

**Knowledge-Based Economic Development Strategies
for the
Youngstown-Warren (Ohio-Pennsylvania)
Metropolitan Statistical Area**

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Abstract

A skill of growing importance to economic development practitioners is the ability to fully analyze the various aspects that describe a regional economy. As a larger percentage of industries and occupations are tied to the growing knowledge-based economy, new techniques to identify the knowledge-generating capacity of regions can be used. This study's holistic analysis of a regional economy uses traditional techniques based on the concentration of industries, as well as newer techniques to identify occupational clusters, degree conferment, journal publications, and patent production. The Youngstown-Warren (OH-PA) metropolitan area is used to illustrate this holistic approach.

Keywords

innovation policy, knowledge-based economy, regional economic development, Youngstown, occupation, regional economy

1. Introduction

Traditional methods of analyzing regional economies concentrate on the industries contained within a geographic area, and the products that are exported out of it. Until the mid-1980s, industries and their products were the near-exclusive units of regional economic analysis, ranging from simple descriptive studies to more sophisticated econometric models (Feser, 2003). And even within a single company, there are many strategies that can be employed to compete in a national and the growing international marketplace. Some facilities compete with low-cost products, some specialize in quick delivery, and others invest in high quality production. The continued expansion of globalization has brought increased pressure to local economies. We are now living in a time when the development of innovative products and services of industries is even more critical to the growth of local economies than in the past.

However, looking only at the industrial structure of a region concentrates economic development strategies on the *types of products* that are created, and not on the *types of work* that are performed. Alfred Marshall first wrote about how labor pools are a critical source to regional economies in his widely used economics textbook (1890). The importance of human capital extends into endogenous theories of the origins of economic growth, where novel technologies and human capital are the source of productivity gains that sustain long-run growth (Romer, 1990). The typology of work and occupations that is performed by a region is at the heart of its innovative capacity. Besides contributing to innovation production, certain occupational analyses can be used to promote policies that connect workforce skills across industries, target underemployed workforce groups, explore entrepreneurship potential, and tie education and training with firm recruitment (Markusen, 2004). It is necessary to join the occupational-functional approach with the standard industry-based approach to understand a region's economy and to plan a region's future (Thompson and Thompson, 1987).

The necessity to analyze relevant metrics is even more important as regional economies transition into more of a knowledge-based economy. Development will be linked less to a region's natural resource endowments, and will be more heavily dependent on human capital (Reich, 1991). Powell and Snellman define the key component of the knowledge-based economy to be the creation of products and services that have a greater reliance on intellectual abilities than on physical inputs or natural resources (2004). Furthermore, there is a greater drive to integrate knowledge-intensive improvements into every stage of the production process. New ideas lead to new and improved products, services, and organizational practices.

Many different measures can illustrate the transition the economy of the United States to more of a knowledge-based economy. For example, the percentage of the U.S. population that is employed in the science and engineering fields has doubled in the past twenty years (National Science Board, 2006). This rapid growth is expected to continue in the near future, as the U.S. Bureau of Labor Statistics expects that during the next decade, employment in science and engineering occupations will increase seventy percent faster than the overall growth rate for all occupations (ibid). In his research, Richard Florida organizes all occupations into distinct clusters whose occupations share an economic function, especially the kind of work they do for a living. He classifies the "creative class" as one linked to the strengthening knowledge-based economy, whose economic function is to create new ideas, new technologies, and new creative content. In 1960 this group represented 17% of U.S. employment, which grew to 19% of the workforce in 1980, and expanded to 30% of total employment in 2000 (Florida, 2002). Morris and Western assert that the growing body of research suggests that many of the jobs created over the past two decades are fundamentally different than the ones that have been lost – with new, higher-wage jobs tending to favor those with more education and additional skills (1999).

Besides occupational groupings and clustering, additional measures of innovation potential such as patent production, journal publications, and educational attainment can be used to monitor the knowledge production of a geographical area. The need to have a degree before starting a career is becoming more and more important, and regions that fail to have an educated workforce will have difficulty attaining many new jobs that are created by the knowledge economy. Likewise, regions that produce many publications in scientific journals will have more opportunities to apply their novel findings to economic applications. Patents are bestowed for inventions judged to be new, useful, and non-obvious and are an indicator of the existence of intellectual capital and economically valuable knowledge (Grindley and Teece, 1997). Patents are an even better measure of technological innovation than research publications and citations (Jaffe, 1989). Bee contends that the principal distinction between more innovative regions and less innovative regions is the existence of large corporate research and development centers that produce an abundance of patents (2003).

All of these components – industrial diversification, occupational specialization, educational attainment, and knowledge production – are integral to a holistic analysis of a regional economy, especially for the task of creating strategies to build the knowledge-based economy of a region. Innovation is now identified as a critical reason why regions of the world are able to develop a competitive advantage and grow economically, and measuring it is becoming an important component of regional economic development strategies. Regions trying to succeed in the development of innovation will be highly reliant of its scientific research capacity, engaged by a share of universities, research institutes, and industry (Dosi, 1998). But these institutions also need to be linked to the region’s human capital. The success of a region in the new economy hinges on whether it has the right mix of workers to produce and disseminate new knowledge (Koo, 2005). Attracting these workers are equally important, as workers become more mobile in their search for personal opportunity and employment. The geographical distribution of knowledge workers will be directly linked to the future geographic distribution of regional growth (Florida, 2002).

This paper will concentrate on the metropolitan region centered in Youngstown (Ohio, U.S.A.) as the unit of analysis in an effort to create knowledge-based economic development strategies for the region. The following questions will be answered in this paper:

Q1: What is the current state of the Youngstown region’s economy, and how is it changing?

Q2: What patterns can be discovered by observing occupational clusters in Youngstown?

Q3: What type of workforce is being created by Youngstown’s educational system?

Q4: What is the measurable knowledge production of the Youngstown region?

The remainder of this paper is organized as follows. Section 2 discusses the history of the Youngstown region from an economic perspective. Section 3 presents a snapshot of the region’s economy based on traditional measures to analyze industry. Section 4 analyzes the regional workforce by using occupation statistics and educational attainment. Section 5 reports on the knowledge production of the region, such as journal publications and patent citations. Section 6 concludes the paper, and the appendix includes recommendations for the region.

2. The Youngstown-Warren Region

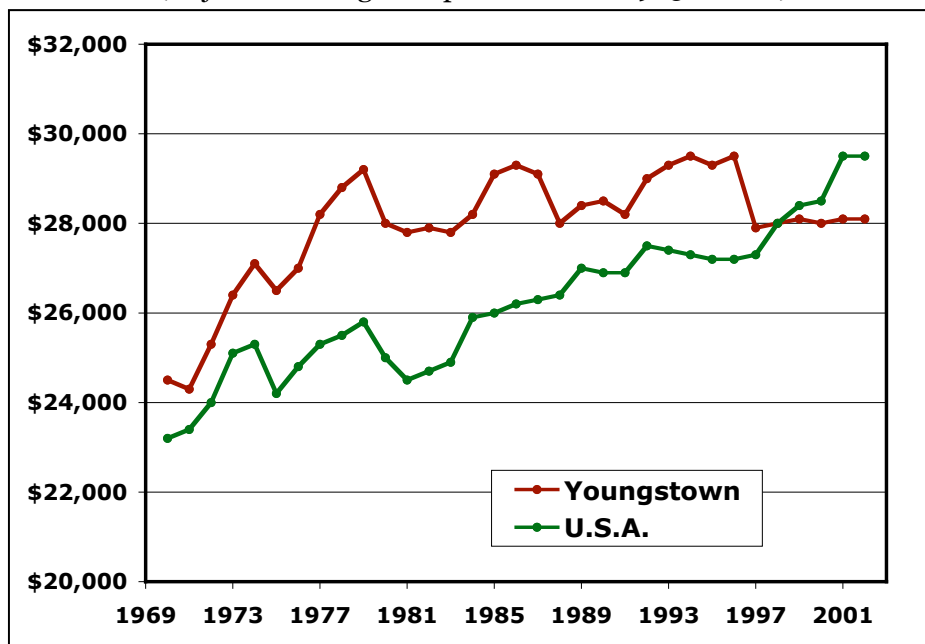
The Youngstown-Warren region is located in Northeast Ohio, along the Pennsylvania border. It is 65 miles from both the city of Cleveland and the city of Pittsburgh. The Mahoning River flows

through the area, running through the region’s central cities of Youngstown and Warren, and eventually joins the larger Ohio River. The geographical area surrounding the river is called the “Mahoning” Valley, whose name is derived from an Indian word meaning “at the salt lick”. John Young founded Youngstown in 1796, and in 1802 the first blast furnace west of the Appalachian Mountains was built nearby. Industry continued to develop along the banks of the Mahoning River, as it was a source of water for manufacturing as well as a route for transportation of materials. In the 1890s, many of the iron mills along its banks were converted into steel mills and the region attracted immigrants from around the world to work in its factories.

The region quickly became one of the largest manufacturing centers in the United States. By 1920, Youngstown was the 50th largest city in the United States, and it was the second largest steel-producing region in the country, with nearby Pittsburgh being the largest. In 1950, manufacturing jobs represented 50% of the employment in the region (Safford, 2004). In the second half of the twentieth century, the region’s manufacturing base declined as business costs, foreign competition, industry consolidation, and modernization issues produced complications for local businesses. The area is one of the few regions in the country to have lost population over the past decades. In fact, over the past decade from 1994 to 2004, the region lost 3.5% of its employed workers. Comparing the 118 metropolitan statistical areas with populations from 200,000 to 3 million inhabitants, the Youngstown-Warren region was second to last (116th) in its employment growth during the last decade (Eberts et al, 2006).

Wages have also remained fairly constant over the past twenty years when indexed for inflation, with current wage levels equal to those around 1977. Figure 1 shows the average earnings per worker in the Youngstown-Warren region and in the United States as a whole from 1970 to 2002. Within the last decade, the United States’ average earnings per worker have surpassed the average earnings in the Youngstown-Warren region and the difference continues to grow.

Figure 1. Average earnings per worker, 1970-2002
(Adjusted for regional price index in 1983 dollars)



Source: adapted from “Why the Garden Club Couldn’t Save Youngstown” (Safford, 2004)

But what is causing this widening gap? This paper theorizes that the widening gap between the Youngstown-Warren region and the rest of the country is the region's difficulty in transitioning to the growing knowledge-based economy. Jobs based on knowledge production that demand higher educational attainment, which are associated with higher salaries, are not as concentrated in the region when compared to other parts of the country. Technological change is indeed often painted as one of the culprits for the growing wage inequality and increasing educational wage differentials in the labor market of the United States (Morris and Western, 1999). The next two sections of this paper will attempt to discern if there are difference between the structure of the Youngstown-Warren economy and that of the nation.

The Youngstown-Warren MSA vs. The Youngstown-Warren CSMA

Before delving into the statistics, two different geographical areas can be used to describe the Youngstown-Warren region. The MSA stands for Metropolitan Statistical Area. For the data used in this report, the U.S. Office of Management and Budget and the Department of Labor defines the Youngstown-Warren MSA to be Mahoning, Trumbull, and Columbiana Counties, all located in the state of Ohio.

The Youngstown-Warren CSMA (Consolidated MSA) is defined to include Mahoning, Trumbull, and Columbiana Counties in Ohio, as well as Mercer County in Pennsylvania. The additional county represents the growing social and economic integration among the different cities in both Ohio and Pennsylvania within the region. The Youngstown-Warren Regional Chamber of Commerce uses the CMSA for some of its economic publications, and most of the bibliometric analysis in this report used the larger CMSA to describe the region. The 2004 population of the Youngstown-Warren CSMA was 715,039 residents. It is important to recognize the differences between the MSA and the CMSA when information is provided in this paper.

3. Economic Snapshot and Employment Data

The next few paragraphs present a snapshot of the economy of the Youngstown-Warren MSA. The North American Industry Classification System (NAICS) is utilized by the U.S. Census Bureau to classify all types of economic activity into specific sectors. NAICS has been used since the late 1990s, and it has replaced the SIC (Standard Industrial Classification) system developed in the 1930s. As an example of this classification, if a company named "Mahoning Tool and Die" employed 50 people in the Youngstown-Warren MSA, then because the company's primary product is a manufactured good, these 50 employees would be included in the manufacturing sector (labeled #31). Table 1 divides the region's employees into various NAICS classifications from 2002 employment data. The table includes other information such as the sector's percentage of jobs compared to the whole region, the percent change since 1999, and location quotients for each sector.

The location quotient (LQ) of each NAICS classification is a ratio of a region's percentage of employment in a certain industry divided by the percentage of employment in that same industry for the United States. If the value of the location quotient is greater than one, then it could be considered that a region has a comparative advantage in that industry, and that many of its products or services in that sector are exported outside of the region. For the Youngstown-Warren MSA, the industry sectors of manufacturing, transportation & warehousing, health care & social assistance, and accommodation & food services have location quotients greater than one, and are considered industries that are larger in the region compared to the nation.

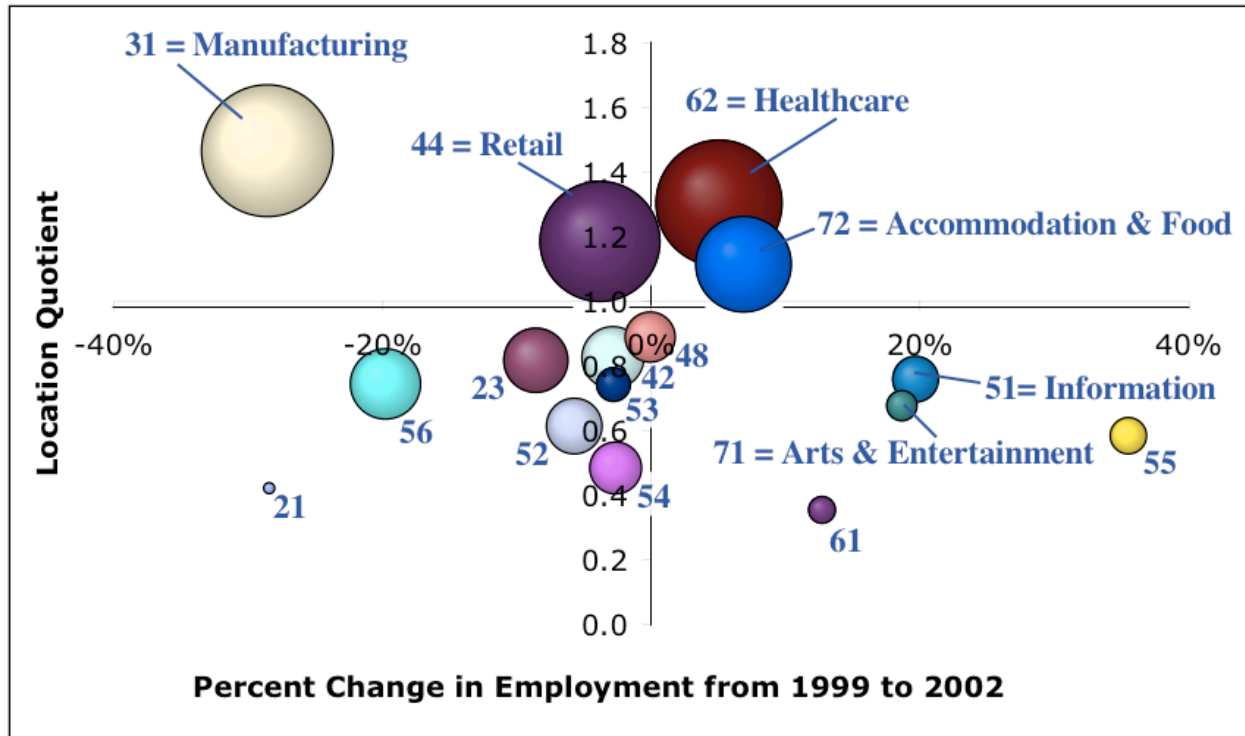
Table 1. Employment Statistics by NAICS codes, 2002

NAICS Industry Classification	Youngstown-Warren MSA - 2002			
	Number of employees 2002	Percentage of total jobs	LQ compared to U.S.	Percent change since 1999
Total Employment	193,336	100%	-	- 7.3 %
21 – Mining	337	0.2%	0.42	- 28.5%
23 – Construction	8,864	4.6%	0.82	- 8.6%
31 – Manufacturing	36,309	18.8%	1.47	- 28.6%
42 – Wholesale Trade	8,317	4.3%	0.83	- 2.9%
44 – Retail Trade	30,223	15.6 %	1.19	- 3.8%
48 – Transportation & Warehousing	5,475	2.8%	0.89	- 0.1%
51 – Information	4,615	2.4%	0.76	+ 19.7%
52 – Finance & Insurance	6,770	3.5%	0.61	- 5.8%
53 – Real Estate	2,574	1.3%	0.74	- 2.8%
54 – Professional & Scientific Services	5,863	3.0%	0.48	- 2.7%
55 – Management of Companies	2,925	1.5%	0.58	+ 35.5%
56 – Administrative Support	10,623	5.5%	0.74	- 19.8%
61 – Educational Services	1,643	0.8%	0.35	+ 12.7%
62 – Healthcare & Social Assistance	33,409	17.3%	1.30	+ 5.0%
71 – Arts & Entertainment	2,069	1.1%	0.68	+ 18.6 %
72 – Accommodation & Food Services	19,273	10.0%	1.12	+ 6.8%

Source: OES values: U.S. Census Bureau, Metro Business Patterns, 1999 & 2002,
<http://censtats.census.gov/cbpnaic/cbpnaic.shtml>

Figure 2 on the next page is a graphical representation of the economy for the Youngstown-Warren MSA. The horizontal axis is the percent change of employment from 1999 to 2002. The vertical axis is the industry's location quotient compared to the United States. The size of the bubble represents the number of employees in each industry. It is interesting to note the industry segments with the largest number of employees are also the industry segments with the highest location quotients. Manufacturing, for example, is the largest sector; it has the highest location quotient, and it has had the largest decrease in employment from 1999 to 2002. Sectors that have growth rates larger than 10% are Information, Educational Services, Arts & Entertainment, and Management of Companies. These high-growth sectors may be opportunity areas for investment.

Figure 2. Snapshot of Youngstown-Warren MSA Economy by NAICS Classification



Source: OES values: U.S. Census Bureau, Metro Business Patterns, 1999 & 2002, 2 digit numbers in this figure refer to the NAICS classifications in Table 1 <http://censtats.census.gov/cbpnaic/cbpnaic.shtml>

4. Occupational Statistics and Degree Conferment

Another method to analyze the employment of an area is to use occupational data provided by the Federal Department of Labor. The Standard Occupational Classification (SOC) groups all workers into separate employment classifications, regardless of the place of employment. For example, if a company named “Mahoning Tool and Die” employed 50 people in the Youngstown-Warren MSA (30 were machinists, 10 were engineers, 5 were managers, and 5 were office assistants), then the data would show 30 people in Production Occupations, 10 people in Engineering, 5 people in Management Occupations, and 5 people in Office & Administrative Support. Simply put, the OES data breaks down employment by occupation for the entire MSA.

Table 2 summarizes the 2003 Youngstown-Warren MSA data from the Department of Labor. All twenty-one OES classification groups are further divided by the employment classes used by Richard Florida in his book, “The Rise of the Creative Class.” Dr. Florida’s methodology divides all employment into what he labels the Service Class, the Working Class, the Creative Professionals, and the Super-Creative Core (2002). He believes that employees from the Creative Professionals and the Super-Creative Core are the engines that will produce innovation, leading to future economic development. Furthermore, regions that have large number of employees in these certain occupational clusters will have a greater competitive advantage in the future. Table 2 includes data for each of the twenty-one groups including the number of employees in 2003, the percent change from 2000, the occupational location quotient, the average hourly wage, and how the average wage compares to other wages across the entire MSA.

Table 2. Employment Statistics by OES Occupational Employment Clusters, November 2003

Occupational Employment Classification	Youngstown-Warren MSA – November 2003				
	Number of Employees	% Change from 2000	LQ	Average Hourly Wage	Wage Level
Service Class					
21 – Community and Social Services	2,280	- 4.6%	0.81	\$16.71	Mid
31 – Health Care Support	8,460	+ 9.6%	1.54	\$10.15	Low
33 – Protective Services	4,930	- 15.7%	0.93	\$14.44	Mid
35 – Food Preparation and Serving	21,930	+ 2.1%	1.23	\$7.37	Low
37 – Building and Grounds Maintenance	7,330	+ 2.9%	0.98	\$9.59	Low
39 – Personal Care and Service	4,440	+ 11.3%	0.82	\$8.31	Low
41 – Sales and Related Occupations	22,130	- 15.0%	0.92	\$12.98	Mid
43 – Office and Administrative Support	33,560	- 4.4%	0.82	\$11.98	Low
Working Class					
47 – Construction and Extraction	8,870	- 10.5%	0.85	\$19.33	High
49 – Installation, Maintenance, and Repair	9,760	- 6.5%	1.10	\$17.62	Mid
51 – Production Occupations	28,360	- 23.2%	1.73	\$16.64	Mid
53 – Transportation and Material Moving	20,780	+ 3.6%	1.32	\$13.26	Mid
Creative Professionals					
11 – Management Occupations	8,000	- 36.3%	0.69	\$36.53	High
13 – Business and Financial Operations	6,070	+ 3.1%	0.63	\$21.41	High
23 – Legal Occupations	1,120	+ 3.7%	0.61	\$27.47	High
29 – Healthcare Practitioners	15,510	+ 16.4%	1.41	\$24.86	High
Super-Creative Core					
15 – Computer and Math	2,390	+ 27.1%	0.43	\$25.74	High
17 – Architecture and Engineering	2,170	- 28.1%	0.50	\$25.24	High
19 – Life, Physical, and Social Sciences	560	n. a.	0.28	\$23.66	High
25 – Education, Training, and Library	13,090	+ 2.3%	1.02	\$19.22	High
27 – Arts and Entertainment	1,990	- 13.1%	0.75	\$14.62	Mid

Sources: OES values: U.S. Department of Labor, <http://www.bls.gov/oes/current/oessrcma.htm>

2003 median wage values: U.S. Department of Labor, <http://www.bls.gov/ro5>

note: wage level intervals were calculated by ordering each occupation by average hourly wage and separating the top third, middle third, and bottom third into distinct intervals. For example, one-third of the occupations in the MSA have average hourly wages between \$12.85 and \$19.00, or the Mid Level.

The Youngstown-Warren MSA has a larger percentage of employees when compared to the nation in the fields of Health Care, Food Preparation, Maintenance & Repair, Transportation, and Production Operations, which on average, are paid less than or around the average wage for the region. The only two occupational clusters from the Creative Professional or the Super-Creative Core with a location quotient greater than one are Healthcare Practitioners and by a

small margin, Education and Library Occupations. All other occupational clusters have location quotients less than one, and most occupations in the Super-Creative Core have very low representation in the region, when compared to the United States as a whole. This table also shows that many middle and high wage jobs in the areas of Production Occupations and Engineering have decreased since 2000. However, there is growth in some higher-wage jobs within the MSA, especially in the Healthcare and Computer Occupations. Table 3 compares the percentage of employees in each occupational class for the Youngstown-Warren MSA, Ohio, and the United States.

Table 3. Employment by OES Occupational Employment Clusters, November 2004

Occupational Employment Classification	Youngstown	Ohio	U.S.A.
Service Class			
All Service Class	47.2%	47.7%	48.5%
21 – Community and Social Services	1.0%	1.2%	1.3%
31 – Health Care Support	3.7%	3.1%	2.6%
33 – Protective Services	2.3%	2.1%	2.4%
35 – Food Preparation and Serving	9.9%	8.8%	8.3%
37 – Building and Grounds Maintenance	3.3%	3.1%	3.3%
39 – Personal Care and Service	2.0%	2.1%	2.5%
41 – Sales and Related Occupations	9.8%	8.8%	10.7%
43 – Office and Administrative Support	15.3%	3.1%	17.6%
Working Class			
All Working Class	30.3%	27.4%	24.4%
47 – Construction and Extraction	4.0%	4.1%	4.9%
49 – Installation, Maintenance, and Repair	4.7%	4.2%	4.1%
51 – Production Occupations	12.7%	10.8%	7.9%
53 – Transportation and Material Moving	8.0%	8.3%	7.5%
Creative Professionals			
All Creative Professionals	13.8%	14.2%	14.6%
11 – Management Occupations	3.4%	3.9%	4.7%
13 – Business and Financial Operations	3.0%	4.1%	4.1%
23 – Legal Occupations	0.6%	0.6%	0.8%
29 – Healthcare Practitioners	6.9%	5.5%	5.0%
Super-Creative Core			
All Super-Creative Core	8.7%	10.7%	12.5%
15 – Computer and Math	0.8%	1.9%	2.3%
17 – Architecture and Engineering	1.0%	1.8%	1.9%
19 – Life, Physical, and Social Sciences	0.2%	0.6%	0.9%
25 – Education, Training, and Library	5.7%	5.4%	6.2%
27 – Arts and Entertainment	0.9%	1.0%	1.3%

Sources: OES values: U.S. Department of Labor, <http://www.bls.gov/oes/current/oessrcma.htm>

The data provided shows that the Youngstown-Warren MSA lags Ohio, and Ohio lags the entire country in terms of its employment base in the Creative Professionals and Super-Creative Core clusters. The United States as a whole has 27.1% of its workforce associated with these clusters, compared to 22.5% of the workforce of the Youngstown-Warren MSA – a relatively large difference. This value illustrates the gap in the labor pool between jobs associated with the emerging knowledge economy and jobs from other sectors. The direct opposite trend can be seen for the Working Class cluster, with the Youngstown-Warren MSA leading Ohio, and Ohio leading the United States. Florida himself ranks the 81 metropolitan statistical areas in the United States with a population more than 500,000 in population, and the Youngstown-Warren MSA ranks next to last in terms of percentage of employees in these creative clusters (2002). Because of incomplete data on the Bureau of Labor Statistics’ website, a temporal comparison could not be completed for the Youngstown-Warren MSA. In fact, the body of research comparing regions with occupations is minimal because of reliable regional-level occupational data was not provided until recently (Koo, 2005). It remains to be seen if this gap is widening or closing.

Table 4 provides additional information about employment by occupation in the Youngstown-Warren MSA. Every type of occupation in the region has been placed into one of three categories, based upon the average hourly wage. Then for each wage bracket (high, medium, and low) the ten occupations with the highest location quotient are listed, along with the number of employees and the average hourly wage. For example, in the Youngstown-Warren MSA, there is an extremely high concentration of molders and casters in the region (10 times the percentage of jobs when compared to the rest of the country), and in this classification there are 270 employees who make an average of \$12.30 an hour. The skill sets associated with these higher concentrated occupations could possibly be exploited in the region for economic gain, as there is a larger concentration of people with these skills in the area.

Analysis of Table 4 shows that large concentrations of highly skilled production jobs exist at the highest wage levels. But looking closely at these ten occupations with the largest occupational concentrations in the highest wage levels, only one (materials engineers) can be classified as “super-creative” using Florida’s typology. Similarly, working class and service class occupations constitute a majority of the jobs in the lower and middle level wage brackets.

Table 4. Occupations with High Location Quotients for Different Wage Groups, 2003

Occupational Employment Classification		Youngstown-Warren MSA – November 2003		
		LQ	Number of Employees in 2003	Average Hourly Wage
Lower Third (\$12.85 per hour and less)				
51-9195	Molders & Casters, no metal and plastic	10.53	270	\$12.30
42-4121	Library Assistants, Clerical	5.90	890	\$7.90
39-4021	Funeral Attendants	5.74	160	\$9.00
51-9083	Ophthalmic Laboratory Technicians	5.15	90	\$8.98
51-4194	Tool Grinders and Sharpeners	4.03	80	\$11.87
51-4032	Drilling & Boring Machine Setters and Operators	3.48	190	\$10.83
51-9123	Painters	3.43	110	\$9.51
49-3052	Motorcycle Mechanics	3.00	50	\$10.28

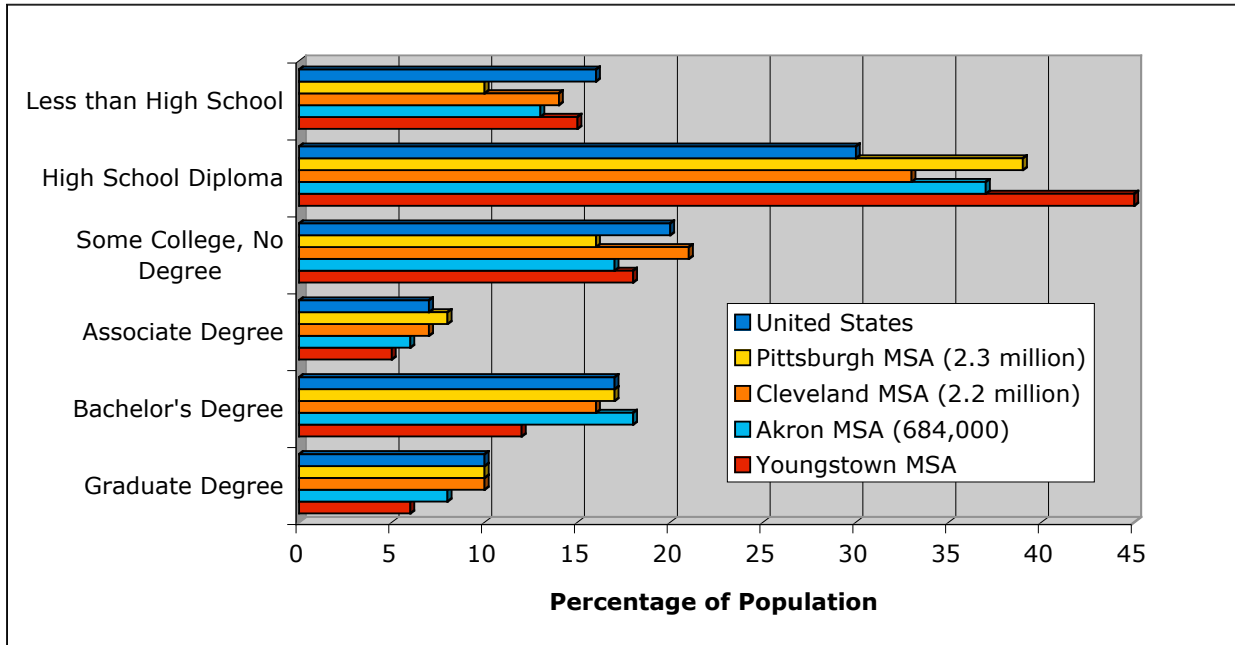
29-2041	Emergency Medical Paramedics	2.88	680	\$11.03
37-3012	Pesticide Handlers	2.68	60	\$12.06
Middle Third (\$12.85 per hour to \$19.00 per hour)				
51-4062	Patternmakers, metal and plastic	14.43	50	\$15.74
51-4023	Rolling Machine Setters and Operators	14.27	690	\$18.33
51-9051	Furnace and Oven Operators	10.75	210	\$14.52
51-4071	Foundry Mold and Coremakers	10.39	110	\$13.16
51-4022	Forging Machine Setters and Operators	9.14	350	\$17.19
31-2011	Occupational Therapist Assistants	6.38	170	\$17.47
53-7081	Refuse & Recyclable Material Collectors	4.89	300	\$14.61
49-2092	Electric Motor and Power Tool Repair	4.42	90	\$15.81
25-4031	Library Technicians	4.13	640	\$15.08
53-7021	Crane and Tower Operators	4.00	230	\$15.06
Higher Third (more than \$19.00 per hour)				
51-9041	Extruding and Compacting Machine Setters and Operators	6.26	500	\$19.53
51-4111	Tool and Die Makers	5.35	840	\$25.54
49-9043	Maintenance Workers Machinery	4.47	500	\$21.64
11-9131	Postmasters	4.23	60	\$25.50
11-9061	Funeral Directors	3.75	90	\$26.30
29-2033	Nuclear Medicine Technologists	3.73	80	\$26.14
33-1011	Managers of Correctional Officers	3.17	70	\$24.60
17-2131	Materials Engineers	3.05	80	\$26.66
47-2221	Structural Iron and Steel Workers	3.05	270	\$23.28
29-2021	Dental Hygienists	2.69	560	\$19.70

Sources: OES values: U.S. Department of Labor, <http://www.bls.gov/oes/current/oesrcma.htm>

Educational Assets and Degree Production

A critical component to the future economic development of a community is the education and workforce skills of its citizens. Every year, the U.S. Bureau of the Census reports in its American Community Survey the levels of educational attainment (for those 25 years of age and older) for the population of every Metropolitan Statistical Area in the nation. Table 4 compares these statistics for the Youngstown-Warren MSA, the Cleveland MSA, the Akron MSA, the Pittsburgh MSA, and the entire United States.

Table 5. Highest Level of Educational Attainment as Percentage of Population, 2003



Source: U.S. Bureau of the Census, American Community Survey 2003

This data reveals that 85% of the Youngstown-Warren MSA’s population have finished high school or received a general education diploma (GED), which is slightly higher than the national percentage of 84%. Compared to other regions in close proximity, this percentage is lower than Cleveland (86%), Akron (87%), and Pittsburgh (90%). Additionally, the Youngstown-Warren MSA lags behind the U.S. average when it comes to percentages of its population with undergraduate and graduate degrees. About 18% of the Youngstown-Warren population has attained at least a bachelor’s degree, compared to a national figure of 27%. The Akron, Cleveland, and Pittsburgh MSAs all have at least 26% of their residents with bachelor’s degrees – on par with the national average. Furthermore, only 6% of Youngstown-Warren MSA residents have a graduate degree, compared to the nation with 10%. In Cleveland and Pittsburgh this percentage is also around 10%, and in Akron 8% of the population has a graduate degree. Possible explanations for these differences include the following: the differing ages of the population base in each of the metropolitan areas, the number of graduate programs provided at local universities, and the possibility of the relocation of residents looking for employment in occupations that require higher levels of education.

Table 6 shows the ten degree-granting institutions in the Youngstown-Warren (OH-PA) CMSA in 2002 and the number of degrees awarded at each. Youngstown State University awards all of the Masters Degrees in the region, and the Northeastern Ohio Universities College of Medicine (NEOUCOM) awards a great majority of the doctoral degrees, even though 2/3 of the students enrolled in this program are not directly affiliated with the Youngstown area because the NEOUCOM student body includes students from the University of Akron and Kent State University (both outside the Youngstown-Warren CMSA). Beginning in 2007, NEOUCOM will commence enrollment in their new doctor of pharmacy program, increasing the local annual production of PhDs.

Table 6. Degree Granting Institutions in the Youngstown-Warren CSMA

Institution	Enrollment	Degrees Granted in 2002			
		Associate	Bachelor	Master	PhD/MD
Totals		469	2075	308	105
Youngstown State University	12,300	166	1387	308	4
NEOUCOM (medical college partnered with Kent and Akron)	315	-	-	-	101
Grove City College	2,300	-	486	-	-
Thiel College	1,245	2	151	-	-
Penn State University Shenango Campus	1,016	67	50	-	-
Kent State University Trumbull Campus	2,300	104	-	-	-
Kent State University Salem Campus	1,050	90	1	-	-
Kent State University East Liverpool Campus	600	40	-	-	-
ITT Technical Institute	400	179	-	-	-
Ohio Valley College of Technology, East Liverpool	160	73	-	-	-

Source: National Center for Education Statistics, <http://nces.ed.gov/ipeds/>
Hobson's College View, <http://www.collegeview.com>

Table 7 further breaks down the diplomas awarded within the Youngstown-Warren CMSA in 2002 by ranking the most numerous degrees within each type of degree. The most numerous Associate Degrees awarded include the fields of information technology, business and marketing, engineering technicians, and computer programmers. Similarly, the most Bachelor's Degrees were awarded in business and management, education, the biological and biomedical sciences, and engineering. Out of the top fifteen graduate degree programs in 2002, only Engineering (18 conferred), Biology (11), and Chemistry (9) represent degrees from scientific and technical fields.

Table 7. Number of Degrees Granted by Field in the Youngstown-Warren CSMA in 2002

Associate (721)	Bachelor (2075)	Masters (308)	Doctorate (105)
Information Technology (102)	Business & Management (509)	Education (127)	M.D. (101)
Business & Marketing (96)	Education (328)	Business Administration (59)	Education (4)
Electrical Engr. Technicians (87)	Biological/Biomedical Sciences (133)	Counseling (18)	-
Computer Programming (80)	Engineering (114)	Engineering (18)	-
Drafting & Design (30)	Psychology (95)	English & Literature (15)	-
Security Services (27)	Criminal Justice (78)	History (12)	-
Accounting (26)	Communication &	Health Care	-

	Journalism (64)	Administration (12)	
Radiation Therapy (24)	English & Literature (56)	Criminal Justice (11)	-
Dental Support (24)	Political Science (54)	Biology (11)	-
Mechanical Engr. Technicians (20)	Visual & Performing Arts (53)	Visual & Performing Arts (9)	-
Physical Therapist Assistant (17)	Chemistry (51)	Physical Therapy (9)	-
Nursing (16)	History (48)	Chemistry (9)	-
Legal Assistant (12)	Nursing (44)	Economics (7)	-
Medical Office Assistant (12)	Social Work (39)	Nursing (4)	-
Child Care & Support (10)	Computer Science (33)	Mathematics (3)	-

Source: National Center for Education Statistics, <http://nces.ed.gov/ipeds/>

5. Knowledge Production Measurements

Publications and Patents in the Youngstown-Warren CSMA

In an attempt to discover what institutions in the area are producing the most publications in scholarly journals, a list of all publications originating from the Youngstown-Warren CMSA over the last decade were collected by using the ISI Web of Science Database. Table 8 lists the top ten publishing institution in the region, along with the institution's primary research field. For example, Youngstown State University is most prolific in chemistry and physics research whereas Penn State Shenango's publications are concentrated in ecology and zoology. A number of local medical organizations make the list, including the regional medical health care providers as well as the Arthritis Center of Northeast Ohio located in Youngstown and the Libby Group and Warren Otologic Group, which specializes in conditions of the ear, nose, and throat (otorhinolaryngology). Two manufacturing companies, Delphi Packard Electric Systems and RMI Titanium, also make the list.

Table 8. Top Publishing Institutions from 1995 to 2004 in the Youngstown-Warren CSMA

Institution	No. of Publications	Primary Research Fields
Youngstown State University	655	Chemistry, Physics
NEOUCOM	226	Medicine
St. Elizabeth's Medical Center	128	Medicine
Penn State University, Shenango Branch	128	Ecology, Zoology
Forum Health	87	Medicine
Arthritis Center of Northeast Ohio	65	Rheumatology, Anthropology
Delphi Packard Electric Systems	24	Automotive, Electrical Connections
Warren Otologic Group	15	Otorhinolaryngology
RMI Titanium	13	Materials Engineering
Lippy Ear, Nose & Throat Group	8	Otorhinolaryngology

Source: ISI Web of Science Database of Publications, <http://www.isinet.com/products/citation/wos/>

All of these knowledge-producing institutions in the Youngstown-Warren CSMA are comprised of creative individuals who are listed as primary or secondary authors in these publications. A list of these individuals and their fields of research are included in Table 9. The most prolific author in the past decade has been Dr. Charles Bursey from Penn State Shenango with 109 publications. The other prolific authors listed perform research in the fields of chemistry, physics, medicine, otorhinolaryngology, and cardiovascular research. It is interesting to note the lack of engineering-related publications in the Youngstown-Warren CSMA.

Table 9. Most Prolific Publishing Individuals in Science, Technology, and Medicine from 1995 to 2004 in the Youngstown-Warren CSMA

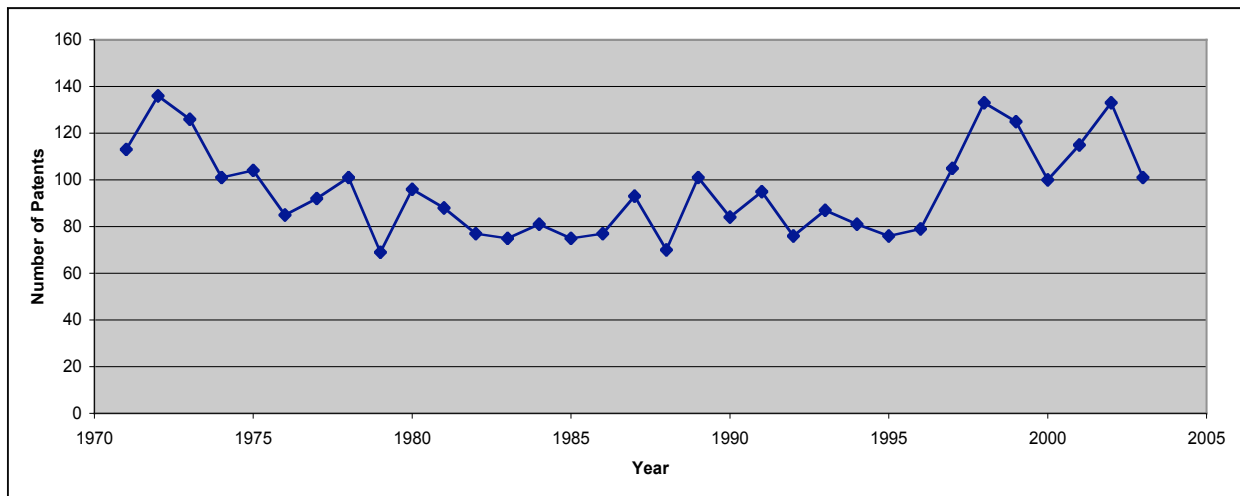
Author	No. of Publications	Institution	Fields of Research
Bursey, C. R.	109	Penn State U. Shenango	Biology, Wetlands Ecology
Rothschild, B. M.	105	NEOUCOM – Arthritis Center of Northeast Ohio	Rheumatology, Bone Disease, Anthropology
Del Bene, J. E.	59	Youngstown State Univ.	Chemistry
Hunter, A. D.	50	Youngstown State Univ.	Chemistry, Crystallography
Zeller, M.	38	Youngstown State Univ.	Chemistry
Carroll, J. J.	36	Youngstown State Univ.	Physics, Optics
Brodell, R. T.	34	NEOUCOM	Dermatology
Watanakunakorn, C.	33	St. Elizabeth’s Medical	Infectious Disease
Rothschild, C.	26	Arthritis Center of Northeast Ohio	Rheumatology, Anthropology
Lippy, W. H.	23	Lippy Group	Otorhinolaryngology
Norris, P.	22	Youngstown State Univ.	Chemistry
Rizer, F. M.	22	Warren Otologic Group	Otorhinolaryngology
Schuring, A. G.	20	Warren Otologic Group	Otorhinolaryngology
Smiley, J. A.	17	Youngstown State Univ.	Chemistry
Dunham, C. M.	16	St. Elizabeth’s Medical	Injury Trauma
Falconer, R. L.	16	Youngstown State Univ.	Chemistry
Porter, J. M.	15	St. Elizabeth’s Medical	Injury Trauma
Burkey, J. M.	14	Warren Otologic Group	Otorhinolaryngology
Kasirajan K.	13	Forum Health	Cardiovascular Systems
Rubin, J. R.	12	Forum Health	Cardiovascular Systems
Wagner, T. R.	12	Youngstown State Univ.	Chemistry

Source: ISI Web of Science Database of Publications, <http://www.isinet.com/products/citation/wos/>

One possible method to the measure economic development potential of a region is to analyze the various patents that originate from that metropolitan area. Patents are good metrics of innovation because they are new and nontrivial ideas, often created with commercial applications in mind. Each patent granted by the U.S. Patent and Trademark Office includes information about the location of the inventor as well as the location of the patent’s assignee (the assignee is usually a company). Figure 3 below shows the annual number of patents since 1971 that were issued to either individuals or companies in the Youngstown-Warren CMSA.

Even though some of the companies included in this data are located outside of the Youngstown-Warren CMSA, the employees who created those patents live within the area and are a component of the region's intellectual capital. This graph shows the most prolific time for patents in the area was the early 1970s and more recently, from 1997 to 2003.

Figure 3. Number of Patents Issued by Year in the Youngstown-Warren CMSA



Source: Community of Science Database of Patents, <http://patents.cos.com>

Table 10 charts the companies that produced the largest number of patents during each decade in the Youngstown-Warren CSMA. Patents from the 1970s and 1980s reflect the various metal fabrication facilities from the area. Patents from the 1990s to the present contain a large number of automobile component and electrical connectors patents, primarily from General Motors and Delphi Packard Electrical Systems. One interesting company to note is Infected Inc. (now NanoLogix, Inc.) located in Sharon, Pennsylvania. This company seems to have the most patents of companies in the biomedical area as they hold a number of patents in microbiology and pathogen detection.

Table 10. Top Patenting Institutions by decade in the Youngstown-Warren CSMA

Years	Institution	No. of Patents	Fields of Commercialization
1971 to 1979	Westinghouse Electric Corp.	119	Electrical Components
	General Motors	67	Automotive Components
	Youngstown Sheet & Tube Co.	46	Steel and Machinery
	Wean Industries, Inc	29	Metal Fabrication
	Ajax Magnethermic Corp.	21	Heating Devices
	GF Business Equipment, Inc	16	Furniture
	General American Transport Co.	15	Train Components
1980 to 1989	The General Fireproofing Co.	12	Furniture
	General Motors	115	Automotive Components
	Commercial Shearing Inc	34	Valves and Machinery
	NRM Corporation	33	Tire Components
1989	Westinghouse Electric Corp.	26	Electrical Components

	Alcan Aluminum Corp.	21	Aluminum Production
	Insul Company	14	Metal Production
	The Babcock & Wilcox Co.	13	Energy Production Components
	The Electric Power Research Inst.	11	Transformers and Conductors
1990 to 1999	General Motors	170	Automotive Components
	The Babcock & Wilcox Co.	34	Energy Production Components
	Winner Royalty Group	29	Security Devices
	Infectech, Inc	27	Microbiology Applications
	Spirex Corp.	12	Extruded Components
	Ajax Magnethermic Corp.	11	Heating Devices
	Packard Hughes Interconnect Co.	9	Electrical Connections
	Century Products Co.	8	Safety Belts and Seats
2000 to 2004	Delphi Technologies Inc	82	Electrical Connections
	General Motors	19	Automotive Components
	Keystone Ridge Designs	12	Furniture
	Alco Industries Inc	9	Pet Supplies
	Danieli Technology Inc	8	Chemical Processes
	McDermott Technologies	8	Energy Production Components
	Winner Royalty Group	6	Security Devices
	Gates Automation Inc	6	Bag Handling

Source: Community of Science Database of Patents, <http://patents.cos.com>

The Super-Creative Core of the Youngstown-Warren CSMA

The publication and patent analysis has been used to discover the knowledge producing institutions and individuals within the region. Table 11 provides more specific information about the most prolific individuals in the CSMA. When creating future knowledge-based economic development strategies, it may be important to contact these individuals and ask them for advice or provide them with assistance when it comes to building research programs and developing an innovative workforce in the Youngstown-Warren CSMA.

Table 11. Important Knowledge-Producing Individuals in the Youngstown-Warren CSMA

Name	Areas of Specialization	Important Information
Dr. Bruce Rothschild brm@neoucom.edu	Rheumatology, Bone Disease, Anthropology, Arthritis of Fossils	<ul style="list-style-type: none"> • Director, Arthritis Center of Northeast Ohio (Youngstown) • 105 publications within last decade • Professor of Medicine (NEOUCOM) • Professor of Bio. Engr. (U. of Akron)
Dr. Mitchell Felder mfelder@infectech.com	Microbiology, Pathogen Identification	<ul style="list-style-type: none"> • CEO of Infectech, Inc. (Sharon) • Renamed NanoLogix in March 2005 • www.nanologix.net states the company has 31 patents
Dr. Charles Bursey cxb13@psu.edu	Wetlands and Marine Biology Research	<ul style="list-style-type: none"> • Professor of Biology (Penn State Shenango in Sharon) • 109 publications within last decade

Dr. Allen Hunter adhunter@cc.yosu.edu	Chemistry, Crystallography	<ul style="list-style-type: none"> • Director, YSU Structural & Chemical Instrumentation Center • Professor of Chemistry, YSU • 50 publications within last decade
Dr. Matthias Zeller mzeller@cc.yosu.edu	Chemistry	<ul style="list-style-type: none"> • Chemistry Research Fellow, YSU • 38 publications within last decade
Dr. James. J. Carroll jjcarroll@cc.yosu.edu	Physics, Optics Photonuclear Reactions	<ul style="list-style-type: none"> • Director, Center for Photon-Induced Processes and X-Ray Effects Lab. • Professor of Physics, YSU • 36 publications within last decade
Dr. Robert Brodell rtb@neoucom.edu	Medicine, Dermatology	<ul style="list-style-type: none"> • Head of Dermatology, NEOUCOM • 34 publications within last decade
Dr. William H. Lippy	Ear Surgery Otorhinolaryngology	<ul style="list-style-type: none"> • Founder of Libby Otology Group • Internationally recognized inner ear surgeon • 23 publications within last decade

6. Conclusion

Performing a multifaceted analysis on a region using metrics such as educational attainment, knowledge production, and occupational concentration helps to achieve a richer understanding of the strengths and weaknesses of a regional economy. Once these components have been identified, economic development practitioners can take the steps to remedy the problems and leverage the perceived opportunities. The next few paragraphs present a summary of the key findings of this report for the Youngstown-Warren region, which will be used as the basis for the recommendations included in the appendix.

The largest employment sector of the Youngstown-Warren regional economy remains manufacturing, which accounts for 19% of the region's total employment. This is followed by health care & social assistance (17%), and then retail trade (16%). Even though they are smaller in employment size, the sectors of information services and management of companies have grown by 20% during the three-year period from 1999 to 2002. However during the last decade, the region has witnessed a decrease in employment; it was one of a handful of metropolitan areas in the United States with a population larger than 200,000 people that has done so. Compared to the other metropolitan areas in the United States, the region has a much larger percentage of its workers in higher wage production jobs, but the number of these jobs is rapidly decreasing. Alternatively, the area has a much lower concentration of jobs in the computer, engineering, life sciences, and arts and entertainment fields. Compared to both Ohio and the nation as a whole, the Youngstown-Warren region is lagging behind in the occupational clusters associated with creative workers and the emerging knowledge-based economy. This may account for the growing gap between the rising average wages in the United States versus the stagnant wage levels in the Youngstown-Warren region.

As a percentage of the population, the Youngstown-Warren area has a smaller percentage of residents with associates, bachelors, and graduate degrees when compared to the neighboring communities of Akron, Cleveland, and Pittsburgh, as well as the United States as a whole. In 2002, the four most numerous associates degrees awarded in the region were in the fields of information technology, business & marketing, electrical engineering technology, and computer programming. The four most numerous bachelors awarded were in the fields of business, education, biological & biomedical sciences, followed by engineering. The four most numerous

masters degrees awarded were in the fields of education, business administration, counseling, and engineering.

The publications originating from the Youngstown-Warren region are mainly concentrated in the fields of chemistry, medicine, and physics. Publications from engineering researchers and companies make up a very small percentage of the total number of publications. The yearly number of patents issued in the Youngstown-Warren area decreased by 30% from the early 70s through the 90s. However, in the past five years, the annual number of patents is re-approaching the numbers from the 1970s. Manufacturing companies are the dominant source of these patents.

One example of a possible strategy for industrial development in the Youngstown-Warren MSA using the findings from this paper is targeting the further development of a chemical industry. With data on the regional educational output, universities there produce about seventy graduates per year with bachelors and masters degrees in chemistry, increasing the skill base of the local workforce that can be employed by potential businesses in the chemistry field. Additionally, chemistry departments in local universities constitute a large number of academic publications, indicating that some novel work is being done inside the region. Only a few local industries specialize in patent production in the chemical industry. The location quotients in the region for chemical engineers and chemists are not that high, which seems to indicate that there may be a disconnect in the employment pipeline of educating workers and employing workers, so students in the field from the region depart after graduation. Other metropolitan statistical areas in close proximity such as Akron, Cleveland, and Pittsburgh have stronger concentrations of employees in the chemistry industry, so perhaps some spillovers are possible or collaboration can occur between universities in the Youngstown-Warren region and industrial partners from nearby communities. Identifying the gaps between knowledge production and occupational opportunities is one way to use this information to develop strategies.

Some important questions for the business, political, and economic development leaders of the Youngstown-Warren CMSA may include the following:

- *Does the region have adequate programs or strategies to create and develop innovative companies, individuals, and institutions?*
- *Does the educational system provide the existing research and development base with the workforce required for the future growth of their companies?*
- *If the local universities are developing individuals in fields that are not well represented in the CMSA, what can be done to attract companies that will hire recent graduates in technical areas?*
- *Do collaborations exist among knowledge-producing companies and knowledge-producing institutions and between existing universities in the region?*
- *Does a dialogue exist between creative individuals and private sector leaders to discuss future collaboration?*
- *Does a current technology transfer infrastructure exist where universities, other institutions, and private companies can all attain grant writing, investment, legal, and business assistance?*
- *Do noticeable linkages exist between the stated needs of the private sector and all levels of the workforce and educational development systems in the region?*

This report has shown to a varying degree the existing economy and workforce, the educational output, and the knowledge generation of the Youngstown-Warren region. By assessing the

connections between these components, certain strengths and weaknesses can be discovered. The recommendations contained within this report may help in reorienting the region towards more participation in the growing knowledge-based economy. Perhaps this report will contribute to the dialogue between researchers, economic developers, community leaders, and public and private institutions to build dynamic partnerships to advance the economy of the Youngstown-Warren region.

Appendix – Recommendations for the Youngstown-Warren Region

A few possible ideas to enhance the economic development of the Youngstown-Warren CSMA are listed for consideration:

UNIVERSITY GROWTH

- Many of the universities in the region are primarily teaching institutions that have been developing additional research opportunities over the past decade. Perhaps as older faculty retire, a new emphasis can be placed on hiring faculty that have experience in entrepreneurship and technology transfer, in addition to teaching and scholarly research. Maybe **university development funds or private donations can be used to develop endowed chairs for “research, development, and entrepreneurship” at local universities.** One program that can be emulated for its ability to attract a highly skilled research workforce is the Georgia Research Alliance (www.gra.org). Their Eminent Scholars program provides not only the funds for each researcher’s salary, but also provides money for laboratory equipment to be used at the discretion of each researcher. Individuals can be sought to complement academic departments that already have high levels of scholarship and graduate programs. At Youngstown State for example, new faculty can be sought who specialize in both chemistry, physics, or materials engineering research and have experience in technology transfer. If investing in this type of program creates start-up businesses, then graduates of local universities can be used as a source of skilled labor. Programs should be created to invest heavily in human capital to create pools of scientific entrepreneurs to exploit knowledge.
- **Strengthen YSU graduate research programs, especially in engineering** and encourage additional collaboration between existing industry, research firms, and universities in the areas of applied technology.
- Right now, the Williamson School of Business at Youngstown State is looking to build a new building by the end of the decade. Perhaps some of **the building design can include space for business incubation.** Having start-up companies on campus may add to the entrepreneurial atmosphere on campus, provide employment opportunities for students and graduates, and can even act as a steppingstone to the Youngstown Business Incubator located downtown.

ACCESS TO RESOURCES

- **Develop a regional organization that can facilitate a dialogue between a diverse collection of researchers, local institutions, and all interested individuals,** in order to develop collaborative efforts and assess the needs of local researchers. Encourage connections within the research community.
- **Create incentive-based programs to motivate individuals within the region to attain more education.** Degree attainment and educational access is a key criterion that knowledge-based companies and other industries use to examine the workforce skills of a potential labor pool. Developing a stronger workforce by strengthening the education system is a long-term project that needs to be continually reinforced by local community leaders.

SOCIAL NETWORKS

- Communicate with the individuals and institutions in this report to determine if any of their technologies are marketable. Perhaps **if individuals in the research and development community have needs, multi-institutional relationships from the private and public sector can pool resources**. For example, if one university does not have the resources to hire a lawyer who specializes in technology transfer, both the university and the city can provide funds for the hiring.
- Recent downsizing at innovation-producing establishments such as Delphi Electric may create a highly skilled labor force with extensive knowledge of certain fields and markets with no immediate employment. Perhaps some of the engineers who chose to remain in the region can be mobilized to form new ventures or be advisors for other firms. **Collaborate with recently retired or laid-off employees to discuss future opportunities for new or existing local companies.**
- **Contact the super-creative individuals in this report and solicit their opinions on how to develop the research community in the region.** These individuals may have specialized needs that local leaders can address.

MARKETING AND MEASUREMENT

- **Include some information on the knowledge-producing components of the Youngstown-Warren CMSA as a central component of the Regional Chamber's website.** Perhaps doing so may provide some high-tech components to the marketing of the region or help to develop the entrepreneurial culture in the area.
- **Continually monitor the innovational development, adaptation of information technology, and the needs of manufacturing firms** in the area. Perhaps local and state entities can provide technology assistance for manufacturing processes and workforce development.
- **Request that local economic development organizations continually monitor the metrics used in this report**, including information on patents, publications, degree conferment, and creative individuals in the area.

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