Regional Variation in the Location Choice of Goods- and Service-Producing Industries

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Overview

In this chapter we examine the location choice variations of goods- and service-producing industries in metro, metro-adjacent and non-metro, non-adjacent regions. Previous studies on location choice either have focused on regions or industries. The combination of multi-industry and multiple regions will improve the understanding of location choice decisions and enhance the options available for the policy makers to target multiple industries. A Conditional Logit Model (CLM) is used to model the location choice decisions in regions using establishment, industry, and community characteristics. Marginal effects of establishment, industry, and community characteristics are estimated and compared across industries and regions.

This study was done in the State of Kansas. The 105 counties in Kansas were classified as metro (17 metro counties), metro-adjacent (21 metro-adjacent counties), and non-metro non-adjacent (67 non-metro counties). The service- producing industries included in the study are services; retail trade; wholesale trade; finance, insurance, and real estate; and transportation, communications, and public utilities. Manufacturing, construction and agricultural services industries are grouped as goods-producing industries. Industries were identified at a four digit-

Standard Industry Classification (SIC). About 339 service-producing and 401 goods-producing industries were included in the study.

The community/regional characteristics included in the study were population density, labor quality, county employment growth, and a proxy measure of remoteness (distance to a metro county). Average industry establishment size, industry research and development expenditures, industry clustering, vertical integration, national growth rate of industry and labor intensity are the industry characteristics that were included in the model. Establishment characteristics included age of the establishment, national employment growth at a three-digit SIC, urbanization of economies, and total industry employment in the regional economy at a two-digit SIC. Our interest is in determining how an identified variable influences the location choice of firms and the attractiveness of regions for a particular industry.

1.0 Introduction

The urban/rural – metro/non-metro dichotomy often is used as the basis for measuring differential economic performance. While empirical studies have shown that metro areas consistently outperform non-metro areas, it is not yet known whether the rapid economic growth in late 20^{th} century has significantly altered the economic trajectory of rural areas. However, it is commonly believed that recent technological advancements together with improved transportation systems have had impacts on non-metro area economic performance. Technological change leads to innovation with the likely result being better economic performance. Schumpeter (1939) argued that technological change is an important element in economic growth.

Exogenous growth theory illustrates that spillovers from other regions can foster local economic growth. These spillovers are the industry-specific externalities that are external to a region. These externalities include, but not limited to, product and process innovations. The link between regions or locations and source of technical change is widely acknowledged. Locations closer to the sources of technological advancements are likely to benefit from spillovers that result from technical change (Cassar and Nicolini, 2003). Research parks and businesses that specialize in relatively high technology are typically located close to universities and centers of innovation (Anselin, et al., 1997). Empirical evidence supports the notion that technological spillovers contribute to economic growth (Anselin et al. 1997).

The availability of advanced telecommunication infrastructure is increasingly a key factor in location choice decisions. Malecki (2001) found that telecommunication infrastructure was among the top five criteria used in industry location decisions, while Lawless and Gore (1999) reported it was the leading criteria in location decisions. Given recent technological advancements in telecommunication industries, and the cost advantages associated with non-metro economies, traditional goods- and service-producing industries have drawn renewed attention as a possible source for further improving rural economic conditions. It is reasonable to hypothesize that advances in communication technology and improved transportation systems have altered the location of the goods- and service-producing industries across metro and non-metro regions. Some industries may have move away from metro areas to non-metro areas, while industries in non-metro areas may have shifted their businesses to metro areas.

There is a renewed interest among economists to examine the impacts of the location choices of firms in the context of technological advancements in telecommunication industries. In this chapter, we examine the location choices of goods- and service-producing industry firms (including existing firms) in a metro/non-metro continuum in 1990, 1996 and 2002, using location, industry, and establishment characteristics. At the start of the 1990s, the U.S. economy had been in a relatively long economic recession, finally ending in 1991. From 1992, the economy started to take off, and by mid 1990s the economy's performance was at its peak. Economic performance again started to decline in 2000, and by 2002, the economy once again was in a short-term recession. By examining the location choice patterns of firms in three distinct time periods and across three different regions we may gain insight into the impacts of general economic conditions on regional economies and the factors that influence firm location choice decisions during times of recession and economic expansion.

The remaining sections of this chapter are structured as follows: in the next section we review the literature on modeling industry location choices. We then specify the empirical model and present a regional classification system. In the following section, the data and variables used in this study are discussed. In the final two sections, the empirical estimation and results, and conclusions and policy implications are presented.

2.0 Modeling Industry Location Choices

Modeling industrial location choices is a complex undertaking. Debate about the appropriate theoretical and empirical modeling procedures is far from over. Selecting the best location for a firm's business operation depends on many implicit and explicit factors, particularly in the context of a global marketplace. The objective of a firm is driven by its competitive strategy (the customer's needs the firm intends to satisfy) and returns to investment. There are an array of factors that influence a firm's location choice apart from a firm's investment, technology, and demand for the product. These factors include market accessibility, physical and telecommunication infrastructure, cost of inputs and other related services, and the incentives that are provided by state or local governments. From a modeler's point of view, it is important to determine which factors are crucial in influencing a firm's location choice decision.

The discrete nature of the outcome (selecting one location over other locations in the region) limits the use of conventional regression models. Binomial and multinomial models are commonly used discrete choice models. The decision being a rational choice process, the modeling can be guided by economic theory. Given the discrete nature of the choice decisions, count data models are commonly used in empirical studies.

2.1 Discrete Choice Models

The modeling of firm location choice begins with selecting from among regions wherein a firm chooses a particular location as its most desirable operating site. In choosing a particular location, there are location-specific factors that were attractive to the firm. From an empirical standpoint, we seek to answer several related questions: what were the key factors that influenced a firm's location choice decision? Given the location's characteristics, what is the likelihood of a similar firm selecting the same location? What was the discrete influence of specific characteristics from among a bundle of characteristics represented in a site? How general are these influences across different regions? These questions can be examined using discrete choice model (binomial or multinomial logit model).

For example, Probit or ordered probit (Basile et al., 2003), tobit (Devereux at el., 2003), logit or mutinomial logit (Gunther, at el., 1998), conditional logit (Guimaraes at el., 2000), negative binomial (Coughlin and Segev, 2000) and Poisson (Guimaraes at el., 2004) models are being used in this empirical work. Theoretical and empirical investigations continue, and are supported by advances in econometric techniques (Guimaraes at el., 2004). With more sophisticated computer power, large volumes of data and complex spatial dependency models are being applied.

2.2 Random Utility Maximization Models

An industry will seek a location within a region where it has the greatest competitive advantage or has potential to maximize expected profit. It is assumed that there are i = 1, 2, …, I industries, and the firms in those industries can choose to locate in j = 1, 2,…,J regions. Industry i has an expected profit in location j (π_{ij}) and an expected profit in location k (π_{ik}). Firms in the industry are likely to choose location j only if (π_{ij}) ≥ (π_{ik}). The expected profit of industry i in location j (π_{ij}) is assumed to be a linear function of industry, establishment, and regional characteristics (Z), estimated coefficients (α and β), and an industry-location specific error term (ε).

$$\pi_{ij} = f(\text{ind-char,est\_char,com\_char}). \tag{1}$$

$$\pi_{ij} = \alpha + \beta' Z + \varepsilon. \tag{2}$$

If the error terms in (2) are assumed to be independently and identically distributed according to the Weibull distribution, then the odds ratio of the probability of choosing location i over location j can be represented by a conditional logit (McFadden, 1974). McFadden's (1974) conditional logit distribution provides a basis for modeling industrial locations decisions. An indicator variable is used to identify firms in industry i choosing location j $(m_{ij} = 1)$ otherwise $(m_{ij} = 0)$. The probability of a firm in industry i choosing j is defined as p_{ij}^* and the probability of finding the firm at another location j is $(1 - p_{ij}^*)$.

3.0 Model and Regional Specifications

3.1 Conditional Logit Model

The Conditional Logit Model (CLM) has been considered to be superior among choice models, given its ability to accommodate alternative location choices, including the present location of existing firms. The merits of this model reside from its use of microeconomic theory in model development. The resulting econometric model is based on a random utility maximization framework. The choice characteristics are considered in modeling the location choice of firms rather than individual characteristics. In the conditional logit model, the individual establishment's industry location choices are modeled using industry, establishment, and community characteristics as explanatory variables.

If it is assumed that a firm's selection of a particular location is choice-specific rather than industry-specific, the conditional logit model is considered to be the more appropriate than a logit model (Green, 2000, p. 862). Using the conditional logit model approach described in Green (2000, p. 862), the probability for firm i choosing location j can be written as:

$$\pi_{ij}^{*} = \frac{\exp\{\alpha + \beta^{'} Z + \varepsilon\}}{\sum_{j=1}^{J} \exp\{\alpha + \beta^{'} Z + \varepsilon\}}, \tag{7}$$

and the probability of not choosing the location is:

$$1 - \pi_{ij}^{*} = \frac{\left(\sum_{j=1}^{J} \exp\{\alpha + \beta^{'} Z + \varepsilon\}\right) - \exp\{\alpha + \beta^{'} Z + \varepsilon\}}{\sum_{j=1}^{J} \exp\{\alpha + \beta^{'} Z + \varepsilon\}}. \tag{8}$$

Although the estimated parameters and their level of significance are important, it may not provide accurate information about specific variables' impacts on the probabilities of choosing one location against another. The marginal effect of a variable can be estimated by differentiating (7) with respect to the variable.

$$\frac{\partial \pi_{ij}^{*}}{\partial Z} = \frac{\exp\{\alpha + \beta^{'} Z + \varepsilon\}\beta^{'}}{\sum_{j=1}^{J} \exp\{\alpha + \beta^{'} Z + \varepsilon\}} - \frac{\exp\{\alpha + \beta^{'} Z + \varepsilon\}\beta^{'}}{(\sum_{j=1}^{J} \exp\{\alpha + \beta^{'} Z + \varepsilon\})^{2}}, \tag{11}$$

or

$$\frac{\partial \pi_{ij}^{*}}{\partial Z} = \left(\Omega(\alpha + \beta^{'} Z + \varepsilon)\right)\left(1 - \Omega(\alpha + \beta^{'} Z + \varepsilon)\right)\beta, \tag{12}$$

where $\left(\Omega(\alpha + \beta^{'} Z + \varepsilon)\right)$ is the probability density function of CLM.

3.2 Regional Specification

The U.S. Bureau of the Census uses a dichotomous system to classify geographic areas as Metropolitan Statistical Areas (MSA) and non-metropolitan areas. A metropolitan area is defined as a collection or one or more cities with a population greater than 50,000; all other areas are classified as non-metropolitan (Morrissey, 1987).

The counties that are in an MSA are considered metro counties (here designated as county type =1); counties that are immediately adjacent to metro counties are identified as metro-adjacent counties (county type =2); all other counties are classified as non-metro counties (county type =3). Applying this classification system to Kansas, there were seventeen metro counties, twenty-one metro-adjacent counties, and sixty-seven non-metro counties. Specific county designations are presented in Appendix I.

3.3 Industry Specification

In this study, industries are classified either as Goods-Producing or Service-Producing. All industry data is specific to a four-digit Standard Industry Classification (SIC), the most detailed industry-scale level in the SIC system. Industry counts are specific to the state of Kansas.

<u>Goods-Producing Industries</u>

Goods-Producing Industries include manufacturing, construction and agricultural services. A total of four hundred and one (401) industries are included in the goods-producing industry group. Appendix II presents the list of industries that were identified as goods-producing industries.

Service-Producing Industries

Service-Producing Industries include services; retail trade; wholesale trade; finance, insurance, and real estate; and transportation, communications, and public utilities. A total of three hundred and thirty-nine (339) industries constituted the service-producing industry category. Appendix III presents the list of industries that were identified as service-producing industries.

4.0 Data and Variables

The response and explanatory variables can be grouped into two categories. The first group of variables are specific to industries (either to the goods-producing industry or service-producing industry), and the other variables are common to both industries. The number of establishments in the region, average establishment size, industry clustering, and vertical integration are the variables included in the former category. Population density, quality of the labor force, and county employment growth rate are included in the latter group. The sources and description of data are presented in Table 1. Summary statistics for the goods-producing industry variables, service-producing industry variables, and the common variables are presented in Table 2, 3 and 4, respectively.

4.1 Sources and Description of Data

Kansas county-level establishment data were obtained from the U.S. Department of Labor, Bureau of Labor Statistics' Quarterly Census of Employment and Wages program (ES-

202) files for the period 1990 to 2002. The ES-202 data file tracks monthly employment and quarterly wages of all employers with employees eligible for unemployment insurance compensation. The response variable was the count of establishments that choose to locate in a particular county within a region (i.e. metro, metro-adjacent, non-metro). If a firm chose a county in a particular region, the location choice indicator variable for that county was assigned a value of one (1), and all the other counties in that region were assigned zero (0). If a firm had two branches in different counties, each was considered a separate business entity, creating two different establishment location choices. There were three groups of explanatory variables representing community/regional, industry, and establishment characteristics. All three groups of variables were used in all models to explain the location choice decision of firms in metro, metro-adjacent, and non-metro counties.

The location choice decisions were examined from 1990 to 2002 in all three regions for service-producing and good producing industries. However, the results reported here are for 1990, 1996 and 2002. Summary statistics for the data are presented in Table 2 and Table 3 for service-producing and goods-producing industries, respectively.

Population density (POP) was considered a potentially important variable in firm location decisions. Coughlin and Segev (2000) suggested that population density can be used as a proxy for either economic urbanization or for land costs. The population density variable was defined as:

$$\text{POP:}\frac{\text{Population of county}}{\text{County land area in square miles}}.$$

The quality of the labor force (QUAL) reflects the knowledge and skill level of the community. Firms are likely to move to locations where the required quality of labor is readily available. College educational attainment had been used as a proxy (Pigeon and Wray, 1999).

In this research, the percentage of workers in high-knowledge industries[1] was used as a proxy for quality of the labor force.

Average industry establishment size (SIZE) for industry i was estimated by summing county employment by industry and then dividing by total county establishments by industry. The average establishment size is an important variable that would indicate which types of establishments were most frequently found in a particular region. It was hypothesized that non-metro regions are attractive to smaller business establishments. Average establishment size was defined as:

$$\text{SIZE} = \frac{\text{Total county employment}}{\text{Total number of establishments}}.$$

The location quotient was used as a proxy measure of industry clustering (CLUS) within counties. The location quotient measures the level of employment of a county industry sector compared to the national industry sector employment. The location quotient measures the relative share of industry employment to national share of employment in that industry. Industry clustering is defined as:

$$\text{CLUS} = \frac{\dfrac{\text{County industry employment}}{\text{Total county employment}}}{\dfrac{\text{National industry employment}}{\text{Total National employment}}}.$$

Vertical integration (INT) measures both upstream and downstream relationships. These inter- and intra-industry relationships are likely to affect availability of inputs for firms' production processes. Vertical integration may arise for a variety of reasons (improved efficiency, technological economies, etc.). Some of the potential disadvantages associated with

[1] An industry is identified as a high-knowledge industry if the industry has more than 40 percent of occupations in managerial, professional and technical positions (Beck, 1992).

vertical integration are the creation of barriers to entry and expansion of competitors (Waterson, 1993), which may have implications for new establishment entry. Regional social accounting matrices were constructed from the IMPLAN economic modeling system (MIG, Inc., 1999), and used to track inter-industry transactions by industry sector. The indirect multiplier, which measures the strength of inter-industry linkages, was used as a proxy for vertical integration.

Growth rates of county employment (CEMP) represent local economic growth conditions for existing industries. Conditions can be either favorable or unfavorable depending on the relative industry employment share in the county. County employment growth was estimated using total employment in all industries in a county that were reported in the ES-202 data files.

$$\text{CEMP}=\left(\frac{\text{County Employment}_{t+1}-\text{County Employment}_{t}}{\text{County Employment}_{t}}\right)*100\,.$$

The presence of an interstate highway (HIGHWAY) has long been recognized as an important factor is location choice decisions. Interstate highways are an important element in the larger multi-model transportation system that links urban centers and various other transportation modes. The highway variable is an indicator variable (1 if present, 0 otherwise). The presence/absence of interstate highway in a county is reported in Appendix I.

Urbanization (URBA) promotes regional economic growth. Indicator variables were used based on the Urban Influence Code (Coughlin and Segev, 2000). A modified Urban Influence Code (Beale code) was used to represent the rural-urban continuum ranging from one to nine.[2] The value one (1) indicated the most urban and nine (9) was the most rural. Definitions for the Urban Influence Code used here are presented in Appendix IV.

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[2] In the original 1993 coding system, metropolitan counties were defined by a population of one million or more. This criterion was scaled back to 400,000 for this research due to the paucity of such counties in Kansas.

Empirical Estimation and Results

The model described in equation (7) was estimated using a maximum likelihood estimator. The Multinomial Discrete Choice procedure was chosen. The location choice of an industry (e.g. goods-producing) in a year (e.g. 1990) for a particular region (e.g. metro) was estimated independently from other industries, years, and regions. The error term in the model was assumed to be independent and identical with a type I Extreme Value (or Gumbel) distribution.

The coefficients from the CLM for goods-producing industries and the marginal effects of the variables on the location choice of firms in metro, metro-adjacent, and non-metro regions are presented in Tables 5 and 6. The results for service-producing industries are presented in Tables 7 and 8.

Most of the coefficient estimates (Table 5) are significantly different from zero. The marginal impacts (Table 6) of population density, quality of the labor, presence of an interstate highway, and urbanization on the probability of a goods-producing firm choosing the region were generally quite small, except for presence of interstate highway and urbanization. For example, the presence of an interstate highway was likely to increase the probability of a goods-producing firm choosing a metro county location by about 3.7 percent in 1990, 7.8 percent in 1996, and 5.5 percent in 2002. The relatively higher marginal impact in 1996 suggests that as the economy expands, highways (and, possibly, other infrastructure) contribute more to economic growth in the metro region by facilitating movement of people and goods. On the other hand, if a region became more urbanized (a one unit reduction in the urbanization code), the probability of a goods-producing industry firm choosing the metro region increased by about

7 percent. Goods-producing industries appear to be more attracted to urban regions. This conclusion is reinforced by the positive, though small impact of population density, which was one of the criteria used in determining the urbanization code.

In 1996 and 2002, the average establishment size had a positive impact on the metro region goods-producing industry, and the marginal effect was larger in 2002. While industry vertical integration had a negative impact on the location choice of goods-producing industry firms in the metro region in 1990 and 1996, it was insignificant in 2002. The decreasing marginal impact over time may show that vertical integration has become increasingly important more recently. Industry clustering had a positive impact on the metro region goods-producing industry in 1990, where a one unit increase in clustering was likely to increase the probability of a goods-producing firm choosing the metro region county by about 3.6 percent. By 2002, however, the impact was negative. While this may indicate market saturation for goods-producing industries, it also could suggest a general weakening of goods-producing-type employment in the face of rising global competition. Interestingly, while county employment growth had a negative impact on the metro region goods-producing industries in 1990, its impact was positive in 1996 and 2002. The marginal effect increased over the three periods, indicating general county employment growth was becoming increasingly important in firm location decisions.

The quality of the labor force had a consistently negative impact on goods-producing industry in metro-adjacent and non-metro regions across the study periods. As the quality of the labor force increases, it may simply indicate rising labor costs. Alternatively, it might be speculated that a process is set in motion leading to the transformation of the economy from traditional goods-producing activities to a relatively greater service orientation.

Average establishment size had a positive impact on goods-producing industries in the metro-adjacent region in 1990, but otherwise insignificant, and insignificant for all years in the non-metro region. The marginal effects of other variables on the probabilities of goods-producing industries choosing a location in either the metro-adjacent or non-metro regions were generally insignificant, except for clustering, vertical integration, and urbanization. Among the factors that positively influence location choice decisions, industry clustering in the metro-adjacent region consistently moved from a negative to a positive influence until, by 2002, it increased the probability of location by about 2.5 percent. Industry vertical integration had a negative impact on the location choice of goods-producing industry firms in the metro-adjacent and non-metro regions. This may indicate that firms could be internalizing backward or forward linkages, leading to fewer independent firms in the region.

The coefficients from the CLM for service-producing industries (Table 7) show that population density, industry vertical integration, and urbanization were significant in the modeling estimation and had positive impacts (Table 8) on the location choice of firms in the metro, metro-adjacent, and non-metro regions. Quality of the labor force had a positive effect only in metro region. In the other regions, the impact was negative for all three periods. Presence of an interstate highway had a positive impact in the metro and non-metro regions, but in the metro-adjacent region, the impact was positive in 1990 and negative in 1996. County employment growth rate had a negative impact in the metro region in 1990 and 1996. The impact was positive in 2002.

In general marginal effects of the variables for service-producing industries (Table 8) indicate population density, quality of the labor force, and county employment growth rate had only modest impacts on the probabilities of service firms choosing metro, metro-adjacent, or non-metro regions. A one unit increase in average establishment size offers interesting results. A negative coefficient could be interpreted as indicating a region is more attractive to smaller firms, while a positive coefficient would suggest the opposite. Over time, the metro region has been transformed from smaller service-producing firms to larger ones. Surprisingly, smaller service-producing firms were attracted to the metro-adjacent region, while larger firms were attracted to the non-metro region. These results show that service-producing industries continued to expand in non-metro region.

Service-producing industry clustering showed mixed results across the regions and over time. In 1990, clustering had a larger positive and negative impact in the metro and metro-adjacent regions, respectively. In the same period, the impact was negative but small in the non-metro region. During an economic downturn, metro region service-producing firms may have benefited from inter- and intra-industry spillovers, while in metro-adjacent and non-metro regions the industry clustering effect may have led to a crowding-out of some service firms. A similar pattern was observed among the service-producing industry firms in the metro region during 1996.

Vertical integration had the largest negative impact among all the variables in all regions and years. In general, we have observed a general weakening of linkages such as those measured by economic multipliers. This is due to the fairly ubiquitous trend toward increasing use of imported inputs to production, the overseas outsourcing of many business activities, and the internalization of many functions that previously had been purchased from outside suppliers. Thus, it is not surprising that a relatively large (one unit) increase in a county indirect output multiplier would lead to a large employment decline overall. It may, in fact, indicate a relatively non-competitive industry in a globally-competitive market place.

The negative impact of highways during 1996 in metro-adjacent region was unexpected, though as can be seen in Table 7, the coefficient is not significantly different from zero, hence the marginal effect should be taken under this caveat. Similar to the goods-producing industry, the urbanization variable had a positive impact on the location choice of service-producing industry firms in metro, metro-adjacent and non-metro regions. In the metro region, the impact was becoming increasingly pronounced in later years, while becoming less so in the metro-adjacent and non-metro regions in the same period.

5.0 Conclusions and Policy Implications

In this chapter we focused on the location choice decisions of goods- and service-producing industries in metro, metro-adjacent, and non-metro regions in three economically-distinct time periods. A conditional logit approach was used in modeling location choice decisions. Selected industry, establishment, and community characteristics were used to explain the location decisions of firms. Population density, urbanization and highways were three important characteristics for understanding goods- and service-producing industry firm location choices across time and regions. Population density had relatively larger impacts on metro-adjacent and non-metro regions. Maintaining population density in non-metro regions would seem one key to maintaining economic prosperity. Considering the phenomenon of regional economic consolidation so pronounced in a state like Kansas, this might suggest the relative importance of regional trade centers in many rural areas and the need for regional perspectives in promoting economic opportunity.

In the metro region, highways continue to play an important role. Industry forward- and backward-linkages (vertical integration) were not an important factor attracting goods- and service-producing firms in any region. This may be due to internal industry consolidation, as well as speak to the globalization of trading relationships. All the other variables had differential impacts across time and regions. For example, quality of the labor force was an important factor attracting goods- and service-producing industry firms in the metro region, but it was an unfavorable factor in the other two regions. The non-metro region was able to attract larger service-producing firms. Given the cost advantages associated with non-metro regions and the continuing development of telecommunication infrastructure, larger service-producing firms may find non-metro regions attractive for business operations. It is possible that non-metro (rural) regions can be competitive in attracting and holding at least some types of service-sector firms.

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Table 1: Description of Variables and Data Sources

Descriptor	Dependent Variable	Source
Firm or establishment	Annual average counts with 1 indicating location in a region and 0, otherwise.	ES-202 data
	Independent Variables	
Population Density	Population density: population per square mile	Woods and Poole Economics, Inc.
Labor Quality	Quality of the labor force: Percent of employees in knowledge industries	ES-202 and Beck (1992)
Estab. Size	Average industry establishment size: total county employment / total number of establishments	ES-202 data
Ind. Clustering	Industry clustering: location quotient (LQ) $LQ = \dfrac{\frac{\text{County industry employment}}{\text{Total county employment}}}{\frac{\text{National industry employment}}{\text{Total national employment}}}$	ES-202 and County Business Patterns
Vert. Integration	Vertical integration: indirect output multiplier in million dollars	IMPLAN software (MIG, Inc., 1999)
Co. Employment	County employment growth in percentage	ES-202 data
Highway	Presence of an interstate highway in the region's county	State Highway Map
Urbanization	Measure of urbanization: Modified 1993 Urban Influence Code	U.S.D.A. Economic Research Service

Table 2: Summary Statistics for the Goods-producing Industry

Region	Variable	Mean	Std Dev	Minimum	Maximum
Metro	Number of Establishments	7,562	670	6,709	8,474
	Average Establishment Size	17.5	223.2	0.0	23,960.5
	Industry Clustering	1.526	0.166	1.323	1.756
	Vertical Integration	0.240	0.034	0.209	0.325
Metro-Adjacent	Number of Establishments	1,884	118	1,732	2,064
	Average Establishment Size	16.4	79.3	0.0	2,963.7
	Industry Clustering	1.595	0.181	1.357	1.865
	Vertical Integration	0.433	1.065	0.105	3.815
Non-Metro	Number of Establishments	3,265	174	3,032	3,577
	Average Establishment Size	15.5	102.9	0.0	3,229.0
	Industry Clustering	1.595	0.206	1.291	1.902
	Vertical Integration	0.196	0.066	0.150	0.378

Source: Calculations found in Table 1.

Table 3: Summary Statistics for the Service-producing Industry

Region	Variable	Mean	Std Dev	Minimum	Maximum
Metro	Number of Establishments	29,490	1,248	27,805	31,506
	Average Establishment Size	12.8	78.8	0.0	8,093.0
	Industry Clustering	2.211	0.201	1.948	2.540
	Vertical Integration	0.287	0.036	0.228	0.363
Metro-Adjacent	Number of Establishments	7,047	255	6,452	7,469
	Average Establishment Size	11.6	57.4	0.0	4,306.0
	Industry Clustering	2.141	0.186	1.923	2.454
	Vertical Integration	0.223	0.029	0.172	0.275
Non-Metro	Number of Establishments	13,261	482	12,421	14,270
	Average Establishment Size	9.6	32.3	0.0	2,107.2
	Industry Clustering	2.074	0.199	1.823	2.401
	Vertical Integration	0.241	0.062	0.144	0.382

Source: Calculations found in Table 1.

Table 4: Summary Statistics for the Common Variables

Region	Variable	Mean	Std Dev	Minimum	Maximum
Metro	Population Density	196.2	304.5	8.1	1072.7
	Quality of the Labor Force	35.95	6.36	24.34	55.22
	County Empl. Growth Rate	1.31	5.23	-27.91	22.58
Metro-Adjacent	Population Density	27.1	25.05	3.79	112.56
	Quality of the Labor Force	33.98	8.63	21.32	67.42
	County Empl. Growth Rate	0.74	4.93	-12.74	27.05
Non-Metro	Population Density	12.4	14.6	1.8	74.9
	Quality of the Labor Force	36.74	8.37	11.97	63.16
	County Empl. Growth Rate	0.67	11.26	-76.09	285.58

Source: Calculations found in Table 1.

Table 5: Coefficients for goods-producing industries

	Metro			Metro-Adjacent			Non-Metro		
Variables	**1990**	**1996**	**2002**	**1990**	**1996**	**2002**	**1990**	**1996**	**2002**
Pop. Density	0.002*	0.001*	0.002*	0.012*	0.017*	0.016*	0.019*	0.02*	0.018*
	(0.00)	(0.00)	(0.00)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Labor Quality	0.056*	0.095*	0.102*	-0.048*	-0.051*	-0.038*	-0.02*	-0.035*	-0.013*
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)	(0.004)	(0.004)	(0.004)
Estab. Size	-0.011	0.019*	0.039*	0.017*	-0.004	0.004	0.001	-0.005	-0.003
	(0.007)	(0.002)	(0.002)	(0.005)	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)
Ind. Clustering	0.656*	0.01	-0.869*	-0.332*	-0.289*	0.455*	-0.036	-0.213*	-0.064
	(0.149)	(0.039)	(0.076)	(0.119)	(0.076)	(0.067)	(0.065)	(0.032)	(0.042)
Vert. Integration	-0.305*	-0.2*	-0.288	-0.059*	-0.051*	-1.611*	-0.006*	-0.002	-1.164*
	(0.021)	(0.012)	(0.256)	(0.014)	(0.01)	(0.211)	(0.002)	(0.001)	(0.126)
Co. Employment	-0.137*	0.027*	0.065*	-0.082*	-0.013*	0.037*	0.005	-0.002	-0.011*
	(0.004)	(0.008)	(0.009)	(0.015)	(0.005)	(0.011)	(0.005)	(0.001)	(0.004)
Highway	0.663*	1.409*	0.988*	0.184*	0.069	0.058	0.24*	0.112*	0.116*
	(0.079)	(0.077)	(0.066)	(0.071)	(0.075)	(0.08)	(0.05)	(0.049)	(0.046)
Urbanization	-1.038*	-1.559*	-1.153*	-0.115*	-0.237*	-0.138*	-0.441*	-0.362*	-0.315*
	(0.181)	(0.045)	(0.051)	(0.035)	(0.026)	(0.026)	(0.041)	(0.032)	(0.033)
Log Likelihood	-14072	-15117	-17534	-4793	-5059	-5555	-11780	-12363	-12398

* Asterisks indicate significance at the 0.05 probability level. The values in parentheses are standard errors.

Table 6: Marginal effects of the variables for good producing industries

	Metro			Metro-Adjacent			Non-Metro		
	1990	**1996**	**2002**	**1990**	**1996**	**2002**	**1990**	**1996**	**2002**
Pop. Density	0.009	0.006	0.009	0.066	0.091	0.091	0.037	0.038	0.035
Labor Quality	0.308	0.526	0.562	-0.267	-0.285	-0.209	-0.040	-0.069	-0.027
Estab. Size	-0.060	0.105	0.215	0.092	-0.024	0.024	0.001	-0.010	-0.007
Ind. Clustering	3.631	0.055	-4.811	-1.839	-1.598	2.517	-0.071	-0.417	-0.127
Vert. Integration	-1.690	-1.107	-1.596	-0.327	-0.281	-8.917	-0.012	-0.004	-2.323
Co. Employment	-0.759	0.148	0.360	-0.453	-0.074	0.207	0.010	-0.004	-0.021
Highway	3.671	7.801	5.468	1.016	0.381	0.323	0.476	0.220	0.232
Urbanization	-5.747	-8.629	-6.386	-0.637	-1.312	-0.766	-0.875	-0.708	-0.628

Table 7: Coefficients for service-producing industries

	Metro			Metro-Adjacent			Non-Metro		
	1990	**1996**	**2002**	**1990**	**1996**	**2002**	**1990**	**1996**	**2002**
Pop. Density	0.003*	0.002*	0.001*	0.018*	0.023*	0.024*	0.012*	0.013*	0.017*
	(0.00)	(0.00)	(0.00)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Labor Quality	0.068*	0.07*	0.072*	-0.047*	-0.057*	-0.042*	-0.02*	-0.025*	-0.022*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Estab. Size	-0.194*	-0.01	0.072*	-0.052*	-0.049*	-0.055*	0.038*	0.053*	0.111*
	(0.012)	(0.007)	(0.006)	(0.01)	(0.014)	(0.008)	(0.008)	(0.007)	(0.006)
Ind. Clustering	0.608*	-0.453*	1.837*	-0.797*	0.51*	-0.681*	-0.257*	0.093*	0.015
	(0.111)	(0.085)	(0.076)	(0.121)	(0.108)	(0.117)	(0.045)	(0.047)	(0.047)
Vert. Integration	-30.175*	-8.279*	-14.67*	-10.239*	-1.678*	-4.239*	-1.234*	-1.176*	-3.142*
	(1.00)	(0.527)	(0.631)	(1.082)	(0.558)	(0.554)	(0.262)	(0.198)	(0.279)
Co. Employment	-0.179*	-0.053*	0.014*	-0.024*	-0.005*	-0.005	0.014*	-0.001*	0.007*
	(0.002)	(0.003)	(0.005)	(0.004)	(0.002)	(0.004)	(0.002)	(0.00)	(0.002)
Highway	0.866*	1.385*	0.447*	0.147*	-0.121*	-0.086	0.238*	0.233*	0.059*
	(0.035)	(0.038)	(0.031)	(0.031)	(0.032)	(0.046)	(0.02)	(0.021)	(0.022)
Urbanization	-1.102*	-2.149*	-2.702*	-0.317*	-0.222*	-0.206*	-0.495*	-0.397*	-0.211*
	(0.04)	(0.026)	(0.033)	(0.017)	(0.014)	(0.014)	(0.019)	(0.016)	(0.019)
Log Likelihood	-62944	-66551	-67989	-22495	-22872	-22026	-62167	-59161	-55988

* Asterisks indicate significance at the 0.05 probability level. The values in parentheses are standard errors.

Table 8: Marginal effects of the variables for service-producing industries

	Metro			Metro-Adjacent			Non-Metro		
	1990	**1996**	**2002**	**1990**	**1996**	**2002**	**1990**	**1996**	**2002**
Pop. Density	0.014	0.009	0.004	0.097	0.128	0.134	0.025	0.025	0.033
Labor Quality	0.375	0.390	0.398	-0.257	-0.314	-0.234	-0.042	-0.050	-0.045
Estab. Size	-1.076	-0.057	0.396	-0.288	-0.269	-0.307	0.077	0.104	0.222
Ind. Clustering	3.367	-2.506	10.170	-4.415	2.822	-3.772	-0.526	0.182	0.031
Vert. Integration	-167.058	-45.834	-81.219	-56.687	-9.289	-23.471	-2.528	-2.312	-6.273
Co. Employment	-0.988	-0.296	0.080	-0.133	-0.026	-0.027	0.029	-0.003	0.013
Highway	4.794	7.670	2.475	0.812	-0.668	-0.477	0.488	0.457	0.117
Urbanization	-6.102	-11.896	-14.961	-1.752	-1.227	-1.138	-1.014	-0.780	-0.421

Appendix I

County type, urban influence code and interstate highway

FIPS	Name	MSA	URINF_Code*	Highway	FIPS	Name	MSA	URINF_Code*	Highway
1	Allen	2	6	0	107	Linn	1	2	0
3	Anderson	2	6	0	109	Logan	3	9	0
5	Atchison	2	5	0	111	Lyon	2	5	1
7	Barber	3	9	0	113	Marion	2	5	1
9	Barton	3	7	0	115	Marshall	3	6	0
11	Bourbon	2	6	0	117	McPherson	2	8	0
13	Brown	2	6	0	119	Meade	3	9	0
15	Butler	1	2	1	121	Miami	1	2	1
17	Chase	2	5	1	123	Mitchell	3	8	0
19	Chautauqua	3	9	0	125	Montgomery	3	7	0
21	Cherokee	3	8	0	127	Morris	2	6	0
23	Cheyenne	3	9	0	129	Morton	3	9	0
25	Clark	3	9	0	131	Nemaha	2	6	0
27	Clay	3	8	0	133	Neosho	3	8	0
29	Cloud	3	8	0	135	Ness	3	9	0
31	Coffey	2	6	1	137	Norton	3	8	0
33	Comanche	3	9	0	139	Osage	1	2	1
35	Cowley	2	3	0	141	Osborne	3	9	0
37	Crawford	3	7	0	143	Ottawa	3	7	0
39	Decatur	3	9	0	145	Pawnee	3	8	0
41	Dickinson	3	8	1	147	Phillips	3	8	0
43	Doniphan	1	2	0	149	Pottawatomie	2	5	0
45	Douglas	1	2	1	151	Pratt	3	8	0
47	Edwards	3	9	0	153	Rawlins	3	9	0
49	Elk	2	6	0	155	Reno	2	3	0
51	Ellis	3	7	1	157	Republic	3	9	0
53	Ellsworth	3	8	1	159	Rice	3	8	0
55	Finney	3	7	0	161	Riley	2	5	1
57	Ford	3	7	0	163	Rooks	3	9	0
59	Franklin	1	2	1	165	Rush	3	9	0
61	Geary	2	5	1	167	Russell	3	8	1
63	Gove	3	9	1	169	Saline	3	7	1
65	Graham	3	9	0	171	Scott	3	8	0
67	Grant	3	8	0	173	Sedgwick	1	1	1
69	Gray	3	9	0	175	Seward	3	7	0
71	Greeley	3	9	0	177	Shawnee	1	2	1
73	Greenwood	2	6	0	179	Sheridan	3	9	0
75	Hamilton	3	9	0	181	Sherman	3	8	1
77	Harper	2	4	0	183	Smith	3	9	0
79	Harvey	1	2	1	185	Stafford	3	9	0
81	Haskell	3	9	0	187	Stanton	3	9	0
83	Hodgeman	3	9	0	189	Stevens	3	8	0
85	Jackson	1	2	0	191	Sumner	1	2	1
87	Jefferson	1	2	0	193	Thomas	3	8	1
89	Jewell	3	9	0	195	Trego	3	9	1
91	Johnson	1	1	1	197	Wabaunsee	1	2	1
93	Kearny	3	9	0	199	Wallace	3	9	0
95	Kingman	2	4	0	201	Washington	3	9	0
97	Kiowa	3	9	0	203	Wichita	3	9	0
99	Labette	3	7	0	205	Wilson	3	8	0
101	Lane	3	9	0	207	Woodson	3	9	0
103	Leavenworth	1	2	0	209	Wyandotte	1	2	1
105	Lincoln	3	9	1					

Counties within a MSA (Metro) = 1; metro-adjacent = 2; non-metro non-adjacent =3
* Urban Influence Code in 1996
Highway 1= presence

Appendix II

Urban Influence Codes

Code	Definition
	Metropolitan
1	Central and fringe counties of metro areas of 400,000 population or more
2	Small - Counties in metro areas of fewer than 400,000 population non-metropolitan counties
	Non-Metropolitan
3	Adjacent to a large metro area with a city of 10,000 or more
4	Adjacent to a large metro area and without a city of at least 10,000
5	Adjacent to a small metro area with a city of 10,000 or more
6	Adjacent to a small metro area and without a city of at least 10,000
7	Not adjacent to a metro area and with a city of 10,000 or more
8	Not adjacent to a metro area and with a city of 2,500 to 9,999 population
9	Not adjacent to a metro area and with no city or a city with a population less than 2,500

Appendix III

SIC code for Goods-producing Industries

SIC	SIC	SIC	SIC	SIC	SIC	SIC	SIC	SIC
711	2023	2231	2599	2843	3262	3423	3537	3635
721	2024	2241	2611	2844	3263	3425	3541	3639
722	2026	2251	2621	2851	3264	3429	3542	3647
723	2032	2254	2631	2861	3269	3431	3543	3648
724	2033	2257	2652	2865	3271	3432	3544	3691
741	2034	2258	2653	2869	3272	3433	3545	3692
742	2035	2259	2655	2873	3273	3441	3546	3694
751	2037	2261	2656	2874	3274	3442	3547	3728
752	2038	2262	2657	2875	3275	3443	3548	3812
761	2041	2269	2671	2879	3281	3444	3549	3821
762	2043	2273	2672	2891	3291	3446	3552	3822
781	2044	2281	2674	2892	3292	3448	3553	3823
782	2045	2282	2675	2893	3295	3449	3554	3824
783	2046	2284	2676	2895	3296	3451	3555	3827
1521	2047	2295	2677	2899	3297	3452	3556	3829
1522	2048	2297	2678	2911	3299	3462	3559	3841
1531	2051	2411	2679	2951	3312	3463	3561	3842
1541	2052	2421	2711	2952	3313	3465	3562	3843
1542	2053	2426	2721	2992	3315	3466	3563	3844
1611	2061	2429	2731	2999	3316	3469	3564	3845
1622	2062	2431	2732	3011	3317	3471	3565	3851
1623	2063	2434	2741	3021	3321	3479	3566	3861
1629	2064	2435	2752	3052	3322	3482	3567	3873
1711	2066	2436	2754	3053	3324	3483	3568	3911
1721	2067	2439	2759	3061	3325	3484	3569	3914
1731	2068	2441	2761	3069	3331	3489	3581	3915
1741	2074	2448	2771	3081	3334	3491	3582	3931
1742	2075	2449	2782	3082	3339	3492	3585	3942
1743	2076	2451	2789	3083	3341	3493	3586	3944
1751	2077	2452	2791	3084	3351	3494	3589	3949
1752	2079	2491	2796	3085	3353	3495	3592	3951
1761	2087	2493	2812	3086	3354	3496	3593	3952
1771	2091	2499	2813	3087	3355	3497	3594	3953
1781	2092	2511	2816	3088	3356	3498	3596	3955
1791	2095	2512	2819	3089	3357	3499	3599	3961
1793	2096	2514	2821	3211	3363	3511	3612	3965
1794	2097	2515	2822	3221	3364	3519	3613	3991
1795	2098	2517	2823	3229	3365	3523	3621	3993
1796	2099	2519	2824	3231	3366	3524	3624	3995
1799	2111	2521	2833	3241	3369	3531	3625	3996
2011	2121	2522	2834	3251	3398	3532	3629	3999
2013	2131	2531	2835	3253	3399	3533	3631	
2015	2141	2541	2836	3255	3411	3534	3632	
2021	2211	2542	2841	3259	3412	3535	3633	
2022	2221	2591	2842	3261	3421	3536	3634	

Source: U.S. Department of Commerce

Appendix IV

Service-producing Industries

SIC	SIC	SIC	SIC	SIC	SIC	SIC	SIC
4111	4932	5113	5521	5995	7021	7515	8412
4119	4939	5131	5531	5999	7032	7519	8422
4121	4941	5136	5541	6011	7033	7521	8611
4131	4952	5137	5551	6019	7041	7532	8621
4141	4953	5139	5561	6021	7211	7533	8631
4142	4959	5141	5571	6022	7212	7534	8641
4151	4961	5142	5599	6029	7213	7536	8651
4173	4971	5143	5611	6035	7215	7537	8661
4212	5012	5144	5621	6036	7216	7538	8699
4213	5014	5145	5632	6061	7217	7539	8711
4214	5015	5146	5641	6062	7218	7542	8712
4215	5021	5147	5651	6081	7219	7549	8713
4221	5023	5148	5661	6082	7221	7622	8721
4222	5031	5149	5699	6091	7231	7623	8731
4225	5032	5153	5712	6099	7241	7629	8732
4226	5033	5154	5713	6311	7251	7631	8733
4231	5039	5159	5714	6321	7261	7641	8734
4311	5043	5162	5719	6324	7291	7692	8741
4412	5044	5169	5722	6331	7299	7694	8742
4424	5046	5171	5731	6351	7311	7699	8743
4432	5047	5172	5734	6361	7312	7911	8744
4449	5048	5181	5735	6371	7313	7922	8748
4481	5049	5182	5736	6399	7319	7929	8811
4482	5051	5191	5812	6411	7322	7933	8999
4489	5052	5192	5813	6512	7323	7941	
4491	5063	5193	5912	6513	7331	7948	
4492	5064	5194	5921	6514	7334	7991	
4493	5065	5198	5932	6515	7335	7992	
4499	5072	5199	5941	6517	7336	7993	
4512	5074	5211	5942	6519	7338	7996	
4513	5075	5231	5943	6531	7342	7997	
4522	5078	5251	5944	6541	7349	7999	
4581	5082	5261	5945	6552	7352	8111	
4729	5083	5271	5946	6553	7353	8211	
4731	5084	5311	5947	6712	7359	8221	
4741	5085	5331	5948	6719	7361	8222	
4783	5087	5399	5949	6722	7363	8231	
4785	5088	5411	5962	6726	7378	8243	
4789	5091	5421	5963	6732	7381	8244	
4911	5092	5431	5983	6733	7382	8299	
4922	5093	5441	5984	6792	7383	8322	
4923	5094	5451	5989	6794	7384	8331	
4924	5099	5461	5992	6798	7389	8351	
4925	5111	5499	5993	6799	7513	8361	
4931	5112	5511	5994	7011	7514	8399	

Source: U.S. Department of Commerce