrial output. Value added (or GDP) generation and jobs are the consequence of those sales that are measured in standard manners by government agencies. Hence, I advise consumers of this information to note, but otherwise not focus, on industrial output statistics. Doing so can distort industries' genuine contributions to the state's economic fortunes.

Comparing Direct and Final Demand Measurement Proportions of Total Economic Activity

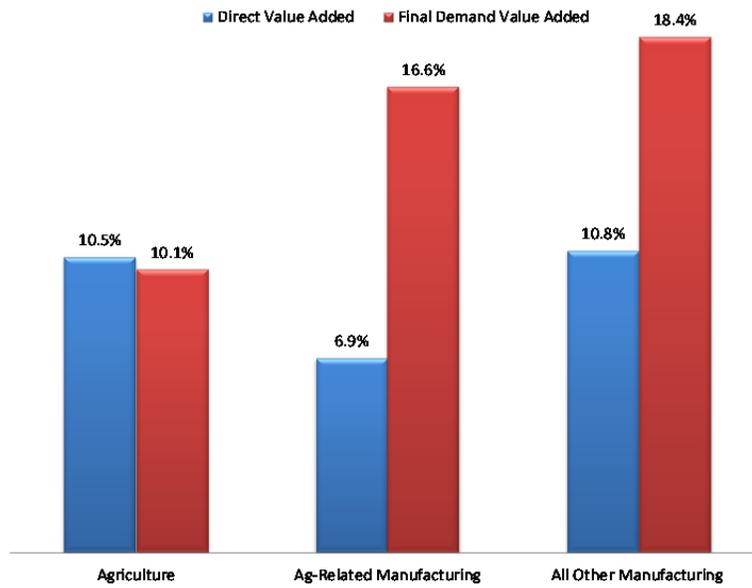


Figure 2

Comparing Direct and Final Demand Measurement Proportions of Total Economic Activity

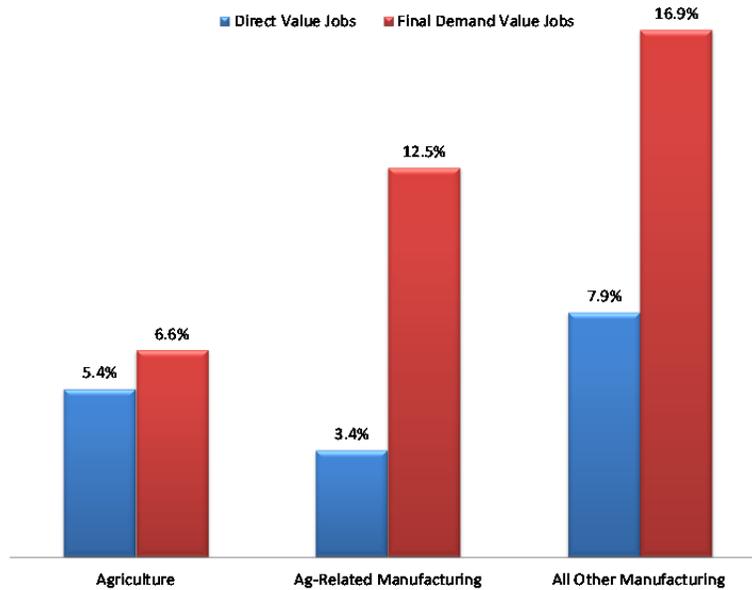


Figure 3

Other Final Demand-Positive Sectors

Final demand-positive sectors are those that are, in fact, a larger fraction of the state's economy using final demand accounting versus looking at the industries' direct values. Just two more major sectors were final demand-positive when compared to their direct amounts considering the levels of aggregation used for this analysis. In Table 6, construction, which feeds into the capital component of final demand, directly explained \$7.99 billion in value added (4.5%) and provided 117,999 jobs (5.8%). Using the final demand approach to allocate inputs and labor values, construction increased to account for \$13.4 billion in value added (7.5%) requiring 199,420 jobs (9.8%).

Federal, state, and local governments, too, yielded growth. Direct government in Iowa was \$17.9 billion of value added (10.1%) and required 257,714 jobholders (12.6%). Using final demand measurements, government explained \$22.33 billion in value added (12.6%) and 316,723 jobs (15.5%). Governments are a final demand sector: they produce goods and services that are used by all households, businesses, and other governments but to which there is no more added value. This explains about 43 percent of government-supplied final demand. Government employment is in part comparatively larger using final demand accounting because of federal employment (exporting government services to the rest of the nation in some instances) and because the state of Iowa maintains a robust higher education system that "exports" educational services to out of state and out of country students. It also exports other government goods (like health care). In all, external demand was about 28 percent of government final demand. Finally, another component of government final demand-positive performance is the addition of public infrastructure and facilities, which explains the remaining 29 percent of government final demand.

Table 6

Indicators of the Iowa Economy by Major Sector, 2014

Financial Amounts in \$Millions

	Total Industrial Output	Labor Income	Value Added	Total Jobs
<i>Direct Amounts</i>				
Construction	\$ 20,088	\$ 6,421	\$ 7,990	117,999
Governments	\$ 20,142	\$ 15,071	\$ 17,903	257,714
<i>Percent of Total</i>				
Construction	5.2%	6.2%	4.5%	5.8%
Governments	5.3%	14.5%	10.1%	12.6%
<i>Final Demand Amounts</i>				
Construction	\$ 29,137	\$ 9,354	\$ 13,377	199,420
Governments	\$ 29,376	\$ 16,907	\$ 22,330	316,723
<i>Percent of Total</i>				
Construction	7.6%	9.0%	7.5%	9.8%
Governments	7.7%	16.2%	12.6%	15.5%

Final Demand-Negative Sectors

Referring back to Table 2 through Table 5, we see that many of Iowa's industries, as aggregated for this assessment, were, on net, final demand-negative. That means that their final demand financial and financial amounts and percentages were lower than their respective direct amounts.

A brief summary of the sectors:

- The very broad aggregation of all other sectors showed minor reductions of final demand value added jobs compared to direct values. That means that the remainder of Iowa's economy, which is composed of mostly small sectors, was a mixed bag of producers for export and producers for, primarily, endogenous consumption.
- Iowa's vaunted banking and insurance sectors, too, yielded minor reductions in amounts and proportions. In the main, those industries service in-state demand. Nonetheless, banking and insurance explained 6.4 percent of state value added production using final demand accounting and 3.9 percent of the state's jobs
- Retail and wholesale trade, as well, are not geared to satisfy final demand – they exist primarily to satisfy existing household, industry, and government needs. Accordingly, while they directly account for hefty fractions of state direct activity, once that activity flows into final demand, substantial amounts are components of either households' or other industries' inputs.
- Similarly, the state's health care economy (hospitals, clinics, and nursing care) explains 5.6 percent of state direct value added and 7.5 percent of jobs. But, at the final demand level they explain a mere 0.7 percent of value added and 1.2 percent of jobs. Health care is not a significant contributor to final demand sales as nearly all is consumed by residents. (note: the University of Iowa Hospitals and Clinics, which would be an exporter of specialized medical services, would be counted in the governments portion of the previous section).
- Finally, there are other sectors like professional services (e.g., accountants, lawyers, engineers, and architects), the entertainment and recreation industry, and Iowa's accommodation sectors (lodging, dining, and drinking). Professional sectors serve, on net, in-state demand. Further, Iowa is not a recreation destination state; accordingly, the amounts of economic activity producing for final demand in entertainment, recreation, and accommodations adds to just 1.0 percent of all value added and 1.6 percent of jobs. These industries do not, comparatively, bring in substantial "external" dollars to Iowa.