# Contribution of Agriculture to the Wisconsin Economy:

UPDATED FOR 2012



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# CONTRIBUTION OF AGRICULTURE TO THE WISCONSIN ECONOMY:

## UPDATED FOR 2012

### VERSION 2.6[1]

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# Executive Summary

Agriculture remains an important part of the Wisconsin economy. Using the data from 2012, this study updates prior analysis of the contribution of agriculture to the Wisconsin economy (Deller 2004; Deller and Williams 2009). For consistency with prior analyses, agriculture is defined as on-farm production and value added food processing. This study is composed of three parts: (1) general historical trends (1998 to 2012) of various measures of economic activity for Wisconsin compared to a national average and averages for the Great Lake States; (2) an economic cluster analysis of various components of Wisconsin agriculture; and (3) an update of the contribution of agriculture to the Wisconsin economy. In addition to examining the contribution of agriculture to the Wisconsin economy in 2012 overall, we also explore the nine (9) sub-regions of Wisconsin as defined by the Wisconsin Agricultural Statistics (NASS regions).

In the most recent study, Deller and Williams (2009) found that Wisconsin agriculture contributes $59.16 billion to total business sales/revenue (about 12.5% of Wisconsin's total business sales); 353,991 jobs (10% of total Wisconsin employment) and $20.2 billion of total income (about 9% of Wisconsin's total income).

- In 2012 on-farm activity contributed 153,900 jobs, $5.7 billion to labor income (wages, salaries and proprietor income), $8.9 billion to total income, and $20.5 billion to industrial sales.

- Food processing activity contributed 259,600 jobs, $12.9 billion to labor income (wages, salaries and proprietor income), $21.2 billion to total income, and $67.8 billion to industrial sales.

- Total agricultural activity contributed 413,500 jobs, $18.6 billion to labor income (wages, salaries and proprietor income), $30.1 billion to total income, and $88.3 billion to industrial sales.

- Dairy remains a strong cluster industry for Wisconsin with growing strength in dried-condensed-evaporated milk and butter production. Cheese remains a strength but the sector is growing more slowly than national production. Dairy in aggregate (farming and processing) contributes 78,900 jobs, $3.9 billion to labor income, $7.2 billion to total income, and $43.4 billion to industrial sales.

- Drought conditions for many parts of Wisconsin in 2012, the study period, caused a downward tick in grain farm activity further complicating the dairy and other livestock feeding challenge. For the analysis here the contribution estimates for farming may be conservative.

- The lingering effects of the Great Recession also placed downward pressure on agricultural processing not only in Wisconsin, but across the nation.

Despite the combined effects of the drought of 2012 and lingering effects of the Great Recession, agriculture has risen in importance for the Wisconsin economy accounting for 11.9% of employment, 10.9% of labor income, 10.9% of total income, and 16.1% of industrial sales.

# Introduction

Policy makers throughout Wisconsin are exploring ways to stimulate the private sector to grow the economy, with an emphasis on job creation. Historically, agriculture has been an important part of the Wisconsin economy. Over the past several decades, the relative importance of agriculture to the economy has diminished as service sector employment, such as recreation-tourism and financial services (e.g. insurance and business services), have become more prominent. With the loss of many manufacturing jobs and the recent Great Recession, there is renewed interest in agriculture as a potential source of new employment opportunities. This renewed interest includes both traditional and alternative agriculture such as local foods.[2] A key question to ask in light of this renewed interest is if the interest is justified: is the agricultural sector one that can have a larger or simulative role in the Wisconsin economy? How should local and state policy makers approach an "old" industry that is re-gaining relevance?

The original study by Deller (2004)[3] examined and documented the contributions of agriculture to the Wisconsin economy. These themes were more recently re-examined by Deller and Williams (2009)[4]. In both of these studies agriculture was defined to include on-farm production and food processing. Ethanol production is not considered as part of this analysis due to the lack of comparable data. Using 2007 data, Deller and Williams (2009) found that Wisconsin agriculture contributed $59.16 billion to total business sales (about 12.5 percent of Wisconsin total business sales); 353,991 jobs (10 percent of total Wisconsin employment) and $20.2 billion of total income (about nine percent of Wisconsin total income).

This study builds on the earlier analysis of agriculture's contribution to the Wisconsin economy. The study proceeds in three parts: first, we look at general trends in on-farm and agricultural processing in terms of employment, income and output as measured by gross domestic product. We look across the period 1998 to 2012 and compare Wisconsin to a national U.S. average and to the Great Lakes States. Next, we update the cluster analysis of Wisconsin agriculture first introduced in Deller and Williams (2009). Here we compare the relative strength of Wisconsin agriculture, in terms of employment, to a national average. We use a simple indicator of relative strength, a location quotient, and examine patterns from 2003 to 2013. Finally, we use an input-output model to document the contribution of agriculture to the Wisconsin economy overall and to each of the nine sub state regions as defined by the National Agricultural Statistical Service (NASS). We use 2012 data in our analysis which corresponds to the most recent U.S. Census of Agriculture.

[2] Local food is a difficult market to define and measure. While we have reasonable data on direct sales to consumers, we lack data on sales of local farmers directly to local institutions such as restaurants or grocery stores. It is also unclear how much of food processing that is targeted toward local markets should be considered "local foods" or the local market is just part of a larger regional, national or even international product market. Consider a Wisconsin located dairy bottling plant that markets to several states including Wisconsin; should the milk marketed in Wisconsin be considered "local foods"?

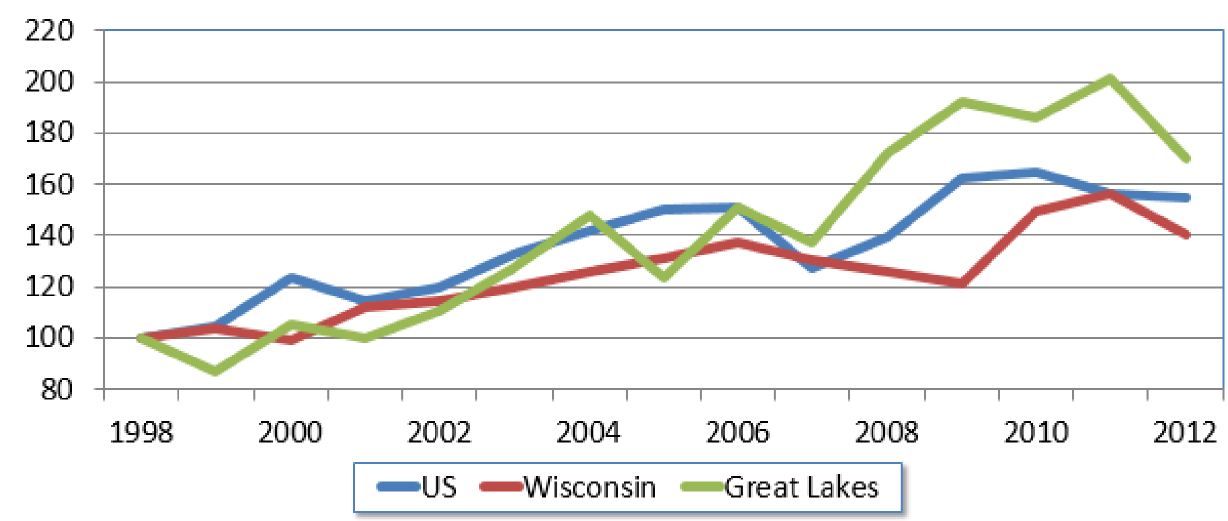
[3] Deller, Steven C. 2004. "Wisconsin and the Agricultural Economy." Department of Agricultural and Applied Economics Staff Paper Series No. 471, University of Wisconsin-Madison/Extension. (March). http://www.aae.wisc.edu/pubs/sps/pdf/stpap471.pdf

[4] Deller, Steven C. and Williams, David. 2009. "The Contribution of Agriculture to the Wisconsin Economy." Department of Agricultural and Applied Economics Staff Paper No. 541. University of Wisconsin-Madison/Extension.(August) .http://www.aae.wisc.edu/pubs/sps/pdf/stpap541.pdf

## General Agricultural Trends

There are numerous ways in which to measure the size of the agricultural economy. A few examples include jobs, wages and salaries, industry or business sales, and gross domestic product.[5] Given the current economic climate and frustratingly high unemployment rates not reflective of the economic recovery, job creation receives considerable attention. In addition, because of its very nature, agricultural sales and labor income tend to be highly sensitive to what are at times wide swings in commodity prices making these measures fairly unstable. This relationship holds for the price of milk, a dynamic particularly important to Wisconsin's agricultural economy. Production, also subject to sensitivity to growing conditions, likely contributed to increased instability as a result of the 2012 drought in the southern part of the state.

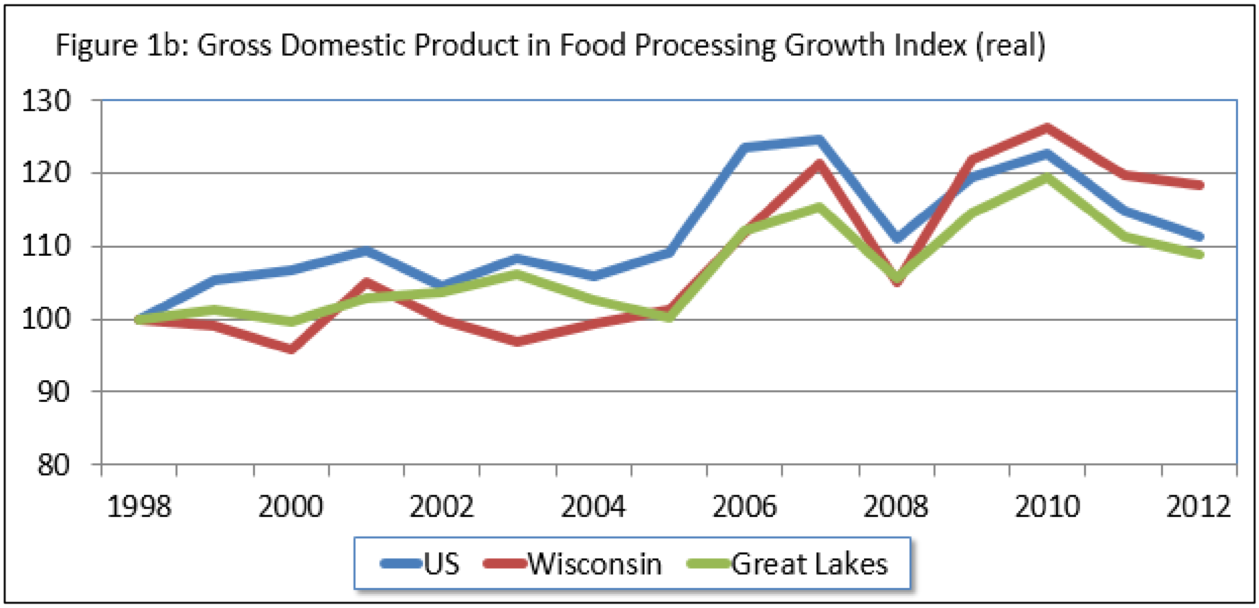
Figure 1a: Gross Domestic Product in Farming Growth Index (real)




Between 1998 and 2012 (Figure 1a) Wisconsin agricultural production, as measured by gross domestic product (GDP), increased by approximately 40.7 percent and peaked in 2011. After accounting for inflation, this growth represents an average annual increase about 2.9%. The decline in GDP from 2011 to 2012 is likely due to drought conditions in the southern part of the state. As highlighted in Figure 1a this decline is comparable to that experienced across the Great Lake States.

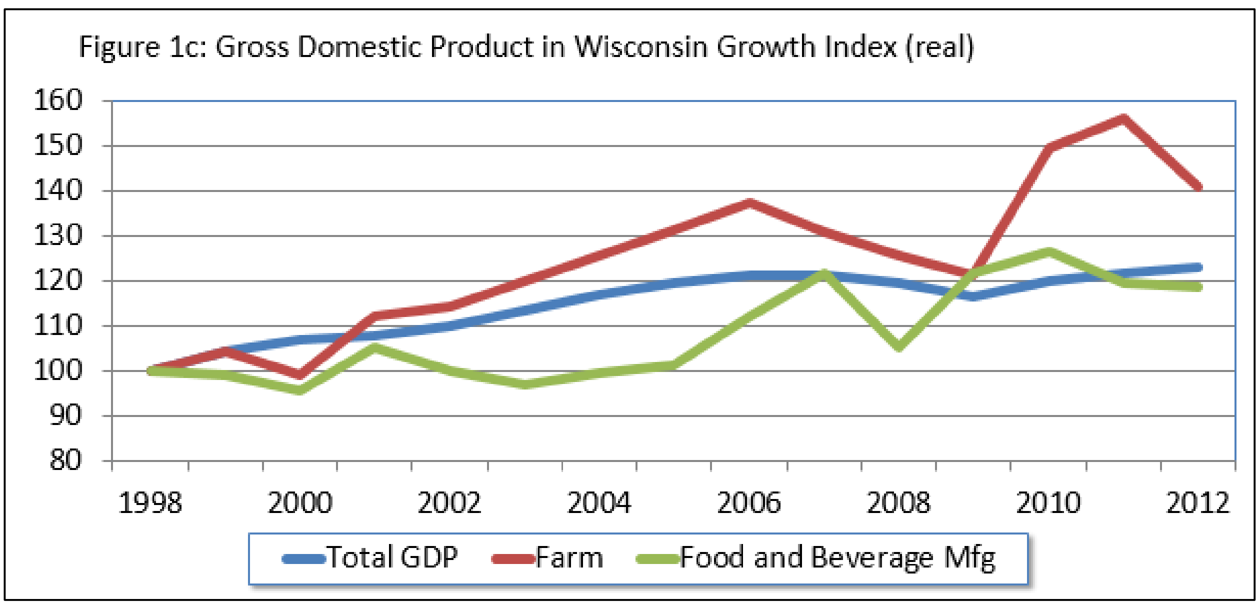
The drought conditions cannot be over looked. Corn for silage yield rates fell from 19.5 tons per acre in 2011 to 14.4 tons per acre in 2012, a decline in yields of nearly 25.6%. Soybeans for beans declined from 46.5 bushels per acre in 2011 to 41.5 bushels, a decline of 10.7% and alfalfa declined to 2.30 tons per acre in the drought year from 2.80 tons per acre in 2011, a decline of 17.8%. These declines impacted not only the ability to export commodities out of the state, thus injecting money into the Wisconsin economy, but also Wisconsin dairy and livestock operations by forcing farmers to pay higher prices for feed and import feed into the state. This substitution of regionally produced feed with imported feed represented a leakage of money out of the Wisconsin economy and thus dampening the impact of dairy and livestock. An assessment of the economic impact of the drought conditions in 2012 is beyond the scope of this study but interpretation of the analysis presented here must take the drought into consideration. At a minimum, the analysis

[5] Gross domestic product (GDP) is the market value of all officially recognized final goods and services produced within a country or region in a year.



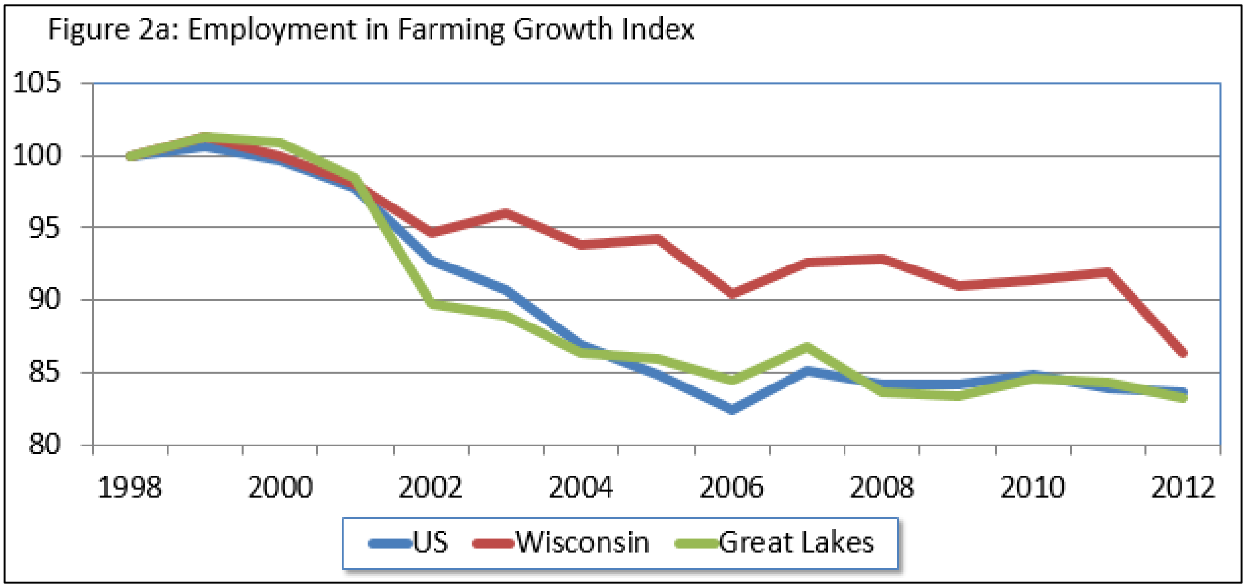

presented in this report should be considered conservative.

Food processing, another important element of the Wisconsin agricultural industry, experienced a more modest increase of 18.5% over the same 1998 to 2012 period (Figure 1b). The more modest growth in food processing is likely a reflection of both industry maturity and greater stability in product pricing. This trend is consistent with national patterns as well as those of the food processing industry across the Great Lake States.

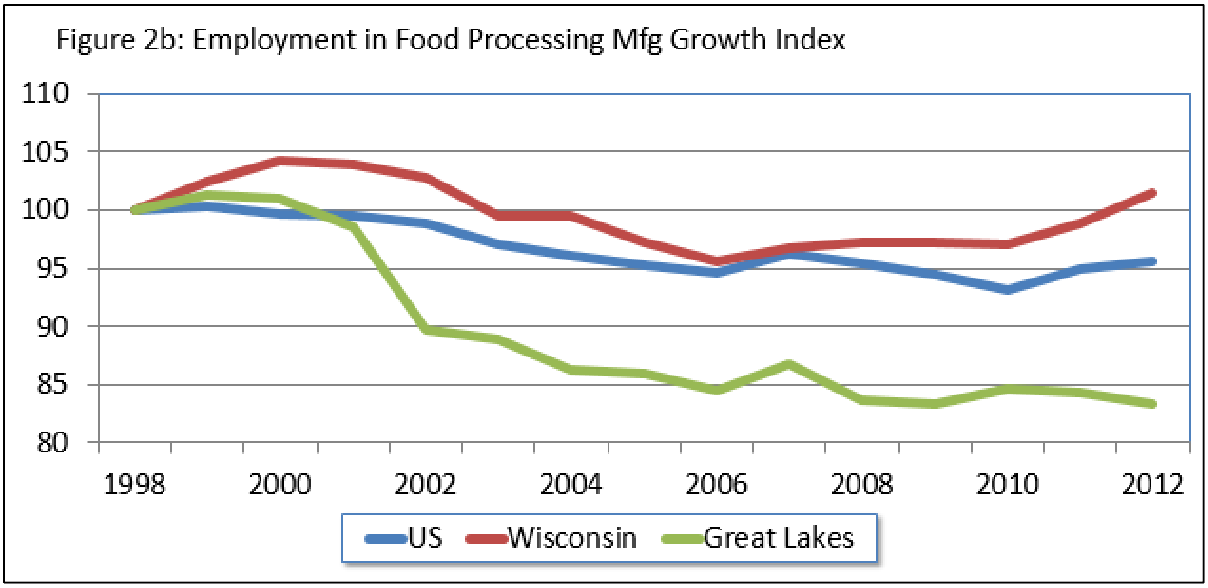



A more important question is how growth in the agriculture sector compares to the growth of the overall Wisconsin economy. Gross domestic product for the Wisconsin economy overall grew by 23% from 1998 to 2012 (Figure 1c). This growth rate is lower than that of on-farm production, but greater than that of food processing. While the Great Recession dampened much of the growth from 2007 through 2009, Wisconsin's gross domestic product has recovered: in 2012 it was slightly above its pre-Great Recession level.

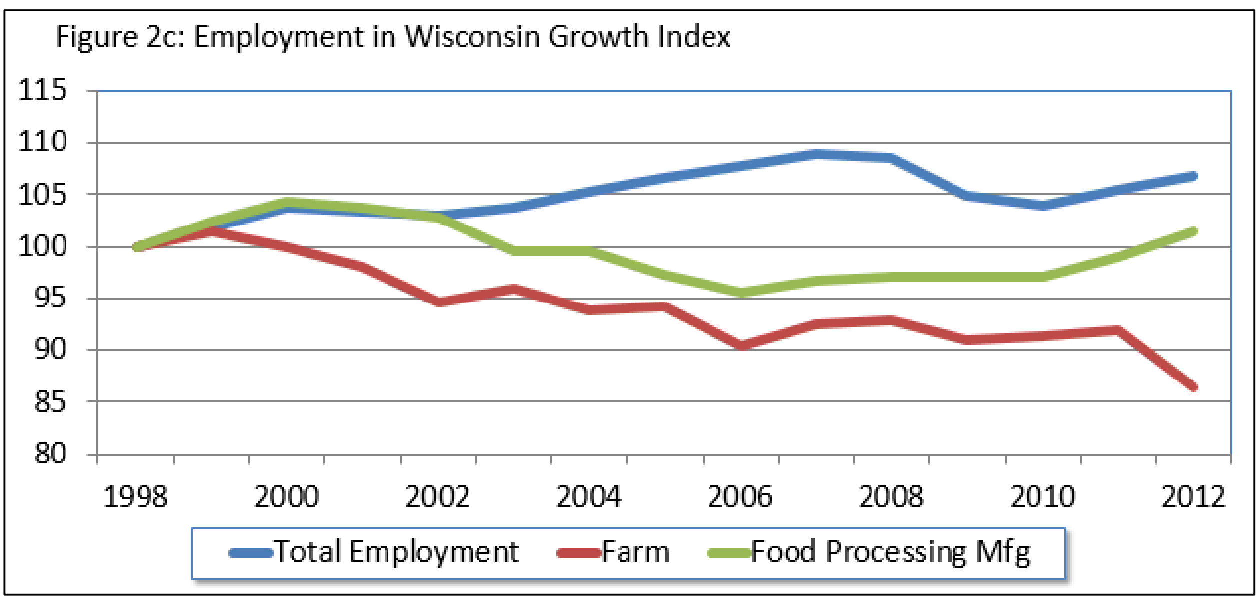
Another widely used metric of economic performance is employment. As the economy has struggled to recover from the Great Recession, job growth has been frustratingly slow not only in Wisconsin, but across the nation. Employment measures over time for farming reflect significant increases in economies of scale. This is driven by advances in capital (machinery) equipment. Many of these advances have resulted in a shift away from labor, and jobs, towards capital equipment. This shift is highlighted in Figure 2a as there has been a noticeable decline in on-farm employment.



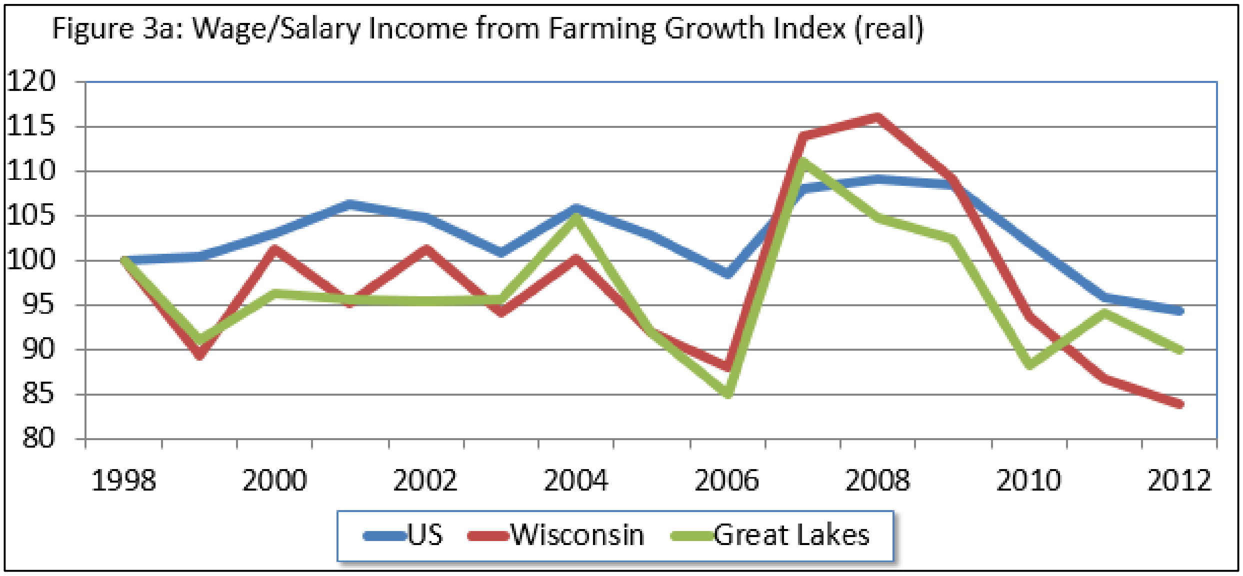

A key observation is that there was a stabilization in farm employment levels beginning in 2006. This stabilization is the subject of continued research. One research avenue, for example, is focused on the movement to smaller scale production associated with local foods. Overall, though, it is not clear if the stabilization in farm employment is a short-term phenomenon or the beginning of a longer-term trend. The marketed decline in 2012 for Wisconsin farm employment is likely due to the effects of drought conditions. Employment in food processing (Figure 2b) has experienced modest growth over the past few years. This could be partially explained by modest expansion of smaller scale food processors which tend to be more labor intensive then larger food processors.




If we compare the employment growth of farm and food processing employment to the whole of Wisconsin, we can clearly see the impact of the Great Recession as well as the slow employment recovery for Wisconsin (Figure 2c). One should note that there is little evidence that the Great Recession had a negative impact on-farm or food processing employment. While one would not think of agriculture to be a stabilizing force in the economy, agriculture did help blunt the impact in Wisconsin throughout the period of the Great Recession. One must be careful not to draw too strong of a policy inference from this observation, though, because of the impact of the drought conditions in 2012.




The third metric of economic activity that we trace over time is wage and salary income. Now some care must be taken with this metric as it pertains to farming because the income to farmers is commonly in the form of proprietor income. For food processing, as for most sectors of the economy, proprietor income is a much smaller share of returns to work. For comparison purposes, this means we must limit farm labor income to wages and salaries.[6] Other than a unique period in 2007-2009, wage and salary income for farming has been relatively flat. The decline in 2012 is again reflective of drought conditions in the southern part of Wisconsin. Because farmer income is generally from proprietor income, however, one should not place too much weight on the insights gained by examining farm wage and salary income.




Wage and salary income from food processing (Figure 3b) experienced overall growth between 1998 and 2012 within Wisconsin, but there was a noticeable decline from 2001 to 2006, but a recovery from 2006 to 2012.This growth, however, was somewhat modest increasing only about 13% over the whole period (1998 to 2012). This growth does not appear to have been affected by the Great Recession. These trends are not unique to Wisconsin, but reflect patterns evident in the data for the whole U.S. and the Great Lake States. When farm and food processing wage and salary income growth are compared to overall growth in the Wisconsin economy, it becomes clear that the growth in agriculture has been much more modest (Figure 3c).

[6] There are some farms in Wisconsin where the business model is structured such that the owner-farmer is a paid employee and may or may not take income in the form of proprietor income. For these farms, the labor related income to farmers is reflected in the wage and salary data. Most farmers, however, structure their businesses as a proprietorship and take labor income in the form of proprietor income. As a result, this income is not reflected in the wage and salary data.

Figure 3b: Wage/Salary Income from Food Processing Mfg Growth Index (real)

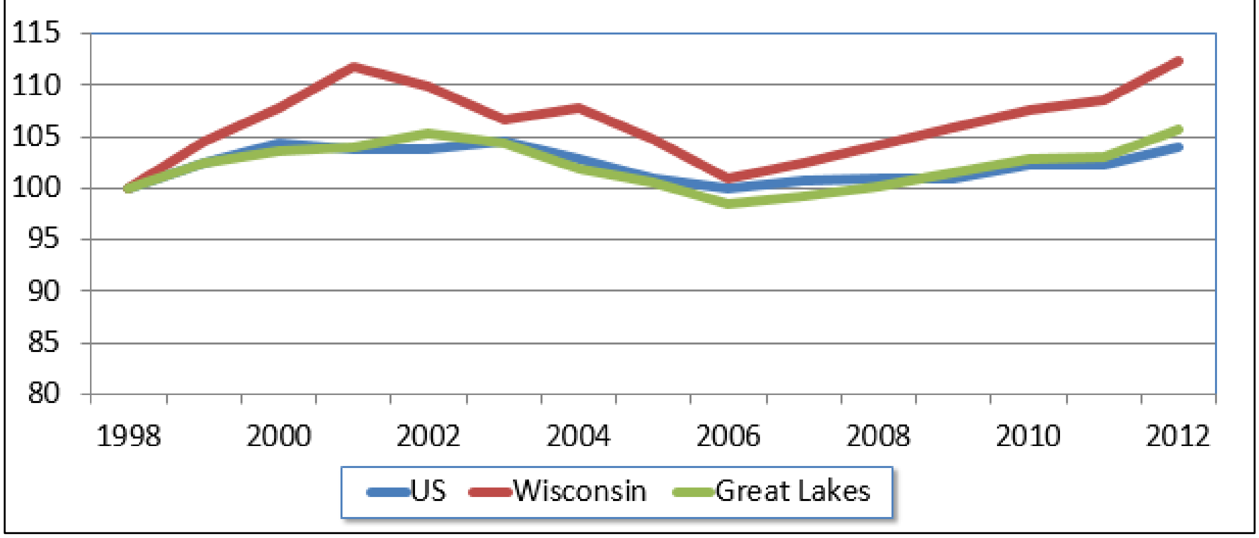
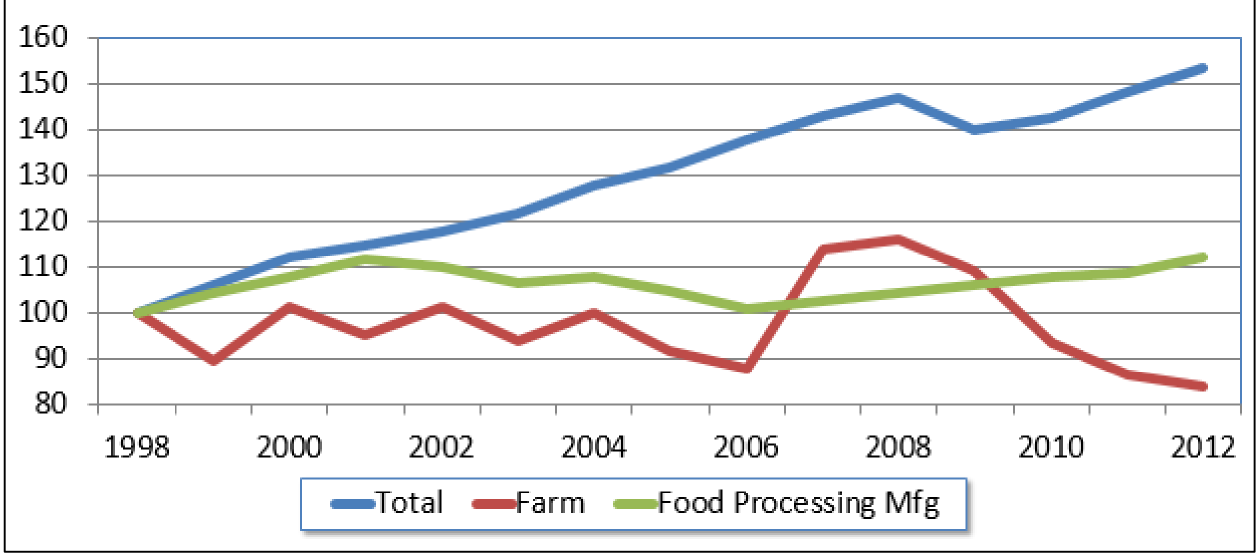



Figure 3c: Wage/Salary Income in Wisconsin Growth Index (real)




Looking at these three economic metrics in totality, some general conclusions can be offered. First, growth in Wisconsin agriculture has been positive, but somewhat modest when compared to the whole of the Wisconsin economy. While Wisconsin agriculture has been showing signs of strength, particular since about 2006, other parts of the economy have experienced stronger growth. Second, the negative impacts of the Great Recession seem to have bypassed agriculture. Indeed, though one might not commonly consider agriculture as a source of stability, agriculture served as a counter balancing force during the Great Recession. We are reminded of agriculture's instability given the downturn in 2012 that is most likely tied to drought conditions in southern Wisconsin. Third, despite the poorer overall conditions of 2012, agriculture appears to be experiencing modest growth. Finally, modest but continued growth food processing demonstrates how the continued promotion of food processing is an important part of the overall agricultural economy. In essence, on-farm activity and food processing are two parts to a complex agricultural economic cluster.

Continued growth of food processing not only may be a continued source of economic growth within itself, but it might also spur continued robustness of on-farm activity.

## Agricultural Cluster Analysis

In 2003, the Wisconsin Office of the Governor and each ensuing governor has embraced the notion of cluster development as the foundation of economic development policies. Forward Wisconsin defines clusters as:

> . . .geographic concentrations of interconnected companies, specialized suppliers, service providers and associated institutions in a particular field. Clusters develop because they increase the productivity with which companies can compete in an increasingly more competitive global market, and they are the source of jobs, income and export growth. The philosophy behind clusters is that large and small companies in a similar industry achieve more by working together than they would individually. Clusters give businesses an advantage by providing access to more suppliers and customized support services, skilled and experienced labor pools, and knowledge transfer through informal social exchanges. In other words, clusters enhance competitiveness.

The state initially identified 10 existing and potential clusters. These clusters included dairy food processing, paper and wood products, biotechnology, plastics, medical devices, information technology and wind energy.

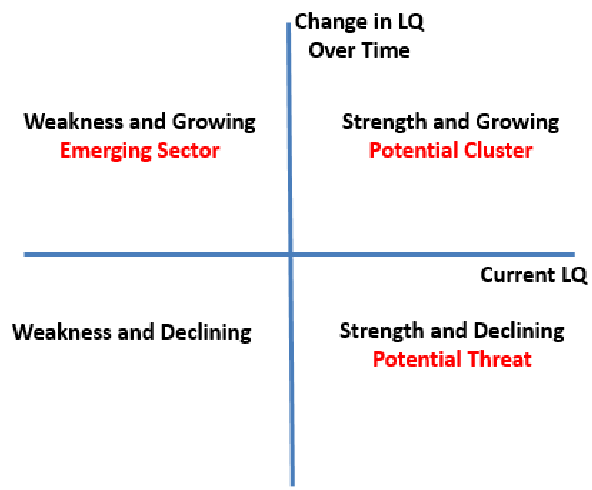
While there is a wide variation in methodologies to identify economic clusters, an approach suggested by Harvard business economist Michael Porter is currently growing in popularity. The approach is built on the notion of location quotients. The location quotient (LQ) is an indicator of the self-sufficiency, or relative strength, of a particular industry. [7] The LQ is computed as:

$$LQ_i = \frac{Percent\ of\ local\ economic\ activity\ in\ sector\ i}{Percent\ of\ national\ economic\ activity\ in\ sector\ i}$$

The proportion of national economic activity in sector *i* located in the region (state or community) measures the region's production of product *i*, assuming equal labor productivity. The proportion of national economic activity in the region is a proxy for local consumption, assuming equal consumption per worker. The difference between local production and consumption is an estimate of production for export (i.e. production > consumption).

[7] The key underlying assumptions of the location quotient approach is that regional production technology is identical to national production technology (i.e. equal labor productivity) and that local tastes and preferences are identical to national tastes and preferences (i.e. equal consumption per worker). Assuming the national economy is self-sufficient, the comparison between the community and the national benchmark gives an indication of specialization or self-sufficiency.

Figure 4: Framework for Identifying Clusters




As constructed, the location quotient is centered on a value of one where a LQ equal to one means the region has the same proportion of economic activity in sector *i* as the nation. This indicates that the region just meets local consumption requirements through local production of the specified good or service. If the location quotient is less than one (1), the region is not producing enough to meet local needs. If the location quotient is greater than one, the region has a larger proportion of its economy in sector *i* than does the nation.

Porters' method for identifying clusters uses current location quotient values, changes in location quotients over time, and relative size of the industry. These metrics, coupled with other industry characteristics and local context, work in tandem to identify cluster. Consider a simple mapping of the level and change of the LQ as outlined in Figure 4. There are four potential combinations.

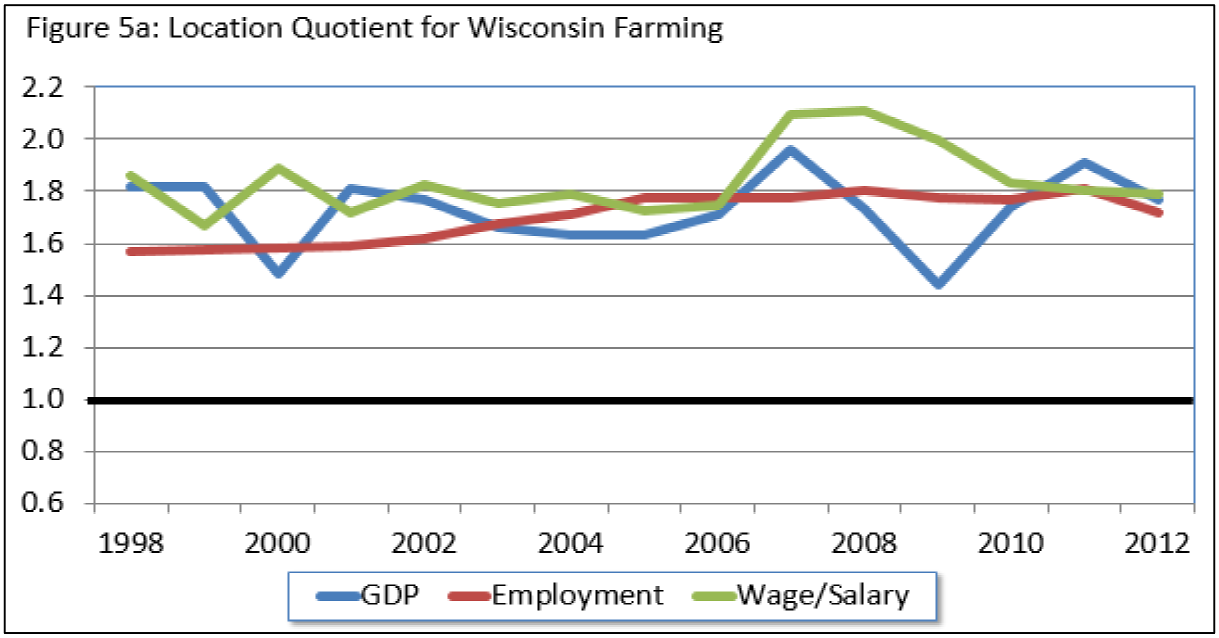
- First, if the industry has a LQ less than one and is decreasing over time, this industry is considered a "weakness and declining" industry and generally should not be considered a potential cluster.

- Second, if the LQ is less than one but increasing, the industry can be considered a "weakness and growing" and may be a possible industry of focus for economic development.

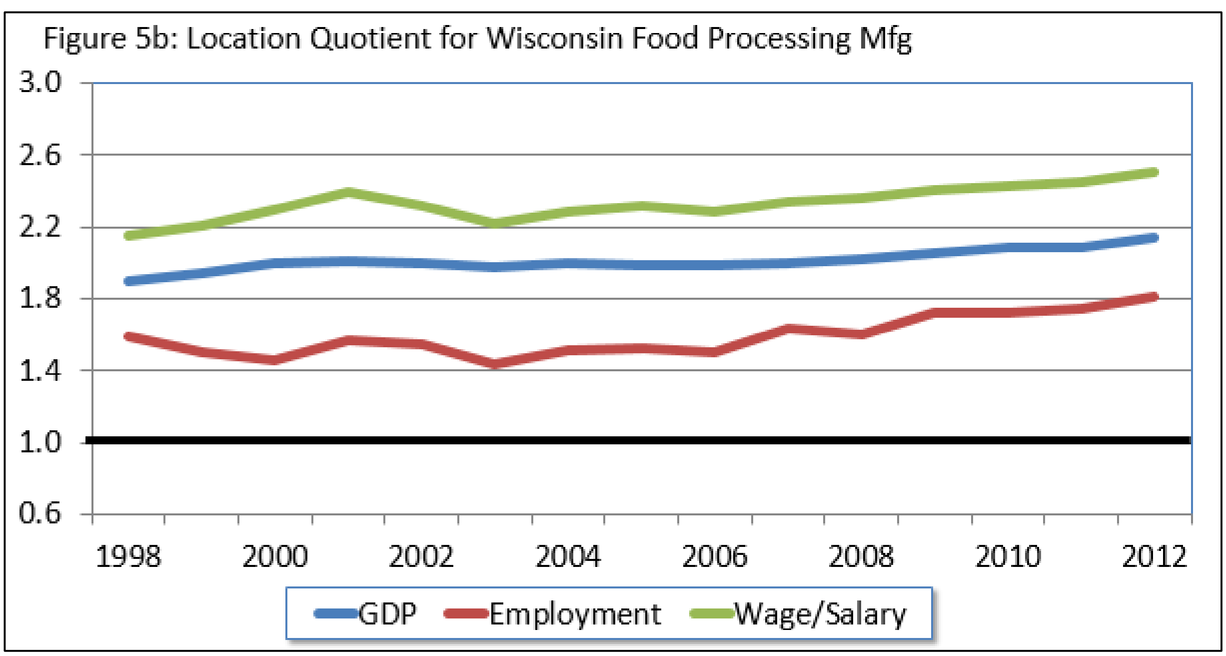
- Third, if the LQ is greater than one but is declining over time, the industry is considered a "strength and declining." Industries in this category might be considered at risk and deserving of special consideration to understand why a strong industry (i.e. $LQ>1$) is weakening (i.e. $\Delta LQ<0$). In particular, does the decline of these industries present a potential risk to the regional economy?

- Fourth, if the LQ is greater than one and growing over time, it is considered a "strength and growing." Porter suggests that industries in this category might be considered potential clusters for economic growth and development. These industries have self-identified the region as having a comparative advantage over other regions and may have further growth potential.

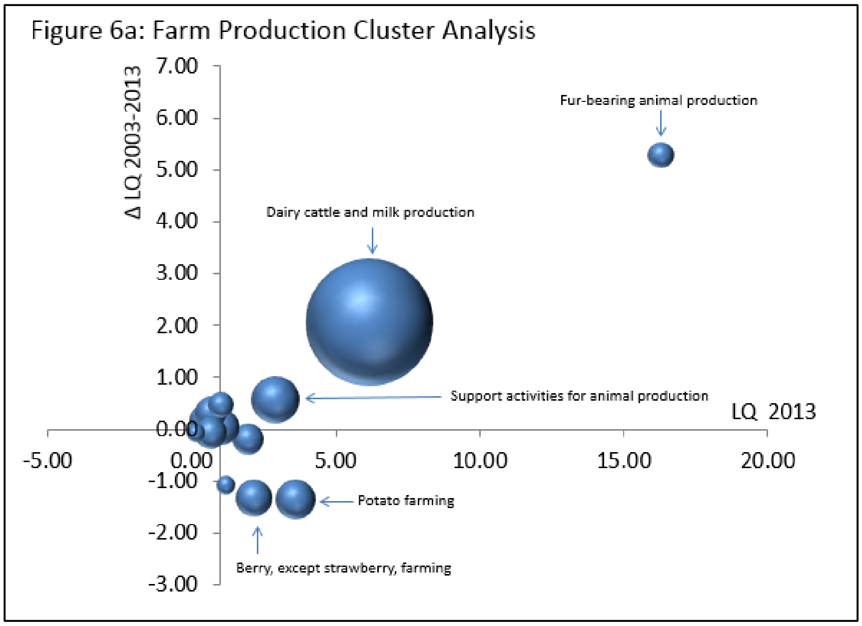
Before populating Figure 4 with the data for Wisconsin agricultural sectors, consider the overall trends in the location quotient for on-farm activity and food processing. For consistency with the trend analysis presented in the previous section of this study, we measure economic activity using gross domestic product, employment and wage/salary income. For the more detailed analysis where we populate Figure 4, we are limited to employment data because GDP and income data are not available in sufficient industry detail.




For on-farm activity (Figure 5a), regardless of the economic metric used, the LQ fluctuates around 1.8 indicating that farming is a strength for the Wisconsin economy when compared to the U.S. There does not appear to be any specific trend, however, either strengthening or weakening. Using employment, there is a modest upward trend from 2002 to 2005 but from 2005 to 2011 the LQ has been relatively flat. The decline in 2012 is again reflective of the significant drop in farm employment (Figure 2a) most like due to the drought conditions in the southern part of Wisconsin. Food processing (Figure 5b) is also a strength for Wisconsin with the LQ ranging between 1.8 and about 2.6 depending on the metric of economic activity. More important is the upward trend in the set of LQs particularly since 2003. In the spirit of Porter (Figure 4), the LQ for food processing is greater than one and is increasing in size over time indicating that food processing is a potential cluster industry for Wisconsin.



Using employment from 2003 and 2013 we are able to calculate the LQ at a more refined level of industrial detail.[8] A cluster plot of each industry of the detailed farming sector for Wisconsin is provided in Figure 6a. The data behind the figure is provided in Table 1. Three sectors are clearly located in the strength and growing quadrant, Quadrant IV: fur-bearing animal production, support activities for animal production, and dairy (cattle-milk) production.




Based on the absolute size of these three industries, fur-bearing animal production could be considered an outlier and too small to draw significant attention. In addition, given the nature of animal production in Wisconsin, support activity for animal production is likely tied closely to the dairy industry. Thus, the one farm based sector that stands out is dairy (cattle-milk) production.

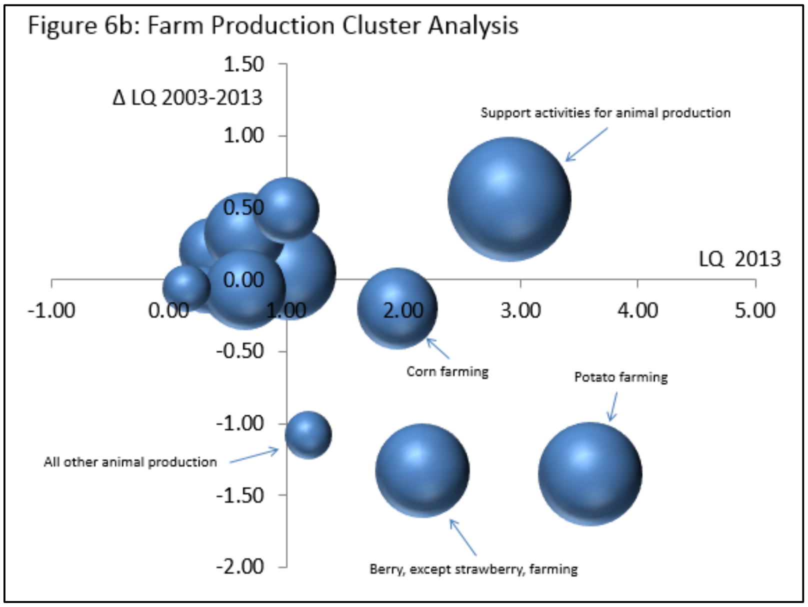
To help with the clarity of the figure, we remove dairy and fur-bearing animal production (Figure 6b). Four farming sectors can be identified as strengths (i.e., LQ>1) but declining (i.e., change in LQ is negative): corn, potato, berry (except strawberry) and all other animal production. Given the growth in ethanol production, the decline in the relative strength of corn production is somewhat surprising. This is likely due to stronger growth in corn production in other parts of the U.S. The same observation could be also applied to potato farming.

[8] Employment data is used for populating Figure 4 for two reasons. First, employment data is available for 2013 whereas detailed GDP and wage/salary data is currently available up to 2012. Second, employment data is available at much finer industrial detail when compared to GDP and wage/salary data at the state level. Thus, for the trend analysis presented in the first section of the report we look at 1998 to 2012, but for the detailed cluster analysis we use data from 2003 and 2013.

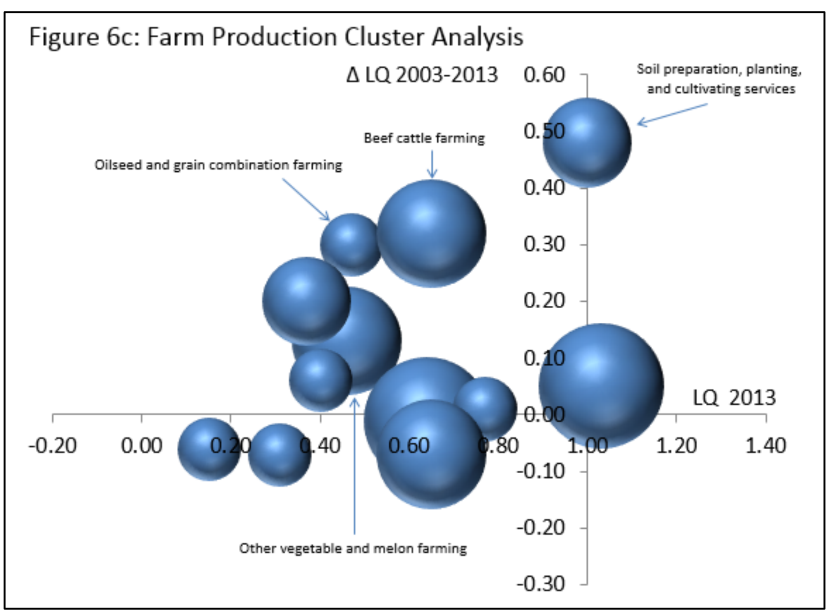
Table 1. Potential Clusters Wisconsin Farm Production

| | LQ 2013 | Change LQ 03-13 | Share of Employment 2013 |
|---|---|---|---|
| **Strength & Growing (Potential Cluster?)** | | | |
| Fur-bearing animal & rabbit production | 16.30 | 5.28 | 0.02% |
| Dairy cattle & milk production | 6.17 | 2.07 | 0.52% |
| Other poultry production | 2.58 | 1.03 | 0.00% |
| Support activities for animal production | 2.90 | 0.56 | 0.07% |
| Soil preparation, planting, & cultivating | 1.00 | 0.48 | 0.02% |
| Hunting & trapping | 1.11 | 0.30 | 0.00% |
| Floriculture production | 1.03 | 0.05 | 0.04% |
| | | | |
| **Strenght & Declining (Potential Threat?)** | | | |
| Corn farming | 1.95 | -0.20 | 0.03% |
| All other animal production | 1.19 | -1.08 | 0.01% |
| Berry, except strawberry, farming | 2.16 | -1.33 | 0.04% |
| Potato farming | 3.59 | -1.35 | 0.05% |
| | | | |
| **Weakness but Growing (Potential Opportunity?)** | | | |
| Beef cattle ranching, farming, & feedlots | 0.65 | 0.32 | 0.03% |
| Oilseed & grain combination farming | 0.47 | 0.30 | 0.01% |
| Other crop farming | 0.37 | 0.20 | 0.02% |
| Other vegetable & melon farming | 0.46 | 0.13 | 0.03% |
| Mushroom production | 0.30 | 0.11 | 0.00% |
| All other grain farming | 0.72 | 0.09 | 0.00% |
| Apple orchards | 0.40 | 0.06 | 0.01% |
| Support activities for forestry | 0.34 | 0.06 | 0.00% |
| Fishing | 0.33 | 0.06 | 0.00% |
| Chicken egg production | 0.77 | 0.01 | 0.01% |
| | | | |
| **Weakness & Declining** | | | |
| Nursery & tree production | 0.64 | -0.01 | 0.04% |
| Other postharvest crop activities | 0.15 | -0.06 | 0.01% |
| Logging | 0.65 | -0.07 | 0.03% |
| Hog & pig farming | 0.31 | -0.07 | 0.01% |
| Other food crops grown under cover | 0.21 | -0.17 | 0.00% |

Based on employment.




To explore the cluster of industries closer to center of the chart, we removed support activity for animal production, potato, corn and berry activity, and all other animal production (Figure 6c). Here we find several farming sectors that are in the weak but growing quadrant. These industries represent potential opportunities and include beef cattle, oilseed and grain (non-corn), other crop production (which includes such crops as hay, hops and spices among others), vegetable and melon production, and perhaps apple orchards. When compared to dairy farming, these sectors are relatively small is absolute size, but point to the diversity of farm production in Wisconsin. Sectors that are weaknesses and declining include nursery and tree production, logging, hog and pig farming and crops that are grown under cover. It is important to note that these weak and declining sectors could represent viable business opportunities for some farmers. Indeed, there is some evidence that these narrower specialty crops (e.g., hops) could present viable opportunities for some farmers. From a state-wide perspective, though, these industries may not grow large enough to draw the same level of attention as larger on-farm industries such as dairy, corn, beef, potato and/or vegetable production.



We conducted an identical cluster analysis for the food processing sector (Figures 7a, 7b and Table 2).[9] Given our industrial groupings, there are 25 different food processing sectors ranging from butter production to ice manufacturing and bottled water.

Figure 7a: Food Processing Cluster Analysis

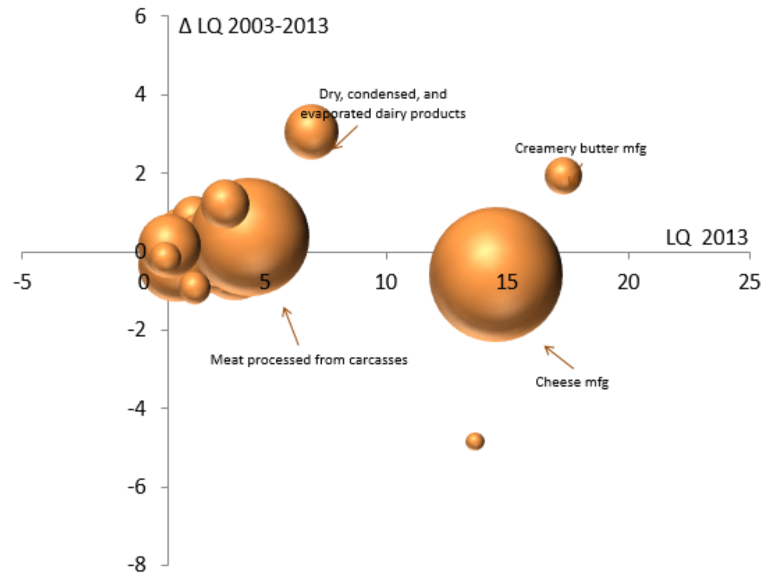
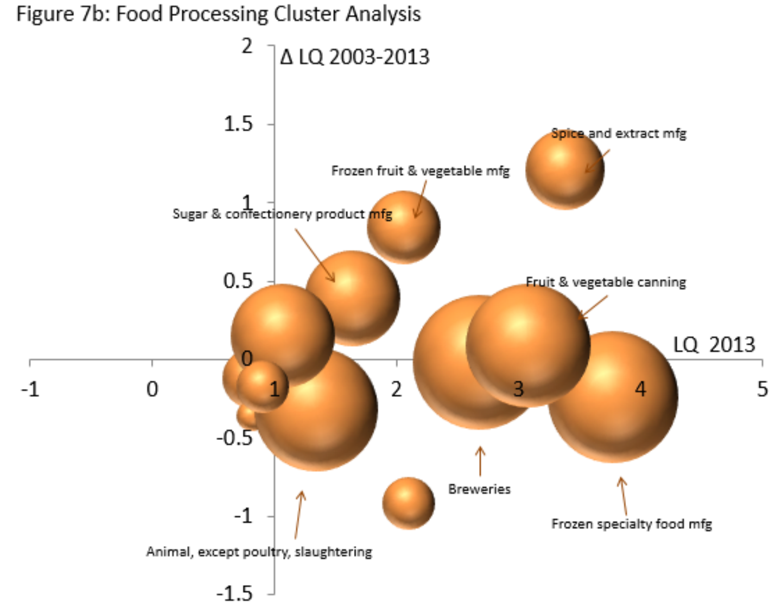



Figure 7b: Food Processing Cluster Analysis




There are 11 sectors that are in the strength and growing quadrant and thus are candidates for potential cluster development. Three of these industries are directly or closely tied to the dairy industry: creamery butter, dry, condensed and evaporated dairy products and meat processing from carcasses. While the last industry is also tied to the beef industry, a significant portion of the meat flowing into the meat processing industry is from culled dairy cows. Although not explored in this study, if one examines the foreign export

[9] For additional information see: http://wp.aae.wisc.edu/wfp/foodprocessinginwisconsin/

data for Wisconsin, much of the growth for dry, condensed and evaporated dairy products appears to be via export channel. By one estimate, of the $1.7 billion in dry, condensed and evaporated dairy products production, some 25% is exported out of the U.S. Because these types of dairy products are more easily transported, growth in the export component has strong potential.

Table 2. Potential Clusters Wisconsin Food Processing Mfg

| | LQ 2013 | Change LQ 03-13 | Share of Employment 2013 |
|---|---|---|---|
| **Strength and Growing (Potential Cluster?)** | | | |
| Creamery butter mfg | 17.29 | 1.94 | 0.04% |
| Dry, condensed, & evaporated dairy products | 6.92 | 3.05 | 0.09% |
| Meat processed from carcasses | 4.35 | 0.38 | 0.43% |
| All other miscellaneous food mfg | 4.29 | 2.15 | 0.11% |
| Spice & extract mfg | 3.38 | 1.21 | 0.07% |
| Fruit & vegetable canning | 3.08 | 0.09 | 0.17% |
| Breweries | 2.86 | 0.47 | 0.09% |
| All other food mfg | 2.32 | 0.72 | 0.13% |
| Frozen fruit & vegetable mfg | 2.06 | 0.84 | 0.06% |
| Sugar & confectionery product mfg | 1.64 | 0.39 | 0.10% |
| Commercial bakeries | 1.07 | 0.15 | 0.12% |
| | | | |
| **Strenght & Declining (Potential Threat?)** | | | |
| Cheese mfg | 14.53 | -0.59 | 0.55% |
| Malt mfg | 13.66 | -4.84 | 0.01% |
| Frozen specialty food mfg | 3.77 | -0.24 | 0.19% |
| Fruit & vegetable canning & drying | 2.68 | -0.02 | 0.20% |
| Mayonnaise, dressing, & sauce mfg | 2.10 | -0.92 | 0.03% |
| Animal, except poultry, slaughtering | 1.34 | -0.32 | 0.17% |
| | | | |
| **Weakness but Growing (Potential Opportunity?)** | | | |
| Ice mfg | 0.81 | 0.45 | 0.01% |
| Bottled water mfg | 0.88 | 0.09 | 0.01% |
| Seafood product preparation & packaging | 0.12 | 0.04 | 0.00% |
| | | | |
| **Weakness & Declining** | | | |
| Fluid milk mfg | 0.82 | -0.12 | 0.04% |
| Cookie & cracker mfg | 0.90 | -0.17 | 0.03% |
| Perishable prepared food mfg | 0.79 | -0.25 | 0.03% |
| Soft drink mfg | 0.26 | -0.26 | 0.02% |
| Ice cream & frozen dessert mfg | 0.82 | -0.36 | 0.01% |

Based on employment.

The sectors that fall into the strength and growing quadrant of Figure 4 include spice and extract processing, fruit and vegetable canning and frozen processing, breweries, sugar and confectionery products and to a lesser extent commercial bakeries. In terms of established size (measured by employment), meat processing appears to be the largest.

There are three food processing sectors in the strength but declining quadrant that warrant attention: cheese manufacturing, frozen specialty food and malt manufacturing. The growing strength of the brewery industry coupled with the decline in malt manufacturing is somewhat surprising. The overall size of the malt industry in Wisconsin, though, is relatively modest. The bigger concern is the weakening of the cheese industry. While the 2013 LQ remains very large (14.53), it nevertheless declined by 0.59 over the recent ten year period, 2003 to 2013. This is not to say that the cheese industry in Wisconsin is in an overall decline. There is indeed evidence that the cheese industry is growing. This growth is slower, though, relative to growth in the rest of the U.S. Further, serious drought conditions in parts of the western U.S. (e.g., California) may have dampened national growth in dairy and cheese suggesting that we as a state should reexamine the Wisconsin cheese industry.

There are three food processing industries in the weak but growing quadrant: ice manufacturing, bottled water and seafood processing. These industries are generally small and the market potential within Wisconsin is not clear. Given Wisconsin's water resources, bottled water may be worth exploring, but recent attempts to build water bottling plants have faced significant local opposition.

This cluster analysis has documented that agriculture, both on-farm production and food processing, remains a strength for the Wisconsin economy. Based on employment dairy production and processing remains the single largest industry within agriculture but there are other equally important and indeed growing elements of agriculture. Vegetable production and processing remain important. Breweries, a historically strong sector for Wisconsin, are also regaining a strong foothold. The analysis suggests that we must continue our focus on the core elements of Wisconsin agriculture. At the same time, we should not limit our attention to only those core elements. Agriculture in Wisconsin is extremely diverse and policies must accommodate that diversity.

## Contribution of Agricultural to the Wisconsin Economy

In this study, we mimic our previous examinations of the contribution of agriculture to the Wisconsin economy (Deller 2004; Deller and Williams 2009, 2011).[10] We use input-output analysis to construct a set of economic multipliers custom to the Wisconsin economy and nine sub-regions which correspond to the

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[10] Deller, Steven C. 2004. "Wisconsin and the Agricultural Economy." Department of Agricultural and Applied Economics Staff Paper Series No. 471, University of Wisconsin-Madison/Extension. (March). http://www.aae.wisc.edu/pubs/sps/pdf/stpap471.pdf

Deller, Steven C. and Williams, David. 2009. "The Contribution of Agriculture to the Wisconsin Economy." Department of Agricultural and Applied Economics Staff Paper No. 541. University of Wisconsin-Madison/Extension. (August). http://www.aae.wisc.edu/pubs/sps/pdf/stpap541.pdf

Deller, Steven C. and Williams, David. 2011. "The Economic Impacts of Agriculture in Wisconsin Counties." Department of Agricultural and Applied Economics Miscellaneous Publications (March). http://www.aae.wisc.edu/pubs/misc/docs/deller.economic%20impacts.03.24.pdf

National Agricultural Statistics Service's (NASS) grouping of counties. We use data from 2012 which corresponds with the 2012 Census of Agriculture. Because of the drought conditions in some parts of Wisconsin during 2012, some caution must be used when interpreting the on-farm contribution analysis.

## A Simple Review of Methods and Definitions of Terms

As discussed in more detail in Appendix A, the power of input-output analysis is in the ability to use the tool to track how small changes in one part of the economy resonate throughout the entire economy. For example, the expansion of dairy farms in the local economy introduces new or additional levels of spending in the local economy. This new spending causes a ripple, or multiplier effect, throughout the economy. Using input-output analysis, we can track and measure this ripple effect.

To continue with the dairy farms example, the impact of an expansion of dairy farms is composed of three parts: the *direct*, *indirect,* and *induced*. The *direct* or *initial* effect captures the event that caused the initial change in the economy: for example, a new dairy beginning its operations or an existing dairy expanding operation. The dairy farm contributes directly to the local economy by selling farm products, paying employees' wages and salaries (generating income) and proprietor income to the farmer. Our new dairy farm has two types of expenditures that can be used to better understand the second two parts of the impact or multiplier. The first are business-to-business transactions, such as the purchase of feed from other farms or feed suppliers, fertilizer, seed and chemicals, veterinary services, trucking services to haul milk and livestock, electric and other utilities, insurance, interest and other financial services, land rent, farm and equipment repairs and maintenance, and many others. These business-to-business transactions are captured in the model through the *indirect* effect. In this situation, a grain farmer uses the proceeds from feed sales to dairy farmers to pay his or her own farm's operating expenses, make investments, or buy new equipment.

The second type of expenditure dairy farms introduce into the local economy are wages and salaries paid to employees as well as to the farmer themselves. Spending this income in the local economy is captured by the *induced* effect. Dairy farmers and their employees spend their income at local grocery stores, movie theaters, restaurants and other retail outlets. The theater owner, then, could use part of the money spent on tickets by dairy farmers to pay theater employees, and the cycle continues.

The combination of the *direct*, *indirect* and *induced* tells us what the complete impact or contribution of any particular industry has on the whole of the economy. By looking at the *indirect* and *induced* impacts, we can gain insights into how the industry of interest is connected or linked into the local economy. For example, industries that tend to be labor intensive and offer high wages tend to have larger *induced* effects on the local economy. Industries that are more capital intensive or offer lower wages tend to have larger *indirect* effects. We can also gain additional insights into the make-up of the local economy by examining the relative size of the multiplier effects. Smaller economies tend to have smaller multiplier or ripple effects than larger economies. This is because the "leakages" out of the local economy occurs faster in smaller economies. Larger economies have greater opportunities to keep those dollars within the local economy for a longer period of time, hence larger multiplier effects. Some smaller, more rural communities that have pursued tourism development have used multiplier analysis to better understand that simply bringing more tourists to the community is not sufficient: there must be someplace for those tourists to spend their money.

For this study, we use four measures of economic activity: employment, labor income, total income, and industrial revenues/sales. Employment here is simply jobs and is *not* a full-time equivalent. For example, two part-time jobs created in the any sector is considered two jobs while one full-time job in any sector is considered one job. Labor income is the return to labor and includes wages, salaries and proprietor income. As noted in the trend analysis above, most labor income comes in the form of wages and salaries. Within agriculture, though, many farmers take income in the form of proprietor income. This proprietor income is the farmer's return on their labor input into the farm. Total income includes labor income and other sources of income such as dividends, interest and rental payments as well as transfer payments such as social security payments. For our purposes, total income is akin to gross domestic product, explored in the trend analysis. Industry sales or revenues are simply total revenues flowing to an industry.

Consider a dairy farmer that has $1 million in sales/revenues, two hired workers who are each paid $25,000. The farmer has structured the business to draw a $50,000 salary. Also suppose that the farm turns a $10,000 "profit" which the farmer takes as proprietor income. In this example, industry sales/revenue is $1 million, employment is three (two workers plus the farmer) and labor income is $110,000. Suppose that this farmer has crop acreage that is rented to a neighboring farmer for which the farmer receives $5,000 in rental income. Here, total income would be $115,000.

## Results of Contribution Analysis

A summary of the total contributions of agriculture and its separate components are provided in Tables 3 through 6. These total contributions include the direct, indirect and total effects and as such include the multiplier effects. Detailed results for the whole of Wisconsin and the nine sub-regions the direct, indirect, induced and total effects are reported and provided in supplemental tables. By comparing the indirect and induced some insights into the nature of the multiplier effect can be gained. For example, if the induced effect is significantly larger than the indirect this implies that the industry is more labor intensive and/or pays higher wages. We also provide a series of maps which provide a visualization of the contribution of agriculture as a percent of the total economy across the nine sub-regions. These sub-regions correspond to the NASS sub-regions.

In summary, on-farm related activities contributed a total of 153,900 jobs to the Wisconsin economy, about 4.4% of total employment in Wisconsin (Table 3). Food processing contributed 259,600 jobs, 7.5% of total employment in Wisconsin. Taken together, agriculture (on-farm and food processing combined) contributed 413,500 jobs which is more than one out of every ten jobs (11.9%) in Wisconsin. In southwestern Wisconsin, agriculture accounts for 18.1% of total employment, the vast majority of that coming from on-farm activities. The region with lowest share of employment associated with agriculture is southeastern Wisconsin where agriculture contributes 4.3% of total employment. This is not surprising as southeastern Wisconsin is the most urban part of the state; yet agriculture still contributed 50,900 jobs, the majority of which is in food processing.

Agriculture contributed $18.6 billion to labor income (wages, salaries and proprietor income) to the Wisconsin economy, or 10.9% of the state's total (Table 4). On-farm activity accounts for $5.7 billion (3.3% of state total) while food processing accounts for $12.9 billion (7.5% of state total). The largest absolute size of contribution is in the east-central region where agriculture contributes $3.8 billion in labor income (12.1% of total), the majority of which comes from food processing. Agriculture contributes the lowest share to total labor income in south-eastern Wisconsin (3.0%), but it is the second largest in absolute dollars ($2.8 billion). Despite the relative size of the overall economy in south-eastern Wisconsin, food processing has a major presence. In terms of total income, agriculture contributes $30.1 billion or 10.9%, of which on-farm production accounts for $8.9 billion and food processing $21.1 billion. South-western Wisconsin is most dependent on agriculture (13.5%) with the majority of this total coming from on-farm activity.

The final metric of economic activity, total industrial sales or revenue, is the one metric that tends to be mostly widely cited in the popular press. As found in the Deller and Williams (2009) study of Wisconsin agriculture using data from 2007 (to correspond with the 2007 Census of Agriculture), agriculture was just over a $59 billion dollar industry in 2007. For 2012, agriculture contributed $88.3 billion to industrial sales/revenue, or about 16% of the state's total. As with the earlier study, food processing accounts for the majority of that contribution at $67.8 billion (of which $35.1 billion comes from dairy processing) and on-farm activity accounting for $20.5 billion. In nominal terms (i.e., not adjusted for inflation) the $88.3 billion represents a 49.3% increase over the $59 billion for 2007.

Across the nine sub-regions, agriculture accounts for at least 20% of total industrial sales/revenue in five regions. In southwestern Wisconsin, this figure grows to 31.2% of industrial sales/revenue. Even in southeastern Wisconsin a predominately urban region, agricultural production, accounts for 18.5% of industrial sales/revenue. Food processing accounts for a large proportion of these sales.

Table 3: Total Contribution 2012: Employment

| | Wisconsin | (%) | North West | | North Central | | North East | | West Central | |
|---|---|---|---|---|---|---|---|---|---|---|
| All On-Farm | 153,878 | 4.4% | 11,223 | 7.6% | 14,801 | 7.6% | 7,867 | 9.9% | 18,905 | 6.5% |
| Dairy Farming | 43,915 | 1.3% | 3,438 | 2.3% | 5,522 | 2.8% | 2,487 | 3.1% | 5,383 | 1.9% |
| Floriculture | 3,799 | 0.1% | 135 | 0.1% | 325 | 0.2% | 80 | 0.1% | 227 | 0.1% |
| Forestry | 5,115 | 0.1% | 1,238 | 0.8% | 1,157 | 0.6% | 839 | 1.1% | 327 | 0.1% |
| Dairy Processing | 35,039 | 1.0% | 1,362 | 0.9% | 3,262 | 1.7% | 1,314 | 1.6% | 3,502 | 1.2% |
| All Food Processing | 259,635 | 7.5% | 11,453 | 7.8% | 14,807 | 7.6% | 4,438 | 5.6% | 18,380 | 6.4% |
| All Agriculture (No Forestry) | 413,513 | 11.9% | 22,676 | 15.4% | 29,608 | 15.1% | 12,304 | 15.4% | 37,284 | 12.9% |
| | | | | | | | | | | |
| | Central | | East Central | | South West | | South Central | | South East | |
| All On-Farm | 12,878 | 7.7% | 22,196 | 3.4% | 20,716 | 15.5% | 24,903 | 4.0% | 9,750 | 0.8% |
| Dairy Farming | 2,630 | 1.6% | 8,326 | 1.3% | 5,572 | 4.2% | 4,776 | 0.8% | 1,442 | 0.1% |
| Floriculture | 146 | 0.1% | 538 | 0.1% | 82 | 0.1% | 747 | 0.1% | 1,174 | 0.1% |
| Forestry | 221 | 0.1% | 198 | 0.0% | 319 | 0.2% | 142 | 0.0% | 35 | 0.0% |
| Dairy Processing | 1,416 | 0.9% | 9,458 | 1.5% | 3,132 | 2.3% | 3,955 | 0.6% | 1,269 | 0.1% |
| All Food Processing | 10,915 | 6.6% | 57,143 | 8.9% | 3,515 | 2.6% | 33,030 | 5.3% | 41,144 | 3.4% |
| All Agriculture (No Forestry) | 23,793 | 14.3% | 79,339 | 12.3% | 24,231 | 18.1% | 57,933 | 9.3% | 50,893 | 4.3% |

Table 4: Total Contribution 2012: Labor Income ($MM)

| | Wisconsin | (%) | North West | | North Central | | North East | | West Central | |
|---|---|---|---|---|---|---|---|---|---|---|
| All On-Farm | $5,714.6 | 3.3% | $324.3 | 5.9% | $471.7 | 5.9% | $255.5 | 8.6% | $611.4 | 5.0% |
| Dairy Farming | $1,633.3 | 1.0% | $89.9 | 1.6% | $174.7 | 2.2% | $74.8 | 2.5% | $157.0 | 1.3% |
| Floriculture | $386.7 | 0.2% | $11.2 | 0.2% | $31.2 | 0.4% | $7.8 | 0.3% | $22.8 | 0.2% |
| Forestry | $213.6 | 0.1% | $54.5 | 1.0% | $42.3 | 0.5% | $32.0 | 1.1% | $13.6 | 0.1% |
| Dairy Processing | $2,294.2 | 1.3% | $77.3 | 1.4% | $207.8 | 2.6% | $60.1 | 2.0% | $221.9 | 1.8% |
| All Food Processing | $12,891.0 | 7.5% | $444.9 | 8.1% | $591.0 | 7.4% | $159.9 | 5.4% | $835.2 | 6.8% |
| All Agriculture (No Forestry) | $18,605.6 | 10.9% | $769.2 | 14.1% | $1,062.7 | 13.2% | $415.3 | 14.0% | $1,446.5 | 11.8% |
| | | | | | | | | | | |
| | Central | | East Central | | South West | | South Central | | South East | |
| All On-Farm | $671.7 | 8.8% | $937.8 | 2.9% | $579.4 | 11.6% | $1,006.9 | 3.3% | $460.2 | 0.7% |
| Dairy Farming | $84.7 | 1.1% | $356.7 | 1.1% | $171.6 | 3.4% | $206.1 | 0.7% | $62.1 | 0.1% |
| Floriculture | $16.6 | 0.2% | $60.4 | 0.2% | $8.2 | 0.2% | $87.2 | 0.3% | $128.1 | 0.1% |
| Forestry | $8.9 | 0.1% | $6.8 | 0.0% | $6.3 | 0.1% | $8.7 | 0.0% | $5.3 | 0.0% |
| Dairy Processing | $74.1 | 1.0% | $726.3 | 2.3% | $164.8 | 3.3% | $270.9 | 0.9% | $90.3 | 0.1% |
| All Food Processing | $494.4 | 6.5% | $2,914.5 | 9.2% | $179.9 | 3.6% | $1,776.5 | 5.8% | $2,393.2 | 2.3% |
| All Agriculture (No Forestry) | $1,166.1 | 15.3% | $3,852.3 | 12.1% | $759.4 | 15.1% | $2,783.4 | 9.1% | $2,853.4 | 3.0% |

Table 5: Total Contribution 2012: Total Income ($MM)

| | Wisconsin | (%) | North West | | North Central | | North East | | West Central | |
|---|---|---|---|---|---|---|---|---|---|---|
| All On-Farm | $8,951.2 | 3.2% | $502.2 | 5.3% | $787.7 | 5.7% | $376.1 | 7.7% | $923.7 | 4.7% |
| Dairy Farming | $3,785.5 | 1.4% | $234.3 | 2.5% | $434.4 | 3.2% | $184.7 | 3.8% | $397.7 | 2.0% |
| Floriculture | $340.9 | 0.1% | $9.3 | 0.1% | $25.2 | 0.2% | $6.0 | 0.1% | $18.3 | 0.1% |
| Forestry | $227.3 | 0.1% | $54.3 | 0.6% | $40.4 | 0.3% | $30.1 | 0.6% | $13.6 | 0.1% |
| Dairy Processing | $3,458.0 | 1.3% | $115.6 | 1.2% | $328.1 | 2.4% | $99.3 | 2.0% | $324.7 | 1.6% |
| All Food Processing | $21,155.1 | 7.7% | $750.4 | 8.0% | $1,071.9 | 7.8% | $301.9 | 6.2% | $1,483.1 | 7.5% |
| All Agriculture (No Forestry) | $30,106.4 | 10.9% | $1,252.6 | 13.3% | $1,859.7 | 13.5% | $678.0 | 13.9% | $2,406.8 | 12.2% |
| | | | | | | | | | | |
| | Central | | East Central | | South West | | South Central | | South East | |
| All On-Farm | $783.5 | 6.2% | $1,526.0 | 2.9% | $1,015.8 | 11.6% | $1,496.7 | 2.9% | $626.8 | 0.6% |
| Dairy Farming | $216.3 | 1.7% | $819.6 | 1.6% | $457.4 | 5.2% | $483.3 | 1.0% | $140.7 | 0.1% |
| Floriculture | $13.1 | 0.1% | $50.7 | 0.1% | $6.9 | 0.1% | $73.3 | 0.1% | $114.7 | 0.1% |
| Forestry | $12.4 | 0.1% | $7.1 | 0.0% | $5.0 | 0.1% | $10.1 | 0.0% | $6.4 | 0.0% |
| Dairy Processing | $113.3 | 0.9% | $1,010.7 | 2.0% | $296.4 | 3.4% | $386.2 | 0.8% | $170.3 | 0.1% |
| All Food Processing | $806.4 | 6.4% | $4,671.5 | 9.0% | $321.9 | 3.7% | $2,836.4 | 5.6% | $3,689.4 | 1.9% |
| All Agriculture (No Forestry) | $1,589.9 | 12.6% | $6,197.5 | 11.9% | $1,337.7 | 15.3% | $4,333.1 | 8.5% | $4,316.2 | 2.5% |

Table 6: Total Contribution 2012: Total Industrial Sales ($MM)

| | Wisconsin | (%) | North West | | North Central | | North East | | West Central | |
|---|---|---|---|---|---|---|---|---|---|---|
| All On-Farm | $20,484.5 | 3.7% | $1,222.5 | 5.6% | $1,748.1 | 6.0% | $810.9 | 7.4% | $2,248.6 | 5.7% |
| Dairy Farming | $8,387.2 | 1.5% | $495.2 | 2.3% | $919.6 | 3.2% | $378.1 | 3.4% | $877.3 | 2.2% |
| Floriculture | $537.9 | 0.1% | $14.9 | 0.1% | $39.4 | 0.1% | $9.4 | 0.1% | $28.6 | 0.1% |
| Forestry | $482.9 | 0.1% | $112.1 | 0.5% | $93.6 | 0.3% | $68.5 | 0.6% | $29.6 | 0.1% |
| Dairy Processing | $35,067.2 | 6.4% | $1,337.5 | 6.1% | $3,362.1 | 11.5% | $1,291.7 | 11.8% | $3,370.8 | 8.6% |
| All Food Processing | $67,822.1 | 12.3% | $3,195.9 | 14.7% | $4,209.1 | 14.5% | $1,451.9 | 13.2% | $5,679.0 | 14.5% |
| All Agriculture (No Forestry) | $88,306.6 | 16.0% | $4,418.4 | 20.3% | $5,957.2 | 20.5% | $2,262.8 | 20.6% | $7,927.6 | 20.2% |
| | | | | | | | | | | |
| | Central | | East Central | | South West | | South Central | | South East | |
| All On-Farm | $1,696.7 | 6.6% | $3,474.2 | 3.0% | $2,415.8 | 12.9% | $3,406.1 | 3.6% | $1,308.5 | 1.7% |
| Dairy Farming | $476.0 | 1.9% | $1,839.7 | 1.6% | $988.6 | 5.3% | $1,064.1 | 1.1% | $300.7 | 0.5% |
| Floriculture | $20.4 | 0.1% | $79.2 | 0.1% | $10.7 | 0.1% | $112.9 | 0.1% | $177.9 | 0.3% |
| Forestry | $25.6 | 0.1% | $19.2 | 0.0% | $21.2 | 0.1% | $19.6 | 0.0% | $12.1 | 0.0% |
| Dairy Processing | $1,341.4 | 5.2% | $9,556.8 | 8.3% | $3,270.6 | 17.5% | $3,739.4 | 4.0% | $1,511.3 | 2.3% |
| All Food Processing | $3,300.0 | 12.9% | $16,282.6 | 14.2% | $3,428.5 | 18.3% | $9,581.8 | 10.2% | $11,221.2 | 16.8% |
| All Agriculture (No Forestry) | $4,996.7 | 19.5% | $19,756.7 | 17.2% | $5,844.2 | 31.2% | $12,987.9 | 13.8% | $12,529.7 | 18.5% |

A comparison of the 2009 study which used data from 2007 with the analysis reported here shows that, despite drought conditions in the southern part of Wisconsin, the contribution of agriculture grew over the five year period (2007 to 2012). Some care must be taken when making these comparisons because of differences in how forestry and logging is treated across the two studies. In addition, labor income was not considered in the earlier study. As already noted, total industrial sales or revenue increased from $59.2 billion in 2007 to $88.3 billion in 2012, an increase in nominal terms of 49.3%. On-farm related activity increased from $12.6 billion to $20.5 billion. In terms of total industrial revenues or sales, this is a nominal increase of 62.7%. Food processing's contribution to industrial sales or revenue increased by 35.6% from just under $50 billion in 2007 to $67.8 billion in 2012.

In 2007, on-farm activity contributed 132,100 jobs and in 2012, the number of jobs increased by 16.5% to 153,900 jobs. Agricultural processing also increased, but by a more modest amount from approximately 252,000 to 259,600 jobs. Looking at the agricultural industry overall, agriculture contributed almost 354,000 in 2007 and increased by 16.8% to 413,500 jobs in 2012. Again, despite the impacts of the drought, most of the job increase over the five year period came from on-farm related activities.

Looking at total income, on-farm related activities contributed $5.4 billion in 2007 and increased to $8.9 billion to 2012, a nominal increase of 66.2%. Note that a nominal increase does not reflect changes due to inflation. Food processing contributed $15.5 billion to total income in 2007 and in 2012 it increased by 35.9% to $21.1 billion. Together, all of agriculture, including on-farm and food processing, contributed $20.2 billion in 2007 and $30.1 billion in 2012, a nominal increase of 49.2 percent.

## Summary

Agriculture remains an important part of the Wisconsin economy. Throughout this study, we defined agriculture as on-farm operations and food processing. In 2012, agriculture contributed a total (i.e., direct, indirect and induced combined) of 413,500 jobs (11.9% of state total employment) to the Wisconsin economy. This is a 16.8% increase from 354,000 in 2007. Agriculture represents $30.1 billion in total income (10.9% of state total) and $88.3 billion to total industrial sales/revenue (16% of total total). Some parts of Wisconsin, such as the south-western region, are more dependent upon agriculture than others. Even in the most urban parts of the state, though, agriculture's contribution is notable. When directly compared, it is clear that food processing, contributes more to the state's economy than on-farm activity. This is mostly because of the strength and size of the processing related to dairy and meat. When we think of Wisconsin agriculture, we must move beyond focusing within farm gate and consider food processing as an important part of the Wisconsin agricultural economic cluster.

The core of Wisconsin agriculture is generally thought to be dairy and although there is some evidence that cheese manufacturing is slowly lagging behind the rest of the U.S., the dairy industry as a whole remains strong. Key to note, though, is that other parts of Wisconsin agriculture such as the beef industry, vegetables, breweries and more specialized activities like hops, grapes, and wineries, are growing in size and importance. Although one may traditionally think of Wisconsin as the "Dairy State," the truth is that agriculture is diverse and is likely becoming more diversified across the state.

Contribution of Agriculture 2012: Wisconsion ($MM)

| | Employment | Labor Income | Total Income | Industrial Sales |
|---|---|---|---|---|
| **On Farm** | | | | |
| Direct Effect | 105,624 | $ 3,588 | $ 4,749 | $ 12,350 |
| Indirect Effect | 16,678 | $ 846 | $ 1,860 | $ 4,353 |
| Induced Effect | 31,574 | $ 1,281 | $ 2,342 | $ 3,782 |
| Total Effect | 153,878 | $ 5,715 | $ 8,951 | $ 20,484 |
| Multiplier | 1.457 | 1.593 | 1.885 | 1.659 |
| Share of State Total | 4.4% | 3.3% | 3.2% | 3.7% |
| **Dairy Farms** | | | | |
| Direct Effect | 26,947 | $ 890 | $ 2,462 | $ 5,229 |
| Indirect Effect | 8,439 | $ 397 | $ 692 | $ 2,136 |
| Induced Effect | 8,526 | $ 347 | $ 632 | $ 1,022 |
| Total Effect | 43,915 | $ 1,633 | $ 3,785 | $ 8,387 |
| Multiplier | 1.630 | 1.835 | 1.538 | 1.604 |
| Share of State Total | 1.3% | 1.0% | 1.4% | 1.5% |
| **Floriculture** | | | | |
| Direct Effect | 1,386 | $ 289 | $ 168 | $ 255 |
| Indirect Effect | 374 | $ 15 | $ 22 | $ 39 |
| Induced Effect | 2,036 | $ 83 | $ 151 | $ 244 |
| Total Effect | 3,799 | $ 387 | $ 341 | $ 538 |
| Multiplier | 2.741 | 1.338 | 2.024 | 2.108 |
| Share of State Total | 0.1% | 0.2% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 3,242 | $ 135 | $ 107 | $ 278 |
| Indirect Effect | 719 | $ 32 | $ 35 | $ 67 |
| Induced Effect | 1,153 | $ 47 | $ 85 | $ 138 |
| Total Effect | 5,115 | $ 214 | $ 227 | $ 483 |
| Multiplier | 1.578 | 1.585 | 2.135 | 1.738 |
| Share of State Total | 0.1% | 0.1% | 0.1% | 0.1% |
| **Dairy Procesing** | | | | |
| Direct Effect | 17,211 | $ 1,127 | $ 1,699 | $ 17,225 |
| Indirect Effect | 13,758 | $ 901 | $ 1,358 | $ 13,769 |
| Induced Effect | 4,070 | $ 266 | $ 402 | $ 4,073 |
| Total Effect | 35,039 | $ 2,294 | $ 3,458 | $ 35,067 |
| Multiplier | 2.036 | 2.036 | 2.036 | 2.036 |
| Share of State Total | 1.0% | 1.3% | 1.3% | 6.4% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 62,441 | $ 3,730 | $ 5,196 | $ 36,916 |
| Indirect Effect | 125,621 | $ 6,256 | $ 10,651 | $ 22,552 |
| Induced Effect | 71,573 | $ 2,904 | $ 5,308 | $ 8,354 |
| Total Effect | 259,635 | $ 12,891 | $ 21,155 | $ 67,822 |
| Multiplier | 4.158 | 3.456 | 4.072 | 1.837 |
| Share of State Total | 7.5% | 7.5% | 7.7% | 12.3% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 168,065 | $ 7,319 | $ 9,945 | $ 49,265 |
| Indirect Effect | 142,299 | $ 7,102 | $ 12,511 | $ 26,905 |
| Induced Effect | 103,147 | $ 4,185 | $ 7,650 | $ 12,136 |
| Total Effect | 413,513 | $ 18,606 | $ 30,106 | $ 88,307 |
| Multiplier | 2.460 | 2.542 | 3.027 | 1.792 |
| Share of State Total | 11.9% | 10.9% | 10.9% | 16.1% |

| Contribution of Agriculture 2012: North West Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 9,085 | $ 255.5 | $ 340.4 | $ 928.7 |
| Indirect Effect | 708 | $ 26.4 | $ 70.7 | $ 143.0 |
| Induced Effect | 1,430 | $ 42.4 | $ 91.1 | $ 150.9 |
| Total Effect | 11,223 | $ 324.3 | $ 502.2 | $ 1,222.5 |
| Multiplier | 1.235 | 1.269 | 1.475 | 1.316 |
| Share of Region | 7.6% | 5.9% | 5.3% | 5.6% |
| **Dairy Farm** | | | | |
| Direct Effect | 2,564 | $ 65.8 | $ 186.5 | $ 396.2 |
| Indirect Effect | 497 | $ 12.9 | $ 23.8 | $ 59.2 |
| Induced Effect | 377 | $ 11.2 | $ 24.0 | $ 39.8 |
| Total Effect | 3,438 | $ 89.9 | $ 234.3 | $ 495.2 |
| Multiplier | 1.341 | 1.366 | 1.256 | 1.250 |
| Share of Region | 2.3% | 1.6% | 2.5% | 2.3% |
| **Floriculture** | | | | |
| Direct Effect | 73 | $ 9.3 | $ 5.8 | $ 8.8 |
| Indirect Effect | 15 | $ 0.4 | $ 0.5 | $ 1.1 |
| Induced Effect | 47 | $ 1.4 | $ 3.0 | $ 5.0 |
| Total Effect | 135 | $ 11.2 | $ 9.3 | $ 14.9 |
| Multiplier | 1.849 | 1.196 | 1.601 | 1.695 |
| Share of Region | 0.1% | 0.2% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 870 | $ 43.6 | $ 34.9 | $ 77.1 |
| Indirect Effect | 126 | $ 3.7 | $ 4.1 | $ 9.4 |
| Induced Effect | 242 | $ 7.2 | $ 15.4 | $ 25.5 |
| Total Effect | 1,238 | $ 54.5 | $ 54.3 | $ 112.1 |
| Multiplier | 1.423 | 1.250 | 1.559 | 1.454 |
| Share of Region | 0.8% | 1.0% | 0.6% | 0.5% |
| **Dairy Processing** | | | | |
| Direct Effect | 888 | $ 50.4 | $ 75.4 | $ 871.8 |
| Indirect Effect | 402 | $ 22.8 | $ 34.1 | $ 394.9 |
| Induced Effect | 72 | $ 4.1 | $ 6.1 | $ 70.8 |
| Total Effect | 1,362 | $ 77.3 | $ 115.6 | $ 1,337.5 |
| Multiplier | 1.534 | 1.534 | 1.534 | 1.534 |
| Share of Region | 0.9% | 1.4% | 1.2% | 6.1% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 4,167 | $ 206.4 | $ 288.8 | $ 2,250.7 |
| Indirect Effect | 5,347 | $ 180.7 | $ 337.9 | $ 744.1 |
| Induced Effect | 1,937 | $ 57.8 | $ 123.7 | $ 201.1 |
| Total Effect | 11,453 | $ 444.9 | $ 750.4 | $ 3,195.9 |
| Multiplier | 2.748 | 2.156 | 2.598 | 1.420 |
| Share of Region | 7.8% | 8.1% | 8.0% | 14.7% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 13,252 | $ 461.9 | $ 629.2 | $ 3,179.4 |
| Indirect Effect | 6,056 | $ 207.1 | $ 408.6 | $ 887.1 |
| Induced Effect | 3,367 | $ 100.1 | $ 214.8 | $ 352.0 |
| Total Effect | 22,676 | $ 769.2 | $ 1,252.6 | $ 4,418.4 |
| Multiplier | 1.711 | 1.665 | 1.991 | 1.390 |
| Share of State Total | 15.4% | 14.1% | 13.3% | 20.3% |

| Contribution of Agriculture 2012: North Central Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 11,443 | $ 351.5 | $ 526.3 | $ 1,280.1 |
| Indirect Effect | 1,110 | $ 44.2 | $ 109.9 | $ 225.2 |
| Induced Effect | 2,246 | $ 76.0 | $ 151.5 | $ 242.8 |
| Total Effect | 14,801 | $ 471.7 | $ 787.7 | $ 1,748.1 |
| Multiplier | 1.293 | 1.342 | 1.497 | 1.366 |
| Share of Region | 7.6% | 5.9% | 5.7% | 6.0% |
| **Dairy Farm** | | | | |
| Direct Effect | 3,723 | $ 116.3 | $ 328.1 | $ 696.8 |
| Indirect Effect | 1,025 | $ 32.2 | $ 54.2 | $ 139.2 |
| Induced Effect | 774 | $ 26.2 | $ 52.1 | $ 83.6 |
| Total Effect | 5,522 | $ 174.7 | $ 434.4 | $ 919.6 |
| Multiplier | 1.483 | 1.503 | 1.324 | 1.320 |
| Share of Region | 2.8% | 2.2% | 3.2% | 3.2% |
| **Floriculture** | | | | |
| Direct Effect | 144 | $ 25.3 | $ 14.5 | $ 22.0 |
| Indirect Effect | 43 | $ 1.2 | $ 1.4 | $ 2.5 |
| Induced Effect | 138 | $ 4.7 | $ 9.3 | $ 14.9 |
| Total Effect | 325 | $ 31.2 | $ 25.2 | $ 39.4 |
| Multiplier | 2.253 | 1.234 | 1.737 | 1.794 |
| Share of Region | 0.2% | 0.4% | 0.2% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 835 | $ 31.1 | $ 22.2 | $ 62.4 |
| Indirect Effect | 129 | $ 4.6 | $ 5.2 | $ 10.3 |
| Induced Effect | 193 | $ 6.6 | $ 13.0 | $ 20.9 |
| Total Effect | 1,157 | $ 42.3 | $ 40.4 | $ 93.6 |
| Multiplier | 1.386 | 1.359 | 1.819 | 1.499 |
| Share of Region | 0.6% | 0.5% | 0.3% | 0.3% |
| **Dairy Processing** | | | | |
| Direct Effect | 1,995 | $ 127.1 | $ 200.7 | $ 2,056.4 |
| Indirect Effect | 1,054 | $ 67.2 | $ 106.1 | $ 1,087.0 |
| Induced Effect | 212 | $ 13.5 | $ 21.3 | $ 218.7 |
| Total Effect | 3,262 | $ 207.8 | $ 328.1 | $ 3,362.1 |
| Multiplier | 1.635 | 1.635 | 1.635 | 1.635 |
| Share of Region | 1.7% | 2.6% | 2.4% | 11.5% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 3,725 | $ 205.3 | $ 282.7 | $ 2,626.4 |
| Indirect Effect | 8,380 | $ 293.8 | $ 606.7 | $ 1,292.7 |
| Induced Effect | 2,702 | $ 91.8 | $ 182.5 | $ 289.9 |
| Total Effect | 14,807 | $ 591.0 | $ 1,071.9 | $ 4,209.1 |
| Multiplier | 3.975 | 2.878 | 3.791 | 1.603 |
| Share of Region | 7.6% | 7.4% | 7.8% | 14.5% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 15,168 | $ 556.9 | $ 809.1 | $ 3,906.6 |
| Indirect Effect | 9,490 | $ 338.0 | $ 716.6 | $ 1,518.0 |
| Induced Effect | 4,948 | $ 167.8 | $ 334.0 | $ 532.7 |
| Total Effect | 29,608 | $ 1,062.7 | $ 1,859.7 | $ 5,957.2 |
| Multiplier | 1.952 | 1.908 | 2.299 | 1.525 |
| Share of State Total | 15.1% | 13.2% | 13.5% | 20.5% |

| Contribution of Agriculture 2012: North East Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 6,455 | $ 212.1 | $ 270.8 | $ 641.2 |
| Indirect Effect | 404 | $ 13.6 | $ 39.2 | $ 63.8 |
| Induced Effect | 1,007 | $ 29.7 | $ 66.0 | $ 106.0 |
| Total Effect | 7,867 | $ 255.5 | $ 376.1 | $ 810.9 |
| Multiplier | 1.219 | 1.204 | 1.389 | 1.265 |
| Share of Region | 9.9% | 8.6% | 7.7% | 7.4% |
| **Dairy Farm** | | | | |
| Direct Effect | 1,857 | $ 55.9 | $ 150.2 | $ 319.0 |
| Indirect Effect | 359 | $ 10.8 | $ 16.8 | $ 30.5 |
| Induced Effect | 272 | $ 8.1 | $ 17.8 | $ 28.6 |
| Total Effect | 2,487 | $ 74.8 | $ 184.7 | $ 378.1 |
| Multiplier | 1.339 | 1.338 | 1.230 | 1.185 |
| Share of Region | 3.1% | 2.5% | 3.8% | 3.4% |
| **Floriculture** | | | | |
| Direct Effect | 42 | $ 6.7 | $ 3.8 | $ 5.8 |
| Indirect Effect | 10 | $ 0.3 | $ 0.3 | $ 0.6 |
| Induced Effect | 29 | $ 0.8 | $ 1.9 | $ 3.0 |
| Total Effect | 80 | $ 7.8 | $ 6.0 | $ 9.4 |
| Multiplier | 1.907 | 1.174 | 1.572 | 1.614 |
| Share of Region | 0.1% | 0.3% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 620 | $ 25.1 | $ 19.0 | $ 49.8 |
| Indirect Effect | 97 | $ 3.3 | $ 3.2 | $ 5.9 |
| Induced Effect | 121 | $ 3.6 | $ 7.9 | $ 12.8 |
| Total Effect | 839 | $ 32.0 | $ 30.1 | $ 68.5 |
| Multiplier | 1.353 | 1.274 | 1.586 | 1.375 |
| Share of Region | 1.1% | 1.1% | 0.6% | 0.6% |
| **Dairy Processing** | | | | |
| Direct Effect | 917 | $ 41.9 | $ 69.3 | $ 901.6 |
| Indirect Effect | 344 | $ 15.7 | $ 26.0 | $ 338.2 |
| Induced Effect | 53 | $ 2.4 | $ 4.0 | $ 51.9 |
| Total Effect | 1,314 | $ 60.1 | $ 99.3 | $ 1,291.7 |
| Multiplier | 1.433 | 1.433 | 1.433 | 1.433 |
| Share of Region | 1.6% | 2.0% | 2.0% | 11.8% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 1,260 | $ 58.0 | $ 85.0 | $ 1,019.5 |
| Indirect Effect | 2,587 | $ 84.4 | $ 178.2 | $ 370.6 |
| Induced Effect | 590 | $ 17.5 | $ 38.7 | $ 61.8 |
| Total Effect | 4,438 | $ 159.9 | $ 301.9 | $ 1,451.9 |
| Multiplier | 3.522 | 2.759 | 3.553 | 1.424 |
| Share of Region | 5.6% | 5.4% | 6.2% | 13.2% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 7,715 | $ 270.1 | $ 355.8 | $ 1,660.6 |
| Indirect Effect | 2,991 | $ 98.0 | $ 217.4 | $ 434.4 |
| Induced Effect | 1,597 | $ 47.2 | $ 104.8 | $ 167.8 |
| Total Effect | 12,304 | $ 415.3 | $ 678.0 | $ 2,262.8 |
| Multiplier | 1.5949 | 1.5380 | 1.9055 | 1.3626 |
| Share of State Total | 15.4% | 14.0% | 13.9% | 20.6% |

| Contribution of Agriculture 2012: West Central Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 14,560 | $ 449.8 | $ 583.8 | $ 1,595.2 |
| Indirect Effect | 1,469 | $ 63.1 | $ 151.0 | $ 351.2 |
| Induced Effect | 2,874 | $ 98.5 | $ 189.0 | $ 302.2 |
| Total Effect | 18,905 | $ 611.4 | $ 923.7 | $ 2,248.6 |
| Multiplier | 1.298 | 1.359 | 1.582 | 1.410 |
| Share of Region | 6.5% | 5.0% | 4.7% | 5.7% |
| **Dairy Farm** | | | | |
| Direct Effect | 3,930 | $ 106.1 | $ 300.2 | $ 637.7 |
| Indirect Effect | 751 | $ 26.7 | $ 51.3 | $ 165.7 |
| Induced Effect | 702 | $ 24.2 | $ 46.2 | $ 73.9 |
| Total Effect | 5,383 | $ 157.0 | $ 397.7 | $ 877.3 |
| Multiplier | 1.370 | 1.479 | 1.325 | 1.376 |
| Share of Region | 1.9% | 1.3% | 2.0% | 2.2% |
| **Floriculture** | | | | |
| Direct Effect | 108 | $ 18.6 | $ 10.7 | $ 16.2 |
| Indirect Effect | 18 | $ 0.7 | $ 1.0 | $ 1.7 |
| Induced Effect | 102 | $ 3.5 | $ 6.7 | $ 10.7 |
| Total Effect | 227 | $ 22.8 | $ 18.3 | $ 28.6 |
| Multiplier | 2.106 | 1.228 | 1.715 | 1.766 |
| Share of Region | 0.1% | 0.2% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 231 | $ 10.1 | $ 7.9 | $ 19.8 |
| Indirect Effect | 36 | $ 1.5 | $ 1.6 | $ 3.4 |
| Induced Effect | 61 | $ 2.1 | $ 4.0 | $ 6.4 |
| Total Effect | 327 | $ 13.6 | $ 13.6 | $ 29.6 |
| Multiplier | 1.417 | 1.352 | 1.710 | 1.493 |
| Share of Region | 0.1% | 0.1% | 0.1% | 0.1% |
| **Dairy Processing** | | | | |
| Direct Effect | 2,200 | $ 139.4 | $ 204.0 | $ 2,117.6 |
| Indirect Effect | 1,074 | $ 68.1 | $ 99.6 | $ 1,034.2 |
| Induced Effect | 228 | $ 14.4 | $ 21.1 | $ 219.1 |
| Total Effect | 3,502 | $ 221.9 | $ 324.7 | $ 3,370.8 |
| Multiplier | 1.592 | 1.592 | 1.592 | 1.592 |
| Share of Region | 1.2% | 1.8% | 1.6% | 8.6% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 5,454 | $ 341.9 | $ 551.2 | $ 3,840.3 |
| Indirect Effect | 9,075 | $ 360.8 | $ 678.5 | $ 1,439.4 |
| Induced Effect | 3,851 | $ 132.5 | $ 253.4 | $ 399.3 |
| Total Effect | 18,380 | $ 835.2 | $ 1,483.1 | $ 5,679.0 |
| Multiplier | 3.370 | 2.443 | 2.690 | 1.479 |
| Share of Region | 6.4% | 6.8% | 7.5% | 14.5% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 20,014 | $ 791.7 | $ 1,135.0 | $ 5,435.5 |
| Indirect Effect | 10,544 | $ 423.9 | $ 829.4 | $ 1,790.6 |
| Induced Effect | 6,725 | $ 230.9 | $ 442.4 | $ 701.5 |
| Total Effect | 37,284 | $ 1,446.5 | $ 2,406.8 | $ 7,927.6 |
| Multiplier | 1.863 | 1.827 | 2.121 | 1.458 |
| Share of State Total | 12.9% | 11.8% | 12.2% | 20.2% |

| Contribution of Agriculture 2012: Central Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 9,127 | $ 542.6 | $ 499.2 | $ 1,197.3 |
| Indirect Effect | 971 | $ 36.2 | $ 95.7 | $ 196.5 |
| Induced Effect | 2,780 | $ 92.9 | $ 188.6 | $ 302.9 |
| Total Effect | 12,878 | $ 671.7 | $ 783.5 | $ 1,696.7 |
| Multiplier | 1.411 | 1.238 | 1.570 | 1.417 |
| Share of Region | 7.7% | 8.8% | 6.2% | 6.6% |
| **Dairy Farm** | | | | |
| Direct Effect | 1,959 | $ 61.3 | $ 169.6 | $ 360.2 |
| Indirect Effect | 334 | $ 12.0 | $ 23.8 | $ 78.9 |
| Induced Effect | 338 | $ 11.4 | $ 22.9 | $ 36.9 |
| Total Effect | 2,630 | $ 84.7 | $ 216.3 | $ 476.0 |
| Multiplier | 1.343 | 1.381 | 1.276 | 1.321 |
| Share of Region | 1.6% | 1.1% | 1.7% | 1.9% |
| **Floriculture** | | | | |
| Direct Effect | 70 | $ 14.0 | $ 8.0 | $ 12.2 |
| Indirect Effect | 10 | $ 0.4 | $ 0.6 | $ 1.0 |
| Induced Effect | 66 | $ 2.2 | $ 4.5 | $ 7.2 |
| Total Effect | 146 | $ 16.6 | $ 13.1 | $ 20.4 |
| Multiplier | 2.090 | 1.191 | 1.633 | 1.678 |
| Share of Region | 0.1% | 0.2% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 149 | $ 6.3 | $ 8.1 | $ 18.0 |
| Indirect Effect | 36 | $ 1.4 | $ 1.9 | $ 3.7 |
| Induced Effect | 35 | $ 1.2 | $ 2.4 | $ 3.9 |
| Total Effect | 221 | $ 8.9 | $ 12.4 | $ 25.6 |
| Multiplier | 1.481 | 1.416 | 1.526 | 1.419 |
| Share of Region | 0.1% | 0.1% | 0.1% | 0.1% |
| **Dairy Processing** | | | | |
| Direct Effect | 960 | $ 50.2 | $ 76.9 | $ 909.7 |
| Indirect Effect | 385 | $ 20.1 | $ 30.8 | $ 364.7 |
| Induced Effect | 71 | $ 3.7 | $ 5.7 | $ 66.9 |
| Total Effect | 1,416 | $ 74.1 | $ 113.3 | $ 1,341.4 |
| Multiplier | 1.475 | 1.475 | 1.475 | 1.475 |
| Share of Region | 0.9% | 1.0% | 0.9% | 5.2% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 4,681 | $ 234.8 | $ 344.9 | $ 2,406.1 |
| Indirect Effect | 4,208 | $ 191.2 | $ 323.6 | $ 675.0 |
| Induced Effect | 2,026 | $ 68.4 | $ 137.9 | $ 218.8 |
| Total Effect | 10,915 | $ 494.4 | $ 806.4 | $ 3,300.0 |
| Multiplier | 2.332 | 2.106 | 2.338 | 1.371 |
| Share of Region | 6.6% | 6.5% | 6.4% | 12.9% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 13,808 | $ 777.4 | $ 844.1 | $ 3,603.4 |
| Indirect Effect | 5,179 | $ 227.4 | $ 419.4 | $ 871.5 |
| Induced Effect | 4,805 | $ 161.3 | $ 326.5 | $ 521.7 |
| Total Effect | 23,793 | $ 1,166.1 | $ 1,589.9 | $ 4,996.7 |
| Multiplier | 1.723 | 1.500 | 1.884 | 1.387 |
| Share of State Total | 14.3% | 15.3% | 12.7% | 19.5% |

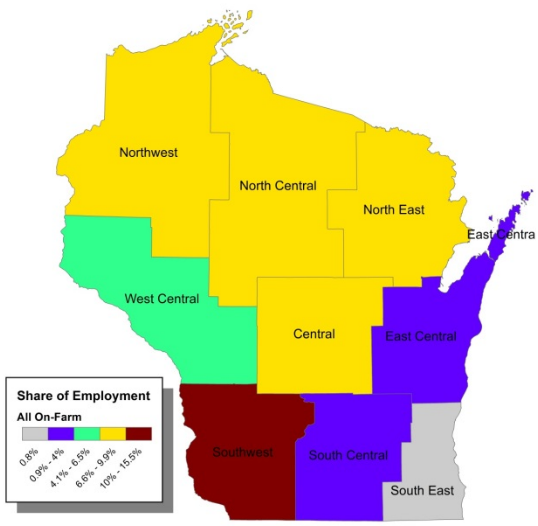
| Contribution of Agriculture 2012: East Central Region ($MM) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Employment | | Labor Income | | Total Income | | Industry Sales |
| **On Farm** | | | | | | | |
| Direct Effect | 14,955 | $ | 635.2 | $ | 914.8 | $ | 2,241.3 |
| Indirect Effect | 2,524 | $ | 123.4 | $ | 274.8 | $ | 694.6 |
| Induced Effect | 4,715 | $ | 179.3 | $ | 336.5 | $ | 538.3 |
| Total Effect | 22,196 | $ | 937.8 | $ | 1,526.0 | $ | 3,474.2 |
| Multiplier | 1.484 | | 1.476 | | 1.668 | | 1.550 |
| Share of Region | 3.4% | | 2.9% | | 2.9% | | 3.0% |
| **Dairy Farm** | | | | | | | |
| Direct Effect | 4,971 | $ | 213.4 | $ | 558.6 | $ | 1,186.4 |
| Indirect Effect | 1,646 | $ | 78.2 | $ | 139.0 | $ | 457.9 |
| Induced Effect | 1,709 | $ | 65.1 | $ | 122.0 | $ | 195.4 |
| Total Effect | 8,326 | $ | 356.7 | $ | 819.6 | $ | 1,839.7 |
| Multiplier | 1.675 | | 1.672 | | 1.467 | | 1.551 |
| Share of Region | 1.3% | | 1.1% | | 1.6% | | 1.6% |
| **Floriculture** | | | | | | | |
| Direct Effect | 196 | $ | 47.0 | $ | 27.0 | $ | 40.9 |
| Indirect Effect | 52 | $ | 2.3 | $ | 3.1 | $ | 5.3 |
| Induced Effect | 290 | $ | 11.0 | $ | 20.7 | $ | 33.1 |
| Total Effect | 538 | $ | 60.4 | $ | 50.7 | $ | 79.2 |
| Multiplier | 2.744 | | 1.285 | | 1.881 | | 1.939 |
| Share of Region | 0.1% | | 0.2% | | 0.1% | | 0.1% |
| **Forestry** | | | | | | | |
| Direct Effect | 110 | $ | 3.2 | $ | 2.5 | $ | 10.9 |
| Indirect Effect | 56 | $ | 2.4 | $ | 2.3 | $ | 4.6 |
| Induced Effect | 33 | $ | 1.2 | $ | 2.3 | $ | 3.7 |
| Total Effect | 198 | $ | 6.8 | $ | 7.1 | $ | 19.2 |
| Multiplier | 1.800 | | 2.130 | | 2.852 | | 1.761 |
| Share of Region | 0.0% | | 0.0% | | 0.0% | | 0.0% |
| **Dairy Processing** | | | | | | | |
| Direct Effect | 5,298 | $ | 406.8 | $ | 566.2 | $ | 5,353.6 |
| Indirect Effect | 3,269 | $ | 251.1 | $ | 349.4 | $ | 3,303.5 |
| Induced Effect | 890 | $ | 68.4 | $ | 95.1 | $ | 899.7 |
| Total Effect | 9,458 | $ | 726.3 | $ | 1,010.7 | $ | 9,556.8 |
| Multiplier | 1.785 | | 1.785 | | 1.785 | | 1.785 |
| Share of Region | 1.5% | | 2.3% | | 2.0% | | 8.3% |
| **Agricultural or Food Processing** | | | | | | | |
| Direct Effect | 16,902 | $ | 1,032.4 | $ | 1,312.0 | $ | 9,819.1 |
| Indirect Effect | 25,663 | $ | 1,327.3 | $ | 2,316.5 | $ | 4,825.2 |
| Induced Effect | 14,578 | $ | 554.7 | $ | 1,043.0 | $ | 1,638.3 |
| Total Effect | 57,143 | $ | 2,914.5 | $ | 4,671.5 | $ | 16,282.6 |
| Multiplier | 3.381 | | 2.823 | | 3.560 | | 1.658 |
| Share of Region | 8.9% | | 9.2% | | 9.0% | | 14.2% |
| **All Agriculture (no forestry)** | | | | | | | |
| Direct Effect | 31,857 | $ | 1,667.7 | $ | 2,226.8 | $ | 12,060.4 |
| Indirect Effect | 28,187 | $ | 1,450.7 | $ | 2,591.2 | $ | 5,519.8 |
| Induced Effect | 19,293 | $ | 734.0 | $ | 1,379.5 | $ | 2,176.6 |
| Total Effect | 79,339 | $ | 3,852.3 | $ | 6,197.5 | $ | 19,756.7 |
| Multiplier | 2.490 | | 2.310 | | 2.783 | | 1.638 |
| Share of State Total | 12.3% | | 12.1% | | 12.0% | | 17.2% |

| Contribution of Agriculture 2012: South West Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 16,575 | $ 435.0 | $ 666.6 | $ 1,794.2 |
| Indirect Effect | 1,616 | $ 61.4 | $ 175.9 | $ 344.1 |
| Induced Effect | 2,525 | $ 83.0 | $ 173.4 | $ 277.5 |
| Total Effect | 20,716 | $ 579.4 | $ 1,015.8 | $ 2,415.8 |
| Multiplier | 1.250 | 1.332 | 1.524 | 1.346 |
| Share of Region | 15.5% | 11.6% | 11.6% | 12.9% |
| **Dairy Farm** | | | | |
| Direct Effect | 3,992 | $ 117.9 | $ 349.1 | $ 741.4 |
| Indirect Effect | 896 | $ 31.1 | $ 61.4 | $ 171.9 |
| Induced Effect | 683 | $ 22.6 | $ 46.9 | $ 75.2 |
| Total Effect | 5,572 | $ 171.6 | $ 457.4 | $ 988.6 |
| Multiplier | 1.396 | 1.456 | 1.310 | 1.333 |
| Share of Region | 4.2% | 3.4% | 5.2% | 5.3% |
| **Floriculture** | | | | |
| Direct Effect | 42 | $ 6.7 | $ 4.2 | $ 6.3 |
| Indirect Effect | 8 | $ 0.4 | $ 0.5 | $ 0.8 |
| Induced Effect | 33 | $ 1.1 | $ 2.2 | $ 3.6 |
| Total Effect | 82 | $ 8.2 | $ 6.9 | $ 10.7 |
| Multiplier | 1.960 | 1.217 | 1.643 | 1.686 |
| Share of Region | 0.1% | 0.2% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 244.0 | $ 3.2 | $ 0.7 | $ 13.0 |
| Indirect Effect | 48.0 | $ 2.2 | $ 2.5 | $ 5.2 |
| Induced Effect | 26.9 | $ 0.9 | $ 1.8 | $ 3.0 |
| Total Effect | 318.9 | $ 6.3 | $ 5.0 | $ 21.2 |
| Multiplier | 1.307 | 1.976 | 7.585 | 1.631 |
| Share of Region | 0.2% | 0.1% | 0.1% | 0.1% |
| **Dairy Processing** | | | | |
| Direct Effect | 1,904 | $ 100.2 | $ 180.2 | $ 1,988.3 |
| Indirect Effect | 1,063 | $ 55.9 | $ 100.6 | $ 1,109.8 |
| Induced Effect | 165 | $ 8.7 | $ 15.6 | $ 172.4 |
| Total Effect | 3,132 | $ 164.8 | $ 296.4 | $ 3,270.6 |
| Multiplier | 1.645 | 1.645 | 1.645 | 1.645 |
| Share of Region | 2.3% | 3.3% | 3.4% | 17.5% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 2,154 | $ 110.3 | $ 197.3 | $ 2,101.3 |
| Indirect Effect | 1,175 | $ 60.1 | $ 107.6 | $ 1,145.9 |
| Induced Effect | 186 | $ 9.5 | $ 17.0 | $ 181.3 |
| Total Effect | 3,515 | $ 179.9 | $ 321.9 | $ 3,428.5 |
| Multiplier | 1.632 | 1.632 | 1.632 | 1.632 |
| Share of Region | 2.6% | 3.6% | 3.7% | 18.3% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 18,729 | $ 545.3 | $ 863.9 | $ 3,895.4 |
| Indirect Effect | 2,791 | $ 121.6 | $ 283.5 | $ 1,490.0 |
| Induced Effect | 2,711 | $ 92.5 | $ 190.4 | $ 458.8 |
| Total Effect | 24,231 | $ 759.4 | $ 1,337.7 | $ 5,844.2 |
| Multiplier | 1.294 | 1.393 | 1.549 | 1.500 |
| Share of State Total | 18.1% | 15.1% | 15.3% | 31.2% |

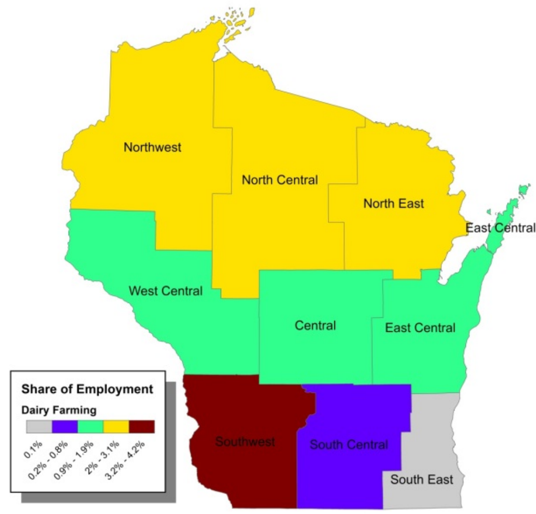
| Contribution of Agriculture 2012: South Central Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 17,136 | $ 681.6 | $ 801.0 | $ 2,129.6 |
| Indirect Effect | 2,782 | $ 130.5 | $ 323.2 | $ 696.5 |
| Induced Effect | 4,983 | $ 194.9 | $ 372.5 | $ 579.9 |
| Total Effect | 24,903 | $ 1,006.9 | $ 1,496.7 | $ 3,406.1 |
| Multiplier | 1.453 | 1.477 | 1.868 | 1.599 |
| Share of Region | 4.0% | 3.3% | 2.9% | 3.6% |
| **Dairy Farm** | | | | |
| Direct Effect | 2,862 | $ 117.9 | $ 323.1 | $ 686.3 |
| Indirect Effect | 972 | $ 51.3 | $ 89.9 | $ 268.1 |
| Induced Effect | 942 | $ 36.9 | $ 70.4 | $ 109.7 |
| Total Effect | 4,776 | $ 206.1 | $ 483.3 | $ 1,064.1 |
| Multiplier | 1.669 | 1.749 | 1.496 | 1.551 |
| Share of Region | 0.8% | 0.7% | 1.0% | 1.1% |
| **Floriculture** | | | | |
| Direct Effect | 272 | $ 67.5 | $ 38.2 | $ 57.8 |
| Indirect Effect | 78 | $ 4.2 | $ 5.5 | $ 8.9 |
| Induced Effect | 397 | $ 15.5 | $ 29.6 | $ 46.2 |
| Total Effect | 747 | $ 87.2 | $ 73.3 | $ 112.9 |
| Multiplier | 2.744 | 1.293 | 1.921 | 1.952 |
| Share of Region | 0.1% | 0.3% | 0.1% | 0.1% |
| **Forestry** | | | | |
| Direct Effect | 44 | $ 4.2 | $ 4.4 | $ 10.6 |
| Indirect Effect | 58 | $ 3.0 | $ 2.8 | $ 4.4 |
| Induced Effect | 40 | $ 1.6 | $ 3.0 | $ 4.6 |
| Total Effect | 142 | $ 8.7 | $ 10.1 | $ 19.6 |
| Multiplier | 3.230 | 2.087 | 2.316 | 1.853 |
| Share of Region | 0.0% | 0.0% | 0.0% | 0.0% |
| **Dairy Processing** | | | | |
| Direct Effect | 2,278 | $ 156.0 | $ 222.4 | $ 2,153.9 |
| Indirect Effect | 1,335 | $ 91.5 | $ 130.4 | $ 1,262.6 |
| Induced Effect | 342 | $ 23.4 | $ 33.3 | $ 322.9 |
| Total Effect | 3,955 | $ 270.9 | $ 386.2 | $ 3,739.4 |
| Multiplier | 1.7361 | 1.7361 | 1.7361 | 1.7361 |
| Share of Region | 0.6% | 0.9% | 0.8% | 4.0% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 11,177 | $ 747.6 | $ 991.2 | $ 6,193.0 |
| Indirect Effect | 13,476 | $ 701.4 | $ 1,217.7 | $ 2,425.4 |
| Induced Effect | 8,376 | $ 327.5 | $ 627.5 | $ 963.3 |
| Total Effect | 33,030 | $ 1,776.5 | $ 2,836.4 | $ 9,581.8 |
| Multiplier | 2.955 | 2.376 | 2.862 | 1.547 |
| Share of Region | 5.3% | 5.8% | 5.6% | 10.2% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 28,313 | $ 1,429.2 | $ 1,792.2 | $ 8,322.7 |
| Indirect Effect | 16,258 | $ 831.8 | $ 1,540.9 | $ 3,122.0 |
| Induced Effect | 13,359 | $ 522.4 | $ 999.9 | $ 1,543.2 |
| Total Effect | 57,933 | $ 2,783.4 | $ 4,333.1 | $ 12,987.9 |
| Multiplier | 2.046 | 1.948 | 2.418 | 1.561 |
| Share of State Total | 9.3% | 9.1% | 8.5% | 13.8% |

| Contribution of Agriculture 2012: South East Region ($MM) | | | | |
|---|---|---|---|---|
| | **Employment** | **Labor Income** | **Total Income** | **Industry Sales** |
| **On Farm** | | | | |
| Direct Effect | 6,170 | $ 301.9 | $ 299.5 | $ 747.5 |
| Indirect Effect | 1,092 | $ 60.6 | $ 132.9 | $ 257.3 |
| Induced Effect | 2,486 | $ 111.7 | $ 194.4 | $ 303.8 |
| Total Effect | 9,750 | $ 460.2 | $ 626.8 | $ 1,308.5 |
| Multiplier | 1.580 | 1.525 | 2.093 | 1.751 |
| Share of Region | 0.8% | 0.7% | 0.6% | 0.7% |
| **Dairy Farm** | | | | |
| Direct Effect | 869 | $ 33.3 | $ 90.2 | $ 191.7 |
| Indirect Effect | 256 | $ 14.5 | $ 25.6 | $ 70.4 |
| Induced Effect | 317 | $ 14.2 | $ 24.8 | $ 38.7 |
| Total Effect | 1,442 | $ 62.1 | $ 140.7 | $ 300.7 |
| Multiplier | 1.659 | 1.863 | 1.559 | 1.569 |
| Share of Region | 0.1% | 0.1% | 0.1% | 0.5% |
| **Floriculture** | | | | |
| Direct Effect | 422 | $ 92.9 | $ 55.6 | $ 84.2 |
| Indirect Effect | 102 | $ 6.0 | $ 8.3 | $ 14.3 |
| Induced Effect | 650 | $ 29.2 | $ 50.8 | $ 79.4 |
| Total Effect | 1,174 | $ 128.1 | $ 114.7 | $ 177.9 |
| Multiplier | 2.7822 | 1.3785 | 2.0636 | 2.1127 |
| Share of Region | 0.1% | 0.1% | 0.1% | 0.3% |
| **Forestry** | | | | |
| Direct Effect | 20 | $ 3.0 | $ 3.3 | $ 7.0 |
| Indirect Effect | 5 | $ 1.0 | $ 1.0 | $ 1.8 |
| Induced Effect | 9 | $ 1.2 | $ 2.1 | $ 3.3 |
| Total Effect | 35 | $ 5.3 | $ 6.4 | $ 12.1 |
| Multiplier | 1.734 | 1.736 | 1.955 | 1.734 |
| Share of Region | 0.0% | 0.0% | 0.0% | 0.0% |
| **Dairy Processing** | | | | |
| Direct Effect | 773 | $ 55.0 | $ 103.8 | $ 873.9 |
| Indirect Effect | 416 | $ 29.6 | $ 55.9 | $ 470.5 |
| Induced Effect | 79 | $ 5.7 | $ 10.7 | $ 166.9 |
| Total Effect | 1,269 | $ 90.3 | $ 170.3 | $ 1,511.3 |
| Multiplier | 1.641 | 1.641 | 1.641 | 1.729 |
| Share of Region | 0.1% | 0.1% | 0.1% | 2.3% |
| **Agricultural or Food Processing** | | | | |
| Direct Effect | 13,908 | $ 857.2 | $ 1,234.9 | $ 7,067.6 |
| Indirect Effect | 14,637 | $ 969.8 | $ 1,467.2 | $ 2,631.7 |
| Induced Effect | 12,597 | $ 566.2 | $ 987.2 | $ 1,521.9 |
| Total Effect | 41,144 | $ 2,393.2 | $ 3,689.4 | $ 11,221.2 |
| Multiplier | 2.958 | 2.792 | 2.987 | 1.588 |
| Share of Region | 3.4% | 2.3% | 1.9% | 16.8% |
| **All Agriculture (no forestry)** | | | | |
| Direct Effect | 20,500 | $ 1,252.0 | $ 1,590.0 | $ 7,899.3 |
| Indirect Effect | 14,429 | $ 984.3 | $ 1,515.6 | $ 2,687.7 |
| Induced Effect | 15,708 | $ 705.2 | $ 1,230.2 | $ 1,896.1 |
| Total Effect | 50,638 | $ 2,941.6 | $ 4,335.9 | $ 12,483.1 |
| Multiplier | 2.470 | 2.349 | 2.727 | 1.580 |
| Share of State Total | 4.2% | 2.8% | 2.2% | 18.7% |

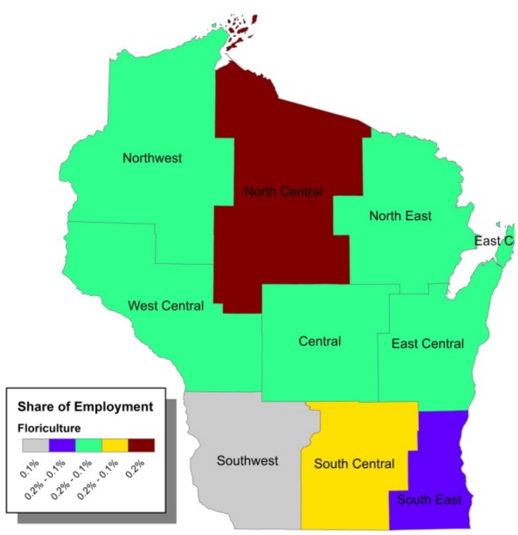
Share of Employment from All On-Farm Activity



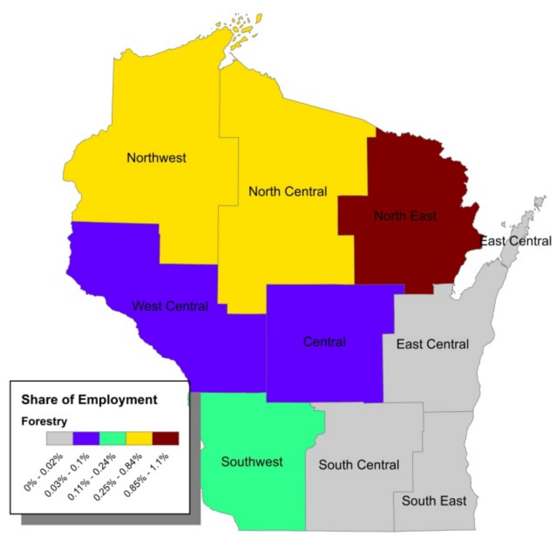

Share of Employment from Dairy Farming



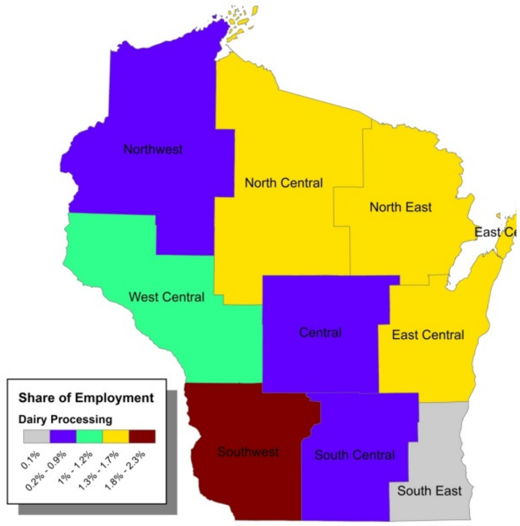

Share of Employment from Floriculture



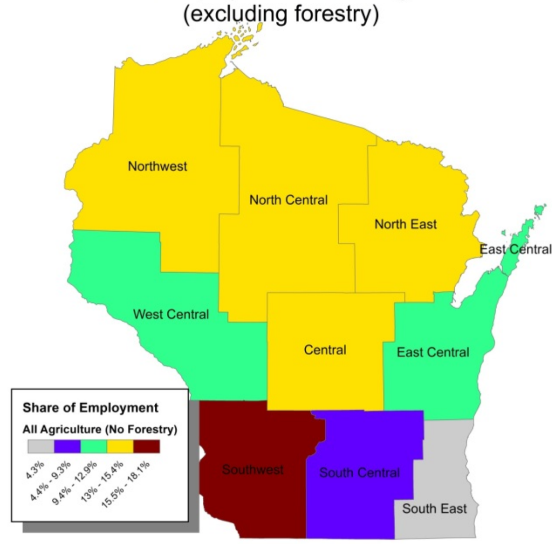

Share of Employment from Forestry



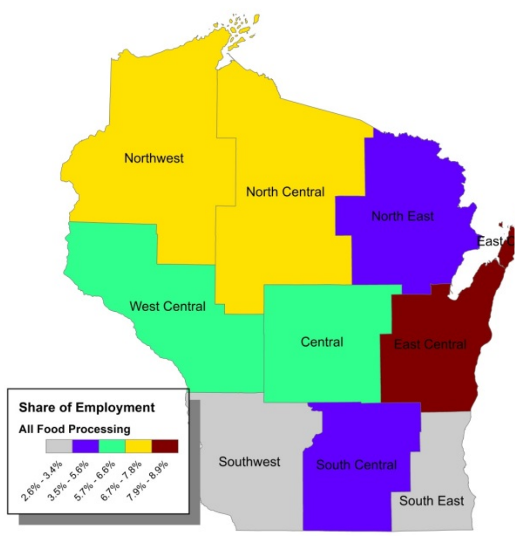
Share of Employment from Dairy Processing



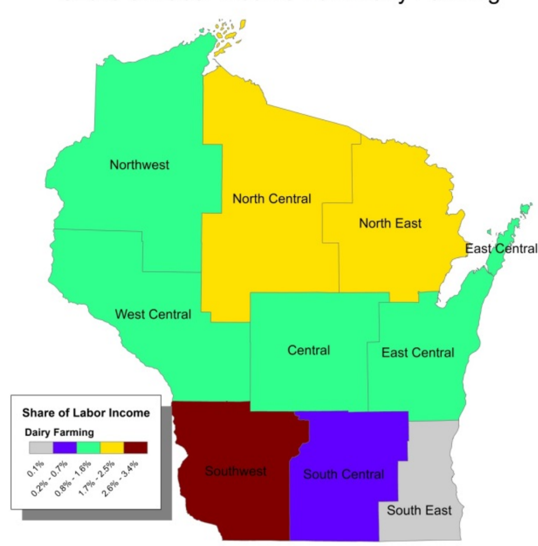

Share of Employment from All Agriculture (excluding forestry)



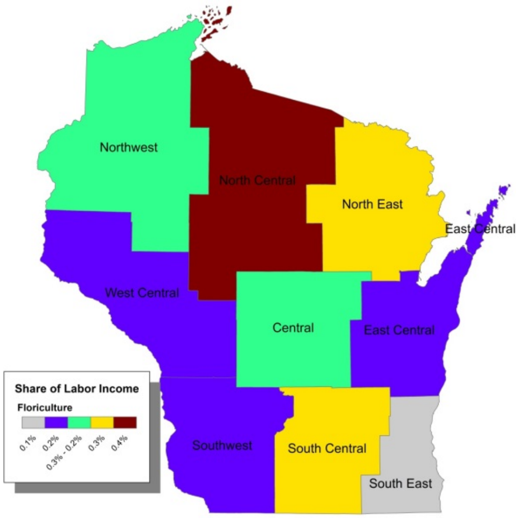

Share of Employment from Food Processing



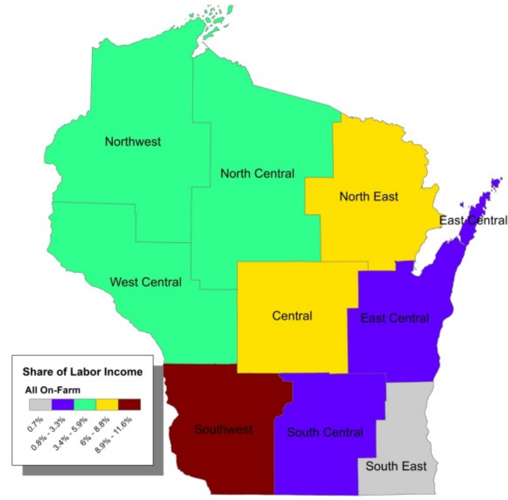

Share of Labor Income from Dairy Farming



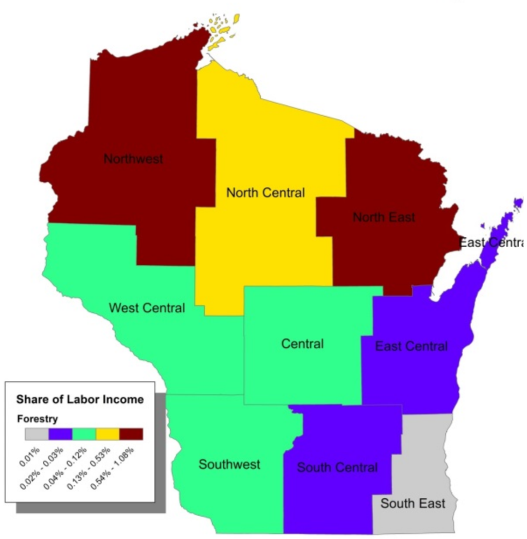
Share of Labor Income from Floriculture



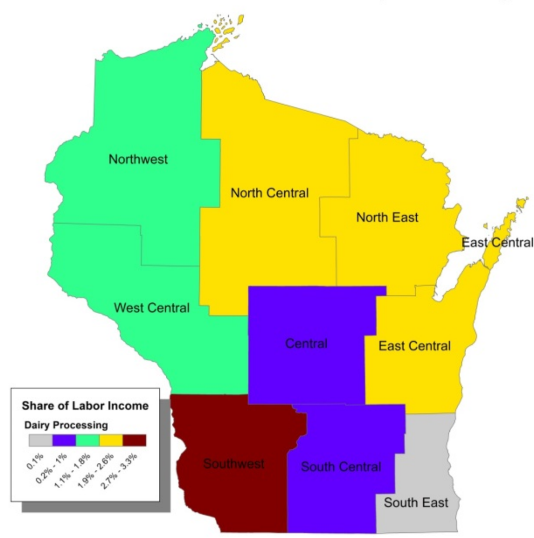

Share of Labor Income from All On-Farm



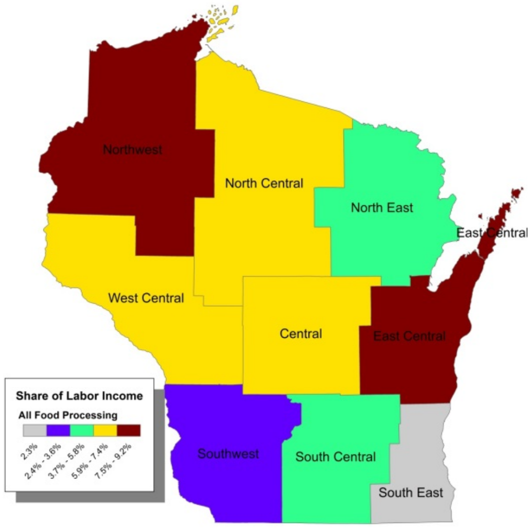

Share of Labor Income from Forestry



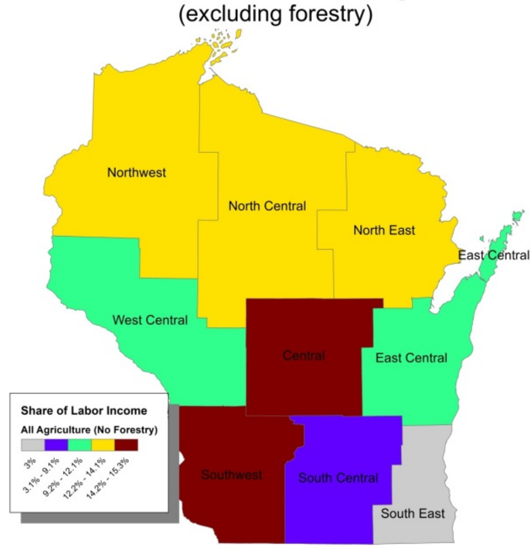

Share of Labor Income from Dairy Processing



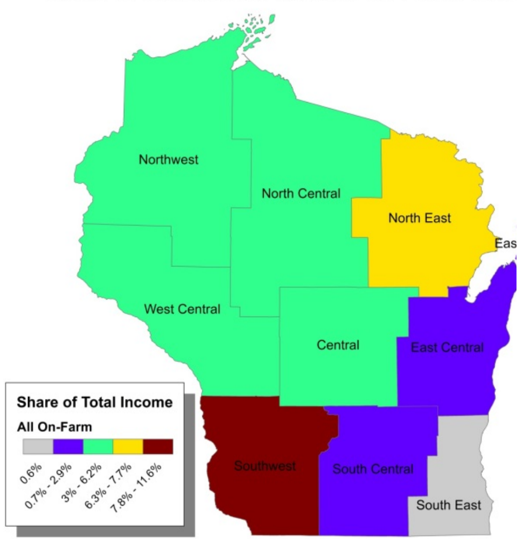
Share of Labor Income from All Food Processing



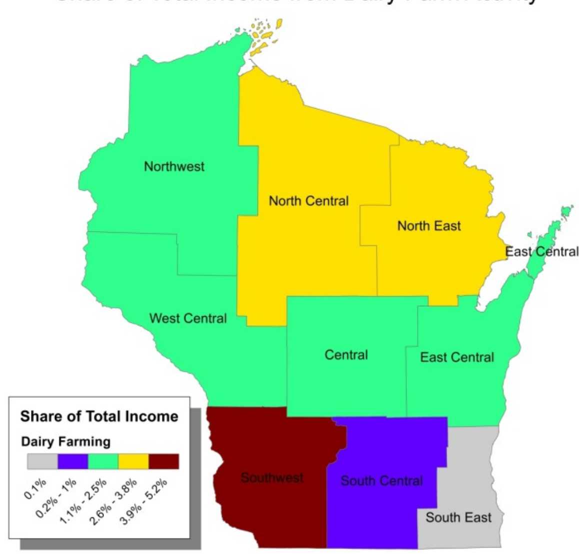

Share of Labor Income from All Agriculture (excluding forestry)

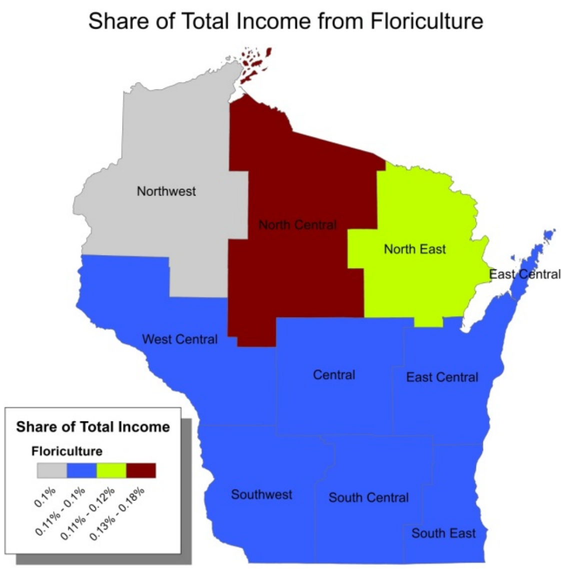


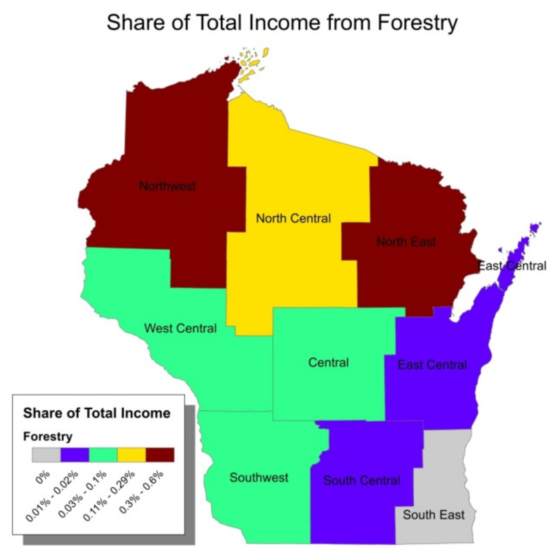

Share of Total Income from All On-Farm Activi

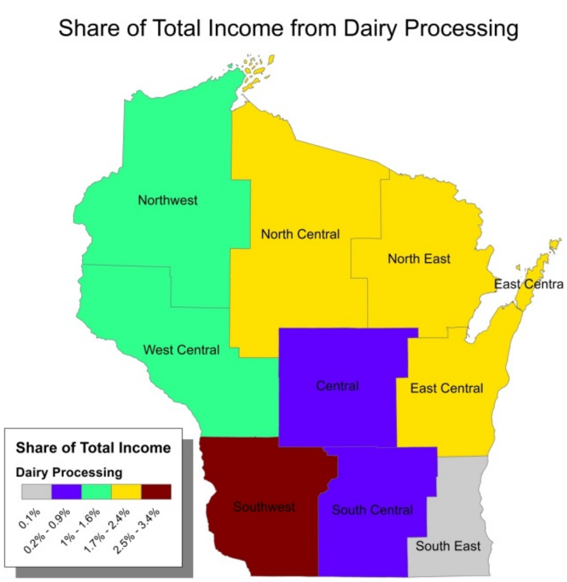


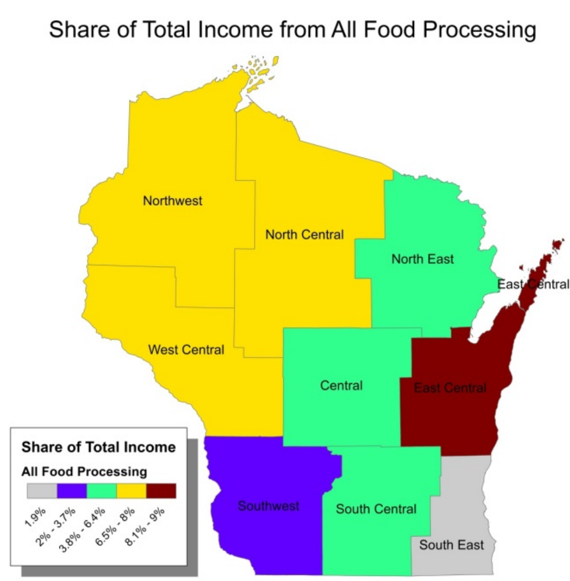

Share of Total Income from Dairy Farm Activity



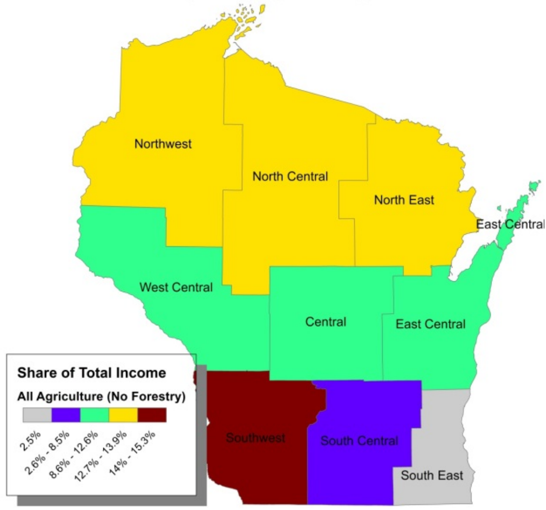

Share of Total Income from Floriculture
Northwest
North Central
North East
East Central
West Central
Central
East Central
Southwest
South Central
South East
Share of Total Income
Floriculture
0.1%
0.11% - 0.1%
0.11% - 0.12%
0.13% - 0.18%


Share of Total Income from Forestry
Northwest
North Central
North East
East Central
West Central
Central
East Central
Southwest
South Central
South East
Share of Total Income
Forestry
0%
0.01% - 0.02%
0.03% - 0.1%
0.11% - 0.29%
0.3% - 0.6%

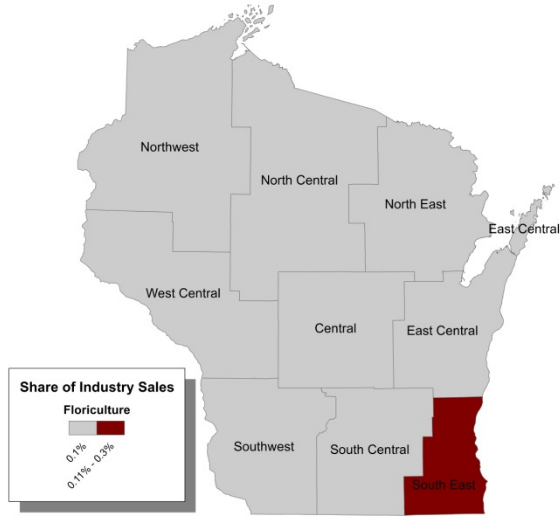

Share of Total Income from Dairy Processing
Northwest
North Central
North East
East Centra
West Central
Central
East Central
Southwest
South Central
South East
Share of Total Income
Dairy Processing
0.1%
0.2% - 0.9%
1% - 1.6%
1.7% - 2.4%
2.5% - 3.4%


Share of Total Income from All Food Processing
Northwest
North Central
North East
East Central
West Central
Central
East Central
Southwest
South Central
South East
Share of Total Income
All Food Processing
1.9%
2% - 3.7%
3.8% - 6.4%
6.5% - 8%
8.1% - 9%

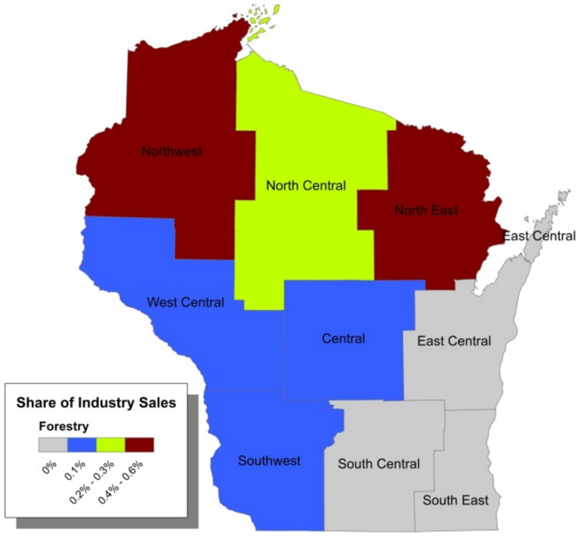
Share of Total Income from All Agriculture (excluding forestry)



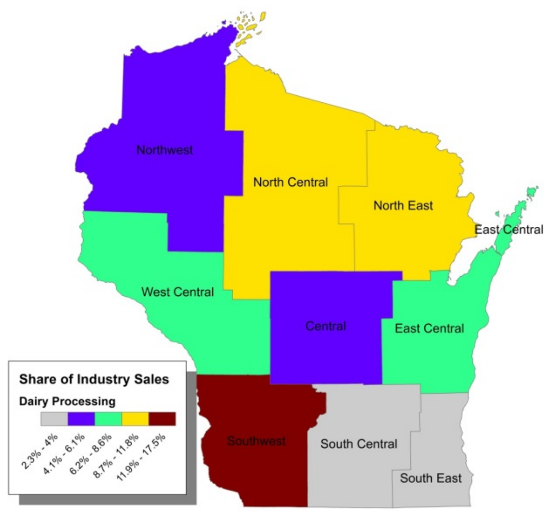

Share of Industry Sales from Floriculture

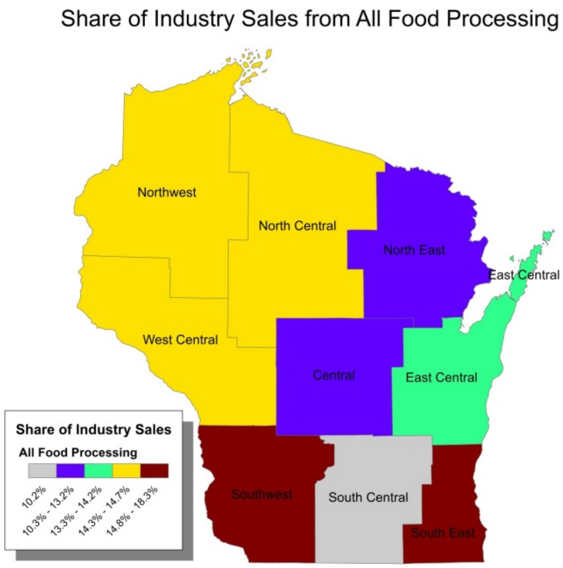


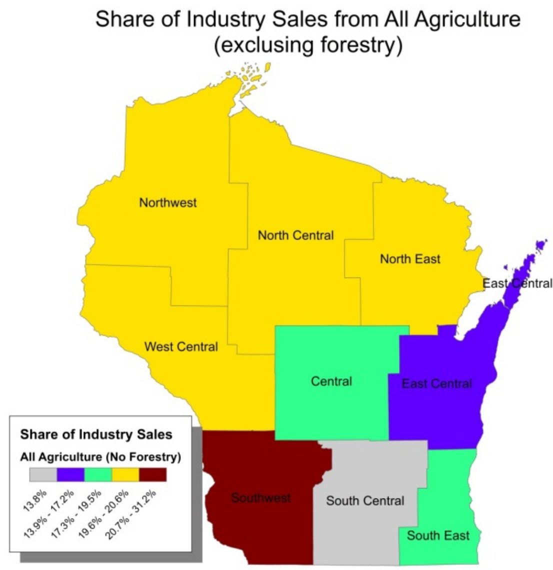

Share of Industry Sales from Forestry




Share of Industry Sales from Dairy Processing




Share of Industry Sales from All Food Processing
Northwest
North Central
North East
East Central
West Central
Central
East Central
Southwest
South Central
South East
Share of Industry Sales
All Food Processing
10.2%
10.3% - 13.2%
13.3% - 14.2%
14.3% - 14.7%
14.8% - 18.3%


Share of Industry Sales from All Agriculture
(exclusing forestry)
Northwest
North Central
North East
East Central
West Central
Central
East Central
Southwest
South Central
South East
Share of Industry Sales
All Agriculture (No Forestry)
13.8%
13.9% - 17.2%
17.3% - 19.5%
19.6% - 20.6%
20.7% - 31.2%

# Appendix A

## Input-Output Modeling

### Basics of Input-Output Modeling

We present a simple non-technical discussion of the formulation of input-output (IO) modeling in this section. An example of similar descriptive treatments would be Shaffer, Deller and Marcouiller (2004). An example of a more advanced discussion of input-output would be Miernyk (1965), and Miller and Blair (1985). As a descriptive tool, IO analysis represents a method for expressing the economy as a series of accounting transactions within and between the producing and consuming sectors. As an analytical tool, IO analysis expresses the economy as an interaction between the supply and demand for commodities. Given these interpretations, the IO model may be used to assess the impacts of alternative scenarios on the region's economy.

### Transactions Table

A central concept of IO modeling is the interrelationship between the producing sectors of the region (e.g., manufacturing firms), the consuming sectors (e.g., households) and the rest of the world (i.e., regional imports and exports). The simplest way to express this interaction is through a regional transactions table (Table A1). The transactions table shows the flow of all goods and services produced (or purchased) by sectors in the region. The key to understanding this table is realizing that one firm's purchases are another firm's sales and that producing more of one output requires the production or purchase of more of the inputs needed to produce that product.

**Table A1: Illustrative Transaction Table**

| | Purchasing Sectors (Buyers/Demand) | | | Final Demand | | |
|---|---|---|---|---|---|---|
| **Processing Sectors (Sellers/Supply)** | **Agr** | **Mfg** | **Serv** | **HH (labor)** | **Exports** | **Output** |
| **Agr** | 10 | 6 | 2 | 20 | 12 | 50 |
| **Mfg** | 4 | 4 | 3 | 24 | 14 | 49 |
| **Serv** | 6 | 2 | 1 | 34 | 10 | 53 |
| **HH (labor)** | 16 | 25 | 38 | 1 | 52 | 132 |
| **Imports** | 14 | 12 | 9 | 53 | 0 | 88 |
| **Inputs** | 50 | 49 | 53 | 132 | 88 | 372 |

The transactions table may be read from two perspectives: reading down a column gives the purchases by the sector named at the top of the column from each of the sectors named at the left. Reading across a row gives the sales of the sector named at the left of the row to those named at the top. In the illustrative transaction table for a fictitious regional economy (Table 1), reading down the first column shows that the agricultural firms buy $10 worth of their inputs from other agricultural firms. The sector also buys $4 worth of inputs from manufacturing firms and $6 worth from the service industry. Note that agricultural firms also made purchases from non-processing sectors of the economy, such as the household sector ($16) and imports from other regions ($14). Purchases from the household sector represent value added, or income to people in the form of wages and investment returns. In this example, agricultural firms purchased a total of $50 worth of inputs.

Reading across the first row shows that agriculture sold \$10 worth of its output to agriculture, \$6 worth to manufacturing, \$2 worth to the service sector. The remaining \$32 worth of agricultural output was sold to households or exported out of the region. In this case \$20 worth of agricultural output was sold to households within the region and the remaining \$12 was sold to firms or households outside the region. In the terminology of IO modeling, \$18 (=\$10+\$6+\$2) worth of agricultural output was sold for intermediate consumption, and the remaining \$32 (=\$20+\$12) worth was sold to final demand. Note that the transactions table is balanced: total agricultural output (the sum of the row) is exactly equal to agricultural purchases (the sum of the column). In an economic sense, total outlays (column sum, \$50) equal total income (row sum, \$50), or supply exactly equals supply. This is true for each sector.

The transactions table is important because it provides a comprehensive picture of the region's economy. Not only does it show the total output of each sector, but it also shows the interdependencies between sectors. It also indicates the sectors from which the region's residents earn income as well as the degree of openness of the region through imports and exports. In this example, households' total income, or value added for the region is \$132 (note total household income equals total household expenditure), and total regional imports is \$88 (note regional imports equals regional exports). More open economies will have a larger percentage of total expenditures devoted to imports. As discussed below, the "openness" of the economy has a direct and important impact on the size of economic multipliers. Specifically, more open economies have a greater share of purchases, both intermediate and final consumption purchases, taking the form of imports. As new dollars are introduced (injected from exports) into the economy they leave the economy more rapidly through leakages (imports).

## Direct Requirements Table

Important production relationships in the regional economy can be further examined if the patterns of expenditures made by a sector are stated in terms of proportions. This means that the proportions of all inputs needed to produce one dollar of output in a given sector can be used to identify linear production relationships. This is accomplished by dividing the dollar value of inputs purchased from each sector by total expenditures. Or, each transaction in a column is divided by the column sum. The resulting table is called the direct requirements table (Table A2).

The direct requirements table, as opposed to the transactions table, can only be read down each column. Each cell represents the dollar amount of inputs required from the industry named at the left to produce one dollar's worth of output from the sector named at the top. Each column essentially represents a `production recipe' for a dollar's worth of output. Given this latter interpretation, the upper part of the table (above households) is often referred to as the matrix of technical coefficients. In this example, for every dollar of sales by the agricultural sector, 20 cents worth of additional output from itself, 8 cents of output from manufacturing, 12 cents of output from services, and 32 cents from households will be required.

In the example region, an additional dollar of output by the agricultural sector requires firms in agriculture to purchase a total of 40 cents from other firms located in the region. If a product or service required in the production process is not available from within the region, the product must be imported. In the agricultural sector, 28 cents worth of inputs are imported for each dollar of output. It is important to note that in IO analysis, this production formula, or technology (the column of direct requirement coefficients), is assumed to be constant and the same for all establishments within a sector. This assumption holds regardless of input prices or production levels.

**Table A2: Illustrative Direct Requirements Table**

| | Purchasing Sectors (Buyers/Demand) | | |
|---|---|---|---|
| **Processing Sectors (Sellers/Supply)** | **Agr** | **Mfg** | **Serv** |
| **Agr** | **0.20** | **0.12** | **0.04** |
| **Mfg** | **0.08** | **0.08** | **0.06** |
| **Serv** | **0.12** | **0.04** | **0.02** |
| **HH (labor)** | **0.32** | **0.51** | **0.72** |
| **Imports** | **0.28** | **0.24** | **0.02** |
| **Inputs** | **1.00** | **1.00** | **1.00** |

Assuming the direct requirements table also represents spending patterns necessary for additional production, the effects of a change in final demand of the output on the other of sectors can be predicted. For example, assume that export demand for the region's agricultural products increases by $100,000. From Table 2, it can be seen that any new final demand for agriculture will require purchases from the other sectors in the economy. The amounts shown in the first column are multiplied by the change in final demand to give the following figures: $20,000 from agriculture, $8,000 from manufacturing, and $12,000 from services. These are called the direct effects and, in this example, they amount to a total impact on the economy of $140,000 (the initial change [$100,000] plus the total direct effects [$40,000]). For many studies of economic impact the direct and initial effects are treated as the same although there are subtle differences.

The strength of input-output modeling is that it does not stop at this point, but also measures the indirect effects of an increase in agricultural exports. In this example, the agricultural sector increased purchases of manufactured goods by $8,000. To supply agriculture's new need for manufacturing products, the manufacturing sector must increase production. To accomplish this, manufacturing firms must purchase additional inputs from the other regional sectors.

Continuing our $100,000 increase in export demand for a region's agricultural products, for every dollar increase in output, manufacturing must purchase an additional 12 cents of agricultural goods ($8,000 x .12 = $960), 8 cents from itself ($8,000 x .08 = $640), and 4 cents from the service sector ($8,000 x .04 = $320). Thus, the impact on the economy from an increase in agricultural exports will be more than the $140,000 identified previously. The total impact will be $140,000 plus the indirect effect on manufacturing totaling $1,920 ($960 + $640 + $320), or $141,920. A similar process examining the service sector increases the total impact yet again by $1,440 ([$12,000 x .04] + [$12,000 x .06] + [$12,000 x .02] = $1,440).

The cycle does not stop, however, after only two rounds of impacts. To supply the manufacturing sectors with the newly required inputs, agriculture must increase output again, leading to an increase in manufacturing and service sector outputs. This process continues until the additional increases drop to an insignificant amount. The total impact on the regional economy, then, is the sum of a series of direct and indirect impacts. Fortunately, the sum of these direct and indirect effects can be more efficiently calculated by mathematical methods. The methodology was developed by the Noble winning economist Wassily Leontief and is easily accomplished using computerized models.

## Total Requirements Table

Typically, the result of the direct and indirect effects is presented as a total requirements table, or the Leontief inverse table (Table A3). Each cell in Table 3 indicates the dollar value of output from the sector named at the left that will be required in total (i.e., direct plus indirect) for a one dollar increase in final demand for the output from the sector named at the top of the column. For example, the element in the first row of the first column indicates the total dollar increase in output of agricultural production that results from a $1 increase in final demand for agricultural products is $1.28. Here the agricultural multiplier is 1.28: for every dollar of direct agricultural sales there will be an additional 28 cents of economic activity as measured by industry sales.

**Table A3: Illustrative Total Requirements Table**

| | **Purchasing Sectors (Buyers/Demand)** | | |
|---|---|---|---|
| **Processing Sectors (Sellers/Supply)** | **Agr** | **Mfg** | **Serv** |
| **Agr** | **1.28** | **0.17** | **0.06** |
| **Mfg** | **0.12** | **1.11** | **0.07** |
| **Serv** | **0.16** | **0.07** | **1.03** |
| **Inputs** | **1.56** | **1.35** | **1.16** |

An additional interpretation of the transactions table, as well as the direct requirements and total requirements tables, is the measure of economic linkages within the economy. For example, the element in the second row of the first column indicates the total increase in manufacturing output due to a dollar increase in the demand for agricultural products is 12 cents. This allows the analyst to not only estimate the total economic impact but also provide insights into which sectors will be impacted and to what level.

Highly linked regional economies tend to be more self-sufficient in production and rely less on outside sources for inputs. More open economies, however, are often faced with the requirement of importing production inputs into the region. The degree of openness can be obtained from the direct requirements table (Table 2) by reading across the imports row. The higher these proportions are, the more open the economy. As imports increase, the values of the direct requirement coefficients must, by definition, decline. It follows then that the values making up the total requirements table, or the multipliers, will be smaller. In other words, more open economies have smaller multipliers due to larger imports. The degree of linkage can be obtained by analyzing the values of the off- diagonal elements (those elements in the table with a value of less than one) in the total requirements table. Generally, larger values indicate a tightly linked economy, whereas smaller values indicate a looser or more open economy.

# Input-Output Multipliers

## Basics of Input-Output Multipliers

Through the discussion of the total requirements table, the notion of external changes in final demand rippling throughout the economy was introduced. The total requirements table can be used to compute the total impact a change in final demand for one sector will have on the entire economy. Specifically, the sum of each column shows the total increase in regional output resulting from a $1 increase in final demand for the column heading sector. Retaining the agricultural example, an increase of $1 in the demand for agricultural output will yield a total increase in regional output equal to $1.56 (Table 3). This figure represents the initial dollar increase plus 56 cents in direct and indirect effects. The column totals are often referred to as output multipliers.

The use of these multipliers for policy analysis can prove insightful. These multipliers can be used in preliminary policy analysis to estimate the economic impact of alternative policies or changes in the local economy. In addition, the multipliers can be used to identify the degree of structural interdependence between each sector and the rest of the economy. For example, in the illustrative region, a change in the agriculture sector would influence the local economy to the greatest extent, while changes in the service sector would produce the smallest change. The output multiplier described here is perhaps the simplest input-output multiplier available. The construction of the transactions table and its associated direct and total requirements tables creates a set of multipliers ranging from output to employment multipliers. Input-output analysis specifies this economic change, most commonly, as a change in final demand for some product. Economists sometimes might refer to this as the "exogenous shock" applied to the system. Simply stated, this is the manner in which we attempt to introduce an economic change.

The complete set includes:

| <u>Type</u> | <u>Definition</u> |
|---|---|
| 1. Output Multiplier | The output multiplier for industry *i* measures the sum of direct and indirect requirements from all sectors needed to deliver one additional dollar unit of output of *i* to final demand. |
| 2. Income Multiplier | The income multiplier measures the total change in income throughout the economy from a dollar unit change in final demand for any given sector. |
| 3. Employment Multiplier | The employment multiplier measures the total change in employment due to a one unit change in the employed labor force of a particular sector. |

The income multiplier represents a change in total income (employee compensation plus proprietary income plus other property income plus indirect business taxes) for every dollar change in income for any given sector. The employment multiplier represents the total change in employment resulting from the change in employment in any given sector. Thus, we have three ways that we can describe the change in final demand.

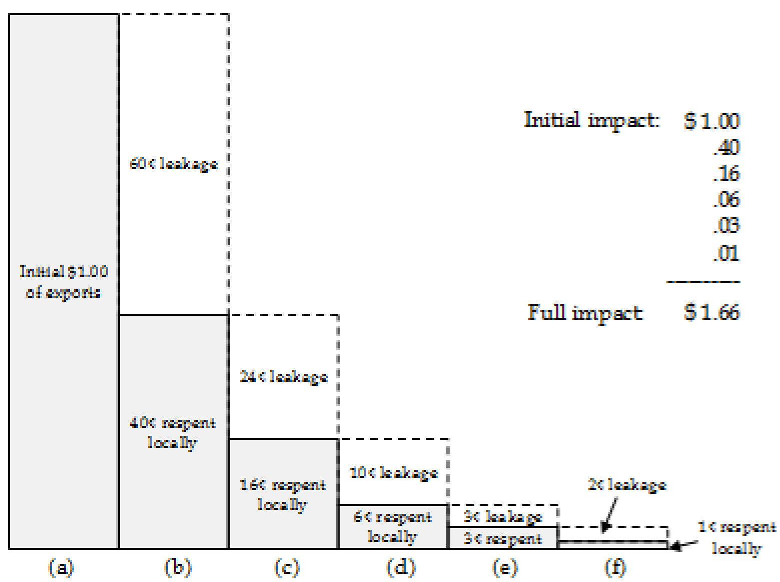
Consider, for example, a dairy farm that has $1 million in sales (industry output), pays labor $100,000 inclusive of wages, salaries and retained profits, and that employs three workers, including the farm proprietor. Suppose that demand for milk produced at these farm increases 10 percent, or $100,000 dollars. We could use the traditional output multiplier to determine what the total impact on output would be. Alternatively, to produce this additional output the farmer may find that they need to hire a part-time worker. We could use the employment multiplier to examine the impact of this new hire on total employment in the economy. In addition, the income paid to labor will increase by some amount and we can use the income multiplier to see what the total impact of this additional income will have on the larger economy.

How are these income and employment multipliers derived if the IO model only looks at the flow of industry expenditures (output)? In the strictest sense, the IO does not understand changes in employment or income, only changes in final demand (sales or output). To do this we use the fact that the IO model is a "fixed proportion" representation of the underlying production technologies. This is most clear by reexamining the direct requirements table (Table 2). For every dollar of output (sales) inputs are purchased in a fixed proportion according to the production technology described by the direct requirements table. For every dollar of output there is a fixed proportion of employment required as well as income paid. In our simple dairy farm example, for every dollar of output there are .000003 (= 1,000,000 ÷ 3) jobs and $.10 (= 1,000,000

÷ 100,000) in income. We can use these fixed proportions to convert changes in output (sales) into changes in employment and income.

Graphically, we can illustrate the round-by-round relationships modeled using input-output analysis. This is found in Figure 1. The direct effect of change is shown in the far left-hand side of the figure (the first bar (a)). For simplification, the direct effect of a $1.00 change in the level of exports, the indirect effects will spill over into other sectors and create an additional 66 cents of activity. In this example, the simple output multiplier is 1.66. A variety of multipliers can be calculated using input-output analysis.

While multipliers may be used to assess the impact of changes on the economy, it is important to note that such a practice leads to limited impact information. A more complete analysis is not based on a single multiplier, but rather, on the complete total requirements table. A general discussion of the proper and inappropriate uses of multipliers is presented in the next appendix to this text.




## Initial, Indirect and Induced Effects

The input-output model and resulting multipliers described up to this point presents only part of the story. In this construction of the total requirements table (Table 3) and the resulting multipliers, the production technology does not include labor. In the terminology of IO modeling, this is an "open" model. In this case, the multiplier captures only the initial effect (initial change in final demand or the initial shock) and the impact of industry to industry sales. This latter effect is called the indirect effect and results in a Type I multiplier. A more complete picture would include labor in the total requirements table. In the terminology of IO modeling, the model should be "closed" with respect to labor. If this is done, we have a different type of multiplier, specifically a Type II multiplier, which is composed of the initial and indirect effects as well as what is called the induced effects.

The Type II multiplier is a more comprehensive measure of economic impact because it captures industry to industry transactions (indirect) as well as the impact of labor spending income in the economy (induced effect). In the terminology of IO analysis, an "open" model where the induced effect is not captured, any labor or proprietor income that may be gained (positive shock) or lost (negative shock) is assumed to be lost to the economy. In our simple dairy farm example, any additional income (wages, salaries and profits) derived from the change in output (sales) is pocketed by labor and is not re-spent in the economy. This clearly is not the case: any additional income resulting from more labor being hired (or fired) will be spent in the economy thus generating an additional round of impacts. This second round of impacts is referred to as the induced impact.

Insights can be gained by comparing and contrasting the indirect and induced effects. For example, industries that are more labor intensive will tend to have larger induced impacts relative to indirect. In addition, industries that tend to pay higher wages and salaries will also tend to have larger induced effects. By decomposing the Type II multiplier into its induced and indirect effects, one can gain a better understanding of the industry under examination and its relationship to the larger economy.

# Appendix B:

## Misuses and Evaluation of Economic Multipliers

Multipliers are often misused or misunderstood. Problems frequently encountered in applying multipliers to community change include: (1) using different multipliers interchangeably; (2) double counting; (3) pyramiding; and (4) confusing multipliers with other economic measurements such as turnover and value added. Please note that if IMPLAN is used to generate the multipliers used in the analysis, many of the concerns outlined in this appendix are resolved.

### Misuse of Multipliers

**(1) Interchanging Multipliers**. As mentioned earlier, multipliers can be estimated for changes in business output, household income, and employment. These different multipliers are sometimes mistakenly used interchangeably. This should not be done because the sizes of the multipliers are different and because they measure completely different types of activity.

**(2) Double Counting**. Unless otherwise specified, the direct effect or initial change is included in all multiplier calculations. Consider, for example, a mining business multiplier of 2.20. The 2.20 represents 1.00 for the direct effect, and 1.20 for the indirect effects. The direct effect is thus accounted for by the multiplier and should not be added into the computation (double counted). A $440,000 total impact resulting from an increase of $200,000 in outside income (using the above 2.20 multiplier) includes $200,000 direct spending, plus $240,000 for the indirect effects. The multiplier effect is sometimes thought to refer only to the indirect effect. In this case, the initial impact is added to the multiplier effect, and is thereby counted twice—yielding an inflated estimate of change.

**(3) Pyramiding**. A more complicated error in using multipliers is pyramiding. This occurs when a multiplier for a non-basic sector is used in addition to the appropriate basic sector multiplier.

For example, sugar beet processing has been a major contributor to exports in many western rural counties. Assume the local sugar beet processing plant was closed and local officials wanted to determine the economic effect of the closing as well as the subsequent effect upon local farmers. The multiplier for the sugar beet processing sector includes the effect upon-farms raising sugar beets because the sugar beet crop is sold to local processors and not exported. Therefore, the processing multiplier should be used to measure the impact of changes in the sugar industry on the total economy. The impact estimate would be pyramided if the multiplier for farms, whose effects had already been counted, were added to processing.

Double counting and pyramiding are particularly serious errors because they result in greatly inflated impact estimates. If inflated estimates are used in making decisions about such things as school rooms or other new facilities, the results can be very expensive, indeed.

**(4) Turnover and Value Added**. Economic measurements incorrectly used for multipliers also result in misleading analysis. Two such examples are turnover and value added. Turnover refers to the number of times money changes hands within the community. In Figure 1, the initial dollar "turns over" five times; however, only part of the initial dollar is re-spent each time it changes hands. Someone confusing turnover with a multiplier might say the multiplier is 5, when the multiplier is actually only 1.66.

Value added reflects the portion of a product's total value or price that was provided within the local community. The value added would consider the value of a local raw product—like wheat delivered to the mill—and subtract that from the total wholesale value of the flour, then figure the ratio between the two. With cleaning losses, labor, bagging, milling, etc., the wholesale value may represent several times the value of the raw product and may be a fairly large number.

## Evaluating Multipliers

The determination of whether a multiplier is accurate can be a complicated procedure requiring time, extensive research, and the assistance of a trained economist. On the other hand, there are several questions that anyone who uses multipliers should ask. The test of accuracy for a multiple is captured in this question: How closely does that multiplier estimate economic relationships in the community (or region) being considered?

**(1) Is the multiplier based on local data, or is it an overlay?** Often, multipliers are used that were not developed specifically from data for that area. These multipliers are overlaid onto the area on the assumption that they will adequately reflect relationships in the economy. An example would be using the mining multiplier from a county in northwestern Wyoming to estimate a mining impact in northeastern Nevada.

A multiplier is affected by the economy's geographic location in relation to major trade centers. Areas where the trade center is outside the local economy have smaller multipliers than similar areas containing trade centers. Geographic obstacles en route to trade centers also affect a local economy. Multipliers for small plains towns are smaller than those for apparently comparable mountain towns, since plains residents usually do not face the same travel obstacles as mountain residents. More services will characteristically develop in the mountain area because of the difficulty in importing services; the larger services base will lead to a larger multiplier effect.

The size of the economy will also influence multiplier size. A larger area generally has more businesses. This means that a given dollar is able to circulate more times before leaking than would be the case in a smaller area. Two economies with similar population and geographic size may have quite different multipliers depending on their respective economic structures. For example, if two areas have similar manufacturing plants, but one imports raw materials and the other buys materials locally, then the manufacturing multiplier for the two areas would be quite different.

The overlaying practice, when used appropriately, can save money and time and produce very acceptable results. It is often difficult to find a similar area where impact studies have been completed so that multipliers can be borrowed readily. An area's dollar flow patterns may be so unique, for example, that overlaying will not work.

**(2) Is the multiplier based on primary or secondary data?** Usually, there is more confidence in a multiplier estimated from data gathered in the community than in published or already-collected data. Primary data collection, though, is expensive and time consuming. Recent research has indicated that in some cases, there is little difference between multipliers estimated by primary or secondary data. In fact, primary data multipliers are not necessarily better than secondary data multipliers. While the type of secondary data needed for estimating multipliers may be available from existing sources, the format and/or units of measurement may not permit some multipliers to be estimated. The resulting adjustments made to use the existing data may cause errors. If secondary data is used, it may be advisable to consult individuals familiar with the data regarding its use.

**(3) Aggregate versus disaggregate multipliers.** As mentioned earlier in this publication, disaggregate multipliers are much more specific and therefore generally more trustworthy than aggregate multipliers. The accuracy required, and the time and money available most likely will determine whether the model will be aggregate or disaggregate. In many cases, an aggregated rough estimate may be sufficient.

**(4) If you are dealing with an employment multiplier, is it based on number of jobs or full-time equivalent (FTE)?** Employment multipliers are often considered to be the most important multipliers used in impact analysis. This is because changes in employment can be transmitted to changes in population, which in turn affect social service needs and tax base requirements. Employment multipliers can be calculated on the basis of number of jobs or on FTE. One FTE equals one person working full-time for one year. When multipliers are calculated on a number-of-jobs basis, comparisons between industries are difficult because of different definitions of part-time workers. For example, part-time work in one industry might be four hours per day, while in another it might be ten hours per week. If calculations were based on number of jobs, a comparison of multipliers would be misleading. The conversion of jobs to FTE also helps adjust for seasonal employment in industries such as agriculture, recreation, and forestry.

**(5) What is the base year on which the economic model was formulated?** Inflation can affect multipliers in two ways: (1) through changes in the prices of industry inputs, and (2) through changes in the purchasing patterns produced by inflation. Each input-output multiplier assumes that price relationships between sectors remain constant over time (at least for the period under consideration). In other words, the studies estimating multipliers assume that costs change proportionally: utility prices change at nearly the same rate as the cost of food, steel, and other commodities. If some prices change drastically in relation to others, then purchasing patterns and multipliers will likely change.

Marketing patterns change slowly, however, and while they must be considered, they usually do not present a major problem unless the multiplier is several years old. The rate of growth in the local area will influence the period of use for the multipliers.

**(6) What can a multiplier do? As are most multipliers encountered by local decision makers,** the multipliers discussed here are static in nature. Static means that a multiplier can be used in "if/then" situations; they do not project the future. For example, if a new mine that employs 500 people comes into the country, then the total employment increase would be the employment multiplier times 500. A static model cannot be used to make projections about the time needed for an impact to run its course, or about the distribution of the impact over time. Static multipliers only indicate that if X happens, then Y will eventually occur.

**(7) How large is the impact in relation to the size of the affected industry on which the multiplier is based?** Dramatic changes in an industry's scale will usually alter markets, service requirements, and other components of an industry's spending patterns. Assume a mining sector employment multiplier of 2.0 had been developed in a rural economy having 132 FTE. If a mine were proposed several years later with an estimated 300 FTE, the multiplier of 2.0 would probably not accurately reflect the change in employment because of the scale of the project relative to the industry existing when the multiplier was developed. In essence, the new industry would probably change the existing economic structure in the local area.

**(8) Who calculated the multiplier—and did the person or agency doing the calculation have a vested interest in the result?** Multipliers are calculated by people using statistics, and as such, there is always the opportunity to adjust the size of the multiplier intentionally. Before accepting the results of a given multiplier, take time to assess the origin of the data. Studies conducted by individuals or firms having a vested interest in the study's results deserve careful examination.

**(9) Is household income included as a sector similar to the business sectors in the local economic model?** The decision to include household income in the model depends upon whether or not the household sector is expected to react similarly to other sectors when the economy changes, or whether personal income is largely produced by outside forces. Discussion of this issue is too lengthy for this publication, but the important point is that multipliers from models that include household sectors are likely to be larger than those from models without household sectors.