Understanding the Employment Complexion of the Twin Cities Metropolitan Region through Location Quotient and Shift Share Analysis

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Keywords: Location Quotient, Shift Share Analysis, GIS (Geographic Information Systems), Economic Development, Industry Sectors, Regional Planning, NAICS (North American Industry Classification System), Quarterly Workforce Indicators (QWI)

Abstract

Two economic analysis techniques, the Location Quotient and Shift Share Analysis, were used to quantify employment strengths and weaknesses within the Minneapolis-St. Paul seven county metropolitan region. Employment data between the years 2002 and 2011 were gathered from the United States Census Quarterly Workforce Indicators (QWI) database of the United States Census Bureau. A Geographic Information System (GIS) was used to process, analyze, and display the data. The resulting tables, charts and maps can serve as a useful tool for regional planners, economic developers and/or general policy makers.

Introduction

This study is concerned with the acquisition, processing, integration, analysis and presentation of large employment datasets using a combination of economic analysis techniques together with cutting edge GIS technology. The study primarily strives to inform regional planners, economic developers, and policy makers so that their decisions are supported by objective data. The study utilizes two primary economic analysis techniques: Location Quotient and Shift Share Analysis. These data were processed and displayed spatially using ESRI's ArcMap, ArcCatalog and ArcGIS Online.

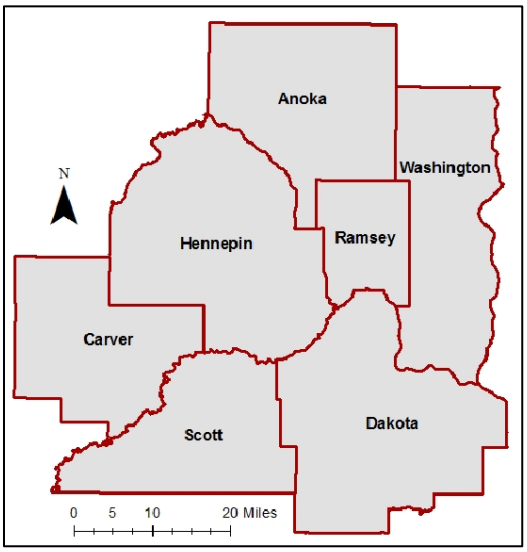

Figure 1. Counties that make up the Twin Cities seven county metropolitan region.

Study Area

The study area encompasses the Minneapolis-St. Paul seven county metropolitan region, which is comprised of Hennepin, Ramsey, Anoka, Washington, Carver, Scott, and Dakota counties (Figure 1).

This region was chosen because it is home to the population and economic hub of Minnesota. According to 2014 estimates, the region was home to 2,977,445 residents, about 55 percent of Minnesota's total population (Metropolitan Council, 2015). In addition to being an area of high economic activity, the region serves as a

useful study area because it is home to a unique regional planning body in the Metropolitan Council. A body of elected officials, the council oversees land use and transit planning activities among others. As the composition of regional economies is always changing, planning efforts must identify and adapt to these changes in order for these regions to remain economically competitive (Baer and Brown, 2006). The Location Quotient Analysis and Shift Share Analysis are ways by which the economic health of the region can be monitored, ensuring that it remains competitive with other areas. GIS mapping allows for the information to be processed and displayed in a way that makes spatial analysis of the data easier to perform.

Data

The years analyzed were 2002-2011. The employment data were derived from the United States Census Bureau's Quarterly Workforce Indicators (QWI) database.

The employment data were classified into industry sectors under the North American Industry Classification System, or NAICS. "NAICS is the standard used by Federal statistical agencies in collecting, analyzing, and publishing statistical data related to the U.S. business economy" (United States Census Bureau, n.d.). NAICS codes' digits range from two to six. For this study, the twenty primary industry sectors were analyzed. These industry sectors and their NAICS codes were as follows: agriculture, forestry, fishing and hunting (11); mining, quarrying, and oil and gas extraction (21); utilities (22); construction (23); manufacturing (31-33); wholesale trade (42); retail trade (44-45); transportation and warehousing (48-49); information (51); finance and insurance (52); real estate and rental and leasing (53); professional, scientific and technical services (54); management of companies and enterprises (55); administrative support and waste management and remediation services (56); educational services (61); health care and social assistance (62); arts, entertainment and recreation (71); accommodation and food services (72); other services except public administration (81); and public administration (92). The first two digits are representative of each major industry sector in the twenty categories. Although not part of this project, the four to six additional digits in a NAICS codes more accurately describe a business establishment. For example, code 221210 represents natural gas distribution businesses. Because the code begins with "22," the business can be identified under the utilities industry sector. There are hundreds of unique business classifications when looking at the six digit codes; it would be difficult to collect and analyze them all, which is why this study was concerned with the primary sectors.

Location Quotient Analysis

The Location Quotient is a powerful statistic that has been utilized in geographical analysis since the 1940s. (Crawley, Beynon, and Munday, 2012). It is a straightforward technique, the purpose being to extract an expression of how well represented an industry sector is in a given study region; this is accomplished by comparing employment values in the study region against a larger reference region. Simply, the Location Quotient can be thought of as a "ratio of a ratio" (Miller, Gibson, and Wright, 1991). The Location Quotient requires a study area which for this project were the census tracts and

counties that fell within the metropolitan region and a reference or "benchmark" region. The benchmark region must be larger than the study region. Typically, the benchmark region is a significantly larger geographic area than the study region, such as a state or the entire country. The benchmark region for this study was the United States. Suppose we would like to know how much arts, entertainment, and recreation (NAICS code 71) are represented by employment in a county compared to its representation within the entire country. Now suppose that within the county (study region), 10% of all jobs fall under the arts, entertainment, and recreation industry sector and 5% of all jobs within the nation (benchmark region) are coded under that sector. To calculate the Location Quotient, one must simply divide the study region ratio (0.10) by the benchmark region ratio (0.05). Thus, the Location Quotient for the arts, entertainment, and recreation industry sector for the county of interest is 2.0. Another way of saying it is arts, entertainment, and recreation jobs were twice as concentrated as compared to the rest of the nation on average. As a mathematical formula, the Location Quotient can be calculated for industry sector *i*

$$LQ_i = \frac{x_i}{n} \Big/ \frac{X_i}{N}$$

where x_i is the number of jobs in the study region for the given industry sector, and *n* is the total number of jobs in the study region. X_i represents the number of jobs in the benchmark region for the given industry sector, and *N* represents the total number of jobs in the benchmark region. A Location Quotient can be calculated for any region where comparable employment data exists for both the study and benchmark regions (Baer and Brown, 2006). Miller *et al*. (1991) argue even though the primary advantage of the Location Quotient is its simplicity, it is relatively unknown and underutilized by development professionals. Further yet, Boasson and Boasson (n.d.) state although there has been a recent upswing of GIS applications related to economic development, the marriage of the two is still new when incorporating spatial-temporal analysis. For this project, the Location Quotient statistic was calculated for every year at the county and census tract levels, and for each of the 20 major industry sectors identified earlier. This adds up to four hundred unique Location Quotient values, which alone provides stakeholders a fairly comprehensive view of what occurred economically from 2002 to 2011.

Assumptions

There are several basic assumptions that are associated with the Location Quotient, and thus must be viewed as limitations of the analysis technique. According to Isserman (1977), the Location Quotient assumes there must be (1) identical productivity per employee within the study region as there is in the benchmark region, (2) equal consumption of the products within the study region as there is in the benchmark region, (3) equality of the product itself within the study region as in the benchmark region. These assumptions of uniformity must be acknowledged when performing a Location Quotient analysis, however the simplicity of calculating Location Quotients must be met with the expectation of having to tradeoff accuracy due to these assumptions.

Shift Share Analysis

There are trends in the employment data that cannot be tracked by the Location Quotient statistic alone, but rather with an analysis technique called Shift Share Analysis. Like the Location Quotient, the Shift Share Analysis has been frequently used to analyze regional growth. The Shift Share Analysis and what it measures is a bit more complex than the Location Quotient. The technique diffuses change in employment values over time and organizes them into components which allows decision makers the ability to discern the forces influencing the growth of a regional economy (Tervo and Okko, 1983).

Beginning and end dates are needed in order to measure employment changes over time. Similar to the Location Quotient, the Shift Share Analysis uses a local economy that is indexed against a larger reference economy (Kiser, 1992). The traditional Shift Share Analysis breaks down the employment values into three components that look at different effects generating employment change. The following sections explain the three primary Shift Share effects when comparing a study region's employment change with a benchmark region's employment change.

National Growth Effect

The national growth effect measures the change in employment that could have occurred within the study region if employment in all industry sectors experienced the same growth rate as what occurred at the national level for all industry sectors (Tervo and Okko, 1983). The national growth effect can be calculated for regional industry sector *i*

$$\mathbf{NGE_i} = a(x)$$

where *a* represents the employment number from the beginning year for a given industry sector and *x* represents the national employment growth rate between the beginning and end years. The resulting value can then be added to the beginning year employment number which shows how the industry sector's employment would have changed over the timeframe had it followed national growth trends.

Industry Mix Effect

The industry mix effect measures the proportional shift of regional employment values to differences between the regional and national economies (Tervo and Okko, 1983). The industry mix effect can be calculated for industry sector *i*

$$\boldsymbol{IME_i} = a(y - x)$$

where *a* represents the employment number from the beginning year for an industry sector, *y* represents the national industry sector growth rate, and *x* represents the national employment growth rate between the beginning and end years. The industrial mix effect examines how the regional industry sector's growth could have changed over time by applying the difference between the national industry employment growth and the national total growth as a multiplier to the beginning year of the timeframe. Simply, the industrial mix effect indicates whether the particular industry sector has grown faster or slower than total national job growth (Kiser, 1992).

Local Share Effect

The local share effect, sometimes known as the regional shift component, measures the differential shift in the same industry

sector between the study and benchmark regions (Tervo and Okko, 1983). The local share effect can be calculated for industry sector *i*

$$\mathbf{LSE_i} = a(z - y)$$

where *a* represents the employment number from the beginning year for an industry sector, *z* represents the local industry sector growth rate, and *y* represents the benchmark industry sector growth rate. The local share effect is seen as growth that remains unexplained, and can be attributed to many factors such as the local economic advantages or disadvantages, entrepreneurial ability, and effects of regional policy (Tervo and Okko, 1983).

Assumptions

Like the Location Quotient analysis, there are assumptions that must be recognized with the Shift Share Analysis. Galambos and Schreiber (1978) bring up a common criticism of the technique noting that the Shift Share Analysis components do not explain why employment changes occurred, but rather provides a monitoring system for changes in the local economy's competitive position.

Along the same lines as the previous point, it is debated whether the Shift Share Analysis provides an acceptable model for predicting future trends in employment growth. Kiser (1992) argues the analysis simply describes local employment trends and it does not explain them or guarantee that they will continue over time.

Another point that one must consider is that the components of the Shift Share Analysis are all mathematically interdependent; the values are directly related to one another. If one were to take the beginning year employment number and individually sum the differences between that value and each Shift Share effect value, then the end year employment value will be the result. This is illustrated below for end year employment number *Y*

$$Y = (X - a) + (X - b) + (X - c)$$

where *X* represents the beginning year employment number, *a* represents the national growth effect value, *b* represents the industry mix effect value, and *c* represents the local share effect value.

Methods

Data Acquisition

The employment data needed for this study were largely acquired from the United States Census Bureau (census.gov). Most of the data for the study and benchmark regions were downloaded from the census website for the years 2002-2011.

There are data available as recent as quarter 3 of 2014, however the data were only accessible at the statewide level, which was not useful when conducting a regional analysis. A primary component of this project's mission was the ability to view data down at the census tract and county levels. At the time of extraction, 2011 was the most recent year for which data was accessible at the scale desired for this study.

There were two primary applications provided on the census bureau's website from which data were extracted: OnTheMap and QWI Explorer. OnTheMap is a data extraction map application that provided an easy way to download QWI employment data for the study years. A GIS shapefile containing

2010 census block-level centroid points was downloaded for each year, spanning the seven county metropolitan area. Each block centroid contained employment data from the respective census block. The application provided many options for catering the dataset to this project's demands. The important aspects about the employment data were (1) the data show where the workers are employed, as opposed to where they live, (2) military and the self-employed are not included, (3) per correspondence with a census bureau employee, the employment numbers are accurate as of the beginning of quarter 2 of each year, (4) only primary jobs are included in the data. The last point is relevant for cases where someone may be employed at multiple jobs; this dataset only considers one job per person, and includes the highest paying job. This was the default setting for the application. For the previous reasons, the employment figures may be different from other published information.

The second data extraction application used from the census bureau was the QWI Explorer. This application provided tabular employment data at the statewide level and when aggregated, formed national employment numbers for the years 2002-2011, i.e. the benchmark region database. The QWI Explorer was used in favor over the OnTheMap application because nationwide GIS data were overwhelmingly large files and also unnecessary to form the nationwide employment database.

The QWI data include every state except Massachusetts, which is currently in the process of making their data available to the QWI database. Tabular employment data were found for Massachusetts on their state government website (massachusetts.gov). The District of Columbia was included in the database, but United States' territories were omitted. There were several states that lacked data for every industry sector across all of the years. The most common reasons for no data availability were the state failed to provide data for the industry sector or the data were intentionally suppressed for confidentiality purposes. In order to supplement the missing data, the average employment number was calculated from the years where data were available for the given industry sector and then applied to the missing years. Although not a perfect solution to the problem, this was acceptable compared to leaving employment values blank.

There were two other GIS files that were needed for use with the employment data. As the data for this project were being analyzed at the census tract and county levels, boundaries had to be downloaded. These files represented the aforementioned boundaries from the 2010 census and were accessed from the metropolitan region's GIS data repository (datafinder.org).

Data Processing

After downloading the data, all of the processing was done in ESRI's ArcMap, ArcCatalog, and Microsoft Excel spreadsheets.

Initially, the data reorganization was done to allow easier integration and analysis within the GIS software. All data fields except for the GEOID, total jobs, and jobs per industry sector were removed. The original shapefile contained other demographic fields that were irrelevant to this study and these were deleted too. A file geodatabase was created as a central workspace to contain all of the geospatial data.

ModelBuilder

ModelBuilder is an application that allows for the creation of automated GIS processing workflows and was used here. When downloading the regional employment data from OnTheMap, the extraction area had to be manually drawn on the map rather than being able to cleanly extract data from each of the seven county boundaries. For this reason, the extraction area was drawn just outside of the actual county boundaries so as to make sure that all data points were included in the file. Therefore, the resulting file included data points just outside the seven county metropolitan region. The first task that was executed with ModelBuilder was to extract the data points that fell within the seven county region (Figure 2).

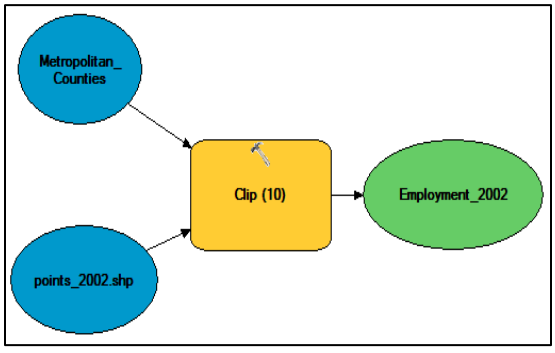

Figure 2. A simple ModelBuilder GIS process that extracts employment points within the metropolitan region.

The original data files contained undecipherable codes for the field names without the use of a reference table. ModelBuilder was used to create duplicate fields of the existing ones and renaming them with more user-friendly titles and aliases.

Location Quotient Analysis Calculations

Once the files were formatted with the appropriate field names, point data to the county and tract boundaries were aggregated. Counties and tracts were chosen as the geographic scales so that one could visually analyze the Location Quotient statistics at both the regional and more localized scales. This provides greater flexibility to those that may desire to examine the data at a regional level for one use, but at a local level for another, such as for site planning of development projects. Initially, zip code and city boundaries were considered to be the more localized boundary levels. These ideas were discarded because the data points are centroids of census blocks, and those boundaries do not spatially fit inside zip code or city boundaries, but they do fit within census tracts. The aggregation process was executed with the ModelBuilder application, which consisted of the following steps:

1. Performed a spatial join between the points features so that they were represented within the county and tract polygons
2. Dissolved the newly joined records by either county name or GEOID, thus removing stacked records. The fields containing employment values were summed so that each county and tract polygon included the total employment numbers that were previously contained in separate points at the census block level.

At this point, the county and tract GIS files were ready to incorporate fields for the calculation of Location Quotients. Again, these tasks were accomplished in ModelBuilder:

1. Added and calculated fields containing the ratios of local industry sector employment numbers divided by the total employment numbers for the tract or county.

2. Added and calculated fields containing the ratios of national industry sector employment numbers divided by the total employment numbers for the United States.
3. Added and calculated fields containing the Location Quotient statistics by dividing the local employment ratios by the national employment ratios.

Once data processing tasks were completed, over 1,200 fields had been created and calculated between the ten tract and county files.

The twenty files were consolidated into two, one for the tracts and one for the counties containing all the year data. The Merge geoprocessing tool was used within ModelBuilder to execute the task.

Tabular Data Processing

As previously mentioned, statewide employment numbers were accessed from the QWI Explorer and the State of Massachusetts. The files were saved as Microsoft Excel spreadsheets (.xlsx) and then aggregated into tabs for each year between 2002 and 2011. The ratios portraying industry sector employment compared to total national employment were calculated within Excel. The ratios were then ready to be integrated into the GIS processing tasks described in the previous sections.

Shift Share Analysis Calculations

The national growth effect, industry mix effect, and regional growth effect values were calculated for each industry sector and for every county. Basic Excel calculations were executed to produce the necessary percent-change values for employment between the beginning year of 2002 and 2011. Shift Share values were not calculated for the census tracts because of the vast number of calculations needed to perform the analysis, and also because there are many tracts that have very few total jobs. In those situations, the analysis would be completely unusable, or at best highly skewed.

Results

The graphic and numerical outputs of the Location Quotient and Shift Share Analysis are found in Figures 3-22 and Tables 1-7 respectively.

The metropolitan counties were the focus of Location Quotient and Shift Share Analysis outputs. Evidence shows the location quotient produces better results for larger study areas Miller *et al.* (1991). Location Quotients were calculated for tracts, however the Shift Share Analysis was only conducted for counties due to the previously mentioned reasons. An interactive web map was created as an intuitive way to display the large abundance of data. The map displays a database containing Location Quotient values for the tracts and counties. The database is hosted by ESRI's ArcGIS Online cloud servers.

Anoka County

Anoka County had strengths in construction, manufacturing, and retail trade. Its weaknesses included information and management of companies and enterprises. Like the metropolitan region as a whole, Anoka County has few mining, quarrying, oil and gas extraction jobs. Manufacturing was an industry

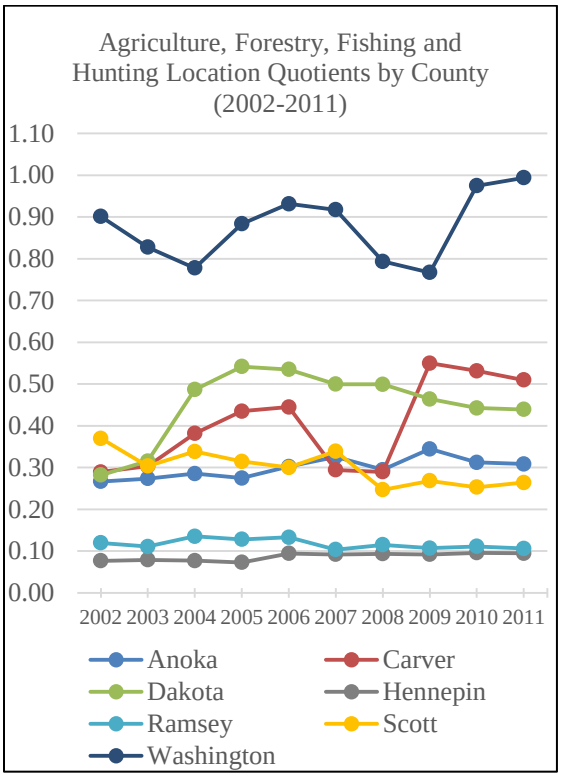

Figure 3. Location Quotients for NAICS code 11.

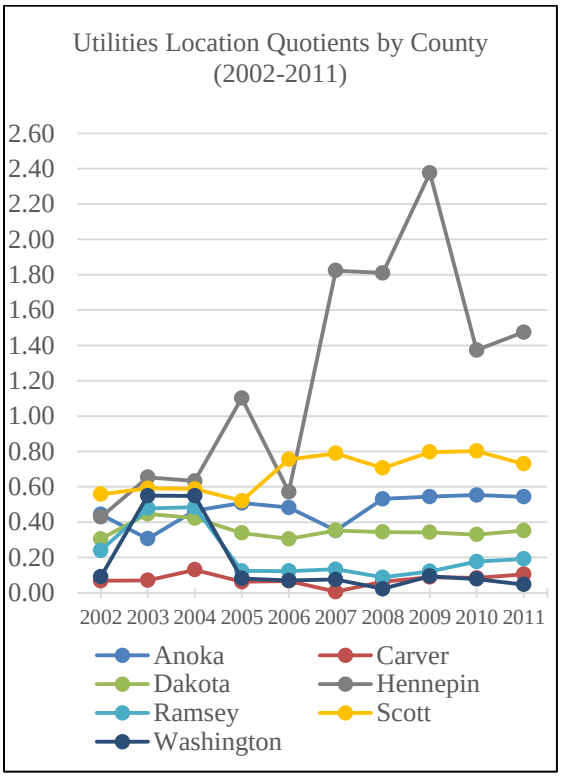

Figure 5. Location Quotients for NAICS code 22.

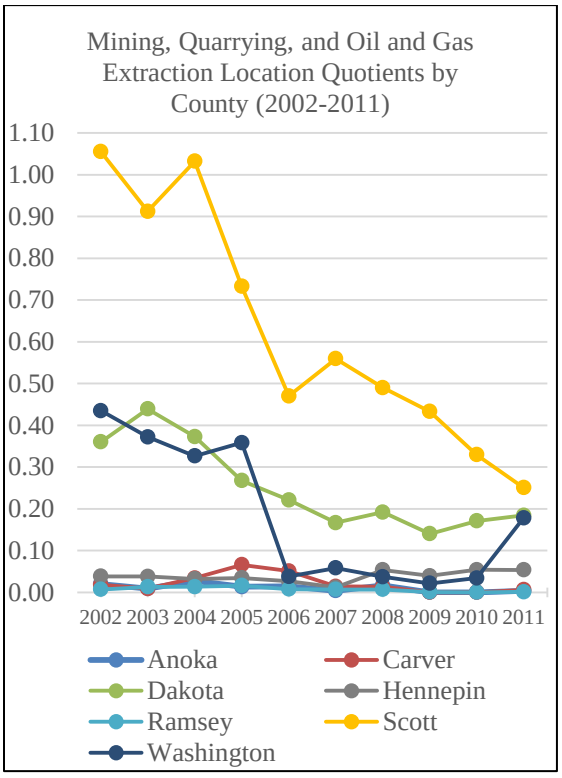

Figure 4. Location Quotients for NAICS code 21.

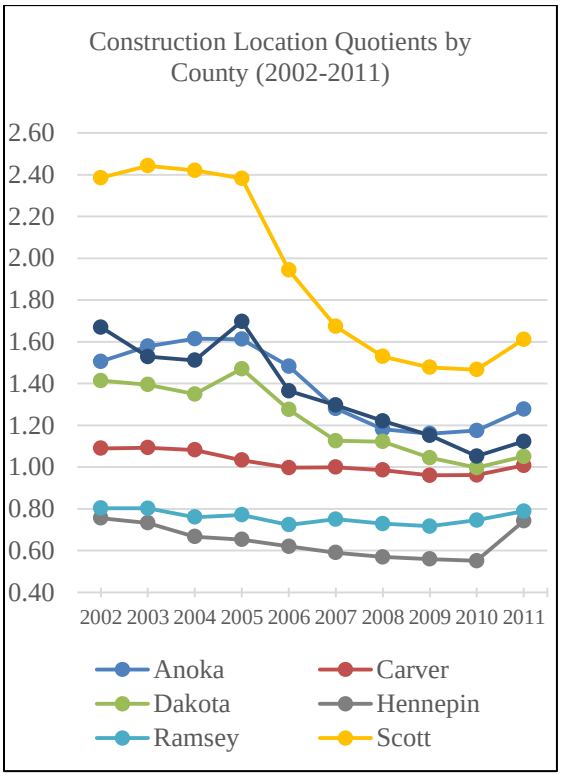

Figure 6. Location Quotients for NAICS code 23.

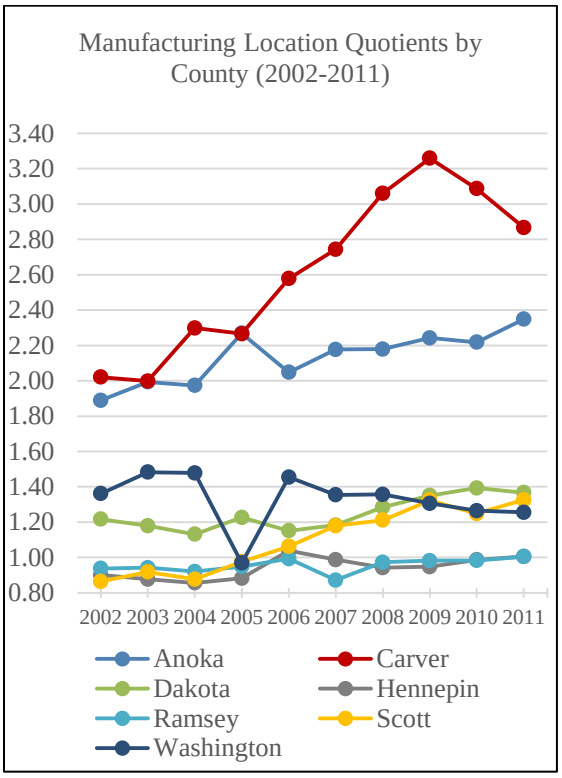

Figure 7. Location Quotients for NAICS code 31-33.

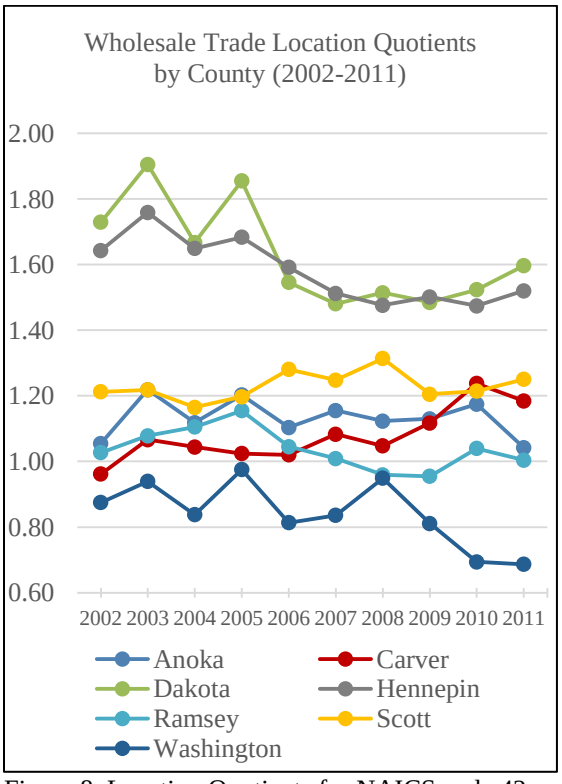

Figure 8. Location Quotients for NAICS code 42.

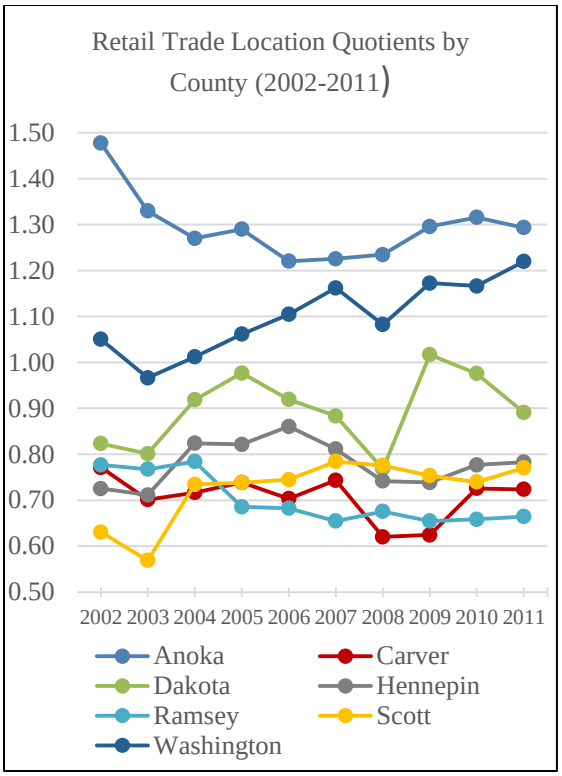

Figure 9. Location Quotients for NAICS code 44-45.

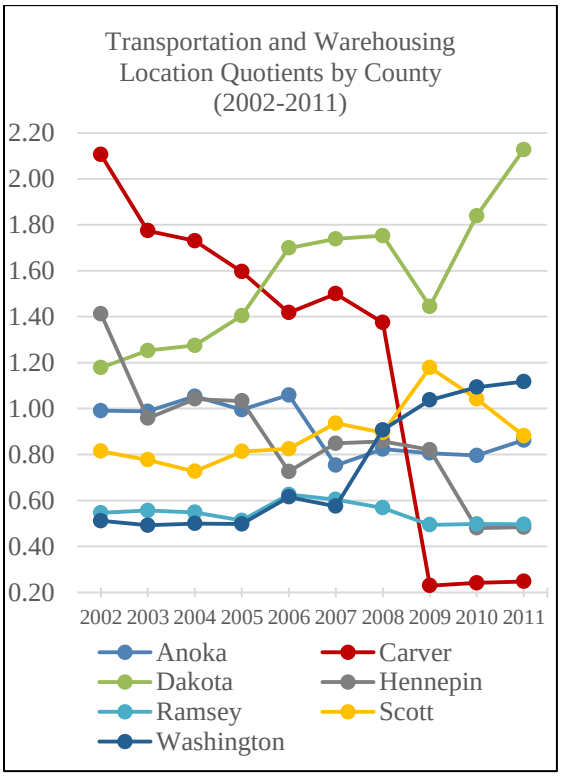

Figure 10. Location Quotients for NAICS code 48-49.

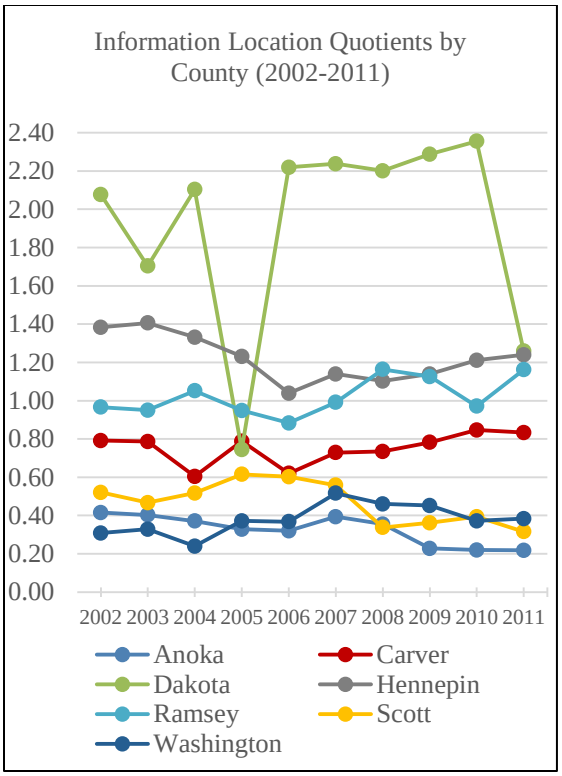

Figure 11. Location Quotients for NAICS code 51.

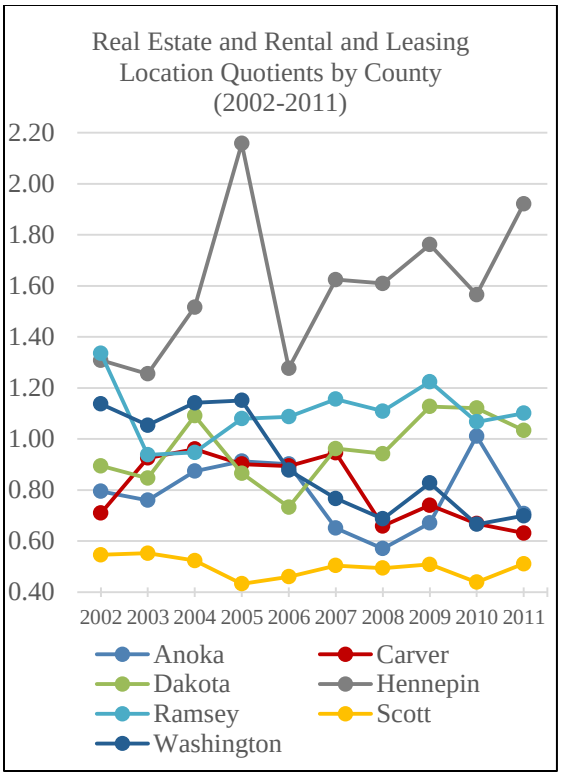

Figure 13. Location Quotients for NAICS code 53.

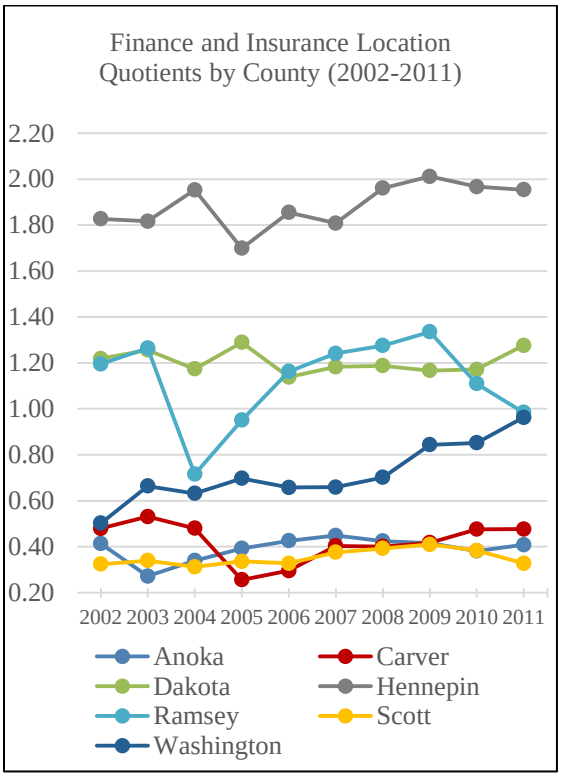

Figure 12. Location Quotients for NAICS code 52.

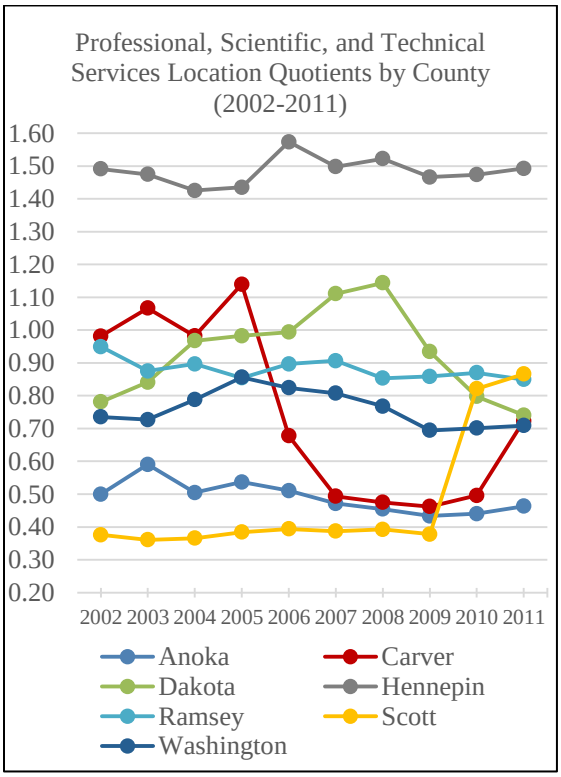

Figure 14. Location Quotients for NAICS code 54.

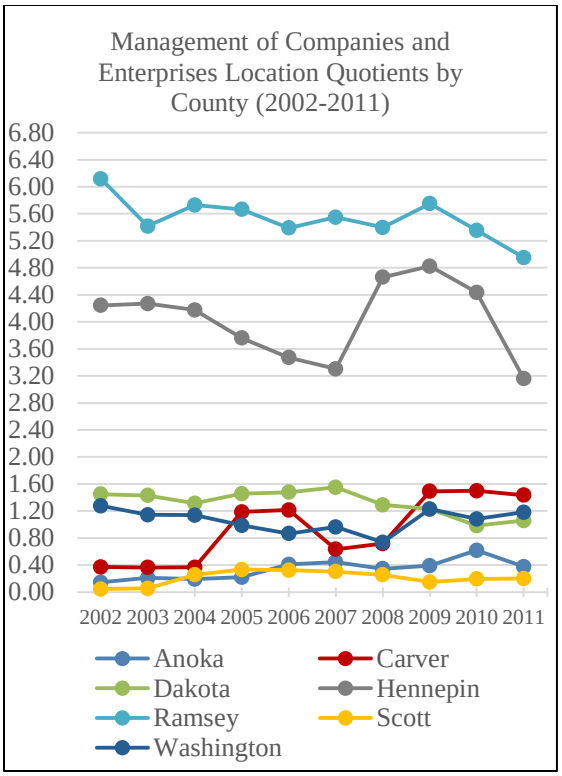

Figure 15. Location Quotients for NAICS code 55.

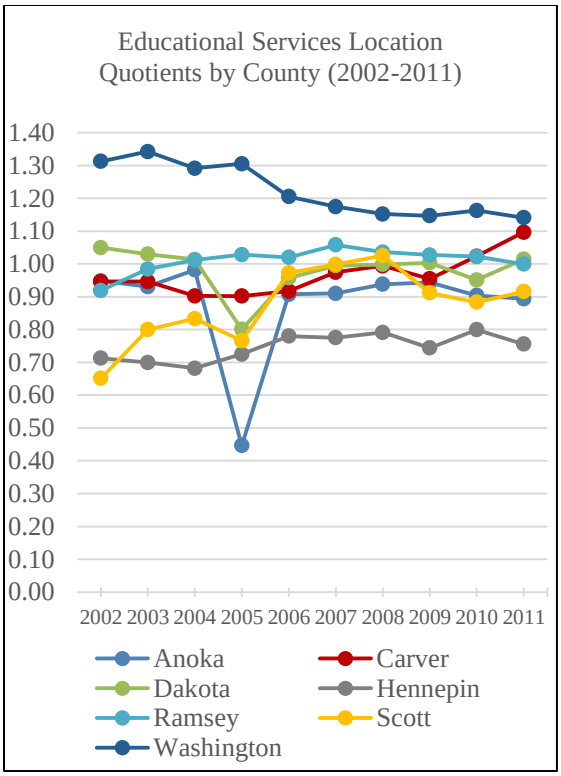

Figure 17. Location Quotients for NAICS code 61.

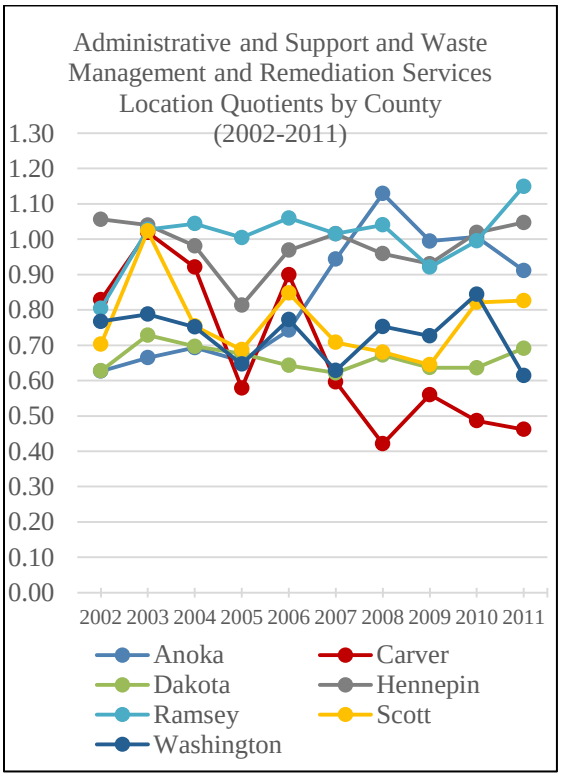

Figure 16. Location Quotients for NAICS 56.

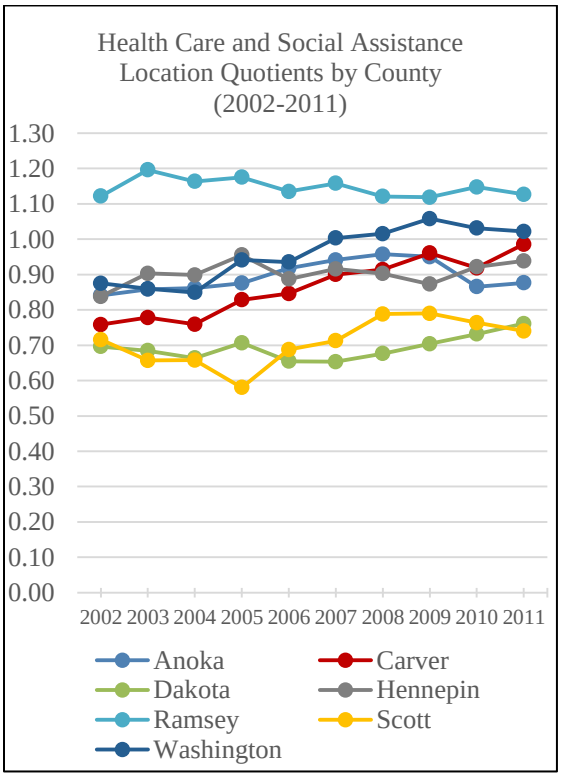

Figure 18. Location Quotients for NAICS code 62.

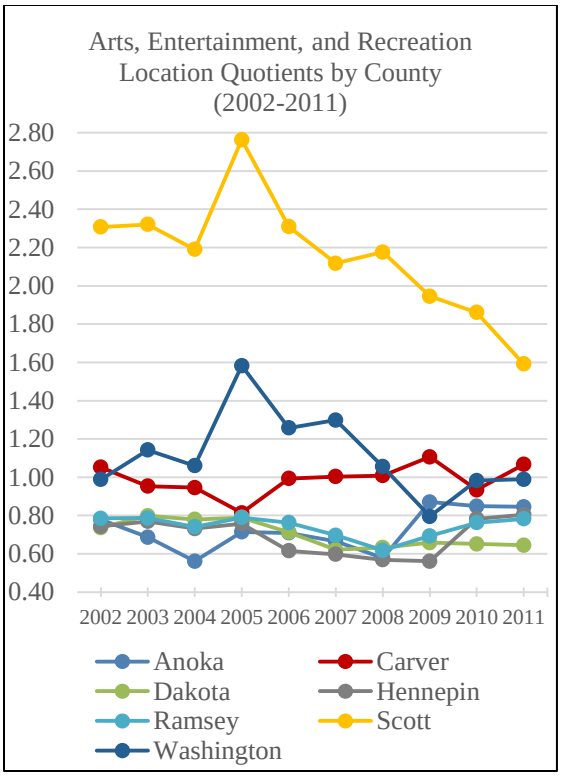

Figure 19. Location Quotients for NAICS code 71.

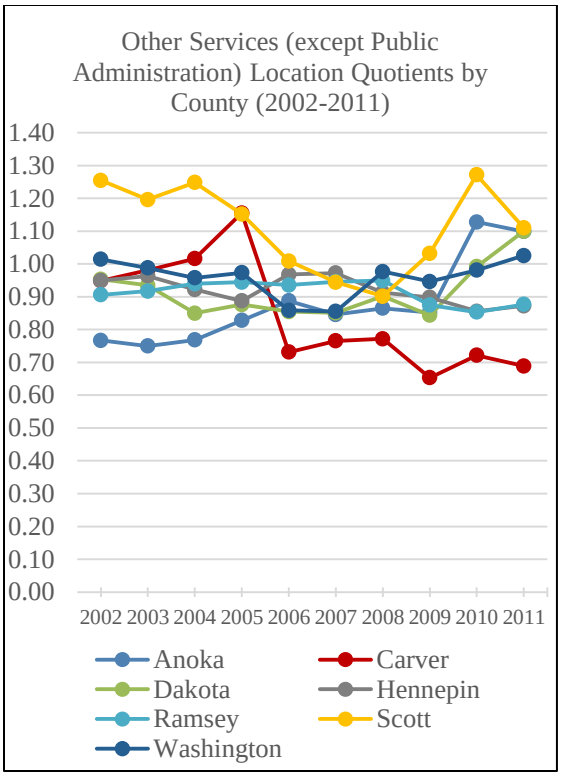

Figure 21. Location Quotients for NAICS code 81.

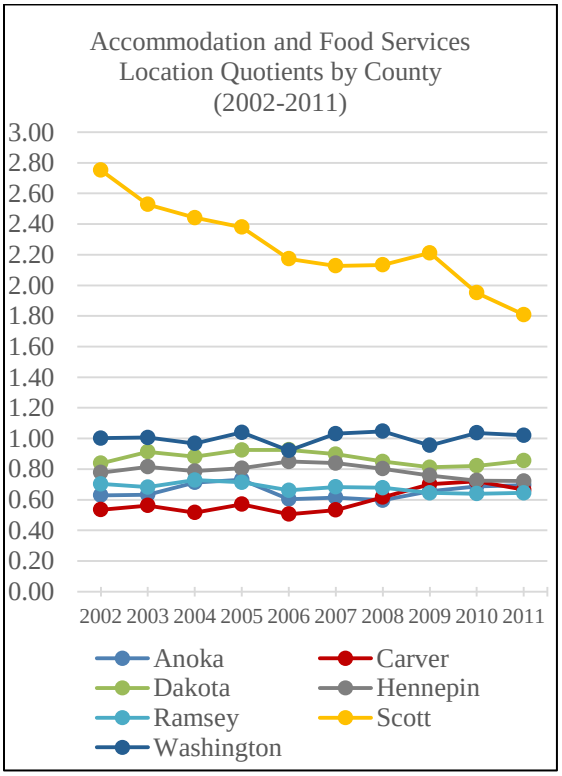

Figure 20. Location Quotients for NAICS code 72.

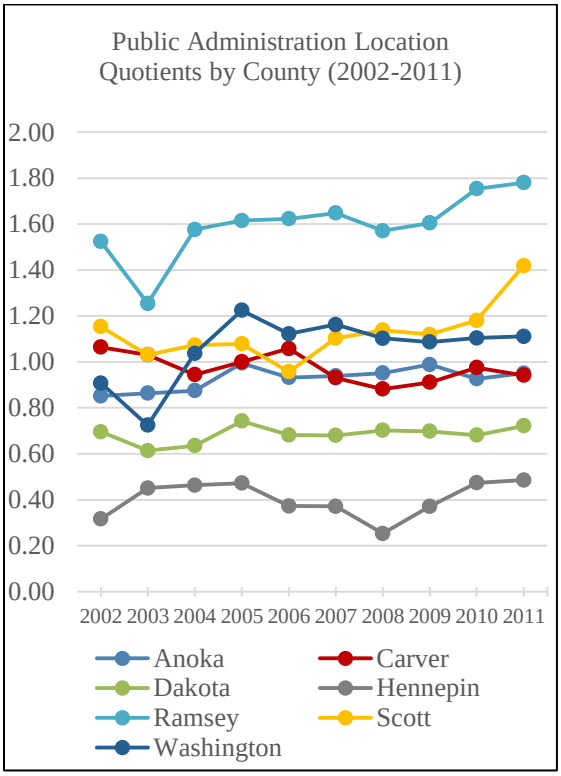

Figure 22. Location Quotients for NAICS code 92.

Table 1. Anoka County Shift Share Analysis.

Industry Sector NAICS Code	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	242	271	243	241	271
21	9	2	9	12	0
22	323	364	324	306	380
23	8,551	5,719	8,582	6,938	7,301
31-33	25,485	23,339	25,577	19,309	29,423
42	5,272	4,898	5,291	5,102	5,049
44-45	19,143	15,776	19,212	18,545	16,306
48-49	3,782	3,190	3,796	3,772	3,187
51	1,270	537	1,275	1,051	751
52	2,083	1,907	2,090	1,984	1,999
53	1,448	1,165	1,453	1,347	1,261
54	3,003	3,041	3,014	3,379	2,654
55	232	650	233	258	623
56	4,000	5,858	4,014	4,146	5,698
61	9,804	9,664	9,839	10,553	8,879
62	10,953	13,333	10,992	13,176	11,070
71	1,384	1,560	1,389	1,480	1,459
72	5,526	6,612	5,546	6,152	5,966
81	2,896	4,182	2,906	3,004	4,063
92	4,402	4,626	4,418	4,268	4,745

Table 2. Carver County Shift Share Analysis.

Industry Sector NAICS Code	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	64	121	64	64	121
21	2	1	2	3	0
22	12	19	12	11	20
23	1,508	1,220	1,513	1,224	1,499
31-33	6,642	7,700	6,666	5,033	7,702
42	1,171	1,504	1,175	1,133	1,537
44-45	2,435	2,385	2,444	2,359	2,452
48-49	1,959	247	1,966	1,954	245
51	589	554	591	488	653
52	589	601	591	561	627
53	315	281	316	293	302
54	1,437	1,283	1,442	1,617	1,098
55	145	671	146	161	654
56	1,289	802	1,294	1,336	750
61	2,384	3,204	2,393	2,566	3,013
62	2,406	4,051	2,415	2,894	3,554
71	455	532	457	487	499
72	1,144	1,708	1,148	1,274	1,574
81	873	708	876	906	672
92	1,340	1,238	1,345	1,299	1,274

Table 3. Dakota County Shift Share Analysis.

Industry Sector NAICS Code	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	312	540	313	311	540
21	200	153	201	268	84
22	271	330	272	256	344
23	9,788	6,586	9,823	7,941	8,397
31-33	20,007	19,007	20,079	15,159	23,783
42	10,535	10,498	10,573	10,196	10,799
44-45	13,009	15,210	13,056	12,602	15,570
48-49	5,482	11,011	5,502	5,467	11,006
51	7,736	4,335	7,764	6,405	5,638
52	7,498	8,338	7,525	7,141	8,668
53	1,988	2,383	1,995	1,850	2,514
54	5,722	6,802	5,743	6,439	6,065
55	2,834	2,561	2,844	3,148	2,237
56	4,886	6,221	4,904	5,064	6,026
61	13,238	15,340	13,286	14,250	14,280
62	11,059	16,193	11,099	13,304	13,909
71	1,595	1,665	1,601	1,706	1,548
72	8,969	11,351	9,001	9,985	10,303
81	4,388	5,854	4,404	4,552	5,674
92	4,385	4,916	4,401	4,251	5,034

Table 4. Hennepin County Shift Share Analysis.

Industry Sector	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	492	607	494	490	607
21	123	232	123	165	190
22	2,212	7,221	2,220	2,093	7,332
23	30,379	24,274	30,488	24,648	29,896
31-33	86,035	73,003	86,345	65,187	93,541
42	58,160	52,198	58,369	56,289	53,859
44-45	66,570	69,777	66,810	64,489	71,618
48-49	38,210	13,068	38,348	38,106	13,035
51	29,933	22,270	30,041	24,783	27,312
52	65,271	66,651	65,506	62,166	69,521
53	16,885	23,126	16,946	15,710	24,241
54	63,452	71,590	63,680	71,399	63,415
55	48,200	39,950	48,374	53,544	34,433
56	47,788	49,187	47,960	49,527	47,276
61	52,200	59,698	52,388	56,190	55,520
62	77,299	104,301	77,577	92,988	88,334
71	9,350	10,840	9,384	10,000	10,156
72	48,376	50,081	48,550	53,854	44,429
81	25,386	24,245	25,477	26,337	23,203
92	11,575	17,262	11,617	11,222	17,574

Table 5. Ramsey County Shift Share Analysis.

Industry Sector	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	307	263	308	306	263
21	9	2	9	12	0
22	493	363	495	466	388
23	12,885	9,975	12,931	10,454	12,359
31-33	35,733	28,211	35,862	27,074	36,741
42	14,498	13,330	14,550	14,032	13,744
44-45	28,436	22,899	28,538	27,547	23,686
48-49	5,892	5,182	5,913	5,876	5,177
51	8,339	8,074	8,369	6,904	9,479
52	17,032	12,978	17,093	16,222	13,727
53	6,875	5,123	6,900	6,396	5,577
54	16,117	15,753	16,175	18,135	13,677
55	27,713	24,206	27,813	30,785	21,034
56	14,506	20,883	14,558	15,034	20,303
61	26,846	30,525	26,943	28,898	28,376
62	41,278	48,423	41,427	49,656	39,896
71	3,939	4,082	3,953	4,213	3,794
72	17,458	17,282	17,521	19,435	15,242
81	9,663	9,423	9,698	10,025	9,026
92	22,242	24,483	22,322	21,563	25,082

Table 6. Scott County Shift Share Analysis.

Industry Sector	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	81	75	81	81	75
21	116	48	116	156	8
22	98	158	98	93	163
23	3,269	2,333	3,281	2,652	2,938
31-33	2,813	4,259	2,823	2,131	4,931
42	1,462	1,899	1,467	1,415	1,941
44-45	1,972	3,036	1,979	1,910	3,091
48-49	750	1,054	753	748	1,053
51	384	251	385	318	316
52	394	494	395	375	511
53	240	272	241	223	288
54	545	1,837	547	613	1,767
55	17	112	17	19	110
56	1,083	1,716	1,087	1,122	1,673
61	1,625	3,198	1,631	1,749	3,068
62	2,250	3,638	2,258	2,707	3,173
71	989	949	993	1,058	877
72	5,834	5,550	5,855	6,495	4,868
81	1,143	1,365	1,147	1,186	1,318
92	1,438	2,231	1,443	1,394	2,270

Table 7. Washington County Shift Share Analysis.

Industry Sector	County 2002 Employment	County 2011 Employment	National Growth Effect	Industry Mix Effect	Local Share Effect
11	380	496	381	379	496
21	92	60	92	123	28
22	31	18	31	29	20
23	4,402	2,857	4,418	3,572	3,672
31-33	8,524	7,089	8,555	6,458	9,124
42	2,030	1,833	2,037	1,965	1,891
44-45	6,320	8,448	6,343	6,122	8,623
48-49	907	2,347	910	905	2,346
51	438	536	440	363	610
52	1,177	2,552	1,181	1,121	2,604
53	962	654	965	895	718
54	2,051	2,644	2,058	2,308	2,380
55	950	1,160	953	1,055	1,051
56	2,276	2,243	2,284	2,359	2,152
61	6,303	8,827	6,326	6,785	8,322
62	5,293	8,827	5,312	6,367	7,734
71	815	1,036	818	872	976
72	4,088	5,505	4,103	4,551	5,027
81	1,778	2,216	1,784	1,845	2,143
92	2,177	3,070	2,185	2,111	3,129

sector that had struggled nationwide but was prevalent in Anoka County, and based on the data, had grown throughout the study years.

Carver County

Carver County had strengths in manufacturing, and management of companies and enterprises. Its weaknesses included utilities, transportation and warehousing, and other services (except public administration). An interesting trend to note was that transportation and warehousing used to be a strength in Carver but employment was lost at a much greater rate than at the national level during the study time period.

Dakota County

Much like Carver, Dakota County had strengths in manufacturing and management of companies and enterprises. Dakota was weak in the utilities, arts, entertainment, and recreation industry sectors.

Hennepin County

Hennepin County, home to Minneapolis, was strong in management of companies and enterprises, finance and insurance, and real estate and rental and leasing. Hennepin was weak in mining, quarrying, and oil, and gas extraction.

Ramsey County

Ramsey County exhibited strengths typical of an urban core. Its primary strength was management of companies and enterprises, and public administration. Ramsey had a high Location Quotient for public administration jobs as it is home to the state's government. Agriculture, forestry,

fishing, and hunting jobs were scarce in Ramsey County.

Scott County

Scott County had strengths in accommodation and food services, arts, entertainment, and recreation, and construction. Its weaknesses included finance and insurance, and information. Scott County was strong in construction employment but was affected harshly by the recession.

Washington County

Like many of the suburban and rural counties, Washington County had a strong manufacturing presence. It showed the most consistency in employment across the industry sectors as many of their Location Quotients fell just below or above one.

Discussion

It is important to analyze and compare the results of both the Location Quotient and Shift Share Analyses. There are trends and behaviors in the data that become more apparent when looking at both. For example, if one were to only look at the Location Quotient change output for the management of companies and enterprises industry sector in Anoka County, it would seem the sector experienced minimal growth. However, after looking at the results of the Shift Share Analysis, it becomes clear the county is home to only a small number of jobs in that industry sector, but over the ten period, it grew substantially more than the national trends. One might look at the healthcare and social assistance Location Quotients for all of the counties and think that perhaps there has been a small increase in that sector for the study region. There has actually been a great increase in employment for that industry sector, however this change has also occurred nationwide. Healthcare and social assistance employment grew by about 21% nationwide during the study timeframe and the metropolitan region roughly reflected the same. Since Location Quotients are values of relativity, this increase would not have been detected with the Location Quotient analysis technique alone. The Shift Share Analysis also confirms trends inferred by the Location Quotient outputs. If the Location Quotients for construction in Scott County is analyzed, one might guess the industry sector performed worse within the study timeframe compared to the nation. That assumption is correct, but without the Shift Share Analysis, the gravity of the change is not as obvious. Indisputably related to the recent recession, the construction industry sector for the nation lost about 19% of employment from 2002-2011. Scott County lost about 29% of construction employment over this same time.

There are some industry sectors that have Location Quotients near one for the entire region, the most notable being educational services. Educational services are considered to be a “non-basic” industry, since it satisfies local demand (i.e. residents living in the region sending their children to schools make up this sector’s demand). Non-basic industry sectors are typically closer to one because their services are not exported, such as products from a manufacturing plant. Industry sectors that primarily export their goods or services outside of the region are considered to be “basic,” and their Location Quotients can be much greater since the demand can come from anywhere. Basic industry sectors tend to draw in the majority of income for a

region (Klosterman, 1990).

Baer and Brown (2006) suggest a Location Quotient of 1.25 or greater is needed in order to start classifying a region as an "exporter," assuming that the region itself does not have excessive demand for the service. A Location Quotient of at least 1.25 can be seen as an appropriate baseline for those looking for industry sector specializations within the region.

Conclusion

As regions continue to grow in complexity, with less space and fewer resources at their disposal, it is critical decision makers are equipped with information that will position economies to thrive. This integration of economic analysis techniques and GIS technology, which allows for an easy analysis of a great amount of information is a way that we can build a brighter future.

Acknowledgements

I would like to express my sincerest gratitude towards Ms. Greta Poser, Mr. John Ebert and Dr. David McConville for sharing their knowledge, guidance and support throughout my time as a student at Saint Mary's University of Minnesota, Department of Resource Analysis. Additionally, I'd like to thank my family and friends for their persistent support and encouragement during these important years of growth.

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