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**A Comparison of Employment Diversity in the St. Louis  
Metropolitan Statistical Area: 1974 and 1997**

by

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*Diverse* is a buzzword commonly used among community planners and regional economic developers to describe the industrial composition of the St. Louis region. Despite the growing use of diversity as a positive and promotional economic development selling point, there is little research regarding its trends or impacts in the St. Louis area. The situation is complicated by a lack of consensus on how to define or measure economic diversity in past studies of other regions. This monograph draws upon the ideas set forth in previous research to measure the change in the employment distribution of the St. Louis Metropolitan Statistical Area (MSA) over a twenty-four year period from 1974 to 1997 using a strict definition of *employment diversity*. Although some studies combine measures of employment diversity with assumptions regarding optimal levels of industry employment, this study focuses solely on measurement and makes no judgment regarding the optimal employment mix for the St. Louis MSA. From this analysis, it can be concluded that the region's employment was less evenly distributed across industries in 1997 than in 1974, making it slightly less diverse. Although economic theory suggests decreased employment diversity should result in greater regional instability, the shift in employment concentration from the manufacturing sector to non-manufacturing sectors is likely to surpass this effect, actually making the region less sensitive to cyclical economic fluctuations.

The body of this study contains five sections. The first section, entitled *Literature Review*, offers a brief description of diversity measures used in past research. Section Two, *Methodology*, compares the advantages and disadvantages of various measures of economic diversity. In addition, this section offers justification for the choice of methodology employed in this study, the equal distribution method, and describes how this method is applied to the St. Louis region. The third section, *Data*, discusses how industry employment was collected from *County Business Patterns* for the years 1974 and 1997. *Results*, the fourth section, presents the findings of the study, including changes in employment diversity and industry mix in the St. Louis MSA between 1974

and 1997. Fifth and finally, the *Implications* section examines how changes in regional employment diversity are expected to affect the St. Louis MSA.

### *Literature Review*

An overview of past literature on regional economic diversity measurement reveals a number of possible methodologies. Bahl, Firestine, and Phares (1971) use an adjusted minimum requirements method, which defines normal employment distribution in each SIC category as the percent that will satisfy local demand, to compare the industrial diversity of 212 Standard Metropolitan Statistical Areas (SMSA). Attaran and Zwick prefer the entropy method, which assumes diversity is achieved when all industries employ an equal percentage of the region's workforce. They use the entropy method to measure employment-based diversity in at least two studies: for the state of Oregon during the thirteen-year period from 1972 to 1984 (1987), and the 50 states and the District of Columbia during the ten-year period from 1972 to 1981 (1989). Wundt (1992) examines manufacturing employment in the state of Connecticut between 1964 and 1983 through application of the portfolio variance method, which accounts for both individual industry and inter-industry employment variations. This study provides an overall measure of regional instability, information on the cyclical characteristics of individual industries, and a method for identifying industries that encourage stability. Malizia and Ke (1993) employ a multiple regression analysis that incorporates the entropy index and several control variables to examine the relationship between economic diversity and unemployment and instability in all of the MSAs in the United States in 1970, 1980, and 1986. Other methods have also been used to examine economic diversity, including the national average and equal distribution (ogive) approaches.

Much of the variety among methodologies results from the definition of *diversity* adopted by researchers. Because *diversity* is a very general term, it has a number of

possible applications in regional economic studies. For instance, *diversity* could refer to the number or distribution of employees, revenues, or other factors in industries, sectors, companies, or employment. Since researchers are unable to agree upon a universal definition of the term *diversity*, each researcher must choose a methodology that measures diversity in accordance with the principles of his/her chosen definition. Therefore, any application of the term *diversity* and the subsequent choice of methodology are subject to the bias of the researcher. For the purpose of this study, the term *diversity* is narrowly defined. Herein, *employment diversity* will refer to the evenness with which employment is distributed across industries within a region, a definition utilized by Simon and Nardinelli (1992). In accordance with this definition, all industries in a perfectly diversified region will employ an equal proportion of the region's workforce. Conversely, a perfectly specialized region will have its entire workforce concentrated in a single industry. It is important that the measure of diversity used in this study calculate diversity according to the principles of the definition of *employment diversity* as previously set forth.

### *Methodology*

For this study, the appropriate method for comparing changes in employment diversity was selected through a process of eliminating possible candidate methods, most of which employ measures that do not adhere to the definition of *diversity* adopted in this study. Such was the case with the portfolio variance method. In addition, it is inferior to alternative methods in examining changes in diversity over time. Also, the national average method, which measures diversity by comparing the percentage of regional employment in each industry to the average percentage of U.S. employment in those industries, uses a definition of *diversity* contrary to the one used in this study. Moreover, the national average method does not have a constant base of comparison, and therefore, is not applicable when comparing changes in diversity over time, as it is impossible to distinguish if changes in diversity are attributable to changes in the

region or changes in the nation. Finally, multiple regression analysis was purged from the pool of possible methodologies because it is a more sophisticated method than is needed, since no attempt will be made to explain the relationships between employment diversity and other economic variables. After eliminating these measures, the entropy and equal distribution indexes were identified to be the best choices. This is because both compare regional employment distribution to a hypothetical uniform distribution (equal employment in each industry). However, the entropy method is a more sophisticated measure that can be decomposed to examine changes in inter-industry diversity patterns over time (Attaran and Zwick 1989). Since this study does not attempt to examine inter-industry diversity patterns, the equal distribution index was chosen over the entropy index.

Although the entropy index is currently the most widely used method for measuring regional diversity, some researchers have criticized equal distribution methods, such as the equal distribution or entropy indices, because they assume diversity can achieve equilibrium when all industries employ an equal percentage of a region's workforce (Siegel and Johnson 1995). As a result, regional disparities in employment due to differences in demand patterns, production technologies, trade flows, preferences, and endowments are ignored (Siegel and Johnson 1995). However, because these factors change within every region as time passes, methods that attempt to measure diversity based on regional comparative advantage will have an inconstant base, causing the method to fail when comparing diversity over time. In addition, an argument can be made that no prior knowledge regarding normal employment distribution exists for any given region, thereby making any method subject to the bias of the researcher. As a result, indices based on equal employment distribution are no more and no less likely to fail than other methods.

The goal of this study is simply to examine the change in the employment diversity of the St. Louis MSA in accordance with the strict definition previously set forth.

Therefore, no consideration is given to other economic diversity factors highlighted by other methods, such as interregional, inter-industry, or national average comparison. This study employs the equal distribution index merely as a measurement tool. The use of this method in no way suggests that equal distribution is the optimal distribution for employment in the St. Louis MSA or any other region. Optimal employment distribution is achieved only when market demands for goods and services are satisfied and unemployment risk is minimized.

As applied in this study, the equal distribution index measures the deviations from equal employment distribution in all industries, and has a constant, comparable base that allows for examination of changes in employment diversity over time. In the St. Louis MSA, employment is spread across 75 different industries, indicating 1.33% as the ideal share of regional employment for each industry. The equal distribution index is formed from the summation of the absolute values of the deviations between each industry's actual and ideal (1.33%) percentage of regional employment, divided by the maximum possible index value. The equal distribution index (EDI) is illustrated in the following equation:

$$EDI_t = \frac{\sum_{i=1}^N \left| \theta_{i,t}^R - 1/N \right|}{\sum_{i=1}^N \left| \theta_{i,t}^R - 1/N \right|}$$

where N represents the number of industries in the region (75), t represents the year,  $\theta_{i,t}^R$

is the region's share of employment in industry i in year t, and 1/N is the equal distribution (ideal) employment share for each industry (1/N = 1/75 = 1.33%) (Wundt 1992). A summation value of zero indicates employment activity is perfectly

diversified within the region, and a value of 1.0 indicates perfect specialization.<sup>1</sup> For the purpose of this study, index values for 1974 and 1997 have been multiplied by 100 to create an index scale with a range from 0 (perfect diversification) to 100 (perfect specialization).

## *Data*

Employment data for each of the 12 counties in the St. Louis MSA was collected for the years 1974 and 1997 from *County Business Patterns*, which is published annually by the U.S. Census Bureau.<sup>2,3</sup> These data represent the number of workers employed by employer firms in each industry at the two-digit Standard Industrial Classification (SIC) level.<sup>4,5,6</sup> The data for the 12 counties was aggregated to create a data set for the entire MSA, which includes 75 industries at the two-digit SIC level.

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<sup>1</sup> See Exhibit Three of the Appendix for calculation of the perfect specialization value.

<sup>2</sup> Employment data as reported by *County Business Patterns* excludes data on self-employed individuals, employees of private households, railroad employees, agricultural production employees, and most government employees.

<sup>3</sup> The starting year (1974) was chosen because it was the first year *County Business Patterns* provided an approximate range of employment in industries for which specific employment figures were unavailable due to disclosure regulations. The ending year (1997) was chosen because it was the most recent year that *County Business Patterns* published employment data in SIC form (*CBP* started using NAICS in 1998).

<sup>4</sup> For a few industries, *County Business Patterns* did not provide specific two-digit employment figures due to disclosure regulations. In such cases, total employment in the remaining two-digit industries was deducted from the reported total employment of the one-digit parent sector employment figure. The difference was used as the employment figure in the undisclosed two-digit industry. When use of this method was impossible due to the existence of more than one undisclosed two-digit industry employment figure, the midpoint of the employment range was used as a substitute for the undisclosed employment figure.

<sup>5</sup> The two-digit SIC employment figures were aggregate from three-digit SIC figures and may differ slightly from two-digit employment figures as reported in *County Business Patterns*.

<sup>6</sup> Because *County Business Patterns* does not report data in insignificant industries, a deviation existed between the total of the two-digit employment figures and the total of the one-digit sector employment figures as reported by *County Business Patterns*. In order to compensate for this discrepancy, the difference between the reported employment of each one-digit sector and the calculated aggregate of its respective two-digit industries was used to create a new two-digit category for employment in the sector's unclassified industries. The final data set was comprised of the new two-digit unclassified employment categories and the two-digit employment categories as reported in *County Business Patterns*.

## *Results*

In 1974, the St. Louis MSA had an employment diversity index of 40.6, which increased to 43.0 in 1997. From these two values, it can be concluded that employment diversity within the St. Louis MSA decreased between 1974 and 1997. Of the 75 industries in the region, 41 industries employed a smaller proportion of the region's workforce in 1997 than in 1974. Most of these industries are concentrated in goods producing sectors, particularly manufacturing. The remaining 34 industries, concentrated mostly in service producing sectors, experienced an increase in their relative proportion of regional employment. Exhibits One and Two of the Appendix list the 75 industries used in this study, and show each industry's gain or loss in regional employment between 1974 and 1997.

It is not surprising that the data show a significant shift in employment from goods producing to service producing sectors; the change in the employment structure of the St. Louis MSA has been discussed in innumerable past forums, both formal and informal. Although this study covers only the period from 1974 to 1997, the region's employment structure actually began to change in the 1950s. In fact, between 1951 and 1997, goods producing employment decreased from 52.8% to 23.3% of total employment in the St. Louis MSA, while employment in service producing sectors increased from 47.2% to 76.6% ("St. Louis..." 1999). While the shift in the employment structure of the St. Louis MSA is drastic, it closely reflects changes that have occurred in other cities, as well as the nation as a whole ("St. Louis..." 1999).

At first glance, the results of this study suggest the economy of the St. Louis MSA weakened during the period from 1974 to 1997. After all, the decrease in employment diversity means employment in the area was concentrated in fewer industries in 1997 than in 1974. As a result, the risk of regional economic instability is expected to increase because the region's workers are more dependent on fewer industries. In



addition, employment in goods producing industries decreased significantly in the region and is unlikely to stimulate significant employment growth in the future. Although this analysis does have some merit, it is over-simplistic because it ignores the economic impacts resulting from the region's shift from goods producing to service producing employment.

### *Implications*

Basic economic theory suggests the economies of diversified regions will be more stable than those of specialized regions. This is because diversified regions have a greater industry mix, and each industry will be affected by cyclical shocks in varying ways and at different times. In diverse economies, decline in one industry will likely be offset by expansion in another industry. As a result, at least some of the declining industry's displaced employees will be able to find jobs in expanding industries. In specialized economies, the lack of industry mix decreases the chance that displaced workers will be able to find employment in other industries. All economists, however, do not accept this assumption.

Some economists argue that since diverse economies have a more heterogeneous pool of workers, displaced workers will have trouble finding employment in other industries due to a lack of industry-specific training and knowledge (Malizia and Ke 1993). These economists believe the homogeneous workers of specialized economies will have more stable employment because they can use their skills and training to find jobs in industries that engage in operations similar to those of the industry from which they were displaced. There is, however, little research to support this hypothesis. A major flaw is that it discounts the effects of industry-specific shocks, which resonate especially far in specialized regions. For instance, a region specializing in automobile manufacturing will experience unemployment when demand for automobiles decreases. However, not only will the region's automobile manufacturers experience a

decline, local related industries, such as metal mining, steel production, and electronics, will also greatly suffer. Due to the decrease in demand, the region's displaced workers will have difficulty finding jobs in industries related to their field of specialization, and they will also have trouble gaining employment in unrelated industries due to the lack of industrial mix in the specialized region.

According to the research presented in this study, employment diversity in the St. Louis MSA decreased slightly between 1974 and 1997. However, it cannot be concluded that the decrease has resulted in less stable employment. During the same period, the region's concentration of employment was shifting from goods producing sectors to service producing sectors. In 1974, jobs in durable goods manufacturing (automobiles, aircrafts, appliances, et cetera) made up the majority of the manufacturing employment in the St. Louis MSA. Because these industries have high demand elasticities, they are among the most cyclically sensitive industries.<sup>7</sup> As a result, the manufacturing sector has more employment fluctuations than non-manufacturing sectors, and many manufacturing jobs are especially susceptible to lay offs, budget cuts, downsizing, foreign competition, and permanent displacement. In contrast, employment in non-manufacturing sectors, such as services and finance, insurance, and real estate (F.I.R.E.), is relatively more stable. By shifting the employment concentration from goods producing to service producing sectors, the St. Louis MSA is likely to experience smaller employment fluctuations during periods of economic decline. In fact, any instability resulting from the region's slight decrease in employment diversity is likely to be surpassed by increased stability due to the shift from manufacturing to service employment.

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<sup>7</sup>Most durable goods purchases are not necessary. Durable goods are usually purchased when consumers have positive feelings regarding their economic situations. When consumers are worried about future economic outlook, they tend to delay purchases of durable goods until more prosperous times.

## Appendix

- Exhibit One            Table: Industries with Decreased Percentages of Total Regional Employment- St. Louis MSA, 1974 to 1997
- Exhibit Two            Table: Industries with Increased Percentages of Total Regional Employment- St. Louis MSA, 1974 to 1997
- Exhibit Three           Calculation of the perfect specialization value for the equal distribution index of the St. Louis MSA

**Exhibit One- Industries with Decreased Percentages of Total Regional Employment**

Sector	SIC Code	Industry	Industry's % of Total Regional Employment		Loss in Industry's % of Regional Employment
			1974	1997	
AG/F/F/M	700	Unclassified AG/F/F/M	0.22%	0.07%	-0.15%
	1200	Coal mining	0.17%	0.05%	-0.12%
	1400	Nonmetallic minerals, except fuels	0.14%	0.06%	-0.08%
Construction	1500	General contractors and operative builders	1.46%	1.44%	-0.02%
	1600	Heavy construction, except building	0.83%	0.60%	-0.24%
Manufacturing	2000	Food and kindred products	2.66%	0.95%	-1.72%
	2000	Unclassified manufacturing	2.71%	1.98%	-0.73%
	2200	Textile mill products	0.10%	0.00%	-0.10%
	2300	Apparel and other textile products	1.29%	0.27%	-1.02%
	2400	Lumber and wood products	0.26%	0.10%	-0.16%
	2500	Furniture and fixtures	0.56%	0.38%	-0.18%
	2600	Paper and allied products	1.00%	0.48%	-0.52%
	2700	Printing and publishing	1.86%	1.40%	-0.46%
	2800	Chemicals and allied products	2.01%	1.00%	-1.01%
	2900	Petroleum and coal products	0.41%	0.16%	-0.25%
	3100	Leather and leather products	0.73%	0.04%	-0.69%
	3200	Stone, clay, and glass products	1.00%	0.26%	-0.73%
	3300	Primary metal industries	2.92%	1.05%	-1.87%
	3400	Fabricated metal products	3.07%	1.32%	-1.76%
	3500	Industrial machinery and equipment	2.74%	1.64%	-1.10%
	3600	Electronic and other electronic equipment	2.11%	0.74%	-1.37%
	3700	Transportation equipment	6.46%	3.82%	-2.64%
3900	Misc. manufacturing industries	0.61%	0.26%	-0.35%	
Transportation	4200	Trucking and warehousing	2.42%	2.04%	-0.38%
	4400	Water transportation	0.37%	0.07%	-0.30%
	4800	Communication	1.82%	1.52%	-0.31%
	4900	Electric, gas, and sanitary services	1.15%	0.76%	-0.39%
Wholesale	5000	Wholesale- durable goods	4.17%	3.81%	-0.35%
	5100	Wholesale- nondurables goods	2.63%	2.37%	-0.26%
Retail	5200	Unclassified retail	1.02%	0.74%	-0.28%
	5300	General merchandise stores	3.14%	2.40%	-0.74%
	5400	Food stores	2.76%	2.33%	-0.43%
	5500	Automotive dealers and service stations	2.19%	2.06%	-0.13%
	5600	Apparel and accessory stores	1.14%	0.82%	-0.32%
F.I.R.E.	6100	Nondepository institutions	0.61%	0.57%	-0.03%
	6600	Combined real estate, insurance, etc.	0.03%	0.00%	-0.03%
Services	7000	Hotels and other lodging places	1.08%	1.04%	-0.03%
	7200	Personal services	1.55%	1.40%	-0.15%
	7600	Misc. repair services	0.37%	0.34%	-0.02%
	8900	Misc. services	0.10%	0.05%	-0.06%
Unclassified	9999	Unclassified business	0.63%	0.02%	-0.61%

AG/F/F/M - Agriculture, Forestry, Fishing, Mining

F.I.R.E. - Finance, Insurance, Real Estate

## Exhibit Two- Industries with Increased Percentages of Total Regional Employment

Sector	SIC Code	Industry	Industry's % of Total Regional Employment		Gain in Industry's % of Regional Employment
			1974	1997	
AG/F/F/M	700	Agricultural services	0.16%	0.48%	0.32%
	1000	Metal mining	0.00%	0.01%	0.01%
Construction	1500	Unclassified construction	0.03%	0.05%	0.02%
	1700	Special trade contractors	3.05%	3.42%	0.38%
Manufacturing	3000	Rubber and misc. plastics products	0.60%	0.82%	0.22%
	3800	Instruments and related products	0.43%	0.50%	0.07%
Transportation	4100	Local and interurban passenger transit	0.37%	0.48%	0.11%
	4100	Unclassified transportation	0.09%	0.43%	0.34%
	4500	Transportation by air	0.41%	0.94%	0.53%
	4700	Transportation services	0.25%	0.43%	0.18%
Wholesale	5000	Unclassified wholesale	0.31%	0.38%	0.07%
Retail	5200	Building materials and garden supplies	0.59%	0.74%	0.15%
	5700	Furniture and home furnishings stores	0.69%	0.72%	0.03%
	5800	Eating and drinking places	5.06%	7.42%	2.35%
	5900	Misc. retail	2.14%	2.35%	0.20%
F.I.R.E.	6000	Unclassified F.I.R.E.	0.18%	0.25%	0.07%
	6000	Depository institutions	1.89%	1.99%	0.10%
	6200	Security and commodity brokers	0.26%	0.78%	0.52%
	6300	Insurance carriers	1.28%	1.31%	0.03%
	6400	Insurance agents, brokers, and service	0.42%	0.61%	0.19%
	6500	Real estate	1.10%	1.13%	0.04%
	6700	Holding and other investment offices	0.21%	0.29%	0.08%
Services	7000	Unclassified services	0.18%	0.81%	0.63%
	7300	Business services	3.64%	7.47%	3.83%
	7500	Auto repair, services, and garages	0.69%	1.05%	0.37%
	7800	Motion pictures	0.23%	0.34%	0.11%
	7900	Amusement and recreation services	0.83%	2.15%	1.32%
	8000	Health services	6.30%	11.21%	4.91%
	8100	Legal services	0.31%	0.78%	0.47%
	8200	Educational services	1.93%	3.26%	1.33%
	8300	Social services	1.05%	2.03%	0.98%
	8400	Museums, botanical, zoological gardens	0.00%	0.06%	0.06%
	8600	Membership organizations	2.05%	2.58%	0.53%
	8700	Engineering and management services	0.76%	2.33%	1.57%

AG/F/F/M - Agriculture, Forestry, Fishing, Mining

F.I.R.E. - Finance, Insurance, Real Estate

**Exhibit Three- Calculation of the perfect specialization value for the equal distribution index of the St. Louis MSA**

Perfect specialization occurs within a region when all of the region’s employment is concentrated in a single industry. For example, assume that in 1974, the St. Louis MSA contained 75 industries, but only one industry, Industry 1, employed the entire region’s workforce. In this case, Industry 1 will employ 100% (1.0) of the workers and the remaining industries will each employ 0.0% (0.0) of the workers. Using this information, the equal distribution index is calculated as follows:

$$\begin{aligned}
 EDI_t &= \frac{\sum_{i=1}^N \sqrt{\theta_{i,t}^R - 1/N}}{N} \\
 &= \frac{\sum_{i=1}^N \sqrt{\theta_{i,1974}^{SL} - 1/75}}{75} \\
 &= \frac{\sqrt{1.0^{SL}_{1,1974} - 1/75} + \sqrt{0.0^{SL}_{2,1974} - 1/75} + \dots + \sqrt{0.0^{SL}_{75,1974} - 1/75}}{75} \\
 &= \frac{\sqrt{1.0^{SL}_{1,1974} - 1/75} + \sqrt{0.0^{SL}_{2,1974} - 1/75} + \dots + \sqrt{0.0^{SL}_{75,1974} - 1/75}}{75} \\
 &= 1.0/1.0 \\
 &= 1.0
 \end{aligned}$$

## References

- Attaran, Mohsen and Zwick, Martin, "Entropy and Other Measures of Industrial Diversification," *Quarterly Journal of Business and Economics* 26 (4, 1987): 17-34.
- Attaran, Mohsen and Zwick, Martin, "An Information Theory Approach to Measuring Industrial Diversification," *Journal of Economic Studies* 16 (1, 1989): 19-30.
- Bahl, Roy W., Firestone, Robert, and Phares, Donald, "Industrial Diversity in Urban Areas: Alternative Measures and Intermetropolitan Comparisons," *Economic Geography* 47 (3, July 1971): 414-425.
- "St. Louis Five Year Strategy Consolidated Plan" (City of St. Louis Community Development Administration (CDA) and Planning and Urban Design Agency (PDA), available online at <http://stlouis.missouri.org/5yearstrategy/> , 1999).
- Malizia, Emil E. and Ke, Shanzi, "The Influence of Economic Diversity on Unemployment and Stability," *Journal of Regional Science* 33 (2, 1993): 221-235.
- Siegel, Paul B. and Johnson, Thomas G., "Regional Diversity and Diversification," *Growth & Change* 26 (2, 1995): 261-284.
- Simon, Curtis J. and Nardinelli, Clark, "Does Industrial Diversity Always Reduce Unemployment? Evidence from the Great Depression and After," *Economic Inquiry* 30 (2, 1992): 384-397.
- Wundt, Bruce D., "Reevaluating Alternative Measures of Industrial Diversity as Indicators of Regional Cyclical Variations," *The Review of Regional Studies* 22 (1, 1992): 59-73.