The Journal of
Regional
Analysis
& Policy

JRAP 38(2):1-18.

Geography of Employment and Establishment Dynamics in Information Technology and E-Commerce Industries

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Abstract. Firm-specific data were used to analyze variation in employment and establishment dynamics (birth, death, expansion, and contraction) of metro, metro-adjacent, and non-metro regions in the State of Kansas. To account for overall dynamism, a model of regional change based on classical economic theory was developed. Employment and establishment dynamics in Information Technology (IT)-producing and using industries, E-commerce-intensive industries, and goods and service-producing industries were studied using panel data between 1990 and 2003. Results indicated there were significantly more employment and establishment births in metro IT-producing, IT-using, and service-producing industries versus the metro-adjacent region. A comparison between the metro and non-metro regions showed higher levels of employment births in metro IT-using and service-producing industries. Overall, the non-metro region showed relatively better employment growth in IT-producing and goods-producing industries. The results shed light on prospects for rural areas to capture a share of the economic growth associated with these industry sectors.

1. Introduction

Information technology (IT) and E-commerce (EC) intensive industries began growing rapidly in the early 1990s, with growth rates peaking near the end of the decade. Technological advances within many of these industries altered the production and delivery of goods and services, consumption, communication, transportation, recreation, and the electoral process. It is widely believed that much of the positive national economic performance seen through the late 1990s would not have been possible without the innovations within, collectively, the IT/EC industries. Although these sectors represent only a small proportion of overall economic activity, their contribution to economic growth was significant. These technological advances have had implications for metropolitan (metro) and non-metropolitan (non-metro) regional economic performance, and altered the landscape of economic activity.

Previous research on the influence of technology in shaping regional economic activity has been primarily concerned with the movement of people and businesses (Frey 1993; Elliot 1995; Clark and Kuijpers-Linde 1994; Audirac 2002, 2005). Much of the earlier interest focused on rural-urban migration patterns, suggesting that either people follow jobs or jobs follow people. Recent research indicates that technological advances in telecommunications and improved transportation systems have altered traditional rural-to-urban migration patterns. Growth and concentration of economic activities in metropolitan areas have since spilled into peripheral areas and may portend the greater decentralization of economic activities. Earlier research contemplated that the decentralization process may reach beyond the metro edges to more distant rural areas and, as a result, urban-rural convergence may be underway (Wardwell, 1980).

Changes in regional economic geography are only possible given changes in the fundamental unit of economic activity. Individual firms are the fundamental economic unit and firm-level changes are prerequisite to altering the economic landscape. It is increasingly difficult to understand the complexities of the

interrelationship between technology, economic geography, and firm-level activity. Any research addressing these questions requires a polycentric, dynamic approach (Anas et. al., 1998).

Economic geography plays a significant role in firm location and mobility, dynamism and inter-firm relationships. Literature on the regional agglomeration of economies indicates that the externalities resulting from agglomeration have a significant impact on the location choice of firms (Carlton, 1983; Guimaraes et al., 2000). Studies focusing on externalities were often regionally oriented. For example, Romer (1986), Lucas (1993) and Krugman (1991) found that externalities were geographically bounded and comparatively higher growth rates were observed in those regions. On the other hand, Harvey (1982) and Massey (1984) attributed regional economic variation to the uneven development associated with capitalism over time and space. The existing stock of knowledge and firms is important if such beneficial externalities are to arise. Lucas (1988) argued that natural growth in metropolitan regions was a result of human capital externalities. That may be because of the geographically bounded nature of knowledge, with variations reflected in differential economic growth across regions.

Recent advances in information and communication technology have called into question the continuing efficacy of the notion of a bounded geography of economic opportunity. Recent studies suggested that 'geography is increasingly becoming irrelevant' for economic performance. The perfect-information assumption in classical economics is becoming more of a reality. As barriers to the flow of information have fallen, relatively more efficient product movement becomes possible. Friedman (2005) argues that the flow of information and trade created a more level playing field as the global economy has become more 'flat.'

E-commerce also has enhanced the flow of information, as well as other goods and services. Firms are increasingly marketing via the Internet, and otherwise disseminating significant amounts of information about their products and services. Firms use e-commerce to develop competitive advantages by providing more useful information, expanding choices for consumers, developing new services, streamlining purchasing processes, and lowering costs (Henry et al., 1999). The greatest advantages of e-commerce use are the global positioning of firms, 'outfit-less' businesses, and 'infinite simultaneous customer attention.' The down side of e-commerce is that firms place themselves in a 'suspension stage,' because products and services are easily imitated using the information available in the vigorous competition for market share. Potential vulnerability mandates innovation among firms as a matter of survival. 'Survival of the best fit' is the rule in an innovating marketplace. Firms transform themselves in a nearly organic fashion and dynamism becomes second nature.

The dynamic nature of firm change and mobility involves a range of activities. Entering into a market, hiring or laying off employees, and firm migration or exit from the market are a few of the important functions considered in this research. While these actions are taken for the firm's own competitive advantage, the aggregate implications are far-reaching for communities and regions. From a socioeconomic perspective, new firm entry or expansion contributes to employment generation and economic growth, while employee layoffs or firm exits are detrimental. Given advances in telecommunication technologies and improved transportation systems, some firms may migrate to non-metro areas to exploit the relatively low cost of land, labor, and other inputs, while firms from rural areas may attempt to expand market access to metro areas. Since these phenomena are firm-specific, different components of this dynamism can be understood only by using firm-level data.

Variation between information technology (IT)-producing, IT-using, e-commerce-intensive, goods-producing and service-producing industry' firm-level dynamism (firm birth/appearance, expansion, contraction, and exit/death) in metro, metro-adjacent, and non-metro non-adjacent regions was the focus of this study. The contribution of this study to the regional economic literature is two-fold. First, the research examines firm-specific dynamism, which requires more detailed information about individual firms. Contrasted with earlier research, most previous studies used aggregate data. Second, the metro, metro-adjacent, and non-metro focus will help examine whether the existing stock of employment or establishments is relevant to firm dynamics. Audretsch (1995) argued that the variation in existing knowledge conditions may cause disparities in the rate of new firm start-ups in different cities. Finally, the IT-producing, IT-using, e-commerce, goods-producing, and service-producing industry focus will help determine whether the patterns of dynamism are common among these broader industry sectors, or whether it is industry-specific. For example, one might suspect that there would be a greater degree of dynamism in IT-producing, IT-using, and e-commerce industry firms than in the broader goods-producing and service-producing industries given the relatively recent emergence of these sectors.

The paper continues with specification of a metro/non-metro county typology and a theoretical model to identify dynamics components. The third section presents a description of the data used in this research and discusses the methods used to estimate firm dynamic components. The results and discussion are presented in section four, and the final section offers several conclusions.

2. Method

The geographic focus of this research was the state of Kansas. Of course, an analysis focusing on one state results in trade-offs. The focus on one state permits the research to acquire significantly more extensive and detailed data on establishments and locations. Sacrificed is the ability to infer research findings to areas that are markedly different from Kansas' metropolitan, metro-adjacent, and rural regions.[1]

The state has two distinct economic geographies. Major metropolitan areas exist in the northeast (Kansas City) and south central (Wichita) regions. Large sections of the western, north central, and southeastern part of the state are agriculturally-dependent and quite rural. Counties were selected as the unit of analysis. In Kansas, there are 105 counties exhibiting considerable economic variation. Since it would have been both computationally cumbersome to complete the analysis for each of the state's 105 counties and questionable whether the analyses would have been useful from a state policy perspective, a homogenous grouping of counties was deemed more appropriate and a standard classification system was used to group counties into subdivisions. The classification system was based on the Office of Management and Budget's (OMB) Metropolitan Statistical Area (MSA) or non-metropolitan area designation (OMB, 2000).

In the regional economic development literature, spatial variation (metro verses non-metro or urban verses rural) is reported to have a significant impact on both economic growth and labor market performance. After studying rural-urban workers' migration in the U.S., Barcus (2004) argued that understanding of rural economic performance likely would differ when utilizing a general landscape variation such as 'rural' and 'urban' compared to a more refined county distinction of metro, metro-adjacent, and non-metro counties. In the latter classification, the variation among intra-group counties in a non-metro region is likely to be less compared to the former classification. For this study, counties were subdivided into three groups.

The counties within MSA's were classified as metro counties, and counties immediately adjacent to metro counties were classified as metro-adjacent. All other counties were classified as non-metro counties. Based on this classification, there were seventeen metro counties, twenty-one metro-adjacent counties, and sixty-seven non-metro counties in Kansas.

2.1 Theoretical Model for Establishment Dynamics

Previous studies of employment and establishment dynamics typically examined the level of employment and number of establishments in two time periods. While this work offers valuable insights to understanding firm dynamics, most lacked a sound theoretical approach to understanding the interplay between the different dynamic components. The dynamic components are birth, death, expansion, and contraction. The focus of this section is to introduce a theoretical model to comprehensively account for employment and establishment dynamics.

According to classical economic theory, a firm selects a region, or an existing firm continues to operate in a region, that yields the highest expected profit. In a market economy, firms operate in a complex and uncertain economic environment. The realization of profit is the key determinant of continued operation, and provides information about the likely future profitability of the firm (Jovanovic, 1982). In this process, firms are subject to Bayesian learning,[2] constantly adjusting operations, including responding to a dynamic competitive environment. Mas-Colell, Whinston and Green (1995) suggested that firms are likely to alter levels of employment (hire and fire) and allow market share to fluctuate in order to achieve the profit maximizing goal.

This theory of employment and establishment dynamics is built on a simple neoclassical economic proposition: 'firms maximize expected profit.' If all

[1] A comparison of Census Bureau demographic, social and economic characteristics data for Kansas and the U.S. average shows only relatively minor variation. Kansas is about average in U.S. state total population, but has a lower population density and larger land area. It has somewhat less racial diversity, is somewhat better educated, has a higher proportion of the population in the work force, and somewhat less poverty. There is no appreciable difference in age or occupational composition compared to the U.S. average. Looking at the structure of Kansas' industry, there is a slightly higher percentage of employment in farming, manufacturing and government. The proportion of employment in other industries is comparable to U.S. state averages.

[2] Jordan (1991) showed that agents or players could achieve Bayesian Nash equilibrium while playing a game based on some current belief, and then updating their subsequent belief system after incorporating the new information from the play that just ended. For more on Bayesian learning refer to Cox and Shachat (2001).

firms select (new firm) or operate (existing) in locations that yield the highest expected profit, it is then possible to construct a Paretian Social Profit Function (SPF) for that region. A Paretian social profit function is defined as the sum of individual firms' profit functions that can be stated using duality theory. The regional Paretian SPF (W_t) consists of the sum of the individual firms' expected profit in a particular region. The expected profit of an individual firm varies depending on its organizational life-cycle stage.

Based on life cycle theory, five organizational survival stages are identified. The first stage is birth (Lippitt and Scmidt, 1967). In this stage, organizations come into existence or a migrating organization first emerges in a particular location. Stage two is the survival stage. In this stage, the organization seeks to grow (Adizes, 1979; Downs, 1967). This stage is crucial to future survival. Those that fail to generate sufficient revenue go out of business (Churchill and Lewis, 1983), or migrate to another location that has greater potential to generate revenue. In the third stage, the organization matures (Adizes, 1979) and attempts to solidify its position in the market. The fourth stage is the renewal stage. In this stage, the organization strives to maintain its growth (Quinn and Cameron, 1983) through innovation and renewal. The final stage is the declining stage, where organizations experience a decline and potential lack of profits and loss of market share (Miller and Friesen, 1984). The objective for organizations, of course, would be to forestall decline through periodic renewal.

Regional labor and industrial studies begin with the focus on employment and establishment dynamics to provide insights into organizational survival and growth. Employment and establishment dynamics consist of four components: birth, expansion, contraction, and death. Employment birth is associated with new establishment startup or the first appearance of a migrating firm. Expansion is the net increase in employment in existing establishments. Employment contraction is related to a decrease in employment in existing establishments, and death is the result of establishments ceasing to function or migrating out of the region. The application of dynamism in organizational life cycle stages helps to identify which stage of the life cycle a firm or industry sector may currently be experiencing.

An organization's performance can be evaluated by examining the profit it generates, and it is assumed that current organizational survival stages are determined by their expected profit. The organizational survival stages and their expected profit (indicated within parentheses) are shown below.

1. New startups (π_c), c = 1,2,…,C
2. In-migrated (π_i) , i = 1,2,…,I
3. Remained in the same location (π_s) , s = 1,2,…,S
4. Out-migrated (π_o) , o = 1,2,…,O
5. Exit from the market (π_e) , e = 1,2,…,E

The expected profit for each of the life stages is estimated with reference to present profit in current location j, and with either expected profit in the host location (present time) or expected profit in some future time. For example, if a firm exits the market (death), the death could be due to: 1) the firm is operating at a loss and does not expect to make sufficient profit in the future (profit = 0) or 2) the firm is making profit and exiting the market (holding its resources) in order to make more profit in the future,

$$\pi_e = \textit{Current profit} - \textit{Expected profit.} \quad (1)$$

In the first scenario, expected future profit is zero and with a current loss, π_e = negative. In the second scenario, expected profit in the future > current profit, therefore π_e = negative. The expected profit of the exiting firm (π_e) is negative in both cases. Similarly, the out-migrated firms' expected profit can be written as:

$$\pi_o = \textit{Profit current location} - \textit{Expected profit host location.} \quad (2)$$

Since the out-migrated firms will have a higher expected profit in the host location, their expected profit π_o is negative. In-migrated, new startups and firms that choose to stay have a positive expected profit. For example, the expected profit for the in-migrated firm can be written as:

$$\pi_i = \textit{Expected profit location (j)} - \textit{Profit current location (k).} \quad (3)$$

Since the expected profit in location j is always greater than location k, the π_i will always be positive. The regional Paretian SPF in region j at time t is

$$W_t = \sum_{i=1}^{I} \pi_t^i + \sum_{c=1}^{C} \pi_t^c + \sum_{s=1}^{S} \pi_t^s - \sum_{o=1}^{O} \pi_t^o - \sum_{e=1}^{E} \pi_t^e . \quad (4)$$

Employment in the organization's life stage at time t can be defined as: $Emp_t^i, Emp_t^c, Emp_t^s, Emp_t^o, Emp_t^e$, which indicate employment in in-migrated, new startups, firms choosing to stay, out-migrated, and firms that exited the market, respectively. The regional employment in location j at time t can be written as:

$$Emp_t = \sum_{i=1}^{I} Emp_t^i + \sum_{c=1}^{C} Emp_t^c + \sum_{s=1}^{S} Emp_t^s - \sum_{o=1}^{O} Emp_t^o - \sum_{e=1}^{E} Emp_t^e \cdot \quad (5)$$

2.2 Information Technology and E-commerce

The ecological theory of new firm formation deals with a single industry. One of the limitations of this approach is that researchers cannot infer anything about the variation of new firm formation across industry sectors (Shane, 2001). It also is possible to use the population ecological approach to examine employment and establishment dynamics of a single industry. Industrial characteristics also may be important factors that could help explain the employment and establishment dynamics of an industry. In order to examine the variation of employment and establishment dynamics in different industries, all establishments in Kansas were classified into five major industry sectors. The classification employs the U.S. Department of Commerce Standard Industrial Classification (SIC) system.[3] Five industry categories were chosen:

1) **Information Technology Producers (IT-Pro)**
   Information Technology Producers are defined by the U.S. Department of Commerce (DOC) as industries that (a) produce, process, or transmit information goods or services as either intermediate or final products, or (b) provide the necessary infrastructure for the Internet (Henry et al., 1999). Thirty (30) four-digit SIC industries were selected as information technology producers based on the DOC criteria. In Kansas, all 30 IT-Producing industries were present during the study period.

2) **Information Technology Users (IT-Use)**
   The DOC identified intensive users of information technology based on (a) value of the industries' information technology capital stock relative to total equipment stock, and (b) IT investment expenditures per worker. The nine highest-ranked industries (2-digit SIC) according to each criterion were designated as significant IT-users, resulting in forty-seven (47) four-digit SIC information technology-using industries included in this research. In Kansas, all 47 IT-Using industries were present during the study period.

3) **E-commerce Intensive Industries (Ecom)**
   According to the DOC (Buckley et al., 2000), almost all industries are engaged in E-commerce. E-commerce is dominated by business-to-business transactions, concentrated in relatively few industries. For the purposes of this study, E-commerce-intensive industries were defined as those industries where E-commerce revenues (or sales or shipments) are a relatively large share (15% or more) of total industry revenues (sales or shipments). A total of one hundred-one (101) four-digit E-commerce-intensive industries were identified for analysis. In Kansas, 66 of the 101 E-Commerce-intensive industries were present during the study period.

4) **Service-Producing Industries (S-Pro)**
   Service-Producing Industries include services; retail trade; wholesale trade; finance, insurance, and real estate; and transportation, communications, and public utilities that were not included in IT-Pro, IT-Use, and Ecom. A total of three hundred and thirty-nine (339) four-digit SIC industries constituted the S-Pro category.

5) **Goods-Producing Industries (G-Pro)**
   Goods-Producing Industries include manufacturing, construction, and agricultural services that were not included in IT-Pro, IT-Use, and Ecom. A total of four hundred-one (401) four-digit SIC industries were included in the G-Pro group.

2.3 Empirical Model

The empirical model developed was based on the theoretical model introduced in section 2.1. A five-step approach was used:

1) Standardization of a unique firm identification system, wherein each firm can be tracked over time;
2) Standardization of industry definitions across time (Dunne et al., 1988);
3) Identification of firms' organizational life cycle stage;
4) Aggregation of annual firm-level data (number of establishments, employment) across the organizational life cycle stage; and
5) Comparison of aggregate annual firm-level data at each organizational life cycle stage across different regions with the lag year data.

[3] The current standard for industry classification is the North American Industry Classification System (NAICS). The NAICS was first introduced in 1997 and, since then, industry data have been available based on this classification system. The SIC system was used in this research because the data could be cross-classified using both the SIC and NAICS systems from 1997 forward. Conversely, there was no way to bridge to the NAICS system backward prior to its introduction.

The first two steps largely depend on the initial data collection, and require a uniform and consistent classification system. The Quarterly Census of Employment and Wages (ES-202) data base was developed by the U.S. Department of Labor and maintained by the State Employment Security Agencies in the 50 states, District of Columbia, Puerto Rico and Virgin Islands. The system assigns a unique employer identification number to each reporting firm that stays with the firm despite any subsequent change in name or location. Thus, the ES-202 system satisfies step one above.

Similarly, the Standard Industrial Classification (SIC) was the standard industry classification system employed in the United States since its introduction by the Central Statistical Board (CBS) in 1941. While the SIC codes have been periodically revised, the changes were documented and literature is available to bridge the record over time (Chao, 2001). A major revision of the SIC system took place in 1997 to introduce a uniform coding system across all of North America (North American Industry Classification System – NAICS). NAICS-SIC bridging tables are available to identify specific industry sectors prior to and after the change of the coding system. The ES-202 system currently cross-classifies each firm by both its SIC and NAICS codes.

Stage three is crucial from an empirical stand point. Since some components of expected profit are known only to organizational management, their decisions regarding entry into some subsequent stage (to stay or move) is unknown. The researcher, therefore, cannot determine an organization's subsequent stage based on a single point-in-time observation. It is possible to determine an organization's functional stage either by comparing two successive stages or times. For example, if an organization migrated to another location, it is then reasonable to conclude that in the former location the organization belongs to the out-migrated stage, and belongs to the in-migrated stage in the latter. It is necessary to trace an organization's history over the time to ascertain its functional stage. Equations (5) and (6) are presented here for t^{th} and $t+1^{th}$ year.

$$\mathrm{Emp}_t = \sum_{i=1}^{I} \mathrm{Emp}_t^i + \sum_{c=1}^{C} \mathrm{Emp}_t^c + \sum_{s=1}^{S} \mathrm{Emp}_t^s - \sum_{o=1}^{O} \mathrm{Emp}_t^o - \sum_{e=1}^{E} \mathrm{Emp}_t^e , \qquad (5)$$

$$\mathrm{Emp}_{t+1} = \sum_{i=1}^{I} \mathrm{Emp}_{t+1}^i + \sum_{c=1}^{C} \mathrm{Emp}_{t+1}^c + \sum_{s=1}^{S} \mathrm{Emp}_{t+1}^s - \sum_{o=1}^{O} \mathrm{Emp}_{t+1}^o - \sum_{e=1}^{E} \mathrm{Emp}_{t+1}^e \qquad (6)$$

where Emp_{t+1} is industry i's total employment in the $t+1^{th}$ year. At the beginning of the t^{th} year, only existing organizations (those that choose to stay) are observed, where Emp_t^c and Emp_t^e do not exist (zero). But in $t+1^{th}$ year, all five organizational stages can be observed. After assuming out-migrated establishments are lost to the region (equivalent to exit) and in-migrated establishments are transformed into continue-to-stay or exit, the t^{th} and $t+1^{th}$ year establishment numbers are

$$\mathrm{Emp}_t = \sum_{s=1}^{S} \mathrm{Emp}_t^s \qquad (7)$$

$$\mathrm{Emp}_{t+1} = \sum_{c=1}^{C} \mathrm{Emp}_{t+1}^c + \sum_{s=1}^{S} \mathrm{Emp}_{t+1}^s - \sum_{e=1}^{E} \mathrm{Emp}_{t+1}^e . \qquad (8)$$

The change in employment over the t^{th} year is

$$\Delta\mathrm{Emp}_t = \left(\sum_{c=1}^{C} \mathrm{Emp}_{t+1}^c - 0\right) + \left(\sum_{s=1}^{S} \mathrm{Emp}_{t+1}^s - \mathrm{Emp}_t^s\right) - \left(\sum_{e=1}^{E} \mathrm{Emp}_{t+1}^e - 0\right) \qquad (9)$$

The change in employment can be disaggregated to four components of change:

Employment Births (Emp_{t+1}^c);

Employment Deaths (Emp_{t+1}^e);

Employment Expansions [$(\mathrm{Emp}_{t+1}^s - \mathrm{Emp}_t^s) > 0$]; and

Employment Contractions [$(\mathrm{Emp}_{t+1}^s - \mathrm{Emp}_t^s) < 0$].

Similarly, establishment births, deaths, expansions, and contractions can be calculated for a particular region or industry by summing the employment/establishments across different employment/establishment dynamic components. The births, deaths, expansions, and contractions for the five industry sectors across metro, metro-adjacent, and non-metro regions will help to illuminate the employment and establishment dynamics in these regions. Simply observing the existing number and size of establishments in the regions at discrete points in time is not the same, and may lead to inaccurate conclusions regarding the dynamics of change within and across regions. The comparison without accounting for the stock of employment or establishments may be misleading. The metro region has a larger initial endowment of employment and establishments, while the other regions have fewer. To account for the stock of employment/establishments, the ratio of the dynamic components was estimated. For example, proportional employment births were estimated as:

$$\text{Proportional Employment Birth}_t\ (A) = \frac{\text{Employment Births}_t}{\text{Total Employment}_t} .$$

Similarly, proportional employment deaths, expansions, and contractions, and establishment births, deaths, expansions, and contractions were estimated:

$$\text{Proportional Establishment Birth}_t \text{ (A)} = \frac{\text{Establishment Births}_t}{\text{Total Establishments}_t}.$$

The metro region's four dynamic components for proportional employment and establishment dynamics were compared with the metro-adjacent region's dynamic components. The metro region's dynamic components were compared with the non-metro region's components. And, a similar comparison was done with metro-adjacent and non-metro regions. Pair-wise t-statistic comparisons showed the level of significance between different means over time.

Finally, to better understand whether a given region had been gaining or losing sectoral employment over time, two summary indices were calculated. A regional dynamism index shows industry performance within regions. The regional dynamism index was thus calculated:

$$\text{Regional Dynamism Index} = \left(\frac{\text{Birth}_r + \text{Expansion}_r}{\text{Death}_r + \text{Contraction}_r} \right).$$

The regional dynamism index provides an absolute measure of dynamism having accounted for the relative levels of the employment or establishment dynamic element. For example, in an industry in location j, there are five births, four deaths, three expansions and two contractions in employment. In the same industry in location k there are 55 births, 54 deaths, 53 expansions and 52 contractions in employment. In both locations the next change in employment is two. One would expect more dynamism in location j than k. The regional dynamism value for region j and k are 1.33 and 1.02, respectively. Further, any value greater than one indicates there is a net increase in employment or establishments.

One of the shortcomings for the regional dynamism index is that it does not capture the region's true industry performance. For example, assume the regional dynamism index is 0.9 for industry i in region j. Industry i may have a dynamism index of 0.8 at an aggregate (state or national) level. Based on the absolute value, industry i appears to be performing poorly, while relative to the aggregate economy, industry i in region j actually is showing above average economic performance. In order to measure the relative dynamism in a region, a measure similar to a location quotient was developed. The employment dynamism quotient (EmDQ) and the establishment dynamism quotient (EsDQ) measure regional dynamism relative to a dynamism index of the aggregate (state) economy:

$$\text{Employment (Emp.) Dynamsim Quotient (EmDQ)} = \frac{\left(\frac{\text{Emp. Birth}_r + \text{Emp. Expnasion}_r}{\text{Emp. Death}_r + \text{Emp. Contraction}_r} \right)}{\left(\frac{\text{Emp. Birth}_s + \text{Emp. Expnasion}_s}{\text{Emp. Death}_s + \text{Emp. Contraction}_s} \right)}$$

and

$$\text{Establishment (Est.)Dynamsim Quotient (EsDQ)} = \frac{\left(\frac{\text{Est. Birth}_r + \text{Esd. Expnasion}_r}{\text{Est. Death}_r + \text{Esd. Contraction}_r} \right)}{\left(\frac{\text{Est. Birth}_s + \text{Esd. Expnasion}_s}{\text{Est. Death}_s + \text{Esd. Contraction}_s} \right)}$$

where the subscript r indicates the region, and s indicates the state.

3. Data

Annual county-level establishment data were obtained from the U.S. Department of Labor, Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW) program (ES-202) data files for 1990 to 2003. ES-202 has commonly been used to study economic growth, entrepreneurship, and industry location choice. For example, Gabe (2004) used ES-202 data to examine establishment growth in U.S. small cities and towns for thirty-five sectors, while Schwarm and Cutler (2005) used it to create a Social Accounting Matrix and regional Computable General Equilibrium model to examine the impact of a 250 employee expansion in three municipalities in Colorado.

The ES-202 data file tracks all employers with employees who are eligible for unemployment compensation insurance. Each data file consists of monthly establishment-level employment, SIC and NAICS codes, county location, establishment start date, a code identifying the members of multi-establishment firms, a code identifying changes in company business names, and quarterly salaries and wages subject to unemployment compensation insurance reporting requirements. The establishments that changed names but not locations were identified and treated as single continually-operating establishments.

While ES-202 is the most comprehensive source of commercial establishment data, and frequently has been used to examine economic development events and policies, it is not without limitations. After using the data for over two years, researchers at the University of Wisconsin-Milwaukee reported problems with the Wisconsin ES-202 data (White et al., 1990). Among the problems observed were establishments that were owned and operated by sole proprietors, farms, and other agricultural enterprises that employ less then ten employees and were not included in the data; estab-

lishments sometimes failed to report, or other establishments reported late and were excluded in the data; the reporting system did not have criteria to distinguish between full-time and part-time employment; misrepresentation of a county or location of employment as the result of centralized reporting (only the main branch of a private company or government unit reported dispersed business activities); and some establishments used their major city mailing address, while the actual employment was located outside the major city. Despite the limitations of the Wisconsin data, the authors concluded "… they [ES-202 data] do not render the data less useful or inferior to other sources of detailed information" (p. 242).

Individual establishments' employment was compared in successive years for employment births, expansions, contractions, and deaths. Based on the observed changes, establishments were classified as establishment births, expansions, contractions, and deaths, respectively. Summary statistics for total employment and establishments in Kansas IT-producing, IT-using, E-commerce, goods-producing, and service-producing industries across metro, metro-adjacent, and non-metro regions are presented in Table 1.

Table 1. Annual Average Level of Employment and Number of Establishments by Industry Sector in Kansas Regions, 1990-2003.

Industry	Metric	Metro	Metro-Adjacent	Non-Metro
Overall	Employment	665,401	146,439	242,724
	Establishments	44,736	11,230	21,920
IT-Pro	Employment	18,158	1,588	2,686
	Establishments	1,322	153	292
IT-Use	Employment	86,044	17,653	32,068
	Establishments	3,683	873	1,649
Ecom	Employment	34,128	5,225	6,635
	Establishments	845	146	255
G-Pro	Employment	131,695	31,134	51,092
	Establishments	7,526	1,881	3,275
S-Pro	Employment	376,190	82,641	128,992
	Establishments	29,552	7,093	13,326

4. Results

The proportionate employment and establishment dynamics (hereafter referred to as births, deaths, expansion, and contraction) for the five industries were compared across regions over the study period. A simple t-test was performed to examine whether the dynamics components were similar. The pooled t-test requires an assumption of equal variance between comparison groups. The folded form F test was used to determine whether the dynamics component had equal variance (Brase and Brase, 2002). When the assumption was violated, a Satterthwaite test was performed. The summary statistics for employment and establishment dynamic components are presented in Table 2 and Table 3, respectively.

IT-producing, E-commerce and goods-producing industry establishment births and deaths were highest in the metro region, followed by the metro-adjacent and non-metro regions, respectively. The industry's mean establishment contractions did not vary across the regions, while mean establishment contraction was higher in metro-adjacent region for all industries. Overall, establishment expansion and contraction were higher than births and deaths. Notably, IT-producing industry establishment contraction was higher than expansion in all three regions.

The employment dynamics comparing the metro and metro-adjacent regions are presented in Table 4. Industry mean annual rates of change and the associated standard errors of employment dynamics components are shown for both regions along the top and left of Table 4. Corresponding cell reference values show the t-test probabilities, and the subscripts a and b distinguish the pooled t-test (equal variance) and Satterthwaite t-test (unequal variance), respectively. Observation of probabilities coupled with inspection of the corresponding means reveals the relative directionality of significant rate change differences across the regions.

Results showed that mean metro employment births in IT-producing, IT-using, and service-producing industries were significantly higher (5% level) than in the metro-adjacent region. Proportionately higher employment births in these industries suggest a greater level of economic activity and better prospects for economic growth. Henry and Drabenstott (1996) and O'hUallachain and Satterthwaite (1992) reported a positive relationship between industry size and employment growth. While the total employment in all industries was higher in the metro region, our

Table 2. Mean Proportionate Annual Rate of Change in the Level of Employment by Dynamic Component and Industry Sector in Kansas Regions, 1990-2003.

Region	Industry	Birth	Death	Expansion	Contraction
Metro	IT-Pro	0.10	0.07	0.12	0.13
	IT-Use	0.06	0.05	0.07	0.07
	Ecom	0.03	0.04	0.08	0.06
	G-Pro	0.05	0.04	0.08	0.09
	S-Pro	0.06	0.05	0.09	0.09
Metro-Adjacent	IT-Pro	0.06	0.04	0.10	0.10
	IT-Use	0.04	0.04	0.06	0.05
	Ecom	0.07	0.05	0.06	0.10
	G-Pro	0.06	0.05	0.07	0.07
	S-Pro	0.05	0.04	0.07	0.07
Non-Metro	IT-Pro	0.10	0.06	0.08	0.08
	IT-Use	0.04	0.04	0.06	0.04
	Ecom	0.04	0.04	0.07	0.07
	G-Pro	0.06	0.05	0.08	0.08
	S-Pro	0.05	0.05	0.07	0.07

Table 3. Mean Proportionate Annual Rate of Change in the Number of Establishments by Dynamic Component and Industry Sector in Kansas Regions, 1990-2003.

Region	Industry	Birth	Death	Expansion	Contraction
Metro	IT-Pro	0.22	0.15	0.32	0.34
	IT-Use	0.12	0.10	0.38	0.33
	Ecom	0.12	0.13	0.33	0.34
	G-Pro	0.13	0.12	0.37	0.37
	S-Pro	0.13	0.12	0.32	0.34
Metro-Adjacent	IT-Pro	0.13	0.12	0.32	0.38
	IT-Use	0.09	0.09	0.38	0.34
	Ecom	0.09	0.13	0.32	0.39
	G-Pro	0.11	0.11	0.36	0.36
	S-Pro	0.10	0.11	0.33	0.35
Non-Metro	IT-Pro	0.11	0.11	0.29	0.31
	IT-Use	0.09	0.09	0.35	0.32
	Ecom	0.07	0.14	0.30	0.37
	G-Pro	0.10	0.11	0.35	0.37
	S-Pro	0.10	0.11	0.33	0.35

Table 4. Annual Average Employment Dynamics in Kansas Metro and Metro-adjacent Regions, 1990-2003, t-test Probabilities.

				Metro-Adjacent																			
				IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
				Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
			Mean	0.06	0.04	0.10	0.10	0.04	0.04	0.06	0.05	0.07	0.05	0.06	0.10	0.06	0.05	0.07	0.07	0.05	0.04	0.07	0.07
			Std Err	0.01	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.02	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01
Metro	IT-Pro	Birth	0.10	0.016a																			
		Std Err	0.01																				
		Death	0.07		0.0386b																		
		Std Err	0.01																				
		Expn.	0.12			0.4419a																	
		Std Err	0.01																				
		Cont.	0.13				0.4327b																
		Std Err	0.03																				
	IT-Use	Birth	0.06					0.0277a															
		Std Err	0.01																				
		Death	0.05						0.203a														
		Std Err	0.01																				
		Expn.	0.07							0.167a													
		Std Err	0.00																				
		Cont.	0.07								0.0449b												
		Std Err	0.01																				
	Ecom	Birth	0.03									0.0812b											
		Std Err	0.01																				
		Death	0.04										0.3594a										
		Std Err	0.01																				
		Expn.	0.08											0.0746b									
		Std Err	0.01																				
		Cont.	0.06												0.1147a								
		Std Err	0.01																				
	G-Pro	Birth	0.05													0.1272b							
		Std Err	0.00																				
		Death	0.04														0.1452b						
		Std Err	0.00																				
		Expn.	0.08															0.1896a					
		Std Err	0.00																				
		Cont.	0.09																0.045a				
		Std Err	0.00																				
	S-Pro	Birth	0.06																	0.0201a			
		Std Err	0.00																				
		Death	0.05																		0.0636b		
		Std Err	0.00																				
		Expn.	0.09																			0.002a	
		Std Err	0.00																				
		Cont.	0.09																				0.0969a
		Std Err	0.01																				

a and b are t-test results from equal and unequal variances, respectively

results indicate that proportionate employment births were industry specific rather than dependent on the overall size of the industry.

IT-producing industry employment deaths in the metro region were significantly higher compared to the metro-adjacent region. The higher rates of metro IT-producing births and deaths suggest a natural linkage within a relatively more dynamic economy. Further investigation suggests there was a moderate degree of association (Pearson Correlation Coefficient = 0.60) between IT-producing industry employment births and deaths in the metro region. IT-using and goods-producing industry employment contractions were significantly higher in the metro region compared to those in the metro-adjacent region.

A comparison of employment dynamic components in the metro and non-metro non-adjacent regions is presented in Table 5. The comparison of metro and non-metro employment births showed that births were higher in the metro region in the IT-using and service-producing industries, while employment expansion was significantly higher in the IT-producing, IT-using, and service-producing industries. None of the industry employment deaths significantly differed between metro and non-metro regions. Overall, the activity in the IT-Using industry was significantly greater in the metro region compared to the non-metro region.

Table 5. Annual Average Employment Dynamics in Kansas Metro and Non-Metro Regions, 1990-2003, t-test Probabilities.

				Non-Metro																			
				IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
				Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
			Mean	0.10	0.06	0.08	0.08	0.04	0.04	0.06	0.04	0.04	0.04	0.07	0.07	0.06	0.05	0.08	0.08	0.05	0.05	0.07	0.07
			Std Err	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Metro	IT-Pro	Birth	0.10	0.9583a																			
		Std Err	0.01																				
		Death	0.07		0.3314b																		
		Std Err	0.01																				
		Expn.	0.12			0.0149b																	
		Std Err	0.01																				
		Cont.	0.13				0.0946b																
		Std Err	0.03																				
	IT-Use	Birth	0.06					0.0295b															
		Std Err	0.01																				
		Death	0.05						0.2722b														
		Std Err	0.01																				
		Expn.	0.07							0.0046a													
		Std Err	0.00																				
		Cont.	0.07								0.0117b												
		Std Err	0.01																				
	Ecom	Birth	0.03									0.7079b											
		Std Err	0.01																				
		Death	0.04										0.8336b										
		Std Err	0.01																				
		Expn.	0.08											0.465a									
		Std Err	0.01																				
		Cont.	0.06												0.6459a								
		Std Err	0.01																				
	G-Pro	Birth	0.03													0.2995b							
		Std Err	0.01																				
		Death	0.04														0.087b						
		Std Err	0.01																				
		Expn.	0.08															0.6735a					
		Std Err	0.01																				
		Cont.	0.06																0.1618a				
		Std Err	0.01																				
	S-Pro	Birth	0.06																	0.0426a			
		Std Err	0.00																				
		Death	0.05																		0.3628a		
		Std Err	0.00																				
		Expn.	0.09																			<.0001a	
		Std Err	0.00																				
		Cont.	0.09																				0.0719b
		Std Err	0.01																				

a and b are t-test results from equal and unequal variances, respectively

An employment dynamic comparison for the metro-adjacent and non-metro regions is presented in Table 6. There were no significant differences in the regional dynamic components among the industries.

Among the industries considered, there was a greater dynamism (births, deaths, expansion, and contraction) in the metro region than in the metro-adjacent or non-metro regions. IT-using industries' and service-producing industries' employment growth (birth and expansion) was significantly higher in the metro region, signifying the relative importance of these industries in the metro region and suggesting at least a relatively greater level of activity and potentially more entrepreneurial environment.

The comparison of establishment dynamics components in the metro and metro-adjacent regions is reported in Table 7. IT-producing, IT-using, and service-producing industry establishment births were significantly higher in the metro region.

Establishment dynamic component comparisons for the metro and non-metro regions are presented in Table 8. Establishment births were significantly higher for all industries in the metro region. This result supports previous research showing high-tech industries are typically found in technology clusters or in metropolitan areas, where regions with specialized industries grow faster. The significantly higher death rates in the metro region IT-producing industries

Table 6. Annual Average Employment Dynamics in Kansas Metro-adjacent and Non-Metro Regions, 1990-2003, t-test Probabilities.

			Non-Metro																			
			IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
			Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
		Mean	0.10	0.06	0.08	0.08	0.04	0.04	0.06	0.04	0.04	0.04	0.07	0.07	0.06	0.05	0.08	0.08	0.05	0.05	0.07	0.07
		Std Err	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Metro-Adjacent	IT-Pro	Birth	0.06	0.0741b																		
		Std Err	0.01																			
		Death	0.04		0.0637a																	
		Std Err	0.00																			
		Expn.	0.10			0.3139b																
		Std Err	0.02																			
		Cont.	0.10				0.0679a															
		Std Err	0.01																			
	IT-Use	Birth	0.04					0.8614a														
		Std Err	0.00																			
		Death	0.04						0.6414a													
		Std Err	0.00																			
		Expn.	0.06							0.3058b												
		Std Err	0.01																			
		Cont.	0.05								0.1331a											
		Std Err	0.00																			
	Ecom	Birth	0.07									0.1903a										
		Std Err	0.02																			
		Death	0.05										0.6064a									
		Std Err	0.01																			
		Expn.	0.06											0.3449b								
		Std Err	0.01																			
		Cont.	0.10												0.1957a							
		Std Err	0.02																			
	G-Pro	Birth	0.06													0.9304a						
		Std Err	0.01																			
		Death	0.05														0.999a					
		Std Err	0.01																			
		Expn.	0.07															0.4571a				
		Std Err	0.00																			
		Cont.	0.07																0.6992a			
		Std Err	0.01																			
	S-Pro	Birth	0.05																	0.773a		
		Std Err	0.00																			
		Death	0.04																		0.3279a	
		Std Err	0.00																			
		Expn.	0.07																			0.2768b
		Std Err	0.00																			
		Cont.	0.07																			0.9663a
		Std Err	0.01																			

a and b are t-test results from equal and unequal variances, respectively

could indicate some IT-producing firms may be migrating to lower-cost non-metro regions, but this is only speculative.

The degree of association between establishment births and deaths in the metro region indicates a moderately negative correlation for IT-producing industries (Pearson Correlation Coefficient = -0.55) and positive correlation for IT-using industries (Pearson Correlation Coefficient = 0.70). A higher proportionate rate of establishment deaths was not associated with a higher rate of establishment entry for IT-producing and IT-using industries. IT-producing and E-commerce industry establishment contractions were higher in the metro-adjacent region.

IT-using industry establishment expansion rates were significantly higher in the metro region. With technical advancement and diffusion of Internet infrastructure, one might speculate that non-metro areas would have growth potential for E-commerce-intensive industries. The results show significantly higher E-commerce establishment contraction in the non-metro region.

The establishment dynamic comparison for the metro-adjacent and non-metro regions is presented in Table 10. Among the dynamic components, only IT-producing industry contraction and E-commerce industry expansion were significantly higher in the metro-adjacent region. There were no significant differences among other establishment dynamic components.

Table 7. Annual Average Employment Dynamics in Kansas Metro and Metro-adjacent Regions, 1990-2003, t-test Probabilities.

				Metro-Adjacent																			
				IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
				Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
			Mean	0.13	0.12	0.32	0.38	0.09	0.09	0.38	0.34	0.09	0.13	0.32	0.39	0.11	0.11	0.36	0.36	0.10	0.11	0.33	0.35
			Std Err	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00
Metro	IT-Pro	Birth	0.22	0.016a																			
		Std Err	0.02																				
		Death	0.15		0.0267a																		
		Std Err	0.01																				
		Expn.	0.32			0.9766a																	
		Std Err	0.02																				
		Cont.	0.34				0.0366a																
		Std Err	0.01																				
	IT-Use	Birth	0.12					0.0001a															
		Std Err	0.00																				
		Death	0.10						0.0471a														
		Std Err	0.00																				
		Expn.	0.38							0.9134a													
		Std Err	0.01																				
		Cont.	0.33								0.6739b												
		Std Err	0.00																				
	Ecom	Birth	0.12									0.1076a											
		Std Err	0.01																				
		Death	0.13										0.8323b										
		Std Err	0.01																				
		Expn.	0.33											0.7084a									
		Std Err	0.01																				
		Cont.	0.34												0.0316b								
		Std Err	0.01																				
	G-Pro	Birth	0.13													0.0639a							
		Std Err	0.01																				
		Death	0.12														0.5214a						
		Std Err	0.01																				
		Expn.	0.37															0.5144a					
		Std Err	0.01																				
		Cont.	0.37																0.3267a				
		Std Err	0.01																				
	S-Pro	Birth	0.13																	0.0007a			
		Std Err	0.01																				
		Death	0.12																		0.0524a		
		Std Err	0.00																				
		Expn.	0.32																			0.2781a	
		Std Err	0.01																				
		Cont.	0.34																				0.2573a
		Std Err	0.00																				

a and b are t-test results from equal and unequal variances, respectively

Finally, several summary indicators were generated to provide an overall indication of regional economic performance focusing on the industry sectors of interest. The regional dynamism index is shown in Table 10. Reading down the columns, the index shows the net annual average gain/loss across the industry sectors within the metro, metro-adjacent, and non-metro regions between 1990 and 2003.

Within the metro region, the strongest employment growth sectors were the IT-using and service-producing sectors. IT-using industry establishment growth also was strongest in the metro region, by far. Relatively stronger growth overall was observed in the metro-adjacent counties with employment growth outpacing decline in four of five sectors with IT-using industries leading the way. In terms of employment growth, IT-producing sector growth showed surprising strength in the non-metro region, and overall employment growth was quite positive in four of the five industry sectors. Interestingly, e-commerce industry performance lagged in terms of both employment and establishment change in all regions. E-commerce industry decline was most pronounced in the non-metro region.

Table 8. Annual Average Employment Dynamics in Kansas Metro and Metro-adjacent Regions, 1990-2003, t-test Probabilities.

				Non-Metro																			
				IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
				Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
			Mean	0.11	0.11	0.29	0.31	0.09	0.09	0.35	0.32	0.07	0.14	0.30	0.37	0.10	0.11	0.35	0.37	0.10	0.11	0.33	0.35
			Std Err	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Metro	IT-Pro	Birth	0.22	<.0001a																			
			Std Err	0.01																			
		Death	0.15		0.0137a																		
			Std Err	0.01																			
		Expn.	0.32			0.2056a																	
			Std Err	0.02																			
		Cont.	0.34				0.1322a																
			Std Err	0.01																			
	IT-Use	Birth	0.12					0.0006a															
			Std Err	0.00																			
		Death	0.10						0.0882a														
			Std Err	0.00																			
		Expn.	0.38							0.0458a													
			Std Err	0.01																			
		Cont.	0.33								0.0495a												
			Std Err	0.00																			
	Ecom	Birth	0.12									0.0012a											
			Std Err	0.01																			
		Death	0.13										0.345a										
			Std Err	0.01																			
		Expn.	0.33											0.0439a									
			Std Err	0.01																			
		Cont.	0.34												0.05a								
			Std Err	0.01																			
	G-Pro	Birth	0.13													0.0065a							
			Std Err	0.01																			
		Death	0.12														0.1738a						
			Std Err	0.01																			
		Expn.	0.37															0.2661a					
			Std Err	0.01																			
		Cont.	0.37																0.9624a				
			Std Err	0.01																			
	S-Pro	Birth	0.13																	0.0008a			
			Std Err	0.01																			
		Death	0.12																		0.0189a		
			Std Err	0.00																			
		Expn.	0.32																			0.4473a	
			Std Err	0.01																			
		Cont.	0.34																				0.2868a
			Std Err	0.00																			

a and b are t-test results from equal and unequal variances, respectively

A relative comparison across regions is observed in the employment (EmDQ) and establishment dynamism quotients (EsDQ) reported in Table 11. Reading across the rows, non-metro IT-producing industries showed the greatest relative employment performance across the state with a general pattern of increase emanating outward from the metro region. The metro-adjacent counties showed the strongest employment growth overall with three to four percent annual growth in four of the observed sectors. Notably, overall establishment growth was observed only in the metro region. Coupling the pattern of establishment growth with the mixed employment performance may suggest a relatively greater degree of overall entrepreneurial activity in the metro area. The relative decline in establishment numbers in the non-metro region suggests an overall declining employer base.

5. Discussion and Conclusions

This research investigated four aspects of employment and establishment dynamics: intra-regional variation of single industry dynamic components (e.g., metro IT-producing verses non-metro IT-producing); inter-regional variation of employment and establishment dynamic components (e.g., metro IT-producing employment dynamics and metro IT-producing establishment dynamics); the degree of association of em-

Table 9. Annual Average Employment Dynamics in Kansas Metro-adjacent and Non-metro Regions, 1990-2003, t-test Probabilities.

			Non-Metro																			
			IT-Pro				IT-Use				Ecom				G-Pro				S-Pro			
			Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.	Birth	Death	Expn.	Cont.
		Mean	0.11	0.11	0.29	0.31	0.09	0.09	0.35	0.32	0.07	0.14	0.30	0.37	0.10	0.11	0.35	0.37	0.10	0.11	0.33	0.35
		Std Err	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Metro-Adjacent		Birth	0.06	0.2325a																		
		Std Err	0.01																			
		Death	0.12		0.8399a																	
	IT-Pro	Std Err	0.01																			
		Expn.	0.32			0.204a																
		Std Err	0.02																			
		Cont.	0.38				0.0035a															
		Std Err	0.01																			
		Birth	0.09					0.594a														
		Std Err	0.01																			
		Death	0.09						0.6452a													
	IT-Use	Std Err	0.01																			
		Expn.	0.38							0.0667a												
		Std Err	0.01																			
		Cont.	0.34								0.0884a											
		Std Err	0.01																			
		Birth	0.09									0.1647a										
		Std Err	0.01																			
		Death	0.13										0.599a									
	Ecom	Std Err	0.01																			
		Expn.	0.32											0.0338a								
		Std Err	0.01																			
		Cont.	0.39												0.5954a							
		Std Err	0.02																			
		Birth	0.11													0.2463a						
		Std Err	0.01																			
		Death	0.11														0.5586a					
	G-Pro	Std Err	0.01																			
		Expn.	0.36															0.6604a				
		Std Err	0.01																			
		Cont.	0.36																0.3887a			
		Std Err	0.01																			
		Birth	0.10																	0.7568a		
		Std Err	0.00																			
		Death	0.11																		0.7454a	
	S-Pro	Std Err	0.01																			
		Expn.	0.33																			0.7312a
		Std Err	0.01																			
		Cont.	0.35																			0.9805a
		Std Err	0.00																			

a and b are t-test results from equal and unequal variances, respectively

ployment births and deaths within a single industry of an individual region; and overall regional industry performance.

The results indicated that when the dynamic components take into account the existing level of employment and establishments, considerable dynamism in IT-producing, IT-using and service-producing industries was observed in the metro region. The employment and establishment dynamic components offered differing indicators of regional industry performance. The degree of association between employment or establishments births and deaths was weak. Higher employment deaths were not strongly associated with higher employment births.

Harkening back to the ecological theory of new industry formation and dynamics, new firm entry should be associated with the initial stock of firms (Garafoli, 1992), implying a generally linear change process. If existing firms 'automatically generate new ones' (Garafoli, 1992, p. 114), one would expect no difference in births of establishments in proportion to existing ones. This should hold across the industries and regions. The study results found here contradict the ecological perspective insofar as new business entry was not associated with the existing stock of establishments. Rather, it was both industry- and region-specific, and generally exhibited a non-linear pattern of dynamism.

Table 10. Kansas Regional Employment and Establishment Average Annual Dynamic Index, 1990-2003**.**

		Metro	Metro-Adjacent	Non-Metro
IT-Pro	Employment	0.994	1.053	1.346
	Establishment	1.047	0.912	0.937
IT-Use	Employment	1.095	1.154	1.141
	Establishment	1.130	1.091	1.080
Ecom	Employment	0.985	0.849	0.899
	Establishment	0.939	0.805	0.731
G-Pro	Employment	0.971	1.027	1.025
	Establishment	1.007	0.991	0.952
S-Pro	Employment	1.069	1.107	1.048
	Establishment	0.969	0.945	0.939

Table 11. Kansas Regional Employment (EmDQ) and Establishment Dynamism Quotients (EsDQ), 1990-2003.

		Metro	Metro-Adjacent	Non-Metro
IT-Pro	EmDQ	0.970	1.027	1.314
	EsDQ	1.027	0.895	0.919
IT-Use	EmDQ	0.987	1.040	1.028
	EsDQ	1.017	0.981	0.971
Ecom	EmDQ	1.035	0.892	0.945
	EsDQ	1.070	0.917	0.833
G-Pro	EmDQ	0.979	1.036	1.034
	EsDQ	1.016	1.000	0.961
S-Pro	EmDQ	0.999	1.035	0.980
	EsDQ	1.012	0.986	0.980

Although the metro region IT-producing industry employment births were significantly higher than in the metro-adjacent region, a similar comparison with the non-metro region indicated no statistical difference. When employment births were compared between the metro-adjacent and non-metro regions, non-metro employment births were significantly higher at the 10 percent alpha level. Employment death also showed a similar pattern. The IT-producing industry appears to have been relatively stable in the metro-adjacent region, while demonstrating considerable dynamism in the metro and non-metro regions. Overall IT-producing industry employment growth was strongest, by far, in the non-metro region.

Metro IT-using industry employment births and contraction were significantly higher compared to the metro-adjacent and non-metro regions. A similar comparison between metro-adjacent and non-metro regions showed no such differences. The mean employment contraction was higher in the metro-adjacent region, but insignificant. IT-using industry employment contraction in the metro region gradually increased over the study period and was higher than in the metro-adjacent region. Similarly, the metro-adjacent region displayed a generally higher trend than the non-metro region.

The overall performance of e-commerce-intensive industries showed clear patterns of weakness in employment and establishment growth across all regions. Clearly, as distance from the metro hub increased, the worse e-commerce-intensive industries performed.

Generally, the most substantial differences across the geographies considered were between the metro and non-metro regions. This suggests that the characteristics of the region were influential in determining the patterns of employment and establishment births, deaths, expansion and contraction. Further, industry employment dynamic components also vary across the regions. For example, IT-producing employment contraction was higher in the metro region followed by the metro-adjacent and non-metro regions, respectively.

For those concerned with the prospects for rural places in light of rapidly changing technology and global trading relationships, the picture emerging from rural Kansas was not as bleak as might have been expected. While the overall employer base shrank over the study period, employment opportunities expanded in the IT-intensive sectors as well as the traditional goods-producing industries. To the extent that technology-driven e-commerce was to be the force that reversed longer-term patterns of rural economic decline, no such evidence was found and the reverse may be true.

In sum, geography remains relevant to the future of rural economic prospects despite the promise of new information technologies. The results found here suggest that IT-producing and IT-using industries may be dispersing from metro areas to metro-adjacent and non-metro. Conversely, E-commerce-intensive industries may be clustering in metro areas. Adjacent and non-metro regions continue to experience lagging service industry performance. This pattern was ob-

served in Kansas throughout the 1990s and early years of the new century. While the continuing development and spread of new information technologies may help even the playing field between urban and rural places, rural areas remain behind in both economic growth and overall dynamism.

Acknowledgements

This project was supported by the National Research Initiative of the Cooperative State Research, Education and Extension Service, USDA, Grant # 2003-35401-13887.

The authors are grateful to Terry Kastens, Department of Agricultural Economics, Kansas State University, for insightful review comments, and David Barkley, Department of Applied Economics and Statistics, Clemson University, for early conceptual leadership.

References

Adizes, I. 1979. Organizational passages: Diagnosing and treating life cycle problems in organizations. *Organizational Dynamics* 8: 3-24.

Anas, A., R. Arnott, and K.A. Small. 1998. Urban spatial structure. *Journal of Economic Literature* XXXVI (September): 1426-1464.

Audirac, I. 2002. Information technology and urban form. *Journal of Planning Literature* 17, 2 (November): 212-226.

_____. 2005. Information technology and urban form: Challenges to smart growth. *International Regional Science Reports* 28(2): 119-145.

Audretsch, D. 1995. *Innovation and Industry Evolution*. Cambridge, MA: MIT Press.

Barcus H. R. 2004. Urban-rural migration in the USA: An analysis of residential satisfaction. *Regional Studies* 38(6): 643-657.

Brase, C. and C. Brase. 2002. *Understandable Statistics: Concepts and Methods.* Boston, MA: Houghton Mifflin Company.

Buckley, P., P. Henry, and D. Gurmukh. 2000. *Digital Economy 2000*. Economics and Statistics Administration Office of Policy Development, Washington, D.C.: U. S. Department of Commerce.

Carlton, D. W. 1983. The location and employment choices of new firms: An econometric model with discrete and continuous endogenous variables. *Review of Economics and Statistics* 65(3): 440-449.

Chao, L.E. 2001. *Report on the American Workforce*. Washington, D.C.: U.S. Department of Labor.

Churchill, N. and V. Lewis. 1983. The five stages of small business growth. *Harvard Business Review* 61, (May-June): 30-50.

Clark, W.A.V. and M. Kuijpers-Linde. 1994. Commuting in restructuring urban regions. *Urban Studies* 31(3): 465-483.

Cox, J. C. and J. Shachat. 2001. An experiment to evaluate Bayesian learning of Nash equilibrium play. *Games and Economic Behavior* 34: 11-33.

Downs, A. 1967. The life cycle of bureaus. In: A. Downs (ed.) *Inside Bureaucracy*. San Francisco: Little, Brown & Co. and the Rand Corporation.

Dunne, T., M. Roberts, and L. Samuelson. 1988. Patterns of firm entry and exit in U.S. Manufacturing. *Rand Journal of Economics* 19(4): 495-515.

Elliot, J. R. 1995. Cycles within the system: Metropolitanization and internal migration in the U.S., 1965-1990. CDE Working Paper No. 95-21. Madison, WI: Center for Demography and Ecology, University of Wisconsin-Madison.

Frey, W. 1993. The new urban revival in the United States. *Urban Studies* 30(4/5): 741-774.

Friedman, T. L. 2005. *The World is Flat: A Brief History of the Twenty-first Century*. New York: Farrar, Straus and Giroux.

Gabe, T. 2004. Establishment growth in small cities and towns. *International Regional Science Review* 27: 164-186.

Garafoli G. 1992. New firm formation and local development: the Italian experience. *Entrepreneurship and Regional Development* 4: 101-125.

Guimarães P, O. Figueiredo, and D. Woodward. 2000. A tractable approach to the firm location decision problem. Working Paper NIMA 2/2000, Universidade do Minho.

Harvey, D. 1982. *The Limits of Capital*. Oxford: Blackwell.

Henry, D., S. Cooke, P. Buckley, J. Dumagan, G. Gill, D. Pastore, and S. LaPorte. 1999. *The Emerging Digital Economy II*. Economics and Statistics Administration, Office of Policy Development, Washington, D.C.: U. S. Department of Commerce.

Henry, M. and M. Drabenstott. 1996. A new micro view of the U.S. rural economy. *Economic Review*. Federal Reserve Bank of Kansas City 81: 53-70.

Jordan, J. S. 1991. Bayesian learning in normal form games. *Games and Economic Behavior* 3: 60-81.

Jovanovic, B. 1982. Selection and the evolution of industry. *Econometrica* 50: 649-670.

Krugman, P. 1991. *Geography and Trade.* Cambridge, MA: MIT Press.

Lippitt, G.L. and W.H. Schmidt. 1967. Crises in developing organizations. *Harvard Business Review* 45: 102-112.

Lucas, R. E., Jr. 1988. On the mechanics of economic development. *Journal of Monetary Economics* 22, 1: 3-42.

_____. 1993. Making a miracle. *Econometrica* 61: 251-272.

Mas-Colell, A., M. D. Whinston, and J. R. Green. 1995. *Microeconomic Theory*. New York: Oxford University Press.

Massey, D. 1984. *Spatial Divisions of Labour: Social Structures and the Geography of Production*. London: Macmillan.

Miller, D. and P. Friesen. 1984. A longitudinal study of the corporate life cycle. *Management Science* 30: 1161-1183.

Office of Management and Budget. 2000. Standards for defining metropolitan and micropolitan statistical areas; notice. *Federal Register* 65(249): 82228-82238.

O'hUallachain, B. and M. Satterthwaite. 1992. Sectoral growth patterns at the metropolitan level: An evaluation of economic development incentives. *Journal of Urban Economics* January: 25-58.

Quinn, R. and K. Cameron. 1983. Organizational life cycles and shifting criteria of effectiveness: Some preliminary evidence. *Management Science* 29: 33-41.

Romer, P. M. 1986. Increasing returns and long-run growth. *Journal of Political Economy* 94(5): 1002-1037.

Schwarm, W. and H. Cutler. 2005. Multiple labor groups and their effects on small city and town SAMS and CGE Models. *Review of Urban and Regional Development Studies* 17(2): 162-176.

Shane, S. 2001. Technology regimes and new firm formation. *Management Science* 47(9) (September): 1173-1190.

Wardwell, J. 1980. Toward a theory of urban-rural migration in the developed world. In: D. Brown and J. Wardwell (eds.) *New Directions in Urban-Rural Migration*. New York: Academic.

White B.S, J.F. Zipp, W.F. McMahon, P.D. Reynolds, F.D. Osterman, and L.S. Binkley. 1990. ES202: *The* data base for local employment analysis. *Economic Development Quarterly* 4(3): 240-253.