A Comparison of Cluster Formation in Spokane and Similar MSAs

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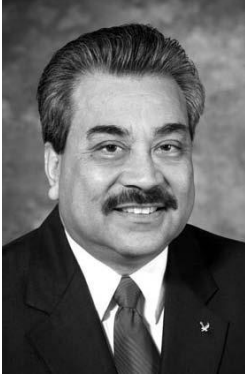Associate Professor
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With this latest monograph from the Institute for Public Policy & Economic Analysis, I welcome you to Eastern Washington University. I hope this research will inform your knowledge of the Inland Northwest. Efforts like this Institute monograph series are manifestations of this University's commitment to serve the region. I applaud the initiative of Eastern's Board of Trustees to launch this Institute.

Teaching remains our core mission at Eastern Washington University. Increasingly, teaching and research are interwoven. Our faculty members stay professionally current when publishing in peer-reviewed journals. These achievements, in turn, allow them to better convey the evolving knowledge base of our academic disciplines.

Our students receive an enhanced education if their classroom experience is informed by the content and enthusiasm of their professor's research. Increasingly, we ask students to conduct research projects of their own. Whether conducting their own projects or assisting professors, our students acquire a richer learning experience through research.

Research for academic journals is not the only area our faculty members target, however. Our University also asks its faculty to engage the communities and region from which we draw our students. This research provides a greater sense of place and a commitment by our faculty to it. It also translates academic methods and findings into a broader, and ultimately more relevant, arena: the lives of the residents of the Inland Northwest.

The overarching goal of the Institute for Public Policy & Economic Analysis is to serve the region by translating knowledge. It does this through a variety of activities, including this series, annual economic forecasts, contract research and the Community Indicators Initiative. I invite you to explore its web site (www.ewu.edu/policyinstitute) to learn more.

I have tremendous optimism that by collaborating with EWU's faculty, staff and partners, I will continue to ensure our institution will be anchored into the daily course of life throughout the Inland Northwest. During these difficult economic times, our collective future depends on an educated and informed citizenry. Helping our region reach higher levels of knowledge is something this University can and will do.

My office and that of the Institute director welcome all comments on how we might better serve.

Rodolfo Arévalo, PhD
President

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I. Executive Summary

In recent years, state and local governments have looked to cluster development as a means of elevating economic performance in their regions and as a way to improve the standard of living for their constituents. This heightened interest in clusters and their formation has provided momentum to regional initiatives fostering their development. Porter (1998, 2003) shows that regions derive significant competitive and economic advantage when there are concentrations of firms (economic clusters) in home markets of similar or related industries. Research posits that these competitive advantages derive from the locational relationships of firms within these clusters, resulting in benefits from knowledge spillover, ease of access to skilled labor, better acquisition and assembly of the inputs of production, and competitive pressures to innovate and increase productivity.

In this study, Porter's (2003) cluster definition as "a geographic proximate group of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by externalities of various types" was used. The existence and strength of clusters are measured by *location quotients (*LQs). Based on employment levels, LQs measure the concentration of a particular industry in a particular local economy, relative to the national average. An industry with an LQ > 1 is interpreted as showing a cluster.

The purpose of this monograph is to profile cluster as well as economic development in Spokane and seven other comparable Metropolitan Statistical Areas (MSAs): Boise, ID; Colorado Springs, CO; Salt Lake City, UT; Provo, UT; Reno, NV; Tucson, AZ; and Albuquerque, NM. The study looks at the impact of cluster development within Spokane and the seven comparable MSAs (the competitive set), as measured by average wage, average wage growth, average number of employees, average annual employee growth, traded firm growth, and patenting (a benchmark for innovation). In addition, the monograph reports on how cluster formation has advanced in Spokane since 1990. Drawing on data from Harvard's Cluster Mapping Project, we arrive at the following conclusions.

Economic Performance

Spokane experienced higher employment growth than the national average over the period 1990-2004, averaging 2.2 percent during the period while the US averaged 1.5 percent. Employment growth in the competitive set ranged from 2.2 percent in Spokane to 4.1 percent in Boise during this period.

Average annual wage in Spokane in 2004 was $31,725, compared to the national average of $36,967. Spokane's average annual wage was higher than Albuquerque, Tucson, and Provo and ranked fifth highest of the MSAs studied. Average wage ranged from $27,526 (Provo) to $35,043 (Reno). The average wage growth for Spokane over the 1990-2004 period was 3.4 percent, compared to 3.6 percent for the US. Average wage growth across the MSAs ranged from 3.4 percent in Spokane to 4.1 percent in Tucson.

Spokane's employment showed a slightly greater percentage of employment associated with *local* clusters than with traded clusters, in comparison to the comparable cities. However, this difference apparently did not negatively influenced average annual wage. Local clusters are made up of local industries. Local industries provide goods and services almost exclusively for the area in which they are

located, which explains why they must spread all across the country. Consequently, local industries show employment in every region, and employment is roughly proportional to regional population.

On the other hand, *traded* clusters are made up of industries that sell products and services across economic areas, and are concentrated in the specific regions where they choose to locate production, due to the competitive advantages afforded by these locations. Employment levels in traded industries vary greatly by region, and have no clear link to regional population levels. Traded cluster development in an area will inevitably have an impact upon local industries, as local services are used by the traded industries in support operations (Porter, 2003).

The study found that the majority of employment in Spokane and in the competitive set MSAs could be accounted for by companies associated with local clusters. Provo proved to be the exception. Employment in companies associated with traded clusters accounted for the next highest level of employment across the eight MSAs. Thus, local and traded industries account for 99 percent of employment within the MSAs studied. The third cluster type, *natural resource-dependent,* contributed very little to any of the MSAs studied.

Innovation Output
There was a marked difference in innovation output across the MSAs studied, as proxied by utility patents. Patents per 10,000 employees in 2004 ranged from an average of 4.35 for Spokane to 76.95 for Boise. The US national average was 7.92.

A similar pattern was also seen in average annual patent growth from 1990-2004. Annual patenting growth rate ranged from 3.8 percent in Salt Lake City to 23.9 percent

in Boise. Spokane's patent growth rate was 4.7 percent over this period, placing it sixth among the MSAs studied. The US national average was 4.4 percent over the same period. Patenting activity was closely associated with certain traded industries whose processes or output involve technology, industries like Information Technology or Biopharmaceuticals. Spokane did not have these cluster types present within its economy. In contrast, six of the seven comparable cities had Information Technology clusters; only Reno, besides Spokane, lacked an IT cluster.

Traded firm establishment growth showed Provo with the highest average rate of traded firm formation during the period 1990-2004, averaging 8.4 percent per year, versus an average 3.6 percent per year in Spokane. The US average was 3.2 percent over this same period.

Evolution of Clusters in the Spokane MSA
Local clusters dominated overall cluster development within Spokane. The top five clusters in the Spokane MSA by employment were associated with local industries. Of the top ten clusters by employment in Spokane, local health services employed the most people in 2004. Provo, with seven, had the highest number of traded clusters within their top ten clusters, while Spokane, Albuquerque, and Tucson, at three, had the lowest number of such clusters within the top ten overall. Spokane's economy appears somewhat more diversified with respect to traded cluster development than are the comparable MSAs.

In Spokane, no one traded cluster appears to dominate the economy. Spokane's average LQ for traded clusters was 1.4 with a standard deviation of 0.40. This standard deviation was one-third of that for the next lowest comparable MSA (Salt Lake City),

reflecting a relatively even distribution of traded cluster employment in Spokane by comparison. This characteristic is consequential, in that it may serve to protect Spokane's economy from the negative effects of industry shock that occurs in economic cycles.

There has been noteworthy cluster formation in Spokane between 1990 and 2004. In 1990, of the top ten clusters present in Spokane, nine were local cluster types. In 2004, there were three traded cluster types within Spokane's top ten clusters. This development reflected an economy that was increasingly becoming more involved in the larger US economy and depended less on the local market. In addition, the findings show that no one traded cluster dominates the Spokane economy.

In fact, Spokane's economic growth was most significant in terms of traded cluster development. In 1990, traded clusters accounted for only 3.3 percent of employment in Spokane's top clusters, yet by 2004 this had risen to 15.2 percent. Two traded clusters, Education and Knowledge Creation as well as Financial Services, grew to the point that they could be recognized within Spokane's top ten clusters.

Spokane appeared most similar to Albuquerque and Tucson in terms of its economic performance indicators. It shares only two traded clusters with Albuquerque (Entertainment and Heavy Equipment Services) yet shares four with Tucson (Entertainment and Heavy Equipment Services; Building Fixtures; Equipment & Services; and Aerospace Vehicles and Defense). By contrast, Spokane appears least similar to Provo, which has seven traded clusters in its top ten clusters. Also, Spokane and Provo have only two traded clusters (Education and Knowledge Creation and Heavy Equipment Services) in common.

Finally, the data suggest that not all traded industries are the same in terms of their impact on economies. It appears that some local cluster types may have greater economic impact on local economies than some traded cluster types. Spokane's large Local Health Services cluster is a good example: It employs a large number of people at above average wages. Consequently, a local cluster such as Local Health Services might more positively impact an economy than a traded cluster, such as leather works, important to Reno and therefore be more desirable for economic development than some traded clusters.

II. Introduction

Promoting economic cluster formation based on technological innovation has become an important new strategy for global competitive advantage and entrepreneurial growth. In *The Competitive Advantage of Nations,* Michael Porter argues that nations gain significant competitive and economic advantage where concentrations of firms, or clusters, exist in home markets of similar or related industries. Cluster location relationships help produce beneficial advantages such as knowledge spillover, ease of access to skilled labor, better acquisition and assembly of the inputs of production, and competitive pressures to innovate and increase productivity. Understanding those factors that motivate cluster formation as well as amplify (or diminish) the regional economic impact of cluster economies will certainly continue to be a public priority.

Problems with the LQ measure include technical difficulties in identifying cluster boundaries and usage of several definitions of clusters. Nevertheless, there is consensus among researchers that clusters represent geographic concentrations of businesses that share related production inputs, specialized labor pools, distribution and communication channels, and network associations.

Clusters are associated with cultures that promote growth and innovation as new technology is created from old technology and spin-off businesses are created from old businesses. Innovation is motivated because of increased exchange of knowledge and employees between cluster companies. Within clusters, an infrastructure exists to support entrepreneurship, including an entrepreneurial environment and capital (venture capital) knowledge. Within this highly competitive environment, the drive to rapidly commercialize innovation is another factor that contributes to the better economic performance of clusters. Because of their proximity advantages, clusters make the "cultural" generation and transmission of knowledge more efficient. Economic activity based upon new knowledge (innovation) has a greater propensity to concentrate within clusters than outside of clusters.

One important consequence of cluster formation is that research shows that new firm founding rates appear greater in clusters than elsewhere. This may be because clusters provide an attractive circumstance for entrepreneurs or new subsidiaries. Further, industrial clusters comprised of small or young companies are more conducive to new business formation than clusters made up of mature and large companies. One reason lies in the apparent better ability of companies located in clusters to perceive new buyers' needs than isolated competitors, because buyers often relocate to clusters to take advantage of cluster economies. In addition, the inputs needed for new business formation, such as capital, skilled labor, specialized equipment or components, suppliers and markets, are typically more readily accessible in clusters than they are elsewhere.

Consequently, new firm formation appears greater in clusters because market opportunities are more easily perceived within clusters. Furthermore, the specialized inputs needed for new firm formation (e.g. capital, skilled labor, suppliers, etc.) are more easily accessed within clusters, and cluster economies make it attractive for new firms to locate within these concentrations.

Economic clusters are mainly composed of *local*, *resource-dependent*, and *traded* industries. Local clusters are made up of

industries which provide goods and services almost exclusively for the area in which they are located, which explains why they must spread all across the country. Local industries show employment in every region, and employment is roughly proportional to regional population. Natural endowment cluster are composed of resource dependent industries where employment is located primarily where the natural resources are found. These industries compete with other domestic industries and other international locations.

On the other hand, traded clusters are made up of industries that sell products and services across economic areas, and are concentrated in the specific regions where they choose to locate production, due to the competitive advantages afforded by these locations. Employment levels in traded industries vary greatly by region, and have no clear link to regional population levels (Porter 2003). Of the three types, *traded* industry clusters are alleged to have the greatest economic regional impact because of their influence on wages in local industries (Porter, 1998; 2003).

Traded industries, such as motion picture and videotape production and automobile assembly, are not resource dependent and sell products and services across regions and sometimes across countries. Traded clusters are purported to positively influence the relative prosperity of the areas in which they are found, for they create demand for local industries that serve commercial customers. Likewise, the higher wages generally paid in traded industries act to influence local household demand thereby impacting local retail commerce (Porter, 2003).

Clusters are found in all 50 U.S. states and around the globe. Some well known U.S. clusters are microelectronics in the Silicon Valley of California, household furniture in

North Carolina, entertainment in Hollywood and gambling casinos in Las Vegas. Typically, a relatively small number of clusters usually account for a major share of the economic activity within a geographic region and the vast share of exports sent out of the region.

The purpose of this monograph is to detail cluster development within the Spokane Metropolitan Statistical Area (MSA) and compare it to that of the seven comparable MSAs: Albuquerque, Boise, Colorado Springs, Provo, Reno, Salt Lake City, and Tucson. The study adopts as measures wages and wage growth, employment and employment growth, firm development, and patenting (a benchmark for innovation). It also looks at how cluster formation has advanced in Spokane since 1990.

III. Data and Methods

Data used for this project come from the Cluster Mapping Project housed within the Institute of Strategy and Competitiveness at Harvard University. The mapping project collects data (excluding government and agriculture) on several measures of economic performance at the county level, including employment, average wages, patents per 10,000 employees, and traded established growth. Employment measures were used to derive the location quotient (LQ), a measure of the concentration of clustering of a particular industry in a particular location, relative to the national average.

Thus, the LQ for an MSA is the ratio of the industry's share of total metro employment, divided by its share of total national employment. An industry with LQ > 1 indicates higher than average employment in an industry in that location, and hence an economic cluster. Or put

another way, a cluster with an LQ of 1.2 means that a local cluster's share of employment is 20% higher than its national share.

Data for the Cluster Mapping Project (CMP) were assembled from U.S. Census County Business Pattern data on employment, establishments, and wages by four-digit Standard Industrial Classification (SIC) Codes. Within the CMP database, patents are allocated to industries and clusters based upon the location of the inventor, using a concordance of technology classifications with SIC codes. Industries in the economy are categorized as traded and local based upon the degree of industry dispersion across the geographic areas. Within the CMP database, data for local clusters are presented separately from data from traded clusters.

Variable descriptions

Definitions for these measures, as described the Harvard Cluster Mapping Project's Institute for Strategy and Competitiveness, (http://www.isc.hbs.edu/cmp/cmp_data_glossary.html, retrieved 12/20/07) are:

- *Employment*. Full- and part-time employees, including salaried officers and executives of corporations, who are on the payroll, including employees on paid sick, holidays and vacations of firms located within the MSA; not included are proprietors and partners of unincorporated businesses.
- *Employee Growth*. Average annual employment growth in the MSA during the period 1990-2004.
- *Average Annual Wages*. Total annual payroll, divided by total employment for a particular cluster/industry-MSA combination. Used as a measure of the standard of living.
- *Average Wage Growth*. Average annual wage growth in the MSA during the period 1990-2004.

- *Patents*. The number of utility patents awarded during the year by the United States Patent and Trademark Office for any new and useful process, machine, article of manufacture, or compositions of matters, or any useful improvements thereof.
- *Patent Growth.* Average patenting growth in the MSA during the period 1990-2004.
- *Traded Company Growth.* The annual formation rate for companies from traded industries in the MSA during the period 1990-2004.

Our analysis started by determining what types of clusters were present in each MSA. In this process, Location Quotients (LQs) were first calculated for each type of traded and local cluster to determine whether or not this cluster existed within the MSA in accordance with the method described in the CMP (http://www.isc.hbs.edu/cmp/cmp_data_glossary.html, retrieved 12/20/07). As noted, clusters are defined as those industries within an MSA with a LQ greater than 1.0. The results were then organized into tables of the top ten clusters and the top traded clusters in each MSA.

In similar fashion, a comparison was made of Spokane's cluster status in 1990 and 2004. The same descriptive data mentioned above were then compared. The results of this analysis are presented later in this report.

Lastly, correlation analysis was conducted on the data set to see if a relationship could be found between the traded cluster development and the economic performance measures and innovation output measures described above. Results of this analysis are presented in Section V (Analysis and Results).

IV. Background

Spokane County is located within the Inland Pacific Northwest, centered east-west on Interstate 90 and north-south on U.S. Highway 395. The City of Spokane downtown lies thirty miles from the Washington-Idaho border. As of 2007, the Spokane MSA had a population of approximately 450,000, of which 200,000 are considered to be City of Spokane residents. The Spokane MSA is equivalent to Spokane County.

Economy and Employment

From 1996 through 2006, Spokane County increased employment in all but one year (2001), with the average increase of 1.4 percent annually. Spokane County's non-farm employment continues to be dominated by three industry sectors, including wholesale and retail trade, government and education, and health sectors. Professional and business services and construction sectors are expected to grow the fastest in the coming years. Spokane County's top ten largest employers, in order, include: Fairchild Air Force Base, Spokane Public Schools, Sacred Heart Medical Center, the State of Washington, the US Government, Spokane County, the City of Spokane, Empire Health Services, URM Stores Inc., and the Community Colleges of Spokane. Avista Corporation, Central Valley School District, Eastern Washington University, West Corp., Northern Quest Casino round out the next five largest employers. (Source: 2006 Market Fact Book)

In Spokane County employment in private enterprise accounts for roughly 79 percent of total employment in the county compared to 77 percent across Washington State. The next largest employer in the County is Government (including Education), with 14.4 percent of employment share, followed by self-employment at 5.8 percent. Almost 66 percent of Spokane County's citizens who are 16 and older participate in the labor force. The largest single occupational category in the County is Management and Professional with 34.3 percent share in 2007. This is followed by Sales and Office (27.2%); Services (18.7%); Production, Transportation and Materials (11.6%); and Construction, Extraction, Maintenance and Repair (7.9%).

The County's four largest employing sectors comprise of Government (including education), Health Care and Social Assistance, Retail, and Manufacturing and together account for approximately 50% of Spokane's labor force. Of these, Manufacturing, the smallest of these top four sectors, has the highest average annual wage of $44,544. Retail, on the other hand, has the lowest average annual wage of the top four sectors with an annual average wage of $26,473. Government and Health Care and Social Services come in at $43,230 and $35,351 respectively. (Source: http://www.communityindicators.ewu.edu/indicators.cfm)

The specific occupations projected to grow the fastest in the County through the year 2012, according to the Washington State Employment Security Department, are led by cabinetmakers and bench carpenters, at 8.2 percent. By comparison, foundry mold and coremakers, at a -2.1 percent annual growth rate represents the fastest expected declining occupation in the County over this same period. Ninety-five percent of Spokane County companies have less than 50 employees accounting for 43 percent of total employment in the county. (Source: 2006 Market Fact Book).

V. Analysis and Findings

Table 1 reflects a comparison of the economic performance measures across the MSAs between 1990 and 2004. At 2.2%, Spokane had higher annual employment growth than the national average (1.5%) but lower growth compared to the competitive set. Employment growth from 1990 to 2004 ranged from 2.5 percent in Spokane to 4.1 percent in Boise. All MSAs exceeded the national average with respect to employment growth.

Average annual wage results for 2004 reflected a fairly tight distribution across the relevant MSAs, ranging from $27,526 in Provo to $35,043 in Reno. All were below, however, the 2004 national average wage of $36,967. In 2004, Spokane's average wage was $31,725, placing it 5th among the MSAs compared. Wage growth from 1990-2004 across the MSAs ranged from 3.4 percent in Spokane to 4.1 percent in Tucson. As Table 1 shows, Spokane was slightly below the national average, at 3.6%, in average wage growth during period 1990-2004, but within 0.3 percent of the five other MSAs (Albuquerque, Boise, Provo, Reno, and Salt Lake City) and less than a one percent from that of Tucson and Colorado Springs.

Table 1 Economic Performance of the MSA Competitive Set: 1990-2004

MSA	Employment[1] Levels in 2004	Employment Growth	Average Wages in 2004	Ave. Wage Growth	Patents per 10,000	Patent Growth	Traded Est. Growth
Spokane	170,031	2.2%	$31,725	3.4%	4.35	4.7%	3.6%
Albuquerque	287,991	2.4%	$31,490	3.5%	8.65	7.0%	3.6%
Boise	205,977	4.1%	$33,081	3.7%	76.95	23.9%	6.6%
Colorado Springs	210,457	3.7%	$33,697	4.0%	13.64	10.8%	6.5%
Provo	146,285	4.0%	$27,526	3.5%	11.55	10.1%	8.4%
Reno	180,860	2.4%	$35,043	3.8%	9.68	12.0%	5.2%
Salt Lake City	492,106	2.9%	$33,778	3.6%	6.19	3.8%	5.3%
Tucson	306,821	2.7%	$31,549	4.1%	10.72	7.2%	4.2%
U.S.	112,402,051	1.50%	$36,967	3.6%	7.29	4.4%	3.2%

[1] Total private, non-agricultural employment

Innovation Output

Innovation activity across the MSAs was measured three ways: 1) the number of utility patents issued per 10,000 employees in 2004, 2) the growth rate in patenting activity during the period 1990-2004 and 3) traded establishment formation rates during the period 1990-2004. Of course, these measures do not capture all innovation taking place within a region. For example, some innovation never gets patented as the expense of patenting, coupled with the pace of technological change, makes this effort not cost effective. Likewise, some innovation gets shelved for future development or exploitation. The chosen measures, however, represent objective metrics for innovation activity, especially those which associated with traded industries.

As Table 1 portrays, there was a marked difference across the MSAs of innovation output in 2004. Patents issued per 10,000 employees ranged from an average of 4.35 for Spokane to 76.95 in Boise. The national average was 7.29 patents per 10,000 employees. A similarly wide range of results in patenting growth appear over the period 1990-2004. The lowest rate was 3.8 percent in Salt Lake City and the highest was 23.9 percent in Boise.

Provo showed the highest rate of traded establishment growth over the period, averaging 8.4 percent per year versus 3.6 percent for Spokane. Albuquerque averaged virtually the same traded establishment growth (3.57%) as Spokane, as seen in Table 1. Boise and Colorado Springs averaged a little over 6.5 percent growth over the same period, while Reno and Boise founded traded businesses at a rate a little over 5 percent per annum. Tucson completes the group by averaging 4.2 percent per year during the same period. Note that all these rates exceeded the national average of 3.2 percent growth over the same period.

Cluster Development

The main focus of this monograph is to describe cluster development for Spokane and seven comparable MSAs. Table 2 presents shares of employment by MSA in the industries associated with varying cluster types in each MSA for 2004. As can be expected, the majority of employment found in these MSAs can be found in those companies associated with local industries. Employment in companies associated with traded clusters account for the next highest level of employment. Thus, local and traded industries account for 99 percent of employment within the MSAs.

The distribution of employment by cluster category varies by MSA. For example, employment in Spokane is split roughly 75%-25%, local versus traded. In contrast, Provo shows a 60%-40% percent split in local versus traded cluster employment. By this measure, Spokane appears most similar to Albuquerque and least similar to Provo, which in turn appears most similar to Reno. Boise, Colorado Springs, Salt Lake City, and Tucson are more similar to each other in broad employment distribution patterns than to the other MSAs.

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Table 2 Cluster Employment by MSA as a Share of Total Employment

MSA	Total[1] Employment 2004	% Employment in Traded Industries 2004	% Employment in Local Industries 2004	% Employment in Natural Endowment Industries
Spokane	170,031	24.5	75.2	0.4
Albuquerque	287,991	25.1	74.8	0.2
Boise	205,977	28.9	70.5	0.6
Colorado Springs	210,457	29.2	70.5	0.3
Provo	146,285	40.2	60.0	0.1
Reno	180,860	34.0	65.7	0.3
Salt Lake City	492,106	29.7	69.8	0.5
Tucson	306,821	27.6	71.1	1.2

[1] Total private, non-agricultural employment

Figure 1 shows the number of traded and local clusters in the top ten clusters by MSA. Provo, with seven, has the highest number of traded clusters. Spokane, Albuquerque, and Tucson, each with three, have the lowest number of traded clusters. In addition, only local and traded clusters compose the top 10 clusters for each MSA with no MSA having a natural endowment cluster within its top ten clusters.

Figure 1 Distribution by Cluster Type Within the Top 10 Clusters of Each MSA

Porter, in his 2003 paper, found that "traded industries appear to heavily influence relative prosperity in metropolitan areas". Using 2004 data, correlation analysis was used to determine if relationships could be found between traded cluster development for these eight MSAs and economic performance measures (listed in Table 1). Correlation analysis is used to determine if two items are related and if so how strongly and in what direction. The correlation coefficient, r, is a unit-less measure that can assume values between -1 and 1. The closer the correlation coefficient is to 1 or -1, the stronger the relationship is between the two items. The sign of the coefficient indicates whether or not the relationship is direct (positive) or inverse (negative).

Of the seven economic performance measures, only traded established growth was positively related to the number of traded clusters (r = 0.672, t_6=2.22, p-value = 0.068). As the number of traded clusters increases, traded establishment growth increases and vice versa.

Spokane: Comparison of Clusters 1990 to 2004

Table 3 gives the top 10 clusters for Spokane in 1990 and 2004; the footnotes include descriptive statistics – mean, median, standard deviation and coefficient of variation. The period from 1990-2004 for Spokane reveals a pattern of consistent economic development within the MSA and a diversification of the economy. As the table shows, in 1990, local clusters accounted for all top ten clusters in the Spokane MSA. By 2004, the distribution of local to traded clusters within the top ten clusters in the MSA had changed: Spokane had three traded clusters in its top ten. In other words, Spokane's economy had become more diversified and less regional over the period.

When measures of central location (mean, median) are used to summarize and describe data, it is also useful to include measures of variability or dispersion. The standard deviation and the coefficient of variation are two variability measures that are commonly used. The larger the value of the standard deviation is, the greater the dispersion among the data. When the standard deviation of a data set equals zero, then there is no dispersion among data points; all data values are the same. A measure of relative dispersion, the coefficient of variation, CV, is a dimensionless number and is useful in comparing the dispersion of data sets with considerably different means. The greater the value of the coefficient of variation is, the more disperse a data set is relative to another data set with a lower coefficient of variation.

As the notes to Table 3 explain, the LQ standard deviation in 2004 is smaller than the LQ standard deviation in 1990, indicating less variability in 2004 clusters (as measured by LQ) than 1990 clusters. Yet, the standard deviation of 2004 cluster employment is greater than the standard deviation of 1990 cluster employment, indicating greater dispersion in the number of employees among the clusters in 2004 than in 1990.

Table 3: Comparison of Top 10 Clusters for Spokane in 1990 and 2004

Spokane 1990 Top 10 Clusters			Spokane 2004 Top 10 Clusters		
Cluster	Total Employment per Cluster[1]	LQ[2]	Cluster	Total Employment per Cluster[3]	LQ[4]
Local Health Services	17,923	1.28	Local Health Services	27,784	1.25
Local Hospitality Establishments	10,793	1.17	Local Real Estate and Construction	16,480	1.15
Local Real Estate, Const., Development	9,623	1.05	Local Retail Clothing & Accessories	7,725	1.17
Local Food & Beverage Processing	6,816	1.13	Local Food & Beverage Processing	7,420	1.09
Local Motor Vehicle Products & Services	5,902	1.30	Local Motor Vehicle Products & Services	7,130	1.13
Local Retail Clothing and Accessories	5,450	1.08	Financial Services	5,634	1.13
Local Community & Civic Organizations	4,777	1.37	Local Financial Services	5,003	1.04
Local Financial Services	3,914	1.04	Education and Knowledge Creation	4,954	1.19
Local Entertainment & Media	2,989	1.33	Local Logistical Services	4,511	1.04
Heavy Construction Services	2,308	1.19	Heavy Construction Services	3,064	1.18

[1]1990 Total Employment per Cluster: n=10, mean =7,049, median = 5,676, standard deviation = 4,676, CV = 66.33
[2]1990 LQ: n = 10, mean = 1.19, median = 1.18, standard deviation = 0.120, CV = 10.08
[3]2004 Total Employment per Cluster: n=10, mean =8,971, median = 6,382, standard deviation = 7,568, CV = 84.36
[4]2004 LQ: n = 10, mean = 1.14, median = 1.14, standard deviation = 0.066, CV= 5.85

In assessing cluster development in Spokane from 1990 through 2004, we found a positive trend of traded cluster development during the period. As Table 4 displays, in 1990 there were five traded clusters identified within Spokane's economy. Recall that to be formally characterized as a cluster, an industry must show a location quotient (LQ) greater than 1.0. By the end of 2004, the number of traded clusters had risen to eight.

Only one traded cluster, Heavy Construction Services, appeared in both 1990 and 2004. For 2004, the Financial Services cluster ranked the highest in terms of total employment in 2004 with Education & Knowledge Creation second. This could be due to the growth of all higher educational

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Table 4: Comparison of Top Traded Clusters for Spokane from 1990 to 2004

Spokane 1990 Top Traded Clusters			Spokane 2004 Top Traded Clusters		
Traded Cluster	**Total Employment per Cluster[1]**	**LQ[2]**	**Traded Cluster**	**Total Employment per Cluster[3]**	**LQ[4]**
Heavy Construction Services	2,308	1.19	Financial Services	5,634	1.13
Analytical Instruments	2,240	1.83	Education & Knowledge Creation	4,954	1.19
Prefabricated Enclosures	2,055	6.03	Heavy Construction Services	3,064	1.18
Information Technology	1,830	2.08	Entertainment	2,360	1.35
Lighting & Electrical Equipment	925	1.97	Metal Manufacturing	1,917	1.11
			Building Fixtures, Equipment, & Services	1,344	1.35
			Power Generation & Transmission	910	2.26
			Aerospace Vehicles and Defense	810	1.73

[1]1990: n=5, cluster employment: mean = 1,872, median = 2,055, standard deviation = 561, CV = 29.96
[2]1990: n=5, LQ: average = 2.62, median = 1.97, standard deviation = 1.937, CV = 73.94
[3]2004: n =8, cluster employment: mean = 2,624, median = 2,139, standard deviation = 1,817, CV = 69.25
[4]2004: n = 8, LQ: average = 1.41, median = 1.27, standard deviation = 0.397, CV = 28.09

institutions, public and private, over the past 15 years. Interestingly, in 2004, the Entertainment cluster was ranked fourth in terms of employment, yet had more employees than the highest employment cluster in 1990, Heavy Construction Services. In addition, the composition of traded clusters with Spokane's economy changed over the period. A comparison of the average location quotient and standard deviation associated with these traded clusters shows that over the period 1990-2004 Spokane's traded cluster development became more diversified and less dominated by any particular traded cluster.

Overall, we see a consistent pattern of traded cluster development, with a commensurate balancing of local to traded clusters development, fueling economic growth in Spokane.

Tables 5 through 13 present a summary of the cluster analysis by MSA. For each MSA, the top 10 clusters overall are shown, then the top traded clusters are presented for 2004. These tables present a snapshot of cluster strength. This section concludes with results from the analysis of the relationships between cluster development in the MSAs and economic performance and innovation output.

Spokane, WA

Spokane's cluster position in 2004 is represented in Table 5. Local clusters dominated overall cluster development within the MSA. Of the top ten clusters, Local Health Services employed the most people. Not unexpectedly, the top five clusters in the Spokane MSA were clusters associated with local industries. Three traded clusters --Financial Services, Education and Knowledge, and Heavy Construction Services -- were identified within the top ten clusters in the MSA. Total employment within these traded clusters accounted for approximately 15 percent of employment within Spokane's top ten clusters.

Information represented in Table 6 reveals that Spokane's economy was more diversified in 2004, as measured by traded clusters, than its comparable MSAs. An assessment of average employment by traded cluster type and of location quotients by traded cluster type (Table 6) shows that Spokane has the smallest standard deviation in these two measures of all the MSAs studied. This implies that no specific traded industry cluster dominated the economy in 2004. The lack of dominance by one traded cluster in the Spokane economy is significant, as this could serve to better shield Spokane's economy from any undesirable effects associated with economic instability affecting any one particular traded industry.

Table 5: Spokane Top Clusters and Top Traded Clusters in 2004

Top 10 Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Local Health Services	27,784	1.25	Financial Services	5,634	1.13
Local Real Estate and Construction	16,480	1.15	Education & Knowledge Creation	4,954	1.19
Local Retail Clothing & Accessories	7,725	1.17	Heavy Construction Services	3,064	1.18
Local Food & Beverage Processing	7,420	1.09	Entertainment	2,360	1.35
Local Motor Vehicle Products & Services	7,130	1.13	Metal Manufacturing	1,917	1.11
Financial Services	5,634	1.13	Building Fixtures, Equipment, & Services	1,344	1.35
Local Financial Services	5,003	1.04	Power Generation & Transmission	910	2.26
Education & Knowledge Creation	4,954	1.19	Aerospace Vehicles and Defense	810	1.73
Local Logistical Services	4,511	1.04			
Heavy Construction Services	3,064	1.18			

Table 6: Descriptive Statistics for Traded Cluster Employment and Location Quotients for the Top Traded Clusters

| MSA	n	Cluster Employment[1]				LQ[2]			
		Mean	Median	Standard Deviation	CV	Mean	Median	Standard Deviation	CV
Spokane	8	2,624	2,139	1,817	69.25	1.41	1.27	0.4	28.37
Albuquerque	7	4,829	6,131	2,758	57.11	2.56	2.16	1.63	63.67
Boise	7	3,873	1,682	4,576	118.15	3.19	1.94	3.55	111.29
Colorado Springs	9	5,247	6,204	3,948	75.24	1.85	1.37	1.50	81.08
Provo	10	4,834	3,067	5,492	113.61	2.68	1.68	1.93	72.01
Reno	8	5,650	3,462	7,167	126.85	3.83	1.84	5.12	133.68
Salt Lake City	10	9,150	7,939	5,211	56.95	1.76	1.45	1.24	70.45
Tucson	8	6,527	3,720	6,375	97.67	4.26	1.53	7.53	176.76

[1] Spokane has the lowest mean, and standard deviation cluster employment. However, Salt Lake City has the lowest coefficient of variation (relative variability) for cluster employment. Boise has the lowest median cluster employment.

[2] Spokane has the lowest mean, median, standard deviation and coefficient of variation LQ.

Figure 2 portrays the boxplots, or distributions of LQ values, for the top traded clusters by MSA. Boxplots are useful for graphically examining and comparing data by groups. Each box represents the middle 50% of the LQ values for each MSA. The line extending below the box represents the lower 25% of the data, extending down to the minimum value. The line extending above the box represents the upper 25% of the data, extending up to the maximum value. The greater the height of the box is, the greater the spread of the middle 50% of values. The asterisks in Figure 2 represent unusually large values.

Figure 2: Top-Traded Cluster LQ Distribution in 2004 by MSA
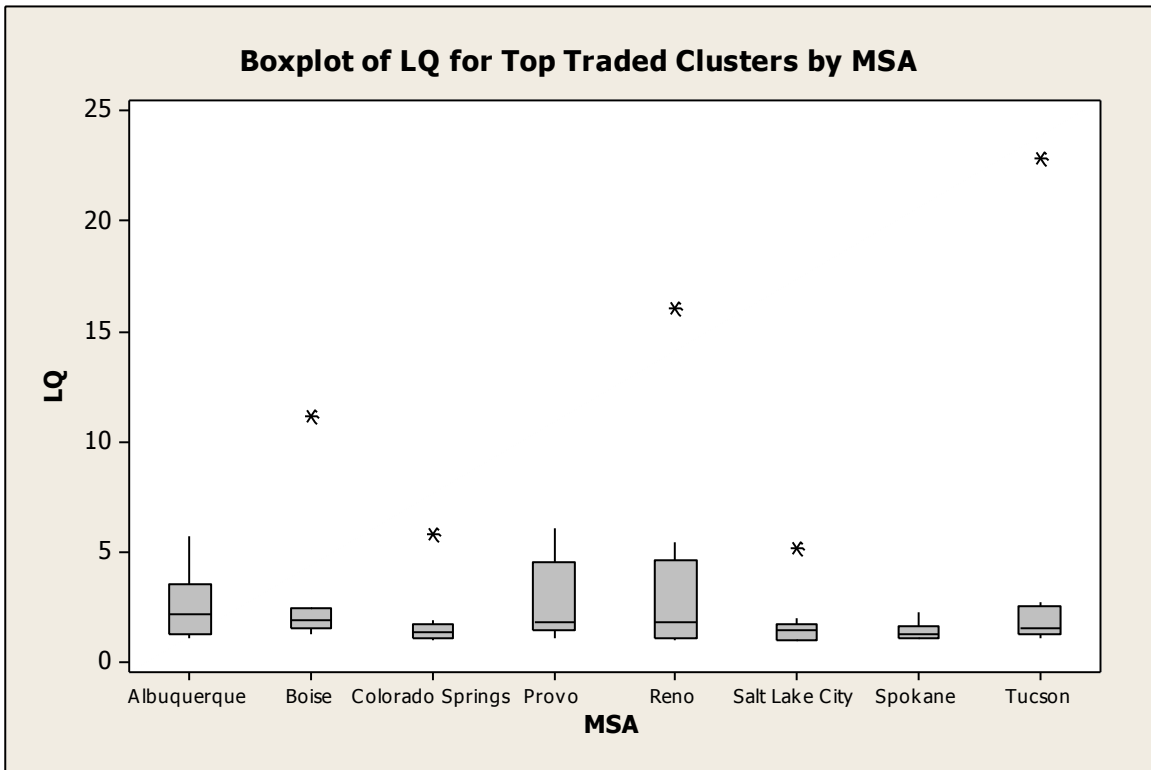
Spokane appears to have the tightest distribution of LQ values, indicating very little variation among the middle LQ values. This implies that its clusters' LQ values are similar. Provo and Reno show the greatest spread of the middle 50% of the LQ values, indicating greater dispersion among the clusters within those two MSAs. The horizontal line inside the box represents the center or median (value that falls at the 50th percentile).

Although the median LQ values for the MSAs appear to be relatively close to each other, Spokane clearly has the lowest median LQ value, indicating its clusters have the lowest center value. Figure 2 shows that Tucson had one cluster in 2004 whose LQ value was very different from the others, with an LQ between 20 and 25. On closer examination, this is the Aerospace Vehicles and Defense cluster. In contrast, Spokane had no clusters whose LQ values are

unusually high compared to the clusters within the MSA. That is, none of Spokane's clusters had an LQ value that is much different from the others, implying that no one traded cluster dominates the Spokane MSA. In summary, Spokane appears to have the least dispersion among its LQ values, with a median LQ value that is lower than the other MSAs, and has no cluster with an usually large LQ.

Albuquerque, NM
The Albuquerque MSA consists of four New Mexico counties, Bernalillo, Sandoval, Torrance and Valencia. Albuquerque has already shown similarities in this monograph to Spokane and an analysis of its cluster development shown in Table 7 reflects a similar pattern to that of Spokane. Specifically, two traded clusters -- Entertainment and Heavy Construction -- are identified within Albuquerque's top ten clusters, as they are in Spokane. Together,

these two clusters account for approximately 9.0 percent of total employment within Albuquerque's top ten clusters. Albuquerque's seven traded clusters account for 25.1 percent of total employment in the MSA, only slightly more than Spokane's 24.5 percent associated with its seven traded clusters (Table 2).

Analysis shows that four clusters -- Entertainment, Hospitality and Tourism, Heavy Constructions Services, and Information Technology -- dominated 2004 traded clusters in Albuquerque. At the same time, Local Health Care, Local Real Estate and Construction, and Local Hospitality Establishments led overall cluster development. Albuquerque's average location quotient for its traded clusters shows that it had a higher concentration of its employment in traded clusters than did Spokane (2.71 vs. 1.41); yet, Spokane's average wage for the same period was marginally higher than Albuquerque's: $31,725 vs. $31,490.

Table 7: Albuquerque Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Local Health Services	38,488	1.02	Entertainment	7,949	2.69
Local Real Estate and Construction	32,366	1.33	Hospitality & Tourism	7,161	1.06
Local Hospitality Establishments	30,531	1.22	Heavy Construction Services	6,497	1.47
Local Retail Clothing & Accessories	12,960	1.16	Information Technology	6,131	3.54
Local Motor Vehicle Products & Services	12,879	1.20	Analytical Instruments	3,259	2.16
Local Food & Beverage Processing	11,852	1.03	Jewelry and Precious Metals	1,563	5.70
Entertainment	7,949	2.69	Medical Devices	1,244	1.32
Local Utilities	7,509	1.56			
Hospitality & Tourism	7,161	1.06			
Heavy Construction Services	6,497	1.47			

Boise, ID

The Boise MSA consists of five Idaho counties, Ada, Boise, Canyon, Gem, and Owyhee. As Table 8 reveals, the Boise MSA had four traded clusters within its top ten clusters. Although Boise's economy was dominated by local cluster development, Information Technology (IT) ranked within the top three clusters in Boise's economy, with a location quotient of 11. The MSA had one traded cluster (Heavy Construction Services) and two local cluster types (Local Real Estate and Construction and Local Retail Clothing and Accessories) in common with Spokane. Boise's four traded clusters accounted for approximately 23.6 percent of employment of Boise's top clusters; Information Technology alone accounted for almost 14 percent of this employment. Overall, traded clusters contributed 28.9 percent of total employment in Boise, compared to 24.5 percent in Spokane (Table 2).

As Table 8 shows, seven traded clusters have developed within the Boise MSA, with Information Technology clearly dominant. Further analysis of Boise's Information Technology cluster reveals the prevailing position this cluster plays within Boise's economy. Of all traded clusters in Boise, Information Technology accounts for over 51 percent of traded cluster employment. The influence of this cluster can also be seen in measures of innovation. Boise had the largest numbers of utility patents filed per 10,000 employees (76.95) as well as the highest patent growth rate (23.89 percent) among the competitive set of MSAs in 2004. This is likely an outcome of the innovation intensity associated with its Information Technology and Analytical Instruments clusters. Yet another consequence of this type of cluster development can be seen in Boise's average wage for 2004: $33,081 versus Spokane's $31,725 (Table 1).

Table 8: Boise Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Local Real Estate and Construction	26,472	1.52	Information Technology	13,835	11.18
Local Hospitality Establishments	18,395	1.03	Heavy Construction Services	4,131	1.31
Information Technology	13,835	11.18	Processed Food	3,882	1.58
Local Retail Clothing & Accessories	9,415	1.18	Analytical Instruments	1,682	1.56
Local Motor Vehicle Products & Services	8,491	1.11	Agricultural Products	1,211	2.37
Local Community & Civic Organizations	7,480	1.09	Heavy Machinery	1,209	1.94
Local Entertainment and Media	6,130	1.61	Prefabricated Enclosures	1,163	2.42
Heavy Construction Services	4,131	1.31			
Processed Food	3,882	1.58			
Analytical Instruments	1,682	1.56			

Colorado Springs, CO

The 2004 Colorado Springs MSA consists of two Colorado counties, El Paso and Teller. An analysis based on Table 9 shows an economy that is more similar to that of Boise than to Spokane. Of Colorado Springs' top 10 clusters, four are traded clusters: Business Services, Information Technology, Hospitality and Tourism, and Distribution Services. Together, these clusters account for 12.2 percent of the top ten cluster employment in Colorado Springs. Overall, Colorado Springs had nine traded clusters in 2004, accounting for 29.3 percent of total employment in the MSA, compared to 24.5 % for Spokane (Table 2). Business Services was the dominant traded cluster in Colorado Springs, counting for approximately 12 percent of overall cluster employment and 6.3 percent of total employment in the MSA.

Although Business Services was the dominant traded cluster in the MSA, Colorado Springs also showed a significant Information Technology cluster, with a location quotient of 5.77. Though smaller than Boise's, when coupled with an Analytical Instruments cluster, IT undoubtedly led to Colorado Springs having the second highest patent activity in 2004, at 13.64 per 10,000 employees, and third highest rate of patent growth of the MSAs in the competitive set. Although these patenting rates are half of those of Boise, Colorado Springs still has one of the highest measures of innovation (or entrepreneurial) output of all the MSAs studied.

Table 9: Colorado Springs Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Clusters	**Cluster Employment**	**LQ**	**Clusters**	**Cluster Employment**	**LQ**
Local Hospitality Establishments	21,665	1.18	Business Services	13,315	1.57
Local Real Estate and Construction	19,682	1.11	Information Technology	7,298	5.77
Local Community & Civic Organizations	14,747	2.09	Hospitality & Tourism	6,771	1.37
Business Services	13,315	1.57	Distribution Services	6,517	1.92
Local Retail Clothing & Accessories	9,482	1.16	Financial Services	6,204	1.01
Local Motor Vehicle Products & Services	8,492	1.08	Publishing and Printing	2,674	1.54
Information Technology	7,298	5.77	Metal Manufacturing	2,441	1.15
Hospitality & Tourism	6,771	1.37	Analytical Instruments	1,140	1.03
Distribution Services	6,517	1.92	Medical Devices	867	1.26
Local Entertainment and Media	6,435	1.65			

Provo, UT

The Provo MSA consists of two Utah counties, Juab and Utah. The data in Table 10 illustrate an economy that has had significant traded cluster development. Of Provo's top ten clusters, seven are traded: Education and Knowledge, Business Services, Information Technology, Distribution Services, Heavy Construction Services, Processed Foods and Publishing and Printing. These clusters account for 62.8 percent employment in Provo's top 10 clusters and 29.3 percent of all employment in Provo. Overall, traded cluster employment accounts for 33.0 percent of all private, non agricultural employment in Provo.

Further analysis shows that Provo's Education and Knowledge Creation cluster is the largest cluster in the MSA, with almost 14 percent of total MSA employment. In addition, Education and Knowledge Creation, Information Technology, and Biopharmaceuticals all demonstrate high cluster strength, comprising an average location quotient of 5.25. Interestingly, Provo had the third highest patenting rate of all MSAs studied, with a rate of 11.55 patents per 10,000 employees. Yet, it had the smallest population of all MSAs studied.

With such a structure, Provo shows a significantly higher level of traded cluster development than the comparable MSAs studied. Provo shares two traded cluster types with Spokane, Educational and Knowledge Creation and Heavy Construction Services. Although Provo registered seven traded clusters in its top ten clusters in 2004, its average annual wage was $27,526, lowest of the comparable MSAs and appreciably lower than Spokane average wage of $31,725.

Table 10: Provo Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Education & Knowledge Creation	19,794	5.53	Education & Knowledge Creation	19,794	5.53
Local Commercial Services	16,340	1.19	Business Services	7,038	1.19
Business Services	7,038	1.19	Information Technology	4,023	4.58
Local Retail Clothing & Accessories	6,092	1.07	Distribution Services	3,617	1.54
Information Technology	4,023	4.58	Heavy Construction Services	3,371	1.50
Distribution Services	3,617	1.54	Processed Food	2,762	1.58
Heavy Construction Services	3,371	1.50	Publishing & Printing	2,356	1.95
Local Personal Services (non-medical)	3,162	1.01	Biopharmaceuticals	2,246	6.10
Processed Food	2,762	1.58	Metal Manufacturing	1,604	1.08
Publishing & Printing	2,356	1.95	Building Fixtures, Equipment, & Services	1,525	1.78

Reno, NV

The Reno MSA consists of two Nevada counties, Storey and Washoe. Table 11 shows Reno with eight traded clusters, four of which were part of Reno's top ten clusters in terms of employment. Overall, these four traded clusters, Hospitality and Tourism, Heavy Construction Services, Distribution Services, and Entertainment, accounted for almost 20 percent of total employment in Reno and 35 percent of employment overall within Reno's top ten clusters. Within its economy, Reno's traded Hospitality and Tourism cluster employed the greatest number of people. Reno's traded clusters accounted for 34.0 percent of employment in 2004, second only to Provo (Table 2). This finding reflects an economy heavily invested in traded cluster development.

Reno shared three traded cluster types with Spokane: Heavy Construction Services; Entertainment; and Building Fixtures, Equipment, and Services. These three clusters accounted for 5.8 percent of employment in Reno, versus 4.0 percent of Spokane's employment. Reno's economy also reflects a Leather and Related Products cluster, with a significant location quotient of 16.0. This high LQ demonstrates that a substantial cluster exists in Reno, though national employment in industries associated with this cluster is relatively small. In Reno, it accounted for only 7 percent of traded cluster employment and 3.2 percent of overall employment. Clearly, the data underscore the dominant role that Hospitality and Tourism play in Reno's economy. The impact of this cluster on the economy is seen in the 2004 average annual wage for Reno, at $33,697 versus $32,725 for Spokane.

Table 11: Reno Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Hospitality & Tourism	23,216	5.47	Hospitality & Tourism	23,216	5.47
Local Real Estate and Construction	22,063	1.45	Heavy Construction Services	4,676	1.69
Local Commercial Services	17,972	1.06	Distribution Services	3,924	1.35
Local Motor Vehicle Products & Services	7,680	1.14	Entertainment	3,694	1.99
Local Retail Clothing & Accessories	7,348	1.05	Leather & Related Products	3,230	16.00
Local Logistical Services	6,187	1.35	Transportation & Logistics	2,754	1.08
Heavy Construction Services	4,676	1.69	Building Fixtures, Equipment, Services	2,173	2.05
Local Entertainment and Media	4,411	1.32	Publishing & Printing	1,532	1.02
Distribution Services	3,924	1.35			
Entertainment	3,694	1.99			

Salt Lake City, UT

The Salt Lake City MSA consists of three Utah counties: Salt Lake, Summit, and Tooele. Table 12 portrays an economy that has had substantial traded cluster development. Six traded clusters are among the MSA's overall: Business Services, Financial Services, Transportation and Logistics, Entertainment, Medical Devices, and Heavy Construction. This was second only to Provo. These six traded clusters represent 40.2 percent of cluster employment in its top ten clusters and 14.6 percent of total employment in the MSA. Salt Lake City's top 10 traded clusters comprised approximately 19 percent of its MSA's total employment while traded clusters accounted for 29.7 percent of employment in the MSA (Table 2).

It is interesting to note that the heavy incidence of traded cluster development in Salt Lake City was not necessarily reflected in its innovation output for 2004. In that year, Salt Lake City generated 6.19 patents per 10,000 employees, with a patent growth rate of 3.8 percent. This placed Salt Lake City seventh of eight in patenting activity and last in terms of patent growth of all MSAs.

An analysis of Table 12 shows that Salt Lake City had at least ten traded clusters, led by Business Services. Salt Lake City shares four traded cluster types with Spokane: Financial Services, Entertainment, Heavy Construction Services, and Building Fixtures, Equipment, & Services. With six traded clusters in its top ten clusters by employment, Salt Lake City had an average annual wage of $33,778 in 2004, second highest of all comparable MSAs and somewhat higher than Spokane's average wage of $31,725.

Table 12: Salt Lake City Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Local Real Estate and Construction	46,533	1.12	Business Services	20,295	1.02
Local Community & Civic Organizations	23,853	1.45	Financial Services	14,795	1.03
Business Services	20,295	1.02	Transportation & Logistics	12,325	1.77
Local Logistical Services	18,732	1.50	Entertainment	8,623	1.70
Local Financial Services	17,885	1.29	Medical Devices	8,288	5.15
Financial Services	14,795	1.03	Heavy Construction Services	7,590	1.01
Transportation & Logistics	12,325	1.77	Processed Food	6,083	1.04
Entertainment	8,623	1.70	Analytical Instruments	5,087	1.97
Medical Devices	8,288	5.15	Information Technology	4,249	1.44
Heavy Construction Services	7,590	1.01	Building Fixtures, Equipment, & Services	4,169	1.45

Tucson, AZ

The Tucson MSA consists of only Pima County, Arizona. Tucson's cluster development has been paced by a substantial Aerospace Vehicles and Defense traded cluster, as Table 13 reveals. Three traded clusters, Aerospace Vehicles and Defense, Hospitality and Tourism, and Heavy Construction Services, are represented in Tucson's top ten clusters. Together these three clusters represented 21.1 percent of employment in Tucson's top ten clusters and approximately 13 percent overall. Likewise, traded clusters made up 27.6 percent of overall employment within Tucson's economy (Table 2).

Eight traded clusters were identified in the Tucson MSA, with Aerospace Vehicles and Defense leading the group. This cluster represents 36.9 percent of traded cluster employment in Tucson. With the exception of this Aerospace Vehicles and Defense cluster, Tucson's traded cluster development is similar to that of other comparable MSAs studied, with the exception of Provo and Salt Lake City.

The average location quotient of Tucson's seven other traded clusters (Hospitality and Tourism, Heavy Construction Services, Entertainment, Information Technology, Analytical Instruments, Medical Devices and Building Fixtures, Equipment & Services) is 1.61. This indicates a certain concentration of these industries but not significantly larger clusters than those found in the other competitive MSAs. Furthermore, Tucson's innovation output performance does not indicate an exceptional influence of its major cluster on innovation intensity. Tucson has the fourth highest patenting rate (10.72 per 10,000 employees) of the eight MSAs, with an annual patent growth rate of 7.2 percent.

Tucson shares four traded cluster types with Spokane: Aerospace vehicles and Defense, Heavy Construction Services, Entertainment, and Building Fixtures, Equipment, & Services. However, within these four clusters, Tucson employed 25,753 more people than Spokane, with the greatest difference occurring in the Aerospace Vehicles and Defense cluster. For Tucson, this cluster was almost 24 times the size of Spokane's. Despite this major difference, the average annual wage for Tucson in 2004 was $31,967, a negligible difference from Spokane's average of $31,725.

Table 13: Tucson Top Clusters and Top Traded Clusters

Top Clusters			Top Traded Clusters		
Cluster	Cluster Employment	LQ	Cluster	Cluster Employment	LQ
Local Health Services	43,396	1.08	Aerospace Vehicles and Defense	19,260	22.85
Local Hospitality Establishments	33,806	1.27	Hospitality & Tourism	12,583	1.75
Local Real Estate and Construction	31,635	1.22	Heavy Construction Services	7,516	1.60
Aerospace Vehicles and Defense	19,260	22.85	Entertainment	4,610	1.46
Local Motor Vehicle Products & Services	12,709	1.11	Information Technology	2,829	2.76
Hospitality & Tourism	12,583	1.75	Analytical Instruments	2,210	1.37
Local Community & Civic Organizations	10,763	1.05	Building Fixtures, Equipment & Services	1,945	1.08
Local Personal Services (non-medical)	8,039	1.23	Medical Devices	1,259	1.25
Heavy Construction Services	7,516	1.60			
Local Household Goods and Services	6,916	1.31			

Table 14 displays a matrix that summarizes the rankings of the top traded clusters by MSA. With its Heavy Construction Services cluster, Spokane is similar to five other MSAs. Spokane shares two clusters, Entertainment and Building Fixtures Equipment & Services, with four different MSAs. The Financial Services and the Metal Manufacturing clusters ranked first and fifth respectively, in Spokane and occur in two other MSAs. The Education & Knowledge Creation cluster, ranked second in Spokane, appears in only one other MSA – Provo. One MSA, Tucson, shares an Aerospace Vehicles and Defense cluster with Spokane. Only Spokane has a Power Generation and Transmission cluster.

Fifteen clusters occur in other MSAs, but are not found in Spokane; most notably is the Information Technology cluster, which

Table 14: Ranks of the Top Traded Clusters[*] (with LQ > 1) by MSA

MSA / Traded Cluster	Spokane	Albuquerque	Boise	Colorado Springs	Provo	Reno	Salt Lake City	Tucson
Financial Services	1			5			2	
Education & Knowledge Creation	2				1			
Heavy Construction Services	3	3	2			2	6	3
Entertainment	4	1				4	4	4
Metal Manufacturing	5			7	9			
Building Fixtures, Equipment & Services	6				10	7	10	7
Power Generation & Transmission	7							
Aerospace Vehicles and Defense	8							1
Hospitality & Tourism		2		3		1		2
Information Technology		4	1	2	3		9	5
Analytical Instruments		5	4	7			8	6
Jewelry and Precious Metals		6						
Medical Devices		7		8			5	8
Processed Food			3		5		7	
Agricultural Products			4					
Heavy Machinery			5					
Prefabricated Enclosures			6					
Business Services				1	2		1	
Distribution Services				4	4	3		
Publishing and Printing				6	6	8		
Biopharmaceuticals					7			
Leather & Related Products						5		
Transportation & Logistics						6	3	

[*]*Note: some MSAs had fewer than 10 traded clusters with LQ > 1.*

is found in six of the seven comparable MSAs. Interestingly, in 1990 the Information Technology cluster was included as one of Spokane's top traded clusters (Table 4). The Analytical Instruments cluster is found in five of the seven MSAs, but not in Spokane. Tucson has four clusters in common with Spokane: Heavy Construction Services, Entertainment, Building Fixtures, and Aerospace Vehicles and Defense. Salt Lake City shares four clusters with Spokane: Financial Services, Heavy Construction, Entertainment, and Building Fixtures. In summary, Spokane shares several clusters in common with the other MSAs. However, several clusters found in the other MSAs are not present in Spokane.

VI. Conclusions & Suggestions for Further Research

This study was undertaken as a basic descriptive analysis of cluster development within Spokane, WA and seven other comparable MSAs. In this context, we should note that the study was not done to proscribe any particular economic development strategy for Spokane; nor should it serve as a scorecard, of sorts, for Spokane's economic planners and administrators. It is, however, an empirical treatment of cluster development in Spokane and other comparable regional economies from which some conclusions may be drawn.

Economic performance

Spokane compares very favorably with the comparable MSAs: Albuquerque, Boise, Colorado Springs, Provo, Reno, Salt Lake City and Tucson. Spokane's employment growth between 1990 and 2004 reflects an economy that that has been on the rise. Since 1990, employment growth has substantially exceeded the national average. Spokane's employment shows that it has a slightly greater percentage of employment associated with local clusters than traded clusters in comparison to the other cities, but this difference appears not to have negatively influenced its average annual wage. In fact, Spokane's average annual wages puts it in the middle of the group of the cities studied – and greater than that of Albuquerque, Provo, and Tucson. This finding is interesting since Provo had the greatest number of traded clusters in their top clusters of the cities studied yet had the lowest average annual wage. From this finding, one might conclude that not all traded clusters are the same in their net affect on local economies. Perhaps some local cluster types might display a more positive economic influence

on regional economies than some traded cluster types.

The results also show that innovation output has been on the rise in Spokane. The MSA's patent growth rate exceeded that of Salt Lake City and the national average, but was lower than that of the other comparable cities. This is not surprising in light of the type of clusters development prevalent in Spokane. Patenting activity is more closely associated with certain traded industries whose processes or output involve technologies, such as Information Technology or Biopharmaceuticals. Spokane does not have these cluster types present within its economy, in contrast to six of the seven comparable MSAs.

Of some significance, the findings suggest that there has been notable economic cluster formation in Spokane since 1990 and that the nature of this cluster development has evolved. In 1990, among the top ten clusters present in Spokane, nine were local cluster types and only one was a traded cluster. By 2004, there were three traded cluster types within Spokane's top ten clusters. These results reflect an economy less dependant upon local industry and one that is participating in the larger US economy.

Further, not one traded cluster dominates economic development here. The boxplots of location quotients (LQs) for traded clusters show that Spokane has the smallest variation in LQ values among its traded clusters of all the cities evaluated. This implies that no one industry is overly represented among Spokane's traded clusters. This is quite different from Boise, Reno, Tucson, Salt Lake City or Colorado Springs. Each of these MSAs shows an economy strongly dominated by at least one traded cluster. As a result, these economies appear less diverse in makeup

and are potentially more vulnerable to industry shock.

Spokane's economic growth has been the most significant in traded cluster development. In 1990, traded clusters accounted for only 3.3 percent of employment in Spokane's top clusters. Yet by 2004, this had risen to 15.2 percent, an almost 300 percent increase. Traded clusters, such as Education and Knowledge Creation and Financial Services had grown to the point that they could be recognized within Spokane's top ten clusters. Heavy Construction Services was the largest traded cluster in Spokane in 1990 but third in 2004. Five traded clusters were identified in Spokane in 1990; by 2004, eight traded clusters could be determined, with only Heavy Construction Services present in both years. This dynamic change reflects a growing economy.

These results raise an interesting question. Spokane appears most similar to Albuquerque and Tucson in terms of general economic performance indicators. However, Spokane shares only two traded clusters with Albuquerque (Entertainment and Heavy Equipment Services) and but four with Tucson (Entertainment and Heavy Equipment Services, Building Fixtures Equipment & Services and Aerospace Vehicles and Defense). Furthermore, Tucson's Aerospace Vehicles and Defense cluster is 13 times that of Spokane's (22.85 vs. 1.73). Likewise, Spokane appears least similar to Provo, which has seven traded clusters in its top ten clusters to Spokane's three. Spokane and Provo have only two traded clusters in common, Education and Knowledge Creation and Heavy Equipment

Services. However, Spokane's average wage is $31,725, versus $27,526 for Provo.

This finding begs for an explanation. It may be that traded cluster development may differentially impact regional economies. Some traded clusters, such as Reno's Leather & Related Products cluster employ relatively few people. So perhaps one might conclude that not all traded clusters are the same in terms of their impact on regional economies.

Another question that emerges from these comparisons is the impact of some local cluster types have on regional economies. Spokane has a large Local Health Services cluster within its economy. Health service industries typically employ a large number of people with above average wages. As such, a local cluster, such as Health Services might more positively impact an economy than some traded clusters and therefore might be more desirable for development than some traded clusters. Further research is warranted.

As stated earlier, this study was undertaken to provide a descriptive snapshot of cluster development in Spokane and seven comparable MSAs. Consequently, no analysis as to what type of further cluster development in Spokane is possible or recommended was conducted. Nor was an explanation given for why Spokane's traded clusters have developed. Future research could pursue these questions. In addition, future research could be conducted to determine what types of cluster development Spokane should support, clusters that would have the greatest economic impact by making efficient use of this region's existing assets.

REFERENCES

"2006 Market Fact Book" *Spokane Journal of Business*. 2006.

Community Initiative Indicators of Spokane. "Economic Vitality." [Online] 20 April 2009. http://www.communityindicators.ewu.edu/indicators.cfm

Institute for Strategy and Competiveness. "Cluster Mapping Project." [Online] 20 December 2007. http://www.isc.hbs.edu/cmp/cmp_data_glossary.html

Porter, Michael E. "Clusters and the New Economics of Competition," *Harvard Business Review,* 77-90, November-December 1998.

Porter, Michael E. "Location, Competition, and Economic Development: Local Clusters in a Global Economy," *Economic Development Quarterly*, 14, 1, 15-34, February 2000.

Porter, Michael E. "The Economic Performance of Regions" *Regional Studies* 37 (6&7), 549-578, August/October 2003.

Spokane 1889-1964: The Great Fire 75th Anniversary. A Publication of the City of Spokane Committee of '64. 1965.

U.S. Census Bureau. "Metropolitan and Micropolitan Statistical Areas." [Online] 10 March 2008. http://www.census.gov/population/estimates/metro-city/List1.txt

APPENDIX - List of Traded Clusters and Subclusters

Aerospace Vehicles and Defense
Aircraft
Missiles and space vehicles
Defense equipment
Distribution and wholesaling
Metallic parts
Electronic parts
Instruments
Semiconductors and computers
Related equipment
Communications equipment
Software and computer services
Research

Agricultural Products
Farm management and related services
Soil preparation services
Irrigation systems
Packaging
Fertilizers
Agricultural products
Wine and brandy
Cigars
Millings and refining
Product distribution and wholesale
Malt beverages
Related processed foods
Related ingredients
Animal health products
Fish products
Agricultural chemicals
Supplies distribution and wholesaling
Related financial services
Transportation and logistic services

Marine transportation services
Bulk packaging
Packaging and packaging machinery
Related services

Analytical Instruments
Laboratory instruments
Optical instruments
Process instruments
Search and navigation equipment
Electronic components
Distribution and wholesaling
Electronic parts
Other parts
Medical equipment
Related process equipment
Related equipment
Computer and software services
Research organizations

Biopharmaceuticals
Biopharmaceutical products
Health and beauty products
Containers
Drug and related wholesaling
Biological products
Specialty chemicals
Packaging
Instruments and laboratory apparatus
Diagnostics
Surgical instrument and supplies
Dental instruments and supplies
Medical equipment

Ophthalmic goods
Patent owners and lessors
Research organizations

Building Fixtures, Equipment, & Services
Plumbing products
Drapery hardware
Fabricated materials
Heating and lighting
Furniture and fittings
Clay and other vitreous products
Floor coverings
Steam and air conditioning
Stone and tile work
Wood cabinets, fixtures and other products
Concrete, gypsum, and other building products
Distribution and wholesaling
Plating and polishing
Lighting products
Ceramic tile
Elevators and moving stairways
Related electrical products
Furnishings
Other vitreous products
Mobile and motor homes
Related parts
Construction materials
Hardware
Millwork
Related fixtures
Steel work

Businesses Services
Management consulting
Online information services
Computer services
Computer programming
Photocopying

Marketing and related services
Professional organizations and services
Engineering services
Laundry services
Facilities support services
Freight arrangement
Surveying services
Media and related services
Catalog and mail-order
Insurance

Distribution Services
Merchandise wholesaling
Apparel and accessories wholesaling
Catalogue and mail-order
Food products wholesaling
Farm material and supplies wholesaling
Transportation vehicle and equipment distribution
Special warehousing and storage
Jewelry and precious stones wholesaling
Construction machinery wholesaling

Education and Knowledge Creation
Education institutions
Research organizations
Education facilities
Patent owners and lessors
Supplies
Research related instruments
Pharmaceuticals
Publishing
Printing
Communications services
Marketing and information services

Online information services
Computer services
Prepackaged software
Computer and software wholesaling and services
Computer equipment

Entertainment
Video production and distribution
Recorded products
Entertainment equipment
Entertainment related services
Entertainment venue
Distribution and wholesaling
Marketing and promotional services
Related attractions
News syndicates
Audio and video equipment

Financial Services
Depository institutions
Security brokers, dealers, and exchanges
Insurance products
Health plans
Risk capital providers
Investment funds
Real estate investment trusts
Passenger car leasing
Information providers
Computer and communication services
Printing services
Patent owners and lessors
Marketing related services
Research organizations

Heavy Construction Services
Final construction
Subcontractors

Primary construction materials
Ceramic tiles
Equipment distribution and wholesaling
Fabricated metal structures and piping
Explosives
Transportation services
Chemical and related products
Glass and clay
Related equipment and components
Elevator and moving stairways
Related services
Tiling and glazing
Heavy Machinery
Construction machinery
Farm equipment
Railroad equipment and rental
Mining machinery
Machinery components
Valves and pipe fittings
Hoists and cranes
Forging, castings and metal parts
Engines
Related parts
Compressors and fans
Tires and inner tubes
Hospitality and Tourism
Tourism attractions
Tourism related services
Water passenger transportation
Accommodations and related services
Boat related services
Ground transportation
Other local transportation
Related professional services
Other attractions
Air services

Vehicle distribution and wholesaling
Facilities support services

Information Technology
Computers
Electronic components and assemblies
Peripherals
Software
Communications services
Distribution and wholesaling
Other electronic components and parts
Recording media services
Online information services
Computer services
Instruments
Communications equipment
Research organizations

Jewelry and Precious Metals
Jewelry and precious metals products
Costume jewelry
Cutlery
Collectibles
Distribution and wholesaling
Precious metal related financial services

Leather and Related Products
Leather products
Fur goods
Coated fabrics
Related products
Accessories
Women's footwear
Men's clothing
Women's clothing and accessories

Lighting and Electrical Equipment
Lighting fixtures
Electrical lamps
Batteries
Switchgear
Electrical parts
Metal parts
Related electrical equipment
Instruments to measure electricity
Electric services
Glass and ceramic products
Wire
Related electrical parts
Other lighting equipment

Medical Devices
Surgical instruments and supplies
Dental instruments and supplies
Ophthalmic goods
Medical equipment
Diagnostic substances
Biological products
Laboratory apparatus
Electronic components
Plastic parts
Metal parts
Software
Online information services
Precision instruments
Computer equipment
Pharmaceutical products
Research organizations

Metal Manufacturing
Fabricated metal products
Metal alloys
Primary metal products
Precision metal products
Fasteners
Wires and springs
Metal processing

Iron and steel mills foundries
Nonferrous molls and foundries
Metal furniture
Environmental controls
Pumps
Saw blades and handsaws
General industrial machinery
Laundry and cleaning equipment
Metal armaments
Measuring and dispensing pumps
Tools, dies, fixtures
Paints and allied products
Lubricating oils and greases
Abrasive products
Metalworking machinery and components
Related metal processing
Industrial furnaces and ovens
Automotive parts and equipment
Hoists and cranes
Related metal products
Motorcycles and bicycles

Power Generation and Transmission
Electric services
Turbines and turbine generators
Transformers
Porcelain, carbon and graphite components
Electronic capacitors
Electric apparatus and instruments
Motors, generators and electric fans
Switchgear, controls and components

Prefabricate Enclosures

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Recreation vehicles and parts
Mobile homes
Trucks and trailers
Caskets
Elevator and moving stairways
Office furniture
Household refrigerators and freezers
Aluminum processing
Non-ferrous processing, except aluminum
 Steel springs
Railroad equipment
Other furniture and cabinets

Processed Foods
Milk and frozen deserts
Baked packaged foods
Coffee
Processed dairy and related products
Meat and related products and services
Flour
Specialty foods and ingredients

Milling
Candy and chocolate
Malt beverages
Paper containers and boxes
Metal and glass containers
Food products machinery
Distribution and wholesaling
Packaging materials
Bulk packaging

Publishing and Printing
Publishing
News syndicates
Signs and advertising specialties
Photographic services
Photographic equipment and supplies
Radio, TV, publisher representatives
Printing services
Printing inputs
Paper products
Specialty paper products
Inked paper and ribbons
Office equipment and supplies

Marketing related services
Printing-related machinery
Online information services
Computer services
Research organizations
Research facilities

Transportation and logistics
Air transportation
Bus transportation
Marine transportation
Ship building
Transportation arrangement and warehousing
Trucking terminal
Airports
Bus terminals
Passenger transportation
Communications equipment and services
Rental of railroad cars
Computer services and equipment

EASTERN
WASHINGTON UNIVERSITY

start something **big**

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Eastern Washington University's mission is to prepare broadly educated, technologically proficient and highly productive citizens to obtain meaningful careers, to enjoy enriched lives and to make contributions to a culturally diverse society. The University's foundation is based on career preparation, underpinned by a strong liberal arts education.

Tradition, Connections, Opportunity
In 1882 the Benjamin P. Cheney Academy opened its doors to more than 200 students. More than a century later, the Academy has evolved into Eastern Washington University. The regional, comprehensive public University is a driving force for the culture, economy and vitality of the Inland Northwest region, with programs also offered in Spokane, Bellevue, Everett, Kent, Seattle, Shoreline, Tacoma, Vancouver and Yakima.

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