i-ACES Vol. 1 No. 1 (2014)
Inquiry in ACES: An Undergraduate Research Journal
Special Edition: Research Apprentice Program 2014
College of Agricultural, Consumer and Environmental Sciences
University of Illinois at Urbana-Champaign

i-ACES
{inquiry-ACES: Highlights of Undergraduate Research in ACES}

Examining Differences between Metropolitan Manufacturing-Dependent Counties and Metropolitan Service-Dependent Counties across the Midwest

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ARTICLE INFO

Article history:
Received 30 July 2014
Accepted 30 September 2014

Keywords: metropolitan, manufacturing-dependent counties, service-dependent counties, difference in means, linear regression

ABSTRACT

Manufacturing outperforms any other sector in the United States and accounts for more than two thirds of company-performed domestic research as well as development spending. Without the manufacturing sector, the U.S. economy would lose innovation ability and living standards would grow more slowly. The objectives of this study are to examine the characteristics of metropolitan manufacturing-dependent counties across the Midwest and determine any significant differences between metropolitan manufacturing-dependent and metropolitan service-dependent counties. Data was collected from a wide variety of sources, such as government agencies, and placed within three categories (education, economic, and labor) for Illinois, Indiana, Michigan, Ohio, and Wisconsin. Means were then calculated for each variable, followed by standard deviations. T-tests were completed for each variable to determine any differences in the calculated means between metropolitan manufacturing-dependent and metropolitan service-dependent counties. The t-tests showed no significant difference, so a linear regression test was run. Two variables, percentage of persons 25 years and older with a Bachelor's degree or higher and manufacturing type, had a p-value less than 0.15. Three variables, poverty rate (2013), people unemployed, and job growth (2006-2011), had a p-value less than 0.20. Each p-value showed there was a relationship between those specific variables and the economic type of that county.

INTRODUCTION

At the end of World War II, the United States' manufacturing sector represented over one quarter of the Gross Domestic Product (GDP). Today, manufacturing counts for less than 12% (Dunn, 2012). According to the Bureau of Labor Statistics, there were 14,782,000 manufacturing jobs in the United States in 1950. In 2010, there were only 11,565,000 manufacturing jobs (Bureau of Labor Statistics). The decline of manufacturing employment has also reduced the total labor force of manufacturing, which was 8% in 2010. Manufacturing employment was 27% in 1950 (Dunn, 2012).

Manufacturing outperforms any other sector in the United States and accounts for more than two thirds of company-performed domestic research as well as development spending. Employees in manufacturing receive about 8% more money in wages per week than any other industry's employees. Over a third of all U.S. engineers work in the manufacturing sector (Wial, 2012). Not only does manufacturing provide high-wage jobs, but it also is the major source of commercial innovation for the service sector, it contributes to reducing the U.S.'s trade deficit, and it contributes to environmental sustainability (Helper, Krueger, and Wial, 2012). Without the manufacturing sector, the U.S. economy would lose innovation ability and living standards would grow more slowly. American wages are reduced when there is a loss in manufacturing jobs, harming especially those workers at the bottom of the economic ladder (Wial, 2012).

Since the 1980s, deindustrialization has been associated with the spread of poverty across the Midwest. Higher rates of poverty are being found in the Southwest, Northeast, Pacific, and Midwest than in the past years. Household income inequality was constant from about 1967 to 1980, until inequality began in earnest. Labor markets in the 1980s shifted from goods producing industries into technical service and low-wage industries, meaning high-wage job opportunities for low-skilled workers were lost, and college graduates were hired for the low-wage and technical service industries. Once the labor markets began to shift to the technical-service jobs, income inequality started to become unstable (USDA ERS, 2014).

According to economists Martha Olney, at the University of California at Berkeley, and Aaron Pacitti, at Siena College, the economy of the United States is slower to recover jobs due to the fact that it has shifted to a higher dependence on people "doing things," rather than "making things" (Olney and Pacitti, 2014). Services in the United States have been preparing the country for the intersection of American manufacturing with service. American manufacturers can increase demand for goods that technology now enhances with service (McCullough, 2012).

The objectives of this study are to examine the characteristics of metropolitan manufacturing-dependent counties across the Midwest and to determine if there are any significant differences between metropolitan manufacturing-dependent and metropolitan service-dependent counties. Before collecting data for this project, research on past studies was discovered.

LITERATURE REVIEW

Adrian Esparza (1990) has studied the manufacturing decline at sub-state scale of the Midwest region of the United States through analyzing various factors, such as city size and location and their influence in the decline of manufacturing (Esparza, 1990). Large declines were found especially in the states of Illinois, Indiana, Michigan, and Ohio. In 1970, these four states accounted for over 23 percent of the manufacturing labor force. By 1987, the percentage had dropped to 19 percent (Agnew, 1987).

National and regional manufacturing movement can be attributed to a variety of things, such as least-cost locations. Variations in labor and production technology are expected in sub-state areas, meaning requirements for firms and their characteristics of labor can vary significantly in different areas. State's different sized cities may create a more complex industry of manufacturing. For example, smaller areas may specialize only in a single industry. Locations adjacent to major metropolitan areas also can add to the industrial differences between cities and sub-state areas.

Esparza discovered declines in manufacturing across the nation, but the highest percentages were found in the Midwest. Both the national and regional declines could be due to international and interregional shifts of manufacturing. Patterns of manufacturing diffusion suggest there are points in time when cities that are closer to metropolitan centers reflects the industrial performance of that urban setting, and isolated areas may have different behaviors (Esparza, 1987).

Justin Pierce and Peter K. Schott (2012) examined a link between the United States' drop in manufacturing employment starting in 2001 and the change in the United States' trade policy with China that eliminated potential tariffs on Chinese imports. Pierce and Schott found a link between the decline and the United States granting Permanent Normal Trade Relations (PNTR) to China. United States imports from China have been subjected to low Normal Trade Relations (NTR) tariff rates since the 1980s. The low rates would then require annual renewals for China, and without renewal, import tariffs on Chinese goods would jump to higher non-NTR tariffs. With no possibility of sudden spikes in Chinese import tariffs, import competition was strengthened and United States employment growth was suppressed. The policy change gave a straightforward measure of its possible effect. This measure is called the "NTR gap," which is the difference between NTR tariff rates and non-NTR rates which could have risen if annual renewal had failed. The NTR-gap tests whether the employment loss in manufacturing industries with higher NTR gaps is larger after PNTR is instituted.

Pierce and Schott found that industries with higher NTR gaps experience larger employment declines with disproportionate increases in United States imports from China, and the count of United States-China importer-exporter pairs. This study demonstrates the

pattern of employment loss in the United States, which correlates to the policy change (Piece and Schott, 2012).

Martha Olney and Aaron Pacitti have studied recoveries from recessions in the United States. They believe the most current recession has taken longer to recover from slower economic growth, not from a longer or deeper recessions. Using graphs created from the Calculated Risk blog, Olney and Pacitti show slower growth with longer recoveries in economies from a shift from production of goods into services.

Using past recessions in the United States, Olney and Pacitti cover the pace of recoveries in different economies. The months it took to recover between downturns were determined with the recession length, or by the National Bureau of Economic Research. Employment was found to increase along with recession length since 1980. Over the same months studied, an increasing amount of the economy was found to be services. Some economists say the economy is now "deindustrialized," which is what is causing a slower economic recovery.

Olney and Pacitti found recoveries from recessions take a longer period of time due to higher shares of services. Services not being able to be produced at the rate of consumer demand and services not being able to be exported are two ideas as to why it takes longer for a service economy to recover. Their study indicated that service can only increase when domestic demand also increases (Olney and Pacitti, 2012). This paper analyzes the characteristics of manufacturing-dependent economies at the county-level in the Midwest region of the United States and compares them with those of service-dependent ones.

METHODOLOGY

Data that was collected is from a wide variety of sources, including the United States Department of Agriculture (Economic Research Service), U.S. Census Bureau, U.S. Department of Labor (Bureau of Labor Statistics), and the U.S. Department of Commerce (Bureau of Economic Analysis). Variables collected were from metropolitan counties in Illinois, Indiana, Michigan, Ohio, and Wisconsin that were manufacturing-dependent and service-dependent. Manufacturing-dependent counties are counties that had manufacturing account for 25 percent or more of total earnings from 1998-2000. Service-dependent counties have an average of 45 percent or more of total earnings from 1998-2000 in retail trade, finance, insurance, real estate, and services (USDA ERS County Typology Codes). This study contained 123 counties, with 22 service-dependent counties and 101 manufacturing-dependent counties, respectively. Once it was determined which counties were service-dependent and manufacturing-dependent counties within the five states, data was able to be collected.

All variables collected are placed within the following categories; economic, labor, education. Economic variables consisted of: rural urban continuum code, manufacturing type (ex: fabricated metal product manufacturing, food manufacturing, chemical manufacturing, etc.), per capita income (2012), net earnings from 2002-2012 for each county, and poverty rate. Poverty rates give the percentage of people who were living in poverty in a calendar year. Poverty is if a family's total income is less than the threshold set by family size. The 2013 poverty threshold for a family of four was $24,028 (United States Census Bureau). Labor variables included: the annual average unemployment rate of 2013, and job growth in each county from 2006 to 2011. Unemployment shows the count of people without work in each county, whereas an unemployment rate would show the percentages of people out of work. Education variables were: the percentages of people over 25 years old that was a high school graduate or higher from 2008-2012 and the percentages of people over 25 years old that had a Bachelor's degree or higher from 2008-2012. Altogether, there were 10 variables.

Means for manufacturing-dependent and service-dependent economies were calculated for each variable within Excel. Standard deviations were also calculated to show the range of the observations for each variable. After reporting standard deviations, I tested for differences in variance with an F-test for each variable. The F-test compares two sample variances and checks whether or not they are equal. From the F-test results, it can be determined what appropriate t-test should be used. A t-test can help one understand if the means of two data samples are different than the original hypothesis of equality (Stat Trek). T-tests completed for this study were used to show whether there were differences in the calculated means of the variables for

metropolitan manufacturing-dependent and metropolitan service-dependent counties.

Hypotheses were created about the differences between manufacturing-dependent and service-dependent counties for each variable. It was hypothesized that service-dependent counties would have a higher poverty rate due to there not being as many jobs for low-skilled workers, which is likely to increase poverty rates in service economies. Manufacturing-dependent counties tend to have bigger industries with a broader variety of manufacturing types, which would increase the likelihood of manufacturing-dependent counties to have a larger net income as well as net earnings. Service-dependent counties may have a higher rate of people that graduated high school and people that have a Bachelor's degree or higher since the service industry requires higher educated workers, but people in service-dependent counties are more likely to be already poor, which could create a cycle of poverty and impact education levels. Therefore, no hypotheses were made on the education variables. It was also hypothesized that service-dependent counties would have a higher unemployment rate due to there being a certain level of education needed to work within the service industry. Job growth is more likely to be higher in manufacturing-dependent counties because based on literature; manufacturing can create jobs based on demand, while service creates jobs based on market.

FINDINGS

First, the descriptive statistics of the data will be discussed (please refer to Tables 1, 2, and 3). One variable that had a difference between means in the economic category was the per capita income. The mean calculated for per capita income in service-dependent counties was $38,917.15. In manufacturing-dependent counties, the calculated mean was slightly higher at $39,423.78. Another variable that had a difference in means within the economic category was poverty rate, which was 13.1% in service-dependent counties and 12.8% in manufacturing-dependent economies. The only variable with difference between means in the labor category was the amount of people unemployed. Service-dependent counties had 10,146 people as the mean, and manufacturing-dependent counties had 9,702 people. Table 4 reports that over 36% had a RUCC of 1, which means that a relatively large share of the counties in the study have a population greater than or equal to 1 million people. Over 80% of all manufacturing-dependent counties had a fabricated metal product manufacturing type (Table 5).

Table 1
Economic Characteristics by Metropolitan Counties in the Midwest Region.

Economic Variables	Service-Dependent Counties N=22	Manufacturing-Dependent Counties N=101
RUCC	2.1 (1.214)	2.1 (1.190)
Manufacturing Type	2.1 (2.354)	2.0 (2.329)
Per Capita Income (2012)	$38,917.15 (6088.214)	$39,423.78 (6574.981)
Net Earnings (2002-2012)	2.6% (0.016)	2.7% (0.015)
Poverty Rate	13.1% (0.042)	12.8% (0.042)

Table 2
Labor Characteristics of Metropolitan Counties of the Midwest.

Labor Variables	Service-Dependent Counties N=22	Manufacturing-Dependent Counties N=101
Annual Average Unemployment Rate	7.8% (0.014)	7.8% (0.015)
People Unemployed	10146.2 (25974.421)	9702 (24834.052)
Job Growth	1.5% (0.016)	1.5% (0.016)

Table 3
Education Characteristics of Metropolitan Counties of the Midwest.

Education Variables	Service-Dependent Counties N=22	Manufacturing-Dependent Counties N=101
Percentage of High School Graduates +25 2008-2012	88.8% (0.029)	89.0% (0.030)
Percentage of People +25 Bachelor's Degree or higher	22.3% (0.085)	22.7% (0.086)

Table 4
Frequency of Rural Urban Continuum Code.

Number of RUCC	Freq-uency	Perce-ntage	Service depen-dent	Manufac-turing-dependent
1-Counties in metro areas of population ≥ 1 million people	45	36.6%	13	32
2-Counties in metro areas of 250,000 to 1 million people	35	28.5%	6	29
3-Counties in metro areas < 250,000 people	34	27.6%	3	31
4-Urban population ≥ 20,000 people, adjacent to metro area	4	3.3%	0	4
5-Urban population ≥ people, not adjacent to metro area	0	0.0%	0	0
6-Urban population 2,500-19,999, adjacent to metro area	5	4.1%	0	5
7-Urban population 2,500-19,999, not adjacent to metro area	0	0.0%	0	0

When the data from the service-dependent counties was compared to the data from manufacturing-dependent counties, no significant differences were found. In order to find the statistical relationship of all variables to the economic type, a linear regression test was run. Two variables were found significant with a p-value less than 0.15, percentage of persons 25 years and older with a Bachelor's degree or higher and manufacturing type (see Table 6). Percentage of people 25 years and older were found with a coefficient of -1.437, indicating a negative relationship with the economic type. Manufacturing type also had a negative coefficient of -0.023, again showing the negative association between manufacturing type and the economic type of the counties. Three variables were significant with a p-value less than 0.20, poverty rate (2013), people unemployed, and job growth (2006-2011). Poverty rate was found with a coefficient of -1.654. People unemployed were found with a small coefficient of -2.01442E-06. Both poverty rate and people unemployed are negatively associated with the economic types. Lastly, job growth was found with a coefficient of 3.083, indicating a positive relationship with the economic type of the counties. These results are presented in Table 7.

Table 5
Frequency of Manufacturing Type.

Manufacturing Type	Frequency	Percentage
1=Fabricated Metal Product Manufacturing	99	80.5%
2=Printing and Related Support Activities	2	1.6%
3=Transportation Equipment Manufacturing	2	1.6%
4=Miscellaneous Manufacturing	1	0.8%
5=Machinery Manufacturing	2	1.6%
6=Wood Product Manufacturing	2	1.6%
7=Food Manufacturing	3	2.4%
8=No Dominant Manufacturing	12	9.8%

Table 6
T-test results with p-value less than 0.15.

	Coefficients	Standard Error	t-Stat	P-value
Percentage of Persons +25 with Bachelor's degree or higher	-1.437	0.813	-1.768	0.080
Manufacturing Type	-0.023	0.014	-1.609	0.110

Although there were no significant differences in this study, there were results that were consistent with the hypotheses made in the beginning of the study. Manufacturing-dependent counties were found to have a positive relationship with job growth, just as hypothesized. Poverty rate had a negative relationship with manufacturing-dependent counties, as hypothesized. A negative relationship also appeared with manufacturing-dependent counties for people 25 years and older with a Bachelor's degree or higher, when there was no hypothesis made for the education variables.

Table 7
T-test results with p-value less than 0.20.

	Coefficients	Standard Error	t-Stat	P-value
Poverty Rate	-1.654	1.286	-1.286	0.200
People Unemployed	-2.014E-06	1.536 E-06	-1.312	0.1924
Job Growth	3.083	2.197	1.403	0.1634

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Study Limitations

Several issues were faced during this study that could not be adequately addressed. In the sample, there was a large gap in the amount of service-dependent counties and manufacturing-dependent counties, which could have influenced results. Another factor could have been there being one main manufacturing type for the counties: fabricated metal product manufacturing. A linear regression test is also not the most appropriate test for count data, considering that the economic types, service and manufacturing, were represented by 0 and 1, respectively. A binary logit or probit regression is a more appropriate choice and should be used for more accurate statistical results.

Additional research should be conducted in the future for additional insights. A larger sample size should be collected, possibly including all the Midwest state counties and Southern state counties. Additional variables should also be included, such as race and ethnicity, which gives more information on the demographics of each county and its influence on culture, population, location.

CONCLUSIONS

In the United States today, manufacturing counts for less than 12% of its GDP. The spread of poverty across the Midwest can date back to the beginning of deindustrialization in the 1980s. The objectives of this study was to examine the characteristics of metropolitan manufacturing-dependent counties across the Midwest, as well as determine if there are any significant differences between metropolitan manufacturing-dependent and metropolitan service-dependent counties. After calculating the respected means and standard deviations of the ten variables, f-tests and t-tests were conducted to compare variance and determine any differences in each calculated mean, respectively. T-test results showed no significant difference. A linear regression test was, then, run for all variables to find statistical relationships of each variable to the economic type of that county. Two variables, percentage of persons 25 years and older with a Bachelor's degree or higher and manufacturing type, had a p-value less than 0.15. Three variables, poverty rate (2013), people unemployed, and job growth (2006-2011), had a p-value less than 0.20. Each p-value showed there was a relationship between those specific variables and the economic type of that county. Manufacturing type, percentage of people 25 years and older with a bachelor's degree or higher, poverty rate, and people unemployed had negative relationships to the economic type. Job growth was found with a positive relationship with the economic type. Additional research with different factors, such as race and ethnicity, should be conducted if this project were to be restudied. People living in metropolitan manufacturing-dependent counties and metropolitan service-dependent counties could benefit from this study by learning about different characteristics about their county that can affect them. This has policy implications for both the public and private sectors. Employments in manufacturing-dependent and service-dependent counties differ due to each respective economic type and the different roles and impacts they have on the economy. Proper legislation and infrastructure is required to ensure economic growth and stability.

REFERENCES

Agnew, J. (Ed.). (1987). The United States in the world-economy: A regional geography (Vol. 1). CUP Archive.

Bureau of Labor Statistics, http://www.bls.gov.

Dunn Jr, J.H. (2012). The Decline of Manufacturing In The United States and Its Impact On Income Inequality. Journal of Applied Business Research, 28(5), 995-1000.

Esparza, A. (1990). Manufacturing decline and technology lags in nonmetropolitan Illinois. Growth and Change, 21(4), 19-32.

Helper, S., Krueger, T., & Wial, H. (2012). Why Does Manufacturing Matter? Which Manufacturing Matters?. Metropolitan Policy Program paper, 1-53.

McCullough, Natalie. (2012). Services, Not

Manufacturing, Will Revive the U.S. Workforce. Forbes.

Pierce, J. R., & Schott, P. K. (2012). The surprisingly swift decline of US manufacturing employment (No. w18655). National Bureau of Economic Research.

Olney, M. L., & Pacitti, A. (2013). Goods, Services, and the Pace of Economic Recovery. University of California, Berkeley, and Siena College, March, http://emlab. berkeley. edu/~ olney/services. pdf.

Stat Trek – Hypothesis Test: Difference Between Means, http://stattrek.com/hypothesis-test/difference-in-means.aspx.

United States Census Bureau, Poverty, https://www.census.gov/hhes/www/poverty/methods/definitions.html.

USDA ERS – County Typology Codes http://www.ers.usda.gov/data-products/county-typologycodes/documentation.aspx#.U7wYl1eiW8A.

USDA ERS – Rural Poverty and Well-being, Geography of Poverty, http://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty.aspx#.U7XGHrGmU20.

Wial, Howard. (2012). Manufacturing is Special: Why America Needs its Makers. Brookings: The Atlantic. http://www.theatlantic.com/business/archive/2012/02/manufacturing-is-special-why-america-needs-its-makers/252796.

This special edition of *iACES* is composed of articles written by high school students enrolled in the College of ACES Research Apprentice Program (RAP), University of Illinois. We gratefully acknowledge the many faculty, staff, and graduate student mentors who account for the success of RAP, its Director, Dr. Jesse Thompson, as well as its generous sponsors. Further appreciation extends to Emily Mayhew for her editorial assistance.

[i] The author thanks Anne Gilot and Dr. J. Allen-Smith for their mentorship and the Department of Agricultural and Consumer Economics for support in conducting this research.