

Geographic Information Systems and the Economic Structure of the Seven Rivers Region

Benjamin R. E. Zietlow

Department of Resource Analysis, Saint Mary's University of Minnesota, Winona, MN 55987

Keywords: Geographic Information System (GIS), Seven Rivers Region, Economic Structure, Economic Development, Census Transportation Planning Package (CTPP), North American Industry Classification System (NAICS), Specialization Index, Location Quotient (LQ), Central Business District (CBD), Economic Centers

Abstract

Geographic Information Systems (GIS) have been used within the economic development and planning communities for over 20 years to improve the efficiency of planners and economic development organizations (EDOs). One possible use is to provide leaders in government and the private sector a static picture of the economic structure for use in future infrastructure and investment planning to support current industry. It is also used as part of decision-support systems. The economic structure of the 7 Rivers Region will be analyzed by identifying centers of economic activity, as well as the specializations at the census tract level by implementing specialization indexes and location quotients.

Introduction

“With unemployment up and tax revenues down, governments are searching for ways to encourage job growth and rebuild local economies” (Vines, 2010). In the late 1980’s and early 1990’s Geographic Information Systems’ (GIS) introduction to the world of economic development was billed as the ahead-of-the-curve innovation that would grant the user a competitive advantage and reputation as “pacesetter” (Pittman, 1990; Jenkins, Bing III, Brown, and Guin, 1990; Pittman and Thrall, 1991). Recent studies show GIS use has become common place amongst planners and viewed as a necessity (Drummond and French, 2008; Klosterman, 2008).

Immediately after the Second World War, cities across the North American landscape witnessed population decentralization away from the inner city and towards the newly forming

suburbs. Then during the early 1960s, jobs began to follow the population movement beginning with consumer services, followed by manufacturing, ‘back-office’ jobs in the 1970s, and finally in the late 1980s and early 1990s the “front-office” jobs (Coffey and Shearmur, 2001; Watkins, 2009).

Shearmur, Coffey, Dubé, and Barbonne (2007) discuss the resulting interest within academic and public policy circles during the late 1980s and 1990s. Urban and regional science, coupled with research by economists such as Krugman’s ‘new economic geography’ and Porter’s work with economic regions, “is largely concerned with the measurement and analysis of sets of indicators that help researchers uncover the underlying economic structures of places so that a better understanding may be gained of how regional economies function and interact with other places” (O’Donoghue and Townshend, 2005). Urban and

regional science attempt to answer questions concerning the location of concentrations of economic activity and then discern the types of economic activity occurring. Watkins (2009) and O'Donoghue and Townshend (2005) both underscore the need for determining a location's (city, county, region, state, etc.) economic structure in terms of infrastructure planning, the creation of economic policy, and future economic development. Utilizing a GIS, the goal is to provide actionable data for planners, developers, as well as business owners by answering those two questions for the ten counties comprising the '7 Rivers Region.'

Study Area

The ten counties representing the 7 Rivers Region form the study area. The counties include: Jackson, Juneau, La Crosse, Monroe, Trempealeau, and Vernon, of Wisconsin; Houston and Winona of Minnesota; and Allamakee and Winneshiek of Iowa (Figure 1). The area has access to multiple sources of transportation including major roads such as Interstate 90, Interstate 94, and highways comprising the "Great River Road." The La Crosse Municipal airport provides a direct commercial link to the Minneapolis–St. Paul's and Chicago's O'Hare International Airport. Amtrak provides passenger rail service with stops in La Crosse, WI, and Winona, MN. Multiple freight rail line companies operate in the region as well. As the name suggests, the 7 Rivers Region is also home to the Mississippi, La Crosse, Black, Root, Trempealeau, Kickapoo, and Iowa rivers. Fort McCoy, Volk Field Air National Guard Base, and Camp Williams are all located within the area. The 7 Rivers Region study area is home to a 2000 census population of 352,189 dispersed

over a combined 7,300 square miles.

La Crosse, WI is the central hub for this region. Located on a broad plain between the Mississippi River to the west and 500 foot bluffs and adjacent coulees to the east, La Crosse's origin can be traced back to this initial advantage as similar points of flat land along the Mississippi are sparse in this region. Winona, MN also benefits from the same initial advantage. The first trading post was initially set up on what is now known as Pettibone Park in 1841 and moved to the main land the following year. A small village was built near the junction of the Black, La Crosse, and Mississippi Rivers, and La Crosse's population grew to approximately 2,000 by 1856. At that point, La Crosse was a major city along the Mississippi River and saw its economy expand with the completion of the La Crosse and Milwaukee railroad in 1856, the birth of sawmills thanks in part to the boom in lumber demand/supply, and in part to access to water for transporting the lumber, the additions of major brewing and manufacturing facilities, and the addition of three educational institutions between 1890 and 1912.

Data

Part 2, Table 4 of the 2000 Census Transportation Planning Package (CTPP) served as the source of attribute data, while 2000 TIGER Census tract shapefiles, downloaded from the U.S. Census Bureau website via the FTP download, served as the spatial unit. The CTPP data is similar to table P49 from the U.S. Census's long form (sf3) in that it reports numbers of workers in particular industries for a particular census area but differs from the P49 table by reporting the data for the location of employment and not residence. The CTPP data places

workers into fourteen different industries and provides the data based on totals, males, and females. Table 1 lists the industries.



Figure 1. The ten counties forming the 7 Rivers Region.

Point or areal unit (census) data can be used to conduct the analysis and deciding which to use is the first step. Coffey and Shearmur (2001) are quick to point out the issues involved with both types of data and the corresponding ‘trade-off’ between availability and detail. The CTPP data is derived from the census data and as such exhibits the same positive and negative characteristics. On the one hand, census data is free to use, fairly manageable, is collected in a highly regulated and supervised manner, and contains vast arrays of information that can be easily viewed within a GIS by joining the tables with the corresponding shapefile. Census data also poses problems.

First, data gathered via the long form questionnaire only constitutes a sample of the population and any resulting analysis should be conducted with that in mind. Another drawback is its lack of

precision not only geographically but also in terms of industrial categorization- the CTPP data is analogous to only the 2 digit North American Industrial Classification System (NAICS) code level causing industries to be aggregated together. Depending on the data and geographical location, long form census data may or may not be available for lesser populated areas. All census data is subject to the modifiable areal unit problem (changing the geographical boundaries significantly changes the resulting analysis), and the choropleth map issue (the population distribution is unrealistically presented as being homogenous). Lastly, census data can be difficult when conducting time series analysis due to the changing areal unit boundaries over time or the addition of new data with no historical data to compare it to.

Point data assigns worker attributes to a single geographic coordinate and is provided by companies like Salesgenie (from Infogroup), InfoUSA, and Dun and Bradstreet. Because the point data is not dependent upon aggregation to different spatial units, a GIS can accommodate the overlay of multiple concurrent spatial unit boundaries atop the point data. While the point data allows for more detailed spatial analysis such as hot-spot analysis, cluster analysis, and spatial autocorrelation, it costs money to acquire. There are concerns regarding the level of detail and completeness attained by the data accruing companies. Coffey and Shearmur (2001) discuss administrative reporting when all jobs from a multiple location business are allocated to one location as another possible source of error. The Department of Transportation’s Federal Highway Administration (FHWA) website, where the CTPP data is disseminated, states this same administrative reporting as a source of error as well. Ridgeway (2009)

Table 1. The 14 industry classifications used in the CTPP's data package, and the corresponding NAICS code descriptions are found below. Then the number of workers within each industry at the national and 7 Rivers Region level is given followed by the region's LQ for each industry.

CTPP Field	NAICS Description	Nation's Workers	National Percentage	Region's Workers	Regional Percentage	Regional LQ
MTABX1	Total Workers	128,279,230		132,245		
MTABX2	Agriculture, forestry, fishing and hunting, and mining	2,376,060	1.8523%	7,414	5.6063%	3.0267
MTABX3	Construction	8,594,010	6.6995%	6,231	4.7117%	0.7033
MTABX4	Manufacturing	17,932,370	13.9792%	24,820	18.7682%	1.3426
MTABX5	Wholesale trade	4,593,355	3.5807%	4,827	3.6500%	1.0194
MTABX6	Retail trade	14,899,375	11.6148%	16,813	12.7135%	1.0946
MTABX7	Transportation, warehousing, and utilities	6,573,625	5.1245%	4,894	3.7007%	0.7222
MTABX8	Information	3,933,840	3.0666%	2,953	2.2330%	0.7282
MTABX9	Finance, insurance, real estate and rental and leasing	8,800,735	6.8606%	6,321	4.7798%	0.6967
MTABX10	Professional, scientific, management, administrative, and waste management services	11,844,950	9.2337%	6,265	4.7374%	0.5131
MTABX11	Educational, health and social services	25,323,310	19.7408%	32,437	24.5280%	1.2425
MTABX12	Arts, entertainment, recreation, accommodation and food services	9,954,735	7.7602%	9,591	7.2524%	0.9346
MTABX13	Other services (except public administration)	6,206,225	4.8381%	5,278	3.9911%	0.8249
MTABX14	Public administration	6,123,840	4.7738%	4,279	3.2357%	0.6778
MTABX15	Armed forces	1,122,790	0.8753%	113	0.0854%	0.0976

provides an example of the type of analysis that can be conducted with point data.

Using data derived from the census and not point data requires a geographical or spatial unit to be chosen for the data to be aggregated to. Examples of spatial units include counties, zip codes, tracts, travel area zones (TAZs), block groups, blocks, etc. Census tracts were chosen for this analysis mainly due to the fact that tracts were the smallest areal unit available with relative temporal stability. TAZs were not available for the entire study area. Coffey and Shearmur (2001) provide an in-depth analysis for a number of spatial units as well as support for the use of census tracts. They write, "In terms of the availability, quality, consistency, and regularity of collection of appropriate place-of-work data, as well as in terms of the temporal stability and inter-metropolitan comparability of spatial units, the CT is by far the superior alternative." According to TIGER line and CTPP data, the 7 Rivers Region study area contains a total of 87 census tracts, and 132,245 workers.

The FHWA's website states the CTPP data is "reliable" and "accurate" due to its large sample size. It is important to note that certain counties contain tracts numbered 999999. These worker counts are these workers that CTPP personnel were unable to place at the tract level. For the purposes of this research, those worker counts were removed from the data during analysis. The FHWA's website also stated total jobs in an area will be higher than CTPP worker counts predict. A couple comments on this:

- Census 2000 does not count jobs but instead employed persons. Those workers with multiple jobs are only counted once.
- CTPP 2000 counts workers at work and

those who are absent during the reference period may not be counted.

- CTPP 2000 includes both full and part time workers of all classes (private or public, wage or salaried, and self-employed), while differences exist amongst other sources.
- Locations with high numbers of part time employees tend to underestimate the true number of workers. Examples include areas with large amounts of retail or service based industries and areas with colleges and universities present.

While census data is limited in terms of depth and temporal availability, it will point one in the right direction, and the fact that it is free should not be underestimated. For example, a specialty manufacturer could easily substitute data that contains narrower NAICS codes than the CTPP data to locate an area that has multiple businesses that would be interested in buying its products. Once areas with high LQs are identified, the manufacturer could look to Google or the Yellow Pages to get the names and locations of the potential buyers.

Methods

In an attempt to describe the economic structure of the 7 Rivers Region, the study proceeds by answering the two previously discussed questions: Where are concentrations of economic activity located? And what types of economic activity are occurring in those locations?

A number of methods have been used by researchers in the past to identify centers of economic activity. Coffey and Shearmur (2001) provide an analysis and comparison of six general classes of methods employed to study the economic structure of Montreal, Canada; these include: Employment Thresholds, Local

Peaks in the Smoothed Employment Density Gradient, Ratio of Total Employment to Residents, Employment Density Combined with Total Employment Threshold, Ratio of total Employment to Resident Workers Combined with Total Employment Threshold, and Analysis of Origin-Destination Flows. Bogart and Ferry (1999) utilized a combination of employment density and minimum employment number, while Shearmur *et al.* (2007) applied a combination of workers to resident ratio with a minimum employment number.

In this study, the method initially used to identify economic centers was a simple ratio of total workers to residents with a minimum ratio of 1.0. Additional analysis was conducted using a percentage of a tract's portion of the study area's total workers at levels of two and one percent.

Once the employment centers were identified, a specialization index (θ) was computed to determine the level of specialization for each tract's industrial make-up. Dewhurst and McCann (2002) provide an analysis of various absolute (regional to regional data) and relative (regional to national data) specialization measures. The specialization index chosen for this research is the same as SPA1 presented by Dewhurst and McCann (2002). If i = a particular industry, t = a given census tract, N = number of industries for a given geographical area (in this case 14), M = number of census tracts in that same geographical area, and E_{it} is the number of jobs in census tract t and industry i , then each industry's share of employment within the census tract can be represented by:

$$S_{it} = \frac{E_{it}}{\sum_{i=1}^n E_{it}}$$

Next, the specialization index for that particular tract can be found by:

$$\theta = \sum_{i=1}^n S_{it}^2$$

Lastly, location quotients were computed for each E_{it} to provide a sector over sector ratio between the smaller and larger geographical areas. Location quotients were computed for census tracts to the 7 Rivers Region as a whole as well as the 7 Rivers Region to the nation to determine the Region's share of national workforce and its economic structure. Bogart and Ferry (1999) provide the following explanation for economic centers within the Greater Cleveland with location quotients greater than 1.4, "The listed specializations include all of the location quotients greater than 1.4. In other words, each of these industries has employment that is at least 40 per cent higher than would be the case if the centre reflected the five-county employment mix." As Figure 2 shows, LQ's will be greater than one when the sectorial percentage within the tract is greater than the same sectorial percentage for the 7 Rivers Region as a whole, and less than one when not.

Results and Discussion

Examination of the 7 Rivers Region's Aggregated Economy

The 7 Rivers Region is composed of 87 census tracts within 10 counties from three states. It is home to 132,245 workers and 352,189 residents. The sectors with LQ's greater than one include: 7,414 workers in agriculture, forestry, fishing, and mining (3.0267), 24,820 workers in manufacturing (1.3426), 32,437 workers in educational,

health, and social services (1.2425), 4,827 workers in wholesale trade (1.0194), and 16,813 workers in retail trade (1.0946). The sectors with the smallest LQ's include 113 workers in armed forces (.0976), 6,265 workers in professional, scientific, management, administration, and waste management (.5131), 4,279 workers in public administration (.6778), and 6,321 workers in the finance, insurance, and real estate (FIRE) industries (.6967). The full list can be seen in Table 1.

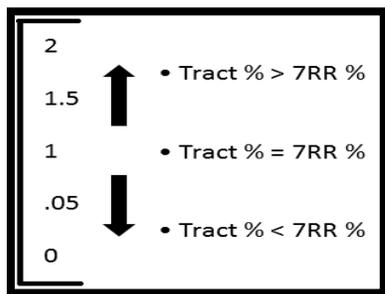


Figure 2. The relationship between the smaller and larger geographical areas and the resulting location quotient.

Identification of Economic Centers

Considering the vast difference between the 7 Rivers Region and those areas studied in previous research such as Cleveland (Bogart and Ferry, 1999), Montreal (Coffey and Shearmur, 2001), Montreal, Toronto, and Vancouver (Shearmur *et al.*, 2007), British urban areas (O'Donoghue and Townshend, 2005; Dewhurst and McCann, 2002), and Melbourne (Watkins, 2009), it is difficult to make direct comparisons. For example, the average area for the census tract in Cleveland's five-county study area was 2.9 square miles while it is 85.01 square miles for the 7 Rivers Region. The number of workers varies between the 7 Rivers Region's 132,245 and that of Cleveland's

984,967, Montreal's 1,133,800, Toronto's 1,769,845, and Vancouver's 620,780. Population counts also highlight this difference: Montreal and Melbourne are both 3 million plus while the 7 Rivers Region's 2000 population was 352,189. The economy of the 7 Rivers Region is clearly of a different kind than those previously studied.

Using the simple ratio of workers to residents identified six different census tracts as economic centers (Figure 3). The six tracts represent 27.1466 % of the 7 Rivers Region's workforce. Five of the six tracts are located within La Crosse County while the tract with the fifth highest ratio was located in Winona County. The six tracts combine for an area of roughly 68 square miles.

Census tract 55063300003 was clearly identified as the central business district (CBD) with a worker to resident ratio of 7.0674. This census tract, located within the heart of downtown La Crosse, was home to 7,550 workers with a strong presence in information; the FIRE sectors; professional, scientific, management, administrative, and waste management; and educational, health, and social services.

Tracts ranked number two and six were similar to one another with specialization indices of .1404 and .1484 respectively. Both tracts had large number of workers in manufacturing, and strong LQ's for wholesale trade (2.1119 and 5.0774 respectively). The second ranked tract also had a strong transportation, warehousing, and utilities sector (LQ of 3.2652, and 870 workers), and 1480 retail jobs. Tracts ranked four and five are good examples of highly specialized tracts with number four having a large presence,

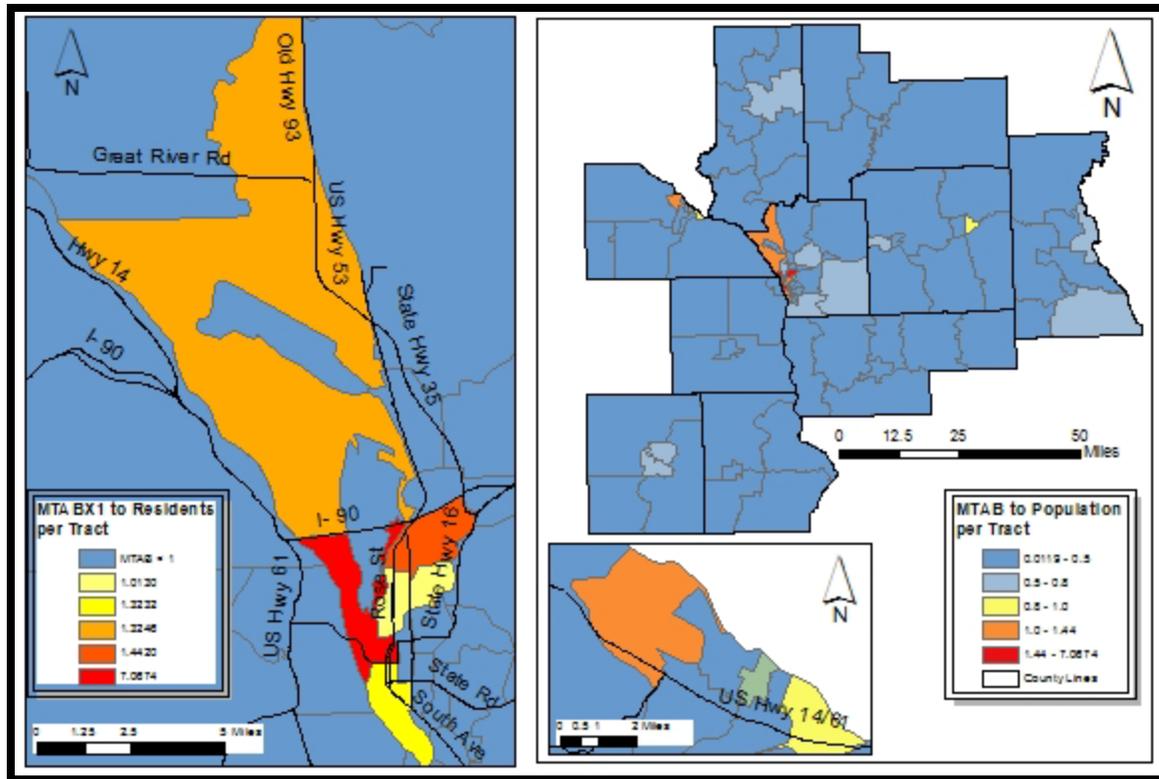


Figure 3. The map above to the left shows five of the six economic centers identified by the worker to population ratio within La Crosse County. The upper right map shows the ratios for each tract within the 7 Rivers Region, while the map on the bottom right shows the fifth ranked tract in Winona County.

4,290 of 6,760 workers, within the educational, health, and social services industries (Gundersen Lutheran is a major employer within this tract), and tract number five (Winona) highly specialized in the manufacturing sector with 2,145 workers of the total 3,430.

The tract ranked number three could be considered a questionable economic center. Although its ratio is 1.3246, 5,640 workers to 4,258 residents, the tract spans approximately 49 square miles. Its concentration of workers, 115.23 per square mile, is the lowest of the six census tracts with the closest at 442.98, tract ranked number five.

It is interesting to point out the six census tracts that comprise the majority of Winona, MN and some of Minnesota City, MN contribute 15,930 workers (approximately 12%) to the 7 Rivers

region but no CBD was identified via the worker to resident ratio. The reason for this goes back to one of the negatives working with census tracts as the areal unit: census tracts are created with equal resident populations in mind. La Crosse's CBD and other tracts are located along the river and extend eastward to the bluffs while Winona's are located along the water and extend westward to Lake Winona and the bluffs. The difference is geographical; whereas Winona's tracts include both industry and residential as they extend from one barrier (the river) to the opposite barrier (either Lake Winona or the bluffs), La Crosse's tracts identified as economic centers lean heavily towards industry as they extend from the river to other census tracts to the east that are primarily residential. Although the magnitude Winona's economy is not on

par with La Crosse's, the census tract with a specialization index of .1664 is closest to that of La Crosse's CBD's specialization index of .1107 and could be considered the CBD of Winona, MN and its surrounding communities.

Using a simple percentage of the 7 Rivers Region's workforce instead of a worker to resident ratio may be better suited for the 7 Rivers Region's economy (Figure 4). Using two percent as a minimum identified an additional 7 census tracts for a total of 13 (~15%) total tracts, and 59,670 workers (~45%). Centers were additionally identified in Decorah, IA with 4,055 workers, Tomah, WI with 3,625, Sparta WI with 2,655, parts of Onalaska and West Salem WI, with 3,140, an additional tract in La Crosse, WI with 2,935 (this area includes Viterbo University, Western Wisconsin Technical College, and St. Francis Hospital and Clinic of the Mayo Health System) and two additional tracts in Winona, MN with 4,030 (previously discussed as the CBD of Winona) and 3,330 workers.

Lowering the minimum to one percent added 18 tracts (31 total) and 36,705 workers (96,375 total). Thirteen of these tracts however were adjacent to tracts previously identified: nine in La Crosse County adding 18,530 workers, two in Winona County adding 3,990 workers, one in Decorah, IA adding 1,970 workers, and one in Tomah, WI adding 1,595 workers. The census tracts in the municipalities of Black River Falls, WI (2,330 workers), Independence, WI (2,315), Viroqua, WI (1,900), and Waukon, IA (1,605) make an interesting group. The four tracts are all on the periphery of the region, and with LQ's in the agriculture sector all under one, despite being surrounded by communities with LQ's in the range of 1.7035 to 12.2878, they seem to be mini-economic centers

supporting the heavily agricultural based neighboring areas. Black River Falls has eight different sectors with LQ's greater than one, while Waukon and Viroqua have six, and Independence three.

Lastly, it should be noted that La Crosse County was divided into 25 census tracts. Of these, all but nine have 7 Rivers Region worker percentages over one. The sum of workers for La Crosse County was 63,435 and square miles approximately 480, while these nine tracts were responsible for 6,360 workers and nearly 40 square miles. Almost two thirds of La Crosse County's census tracts could be considered some sort of economic center.

7 Rivers Region Specialization: Agriculture, Forestry, Fishing, & Mining

As stated earlier, the LQ for the 7 Rivers Region's agriculture, forestry, fishing, and mining sector was 3.0267. Aggregating the tracts to their county level provides a good look at the geographical make-up of the agricultural industry. Besides La Crosse and Juneau, the counties can be described as having a small tract or tracts with little to no agricultural presence surrounded by larger tracts covering the majority of the area with strong LQ's in agriculture. La Crosse County is the complete opposite home to 23 tracts with little to no agriculture surrounding two tracts with high LQ's. Juneau County has equal number of tracts with ten LQ's above and below one. Table 2 and figure 5 highlight these relationships.

7 Rivers Region Specialization: Manufacturing

The 7 Rivers Region's manufacturing sector LQ was 1.3426, second highest, while the number of workers in manufacturing totaled 24,820, also second

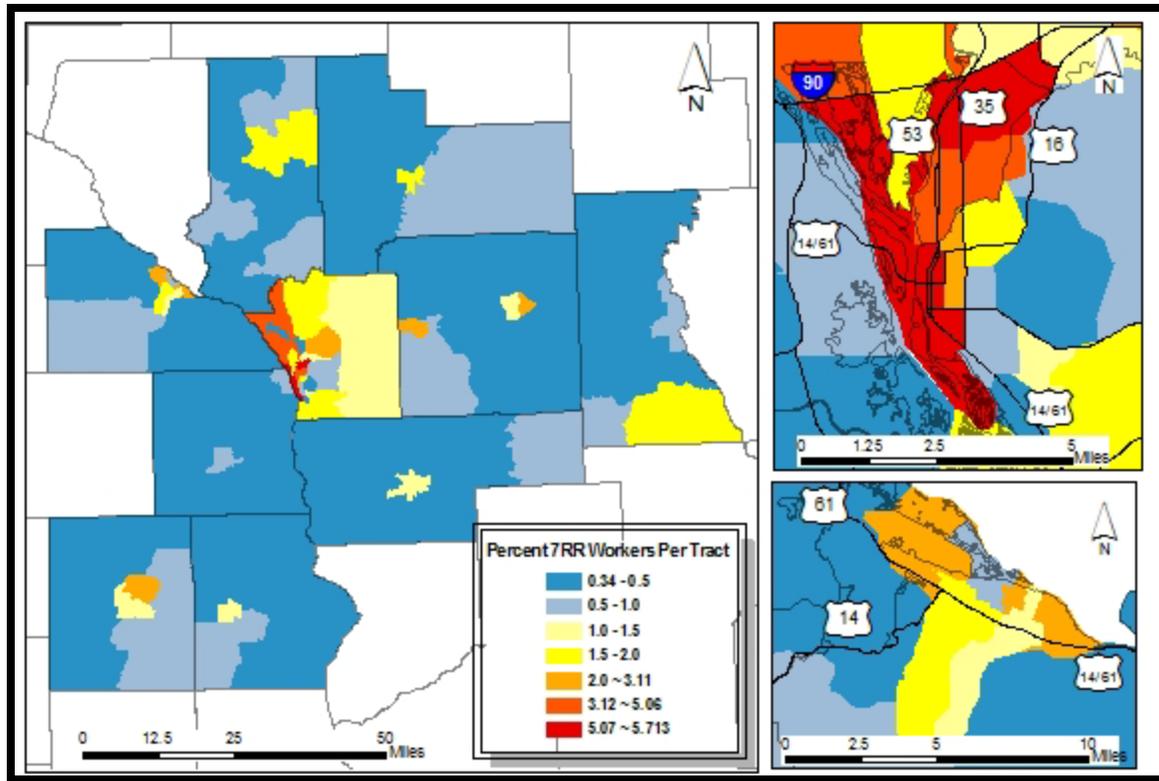


Figure 4. The above maps show tracts identified as economic centers within the 7 Rivers Region based on each tracts' percentage of the total workforce. To the left is the entire 7 Rivers Region, the upper right shows those tracts in and around La Crosse, WI. The map on the bottom right is Winona, MN

.highest. The LQ's for the top six ranked tracts ranged between 4.1542 and 2.7799. They accounted for 8,165 total manufacturing workers (just under a third), with a minimum of 230, a maximum of 2,145, and an average of 1360. These tracts were highly specialized with an average θ of 0.4144, with a minimum and maximum θ of 0.3066 and 0.6204. Unlike the agricultural sector, the manufacturing sector does not have an obvious geographical pattern (Figure 6).

The highest ranked tract (just under a two mile stretch along Mormon Coulee road on the south side of La Crosse, WI) was only home to 230 jobs. The tract with the second ranked LQ, 3.5549, also resides in La Crosse. It includes parts of Onalaska and West Salem between I-90, Sand Lake Road, County Road S, and County Road M, and hosts 2,095 manufacturing

workers- the second most amongst all tracts.

Tracts ranked 3rd, 4th, and 6th reside in Winona County, and account for 4,580, or approximately 18.5% of all manufacturing workers in the study area while only occupying a total of 13.25 square miles. All three tracts are located adjacent to the Mississippi River. The 3rd ranked tract, an LQ of 3.332, includes the northern portion of Winona and the southern portion of Minnesota City. Its 2,135 workers are the most of any tract in the study area. The Sugar Loaf area of Winona was the fourth ranked tract with an LQ of 2.9361 and 1,835 manufacturing workers while the tract adjacent to Riverview Drive was ranked 6th with an LQ of 2.7799 and 600 manufacturing workers.

The majority of the fifth ranked

Table 2. A comparison of tracts with LQ's greater than and less than one for the agriculture, forestry, fishing and hunting, and mining industries (X2).

Description	> 1	< 1	~ % Split
Number of Tracts	42	45	48 / 52
Avg. X2 LQ	5.34	0.1788	-
X2 Workers	6650	764	90 / 10
Avg. X2 Workers per Tract	158.33	16.98	-
Range	40 - 350	0 - 115	
Total Workers	25,065	107,180	19 / 81
Avg. Workers per Tract	596.79	2,381.78	-
Avg. θ	0.2074	0.237	-
Area in square miles	6,299	1,010	86 / 14
Avg. Area Per Tract	150	22.5	-
Population	157,763	194,426	45 / 55
Avg. pop. per square mile	88.3	1,512.13	-

twelve accounted for only 2,635 workers—considerably less than the first six. The range of 445 was also considerably less than the 1,915 for the top six. The minimum number of workers was 275, maximum was 720, and an average of 440. The minimum, maximum, and average θ were: 0.1745, 0.2471, and 0.2140.

Three other tracts should be noted due to the large number of manufacturing workers. The thirteenth ranked tract with an LQ of 1.6536 was 6.37 square miles and was located in Tomah, WI. It had 1,125 workers. The other two are located on La Crosse's Northside. The tract bordered by the La Crosse River to the south and Gillette and Sill Street to the north ranked nineteenth overall with an LQ of 1.3433, and 1,340 workers. The northern tract of the two contained more workers, 1,600, but had a smaller LQ of 1.184.

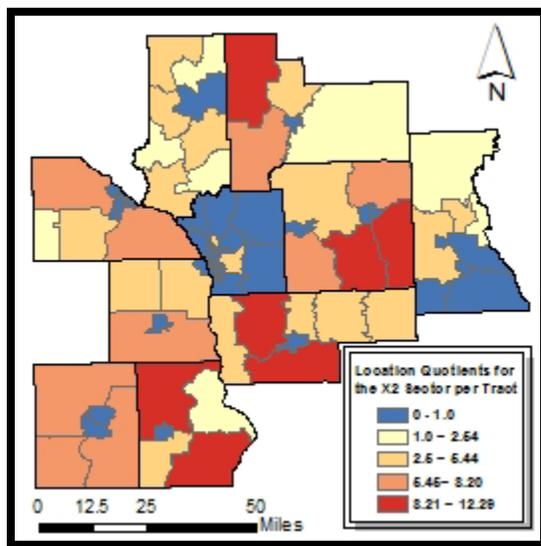


Figure 5. Location quotients per census tract for the agriculture, forestry, fishing and hunting and mining sector throughout the 7 Rivers Region.

tract, an LQ equal to 2.899, was found in Whitehall, WI, but also included parts of Blair, Independence, and Osseo with 1,260 workers. The tracts ranking seven through

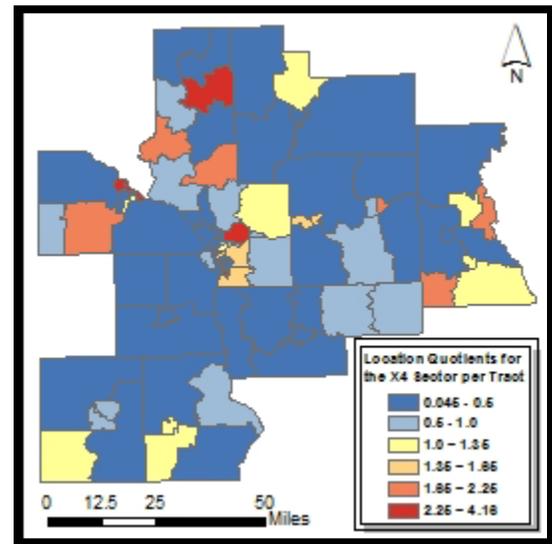


Figure 6. Location quotients per census tract for the manufacturing sector throughout the 7 Rivers Region.

**7 Rivers Region Specialization:
Educational, Health, and Social Services**

With multiple institutions of higher

learning and multiple major clinics and hospitals throughout the area, it is no surprise that the 7 Rivers Region would have a strong presence in the educational, health, and social services sector with an LQ of 1.2425 and a total worker count of 32,437 - the most for any industrial sector. Jobs in this sector seem to be highly clustered due to large institutions and corporations. Figure 7 shows the LQ distribution for the study area.

Four of the top ranking tracts were also the top four tracts in terms of number of workers. La Crosse was home to four of the top five tracts. The top ranked tract's LQ of 3.0060 and 1,670 workers included the University of Wisconsin- La Crosse. The second ranked tract, an LQ of 2.6879 and 1,935 workers, contained Viterbo University, Western Wisconsin Technical College, and St.

Francis Medical Center. The fourth ranked tract, an LQ of 2.5873, contained Gundersen Lutheran. Its 4,240 workers was tops. In total, these three tracts provided 7,895 workers. Luther College in Decorah, IA was partly responsible for its fifth place ranking with 1,950 workers, and an LQ of 1.9606.

Again, Winona, MN mirrors La Crosse's economy if on a smaller scale. With St. Mary's University of Minnesota, Winona State University, and the Winona Community Memorial Hospital, the three tracts hosted a combined 2,810 workers. The tracts' LQs were 1.3970, 1.3708, and 1.5910 and number of workers 735, 1,355, and 720 respectively.

Outside of La Crosse and Winona, this industry was similar to the mini economic centers we saw earlier using 1% as a minimum requirement: peripheral

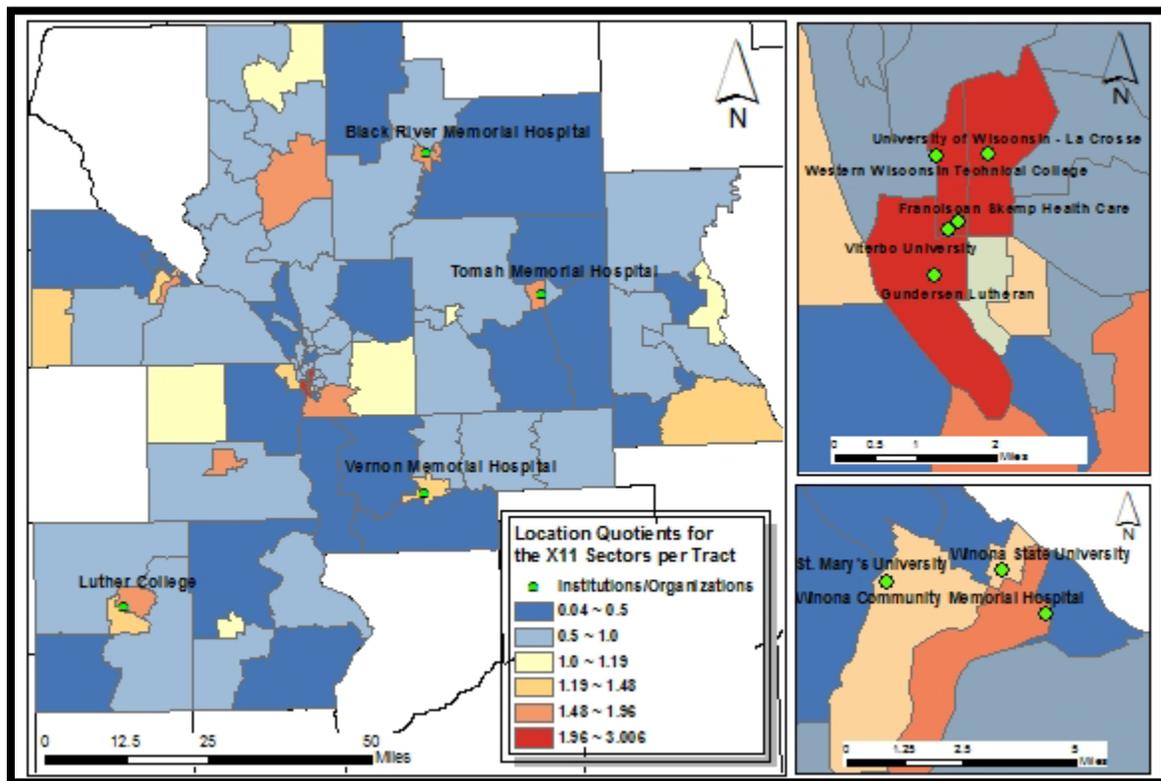


Figure 7. The above maps show the location quotients for the educational, health, and social services per tract in the 7 Rivers Region and important institutions. The map on the left shows the entire study area. The upper right map shows tracts and institutions in La Crosse, WI while the lower right map shows the same for Winona, MN.

tracts, small in size, now with specializations in the health services sector. Black River Falls had an LQ of 1.6098 and 920 workers, Tomah an LQ of 1.7509 and 685 workers, Viroqua an LQ of 1.4699 and 685 workers, and Waukon, IA with an LQ of 1.1812 and 465 workers. In some cases this was the result of smaller hospitals located in the tract while other cases may be explained by the efforts of major health care providers bringing healthcare closer to the patient via outreach programs converging in the same locations.

Conclusion

The 7 Rivers Region is an economy that is specialized in the educational, health, and social services sector, the manufacturing sector, and the agriculture sector. Based on this research, certain industries support larger numbers of workers in smaller spaces, while others require more space and fewer workers to prosper.

It will be interesting to see how this analysis will change when the data is available from the 2010 census. Has there been growth? Will the region realize an increase or decrease in its specializations? Will the region become a hotbed for another industry such as the information sector? How will the closing of businesses and the creation of new businesses effect specializations and LQs of tracts and the region as a whole?

Acknowledgements

I would like to thank Dr. David McConville, Mr. John Ebert and Ms. Greta Bernatz for their teachings, guidance, and assistance throughout the past year while completing this research.

References

- Bogart, W.T., and Ferry, W.C. 1999. Employment Centres in Greater Cleveland: Evidence of Evolution in a Formerly Monocentric City. *Urban Studies*, 36, 12, 2099-2110.
- Coffey, W.J., and Shearmur, R.G. 2001. The identification of employment centres in Canadian metropolitan areas: the example of Montreal, 1996. *The Canadian Geographer*, 45, 3, 371-386.
- Dewhurst, J.H., and McCann, P. 2002. A Comparison of Measures of Industrial Specialization for Travel-to-work Areas in Great Britain, 1981-1997. *Regional Studies*, 36, 541-551.
- Drummond, W.J., and French, S.P. 2008. The Future of GIS in Planning: Converging Technologies and Diverging Interests. *Journal of the American Planning Association*, Spring 2008 161-174.
- Jenkins, D.D., Bing III, W., Brown, L.J., and Guin, J.T. 1990. Implementation Factors for an Economic Development Geographic Information System. *Economic Development Review*, Fall 1990, 8-14.
- Klosterman, R.E. 2008. Comments on Drummond and French: Another View of the Future of GIS. *Journal of the American Planning Association*, Spring 2008, 174-176.
- O'Donoghue, D., and Townshend, I.J. 2005. Diversification, Specialization, Convergence and Divergence of Sectoral Employment Structures in the British Urban System, 1991-2001. *Regional Studies*, 39.5, 585-601.
- Pittman, R.H. 1990. Geographic Information Systems: An Important New Tool for Economic Development Professionals. *Economic Development Review*, Fall 1990, 4-7.
- Pittman, R.H., and Thrall, G.I. 1991. Using Geographic Systems in Economic Development: An Introduction.

- Economic Development Review*, Fall 1991, 14-21.
- Ridgeway, J. 2009. Minnesota's Composites Cluster. *Minnesota Economic Trends*, December 2009, 2-11.
- Shearmur, R., Coffey, W., Dubé, C., and Barbonne, R. 2007. Intrametropolitan Montreal, and Vancouver, 1996-2001. *Urban Studies*, 44, 9, 1713-1738.
- Vines, E. 2010. Growing Economic Gardens. *American City & County*, April 2010, 36-39.
- Watkins, A.R. 2009. The Dynamics of Urban Economies: Melbourne 1971 to 2006. *Urban Studies*, 46, 8, 1553-1576.