Competitiveness of Southern Metropolitan Areas:

The Role of New Economy Policies

The objective of regional competitiveness is increasingly popular among academics, policymakers, and economic development practitioners. However, efforts to cultivate competitive advantages are often complicated by confusion surrounding the definition and measurement of competitiveness. At the same time, the rise of the New Economy encourages regions to use principles of knowledge and innovation to compete on a global playing field. This paper explores the effects of New Economy development policies (e.g., innovation inputs, knowledge workers, labor employability, and entrepreneurship) on different competitiveness outcomes (growth in population, employment, and per capita income). The results suggest that development policies have different effects on various economic outcomes, suggesting that policymakers should define what they mean by regional competitiveness. Furthermore, entrepreneurship exhibits stronger relationships with economic outcomes than do innovation and knowledge inputs. A hysteresis effect is also evident. The study area for this analysis is the 151 metro areas in the Southern US Census region.

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COMPETITIVENESS OF SOUTHERN METROPOLITAN AREAS:

THE ROLE OF NEW ECONOMY POLICIES

I. INTRODUCTION

Competition among regions is a popular concept as indicated by the attention given to the rankings of cities and states in the academic literature and popular press. The Beacon Hill Institute's *State Competitiveness Report* (Tuerck et al., 2007) and the Milken Institute's *Best Performing Cities* (DeVol et al., 2007) are just two of many recent reports that rate regions based on their perceived environments for or success in competing in the New Economy.[1] Community leaders and local economic development officials cite high rankings in these reports (or movement up the rankings) as indication that existing development strategies are successful and the community is "winning" its competition with other regions to develop or attract economic activity.

Bristow (2005) and Krugman (1996) attribute the popularity of inter-regional competition to the fact that the language of competitiveness is the language of the business community. That is, business leaders can project their understanding of firm-level competitiveness onto the regional economy. Camagni (2002) adds support for a competitiveness strategy in his argument that regional economic development is based on the principal of absolute advantage rather than comparative advantage. Under the principle of absolute advantage based on competitive advantages (and agglomeration economies), Camagni refutes the premise that each region will be afforded a specialization and a role in the national and world economies. Thus, Camagni and Greene et al. (2007) suggest that regions can either get competitive or become locked in a spiral of declining economic activity.

Bristow (2005) notes that firms, and not regions, do the actual competing, but regions help set the stage for competitiveness. Successful regions specialize in the production of goods and services for which local firms are the efficient producers. At the same time, firm productivity is affected by the quality of the regional business environment and the region's institutions, industrial structure, and economic legacy. Barney (1991) and Ma (2000) propose that competitive advantage is based on resources that are rare, valuable, inimitable, non-tradable, non-substitutable, and firm- and region-specific. In addition, Ma suggests that a region may possess multiple competitive advantages that are compounded to make the region the most efficient producer of a good or service, thus providing the region an absolute advantage in its production.

Programs and policies to enhance a region's competitiveness potential in the New Economy focus on the availability and quality of human capital, the investment in and commercialization of innovative activity, and the environment for entrepreneurship and small business development (Malecki, 2004). The Southern Growth Policies Board (SGPB) is a regional leader in promoting increased roles for innovation, entrepreneurship, and human capital in state and local economic development strategies. Examples of SGPB initiatives include "Innovation with a Southern Accent" (Doron et al., 2006), "EntrepriseSouth.biz" (Taylor et al., 2007), and "The Mercedes and the Magnolia: Preparing the Southern Workforce for the Next Economy" (Conway and Clinton, 2002). Yet, metropolitan areas in the South are relatively reluctant to shift a significant share of their economic development resources from traditional industrial development activities (e.g., branch plant recruitment and infrastructure improvements) to the New Economy programs. This reluctance derives partly from past successes in recruiting large manufacturing plants and partly from a concern by policy makers that a focus on knowledge economy activities offers little short-term economic development potential for Southern metro areas with legacies of traditional manufacturing.

The goal of this paper is to investigate relationships between the policy recommendations to enhance regional competitiveness in the New Economy (innovation, entrepreneurship, and labor quality) and the 2000-2006 changes in population, employment, and per capita incomes for 151 metropolitan areas in the South. Our findings indicate that the selected inputs to the competitiveness process are associated with metropolitan growth in employment and per capita income; however, different measures of competitiveness respond to different inputs. Specifically, we find that metro employment change is positively associated with lagged levels of innovation and entrepreneurship while income change is positively related to prior levels of human capital. In fact, different facets of entrepreneurship appear to affect economic outcomes differently. These results support a holistic approach to regional competitiveness for Southern metro areas. An increase in both the size of the local economy and the well-being of the area's residents is more likely if economic development policies are designed to support innovation, entrepreneurship, and human capital development.

The paper is organized as follows. In the following section, regional competitiveness is defined, and conceptual and econometric models of competitiveness are presented. In section three, measures of inputs to the regional competitiveness process are introduced, and factor analysis is used to develop a set of relatively uncorrelated measures of New Economy policy variables and regional industrial structure. In section four, the estimation results from a Carruthers-Mulligan (2008) system of equations model are summarized, and policy implications of the findings are suggested. Section five concludes the paper.

II. COMPETITIVENESS CONCEPTS

Definition

Michael Porter (1990) is often credited with popularizing the concept of competitiveness as the ability of firms and industries to gain and retain a share in contested markets (Bristow, 2005; Budd and Hirmis, 2004).[2] Porter (1990, 2002) and Krugman (1990) define competitiveness, which Porter also calls competitive advantage, almost exclusively in terms of productivity.

Other researchers consider competitiveness a composite measure of economic and social outcomes. Storper (1997, p. 20) includes quality of life in addition to productivity in defining competitiveness as

> "…the capability of a sub-national economy to attract and maintain firms with stable or rising market shares in an activity, while maintaining or increasing standards of living for those who participate in it."

Gardiner (2003) and the European Commission (1999) also acknowledge the role of quality of life in determining regional competitiveness, and they link a region's economic fortunes to its position in the global economy.

Camagni (2002) posits that sub-national economies competing at a global level operate under a principal of absolute rather than comparative advantage. Regions do not have the flexibility afforded nations in adjusting wages and currency values. Consequently, regions will not have the opportunity to export the good or service they produce least inefficiently; they must cultivate competitive advantages to make regional firms the most efficient producers of a class of goods or services. Camagni's principal of absolute advantage recognizes the importance of increasing returns to scale and agglomeration economies. Audretsch (2000) also finds that local economies are more important in today's globalized economy because knowledge-based activity is a local phenomenon. Thus regions with competitive advantages in knowledge-based activities are poised to attract industries with rising market shares and support rising standards of living.

Conceptual and Econometric Models

Greene et al. (2007) find that input-output-outcome models are prevalent in measuring regional competitiveness. Gardiner et al. (2004) and Ireland's National Competitiveness Council (2007) configure input-output-outcome models into pyramids. The pyramid structure is appealing from a policy perspective because it implies that regions can build on their regional characteristics and their competitive advantages to achieve their target outcomes. This study adopts a pyramid model in which New Economy competeviveness inputs and traditional economic environment policies both contribute to competitiveness outcomes (Figure 1).

The base of the pyramid contains the principal inputs to economic competitiveness in the New Economy as identified in previous studies of competitiveness: innovation inputs, knowledge workers, labor employability, and entrepreneurial environment. The middle layer includes measures of traditional policies focused on improving the regional economic environment through industrial growth: establishment age/churning, business size/competitiveness, industrial composition, and industrial specialization. Outcomes of the competitiveness process include income, jobs, quality of life, and sustainable development. Each box in Figure 1 represents an element of regional competitiveness identified in earlier research on the determinants of regional growth.

There is no reason to expect that all competitiveness inputs affect economic outcomes with the same magnitude (Atkinson and Gottlieb, 2001; Atkinson and Correa, 2007; Eberts et al., 2006). Furthermore, inputs are unlikely to have the same effect on all measures of outcomes (e.g., jobs vs. incomes). For example, labor force education and skills may influence changes in employment and income more than changes in population, and entrepreneurial activity may stimulate growth in employment more than growth in income. A principal goal of the proposed econometric analysis is to test for the potential differential effects of policy variables on regional outcome growth rates.

The econometric model is specified following Carruthers and Mulligan (2008). The Carruthers-Mulligan (C-M) model is a simultaneous system of equations in which each competitiveness outcome is determined by its own lagged value, the current value of the other outcomes, and the lagged values of the explanatory variables. The model estimates three competitiveness outcomes: the logged ratios of population density (p), employment density (e), and per capita income (y) in times *t* and *t-i*, where *i* is the lag period. In the Carruthers-Mulligan model presented in Equations 1 though 3, the natural log of each dependent variable's rate of change is a function of its lagged natural log, the current logs of the other two endogenously determined variables, and a vector of initial regional conditions (*X*) expected to affect productivity and to influence local quality of life:

$$\ln\left(\frac{p_t}{p_{t-i}}\right) = \alpha_{0p} + \alpha_{1p}\ln p_{t-i} + \alpha_{2p}\ln e_t + \alpha_{3p}\ln y_t + \beta_p X_{t-i} + \varepsilon_{pt}, \tag{1}$$

$$\ln\left(\frac{e_t}{e_{t-i}}\right) = \alpha_{0e} + \alpha_{1e}\ln p_t + \alpha_{2e}\ln e_{t-i} + \alpha_{3e}\ln y_t + \beta_e X_{t-i} + \varepsilon_{et}, \tag{2}$$

and

$$\ln\left(\frac{y_t}{y_{t-i}}\right) = \alpha_{0y} + \alpha_{1y}\ln p_t + \alpha_{2y}\ln e_t + \alpha_{3y}\ln y_{t-i} + \beta_y X_{t-i} + \varepsilon_{yt}. \tag{3}$$

The ε term reflects the error.

Equations 1, 2, and 3 can also be expressed

$$\ln\left(\frac{p_t}{p_{t-i}}\right) = \alpha_{0p} + \alpha_{1p}\ln p_{t-i} + \alpha_{2p}\ln e_t + \alpha_{3p}\ln y_t + \sum_{j=1}^{n}(\beta_{jp}\, x_{jt-i}) + \varepsilon_{pt}, \tag{4}$$

$$\ln\left(\frac{e_t}{e_{t-i}}\right) = \alpha_{0e} + \alpha_{1e}\ln p_t + \alpha_{2e}\ln e_{t-i} + \alpha_{3e}\ln y_t + \sum_{j=1}^{n}(\beta_{je}\, x_{jt-i}) + \varepsilon_{et}, \tag{5}$$

and

$$\ln\left(\frac{y_t}{y_{t-i}}\right) = \alpha_{0y} + \alpha_{1y}\ln p_t + \alpha_{2y}\ln e_t + \alpha_{3y}\ln y_{t-i} + \sum_{j=1}^{n}(\beta_{jy}\, x_{jt-i}) + \varepsilon_{yt}, \tag{6}$$

where the x_j terms are the components of the X vector. The terms may be statistically correlated variable groupings that characterize the policy and industrial legacy elements of the competitiveness pyramid.

The x_j components of the X vector represent the elements of the regional competitiveness pyramid. Variable groupings selected to represent sections of the pyramid are included explicitly in equations 7-9:

$$\ln\left(\frac{p_t}{p_{t-i}}\right) = \begin{array}{l}\alpha_{0p} + \alpha_{1p}\ln p_{t-i} + \alpha_{2p}\ln e_t + \alpha_{3p}\ln y_t + \beta_{1p}INNOV_{t-i} + \beta_{2p}KNOW_{t-i} \\ + \beta_{3p}LABOR_{t-i} + \beta_{4p}ENT_{t-i} + \beta_{5p}AGE_{t-i} + \beta_{6p}SIZE_{t-i} \\ + \beta_{7p}SPEC_{t-i} + \beta_{8p}COMP_{t-i} + \varepsilon_{pt}\end{array}, \tag{7}$$

$$\ln\left(\frac{e_t}{e_{t-i}}\right) = \begin{array}{l}\alpha_{0e} + \alpha_{1e}\ln p_t + \alpha_{2e}\ln e_{t-i} + \alpha_{3e}\ln y_t + \beta_{1e}INNOV_{t-i} + \beta_{2e}KNOW_{t-i} \\ + \beta_{3e}LABOR_{t-i} + \beta_{4e}ENT_{t-i} + \beta_{5e}AGE_{t-i} + \beta_{6e}SIZE_{t-i} \\ + \beta_{7e}SPEC_{t-i} + \beta_{8e}COMP_{t-i} + \varepsilon_{et}\end{array}, \tag{8}$$

and

$$\ln\left(\frac{y_t}{y_{t-i}}\right) = \begin{array}{l}\alpha_{0y} + \alpha_{1y}\ln p_t + \alpha_{2y}\ln e_t + \alpha_{3y}\ln y_{t-i} + \beta_{1y}INNOV_{t-i} + \beta_{2y}KNOW_{t-i} \\ + \beta_{3y}LABOR_{t-i} + \beta_{4y}ENT_{t-i} + \beta_{5y}AGE_{t-i} + \beta_{6y}SIZE_{t-i} \\ + \beta_{7y}SPEC_{t-i} + \beta_{8y}COMP_{t-i} + \varepsilon_{yt}\end{array}, \tag{8}$$

where:

p_t = population per square mile at time *t*
p_{t-i} = population per square mile at time *t-i*
e_t = employment per square mile at time *t*
e_{t-i} = employment per square mile at time *t-i*
y_t = per capita income at time *t*
y_{t-i} = per capita income at time *t-i*
$INNOV_{t-i}$ = innovation inputs at time *t-i*
$KNOW_{t-i}$ = availability of knowledge workers at time *t-i*
$LABOR_{t-i}$ = labor force availability and quality at time *t-i*
ENT_{t-i} = entrepreneurial activity at time *t-i*
AGE_{t-i} = establishment age and churning at time *t-i*

$SIZE_{t-i}$ = business size and competitiveness at time *t-i*
$SPEC_{t-i}$ = industrial specialization at time *t-i*
$COMP_{t-i}$ = industrial composition at time *t-i*.

This study focuses on short-run changes in regional competitiveness that result from changes in the selected policy inputs. The model does not include all of the policy inputs that may influence economic competitiveness (e.g., miles of interstate highway and availability of air transportation). However, the equations focus on period-to-period innovations to each region's labor, capital, technology, and environment for development. Static factors are cancelled out in the differencing process, thus decreasing the potential for omitted variable bias.

III. DATA COLLECTION

Study Area

Data is collected and analyzed for 151 MSAs in the Southern US Census Region.[3] The states that make up the South are Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia (Census Bureau, 2007b). Fisher (2005) and Atkinson and Gottlieb (2001) find that the appropriate level of study is the metropolitan area. Metropolitan areas are more cohesive economic units than states. Metropolitan areas share common labor markets and other resources (Haughton and Murg, 2002). Economic conditions can vary dramatically within a state (Fisher, 2005), and the variation of economic factors may be greater within a state than between states (Atkinson, 1990).

Each MSA is made up of one or more counties that comprise and surround an urban core. The US Bureau of the Census (Census Bureau) periodically updates the MSAs' boundaries to reflect commuting and population patterns. This study uses the Census Bureau's 2003 MSA definitions that also are used in the 2006 American Community Survey (Census Bureau, 2007c).

The MSA boundaries are different for the 2000 and 1990 Censuses (Census Bureau, 2002c, 2001a). Furthermore, some 2006 MSAs were not considered MSAs in 2000 or 1990 or were combined with another metropolitan area or areas in those years.[4] The 2000 and 1990 MSA data are adjusted using county-level data to conform to the MSA definitions in effect in 2003 and 2006.

Variable Selection and Measures

Many of the determinants of economic growth are difficult to measure (e.g., social capital) or are fairly constant over time (e.g., the distance to other MSAs and the proximity of ports and airports). In this study, variables believed to be responsive to policy changes and inputs in the short-run are used to benchmark rates of change in population, employment, and per capita income in the MSAs of US South. Data are collected for each of the Southern MSAs for 1990, 2000, and 2006. In some cases, data is not available for a particular year so data from the nearest year is used in its place. For example, the number of PhD students in science and engineering fields is not available for 1990, so the 1994 (earliest available) data is used instead. The variable descriptions are grouped according to the elements of the regional competitiveness pyramid (Figure 1). These elements, the variables selected to represent them, and the sources and years for data obtained are provided in Table 1 and discussed below. Descriptive statistics for the variables are provided in Table 2.

Outcome Variables

Population. Many competitiveness studies measure population or its growth (e.g., Carlino and Mills, 1987; Carruthers and Mulligan, 2008; and Glaeser et al., 1995). If competitive regions are defined as “places where both companies and people want to locate and invest in” (Kitson et al., 2004, p. 997), then by definition, competitive regions have growing populations. Population growth rates are hypothesized to display convergence through a negative association with lagged (base year) population levels and a positive association with per capita income as people migrate to take advantage of high-income job opportunities (Carruthers and Mulligan, 2008; Glaeser et al., 1995).

Employment. Eberts et al. (2006) note that population growth can also be associated with urban sprawl. Therefore population is not a good measure of regional competitiveness by itself. People in the labor force want to locate where they can find jobs. Following Carlino and Mills (1987), Carruthers and Mulligan (2008), Eberts et al. (2006), and the Corporation for Enterprise Development (2007), employment is an outcome measure of this study.

Per capita income. The third outcome measure is per capita income, which measures productivity and the quality of life aspect of competitiveness (Eberts et al., 2006; Glaeser et al., 1995). The growth rate of per capita income reflects the effects of labor supply and demand on wages, and it is expected to be negatively related to population growth (potential labor supply) but positively related to employment growth (labor demand) (Carruthers and Mulligan, 2008).

Innovation Input Variables

Innovation is widely regarded as a driver of economic growth and competitiveness (Acs, 2002; Audretsch, 2000; Camp, 2005). Inputs to innovation include graduate students in science and engineering per 10,000 residents; PhD degrees awarded in science and engineering per 10,000 residents; academic research and development (R&D) funding per capita; college and graduate school enrollment; the percent of the population ages 25 or older with a graduate or professional degree; and the percent of employment in computer, science, and engineering occupations. Clearly, the innovation grouping has a large student component. Innovation inputs are expected to increase population growth as more students enroll in universities. However, students are not as likely to be in the labor market, so innovation is expected to have a negative relationship to employment growth. Researchers with advanced economic degrees are skilled workers with relatively high earnings so innovation should be associated with increased per capita income growth.

Knowledge Workers Variables

Knowledge workers are highly-educated people in creative occupations (Florida, 2002a, 2002b). Florida proposes that knowledge workers stimulate economic growth by starting businesses and by attracting other high-skilled workers. Variables in the knowledge workers grouping include the percent of employment in computer, science, and engineering occupations (discussed with the innovation inputs); the percent of people employed in management, business/operations, finance, computers, math, architecture, engineering, sciences, law, education, healthcare, arts, design, entertainment, media, and high-end sales occupations; the percent of employment in professional, scientific, and technical industries; the percent of the population older than age 25 with a bachelor's degree; the percent of the labor force in the manufacturing sector; and the percent of the population older than age 25 with less than a high school diploma.[5] The last two variables are expected to have a negative relationship to the other variables in the knowledge workers grouping. Knowledge workers are expected to have a positive effect on the growth rates of per capita income, employment, and population.

Labor Employability Variables

In the New Economy, skilled labor is often more important to firms than is inexpensive labor (Malecki, 2004). Eberts et al. (2006), Tuerck et al. (2007, 2008), and others recognize the importance of labor force participation, employment rates, and labor skills in promoting economic growth. The labor employability variables include the percent of the population ages

25 and older with less than a high school diploma (discussed with the knowledge workers variables); the percent of the population ages 25-64; the labor force participation rate; the employment rate; the percent of the population who speak English well; and the percent of the population who are not in poverty. Labor employability is expected to have a positive relationship to the growth rate of per capita income as wages are driven up by tight labor supplies. However, employment and population growth rates are expected to slow because firms may avoid locations with tight labor markets.

Entrepreneurial Environment Variables

Entrepreneurship is an important component of economic development because local business owners are more likely to build supply linkages with other local businesses and to spend profits locally, thus enhancing multiplier effects (Barkley, 2001; Markusen, 1996). Small businesses also are an important source of employment opportunities and job growth. Entrepreneurship has multiple components that are captured by three variable groupings: the business proprietors grouping, the establishment age and churning grouping, and the business size and competitiveness grouping.

Proprietorship Variables. The proprietorship grouping measures entrepreneurial depth and breadth. It includes the number of proprietors per capita, the ratio of proprietors' income to total earnings in the MSA, and the percent of the population that is considered a racial minority. Entrepreneurship is expected to be associated with higher employment and per capita income growth rates, but entrepreneurs are not expected to have a significant effect on population growth.

Establishment Age and Churning Variables. Regions with a large proportion of young businesses are more likely to have higher productivity and more rapid employment growth rates

(Davis et al., 2008; Steinle, 1992). The establishment age and churning variable grouping includes the percent of establishments fewer than five years old and a business churning measure (establishment births plus deaths as a percent of total establishments). Young establishments also are expected to have a positive association with per capita income growth rates, but there are no *ex ante* expectations about the relationship of young establishments to population growth rates.

Business Size and Competitiveness Variables. Shaffer (2002) and Steinle (1992) find that regional economic growth is stronger when employment is spread across many smaller firms rather than concentrated in a few large firms. The presence of small businesses is measured by the number of establishments per employee and the percent of establishments with fewer than 20 employees. The business size and competitiveness variables are expected to be associated with increased growth in employment and per capita income. However, small businesses may be associated with lower population growth rates because small businesses may arise in response to a lack of other economic opportunities, a characteristic that discourages in-migration.

Industrial Specialization

Industrial specialization provides agglomeration economies as firms take advantage of localization economies, labor pools, and knowledge spillovers. Consequently, specialization may indicate the presence of industry clusters. Alternatively, industrial diversity helps regions to survive business cycles and long-term shifts in economic activity (CFED, 2003; Dissart, 2003; Malecki, 2004). Diversity also allows firms to take advantage of urbanization economies (Barkley and Henry, 2001). Krugman (1991) defines a region's industrial diversity as the inverse of the region's industry employment specialization.

In this study, industrial specialization ($SPEC_r$) is calculated using Krugman's employment index (Krugman, 1991):

$$SPEC_r = \sum_{i=1}^{n} \left|\frac{EMP_{i,r}}{EMP_r} - \frac{EMP_{i,US}}{EMP_{rUS}}\right|, \tag{10}$$

where $EMP_{i,r}$ and EMP_r are industry *i* employment in region *r* and total employment in region *r*, respectively, and $EMP_{i,US}$ and EMP_{US} are US employment in industry *i* and total US employment. Industrial specialization is expected to be associated with slower population growth; however, there are no *ex ante* expectations for relationships between industrial specialization and the growth rates of employment or per capita income.

Industrial Composition

Industrial composition describes the types of industries that have traditionally sustained a region's economy. The relative wage within traded industries compares the average wages in a region's traded industries to the average wages in those same industries in the US. Data on average wages in traded sectors are provided by the Cluster Mapping Project at Harvard Business School (2008).

The relative wage is a proxy measure for regional productivity (DeVol et al., 2007) and the region's stage in the product and profit life cycles (Markusen, 1985). More rapid wage and employment growth is anticipated in industries characterized by relatively productive labor and early-stage production processes. In addition, Porter (2003) recommends a focus on the traded sector because these basic industries play a considerable role in driving wages and, to a lesser degree, employment throughout all industries in the region. Each region's relative wage within its traded industries ($RelativeIndWage_r$) is estimated as

$$RelativeIndWage_r = \sum_i \left(\frac{EMP_{i,r}}{EMP_r} \times \frac{W_{i,r}}{W_{i,US}}\right), \tag{11}$$

where $EMP_{i,r}$ is employment in traded industry *i* in region *r*, EMP_r is employment in all traded industries in the region, $W_{i,r}$ is the average wage in industry *i* in region *r*, and $W_{i,US}$ is the US average wage for industry *i*. If $RelativeIndWage_r$ is greater than one, then region *r*'s average wage in its traded industries is higher than the US average wage in those same industries. Regions with higher relative industry wages are hypothesized to be at earlier stages of their industries' product life cycles, thus exhibiting greater growth potential and increased opportunities for the region's residents (Markusen, 1985). Therefore, high relative wages are predicted to be associated with higher growth rates of population, employment, and per capita income.

Factor Analysis

Variables are measured in per capita form to prevent the large cities' values from overwhelming smaller cities' data. Policy and structure/legacy variables are standardized to a mean of zero and a standard deviation of one. Standardization facilitates the combination of variables with different measurement scales (e.g., dollars per person and establishments per employee) and prevents larger absolute values from dominating the analysis. Competitiveness outcome variables (the ratios of population, employment, and per capita income in 2006 to their 2000 values) are measured in log form and thus represent growth rates.

Several of the variables measure similar metropolitan area characteristics (e.g., innovation or labor employability), and therefore some of the variables are highly correlated. Factor analysis is used to categorize variables into groupings, each with a common underlying characteristic called a factor. A composite measure made up of the variables with a common factor is used in the estimated regressions to reduce the instability and imprecision caused by multicollinearity (Greene, 2003; Intriligator, 1978).

The principal-factor method is used to group variables according to their squared correlation coefficients. Six factors are identified through evaluation of eigenvalues and scree tests in Stata, an econometrics program (StataCorp, 2005). A minimum eigenvalue of one provides factors that fit well with economic theory and previous research results, are interpretable, and are reasonably invariant to changes in variables and structure.[6] The factor pattern matrix is then rotated orthogonally (varimax rotation) to more easily identify variables with a single factor and to facilitate interpretation of the factors (Hatcher, 1994; Kim and Mueller, 1978). Table 3 provides the rotated variable loadings from the factor analysis.

The sign of a variable loading does not indicate the direction of the relationship of the variable to the factor. However, the signs of the loadings do indicate the relationships between variables in a factor. Different signs mean the variables affect the factor in opposite ways (Kim and Mueller, 1978). The variable loadings are provided in parenthesis to clarify the strength of relationships between variables and underlying factors and the direction of correlations between variables. Two variables, the industry specialization index and the relative industry wage, are not grouped with other regional characteristics.[7]

A one standard deviation increase in all variables included in a factor would cause the factor score to increase by one. Each factor has a mean of zero, but the standard deviations range from 0.9231 for the innovation factor to 2.1433 for the knowledge factor. Most standard deviations are near one.[8] Although the variables in this study are standardized to facilitate the combination of disparate values into factors, the factors are not further standardized. Standardizing variables and then standardizing factors created from those variables can distort the variables' importance in determining outcomes (Fisher, 2005; Johnson and Wichern, 2007). For example, a standardized variable in a standardized factor with six components would carry only half the weight of a standardized variable in a standardized factor with three components. Furthermore, standardized factors with extremely high variable loadings would have the same weight as factors with lower levels of communality among the selected variables.

Estimations of Regional Growth Models

Appropriate variable weights for indices of competitiveness are suggested by regressing the natural logs of the ratios of the 2006 to 2000 values of the competitiveness outcomes (population, employment, and per capita income) on the explanatory variables: the log of 2000 population, the standardized value of 2000 per capita income, and the groupings of the 1990 initial conditions identified by factor analysis.[9] The base year for the lagged outcomes is 2000 while 1990 data is used for the independent variables to reduce potential endogeneity bias.

The model provided in Equations 7 through 9 is estimated using the eight variable groupings identified by the factor analysis. The Carruthers-Mulligan simultaneous equations model is estimated using two-stage least square (2SLS). The first stage estimates the two simultaneous outcome levels, and those predicted values are used in the second stage estimation of the change in the growth rate of population, employment, or income. For example, the 2SLS estimation of the change in the population growth rate (Equation 3.46) includes a first-stage estimation of the 2006 levels of employment and per capita income. The predicted 2006 employment and income values are then used to estimate the change in the population growth rate.[10]

The use of variables derived from factor analysis decreases the unreliability of regression coefficients caused by multicollinearity. Even so, the innovation inputs and knowledge workers factors are not included in the same regression due to high correlation between the factors.[11] One regression is run with the knowledge workers factor dropped, and another regression is run with the innovation factor dropped to simplify the model and distinguish the separate effects of the factors (Intriligator, 1978). The two models achieve consistent results.[12]

Potential correlation issues are further reduced by using year 2000 values of the lagged, or base year, outcome variables and 1990 values of the remaining explanatory variables, also called initial conditions. The use of 1990 values for the policy and structure/legacy variables also reduces the likelihood of endogeneity bias between explanatory variables (e.g., knowledge workers) and dependent variables (e.g., change in per capita income).[13] To address heteroskedasticity in the population and employment growth, White-adjusted standard errors are used to determine the significance of the estimated coefficients.

IV. RESULTS

The results from the system estimation test the hypothesis that variables affect each outcome differently.[14] Table 4 provides the estimation results of the simultaneous equations for growth in metropolitan area population, employment, and per capita income both when the knowledge worker factor is dropped from the regressions and when the innovation factor is dropped. The coefficient on the logged terms is interpreted as the percent change in the dependent variable given a one percent increase in the logged term, holding all else constant. For example, the in the estimation of population growth using the innovation factor, population is expected to grow 0.6325 percent slower given a one percent increase in the 2000 metropolitan area population density.

The estimated coefficients on the policy input factors are interpreted as the percent change in the dependent variable if the factor increases by one factor score. For example, population is predicted to grow 0.0195 percent faster if the business size and competitiveness grouping increases by one factor score. For the coefficients on the industry employment specialization and relative industry wage variables, a one factor score increase is equivalent to a one standard deviation change in the explanatory variable. In other words, a one standard deviation increase in the employment specialization index, for example, is associated with a 0.0101 percent decrease in per capita income growth.

Coefficients on Lagged and Simultaneous Outcome Variables

The estimated coefficients on the base year outcome variables have the same signs as found by Carruthers and Mulligan (2008). Growth in population density is positively associated with current employment density and negatively associated with the base year population density and current per capita income. Growth in employment density is positively correlated with current population density and income and negatively correlated with base year employment density. Per capita income growth is positively associated with current employment density and negatively associated with current population density and base year per capita income, although only the coefficient on lagged income is statistically significant.

The negative and significant coefficients on the lagged dependent variables in each equation support the regional convergence hypothesis (Barro, 1991; Glaeser et al., 1995) and indicate a hysteresis effect (Cortright, 2001; Nitsch, 2003). People and firms respond to simultaneous as well as lagged effects. People appear to prefer areas where jobs currently are plentiful but where the current cost of living as suggested by per capita incomes is low. Employment growth is stronger where large current populations indicate a large labor force and where high current incomes suggest industries in early, high-growth stages of maturation. Meanwhile income growth is associated with more dense employment and less dense population.

Coefficients on Policy Input Variables

Most policy input variables are significantly associated with at least one outcome measure. The estimations including the innovation factor and the knowledge workers factor produce similar results for the policy variables (innovation inputs, knowledge workers, labor employability, and entrepreneurial environment). The innovation factor is associated with slower population growth and faster employment growth. Knowledge workers have a significant positive relationship to income growth, but there is not a significant correlation with employment growth or population growth. This finding does not support Florida's (2002b) belief that the creative class attracts economic activity. However, considered collectively, the significant coefficients on innovation inputs and knowledge workers agree with studies that find education (Florida, 2002b; Glaeser, 2005) and innovation (Acs, 2002; Audretsch, 2000) are critical drivers of economic growth. Finally, a tight skilled labor market (as reflected in the labor employability factor) is associated with higher income growth.

The various entrepreneurship measures have significant relationships with all of the competitiveness outcomes. The proprietorship factor has a significant positive association with employment growth and a negative association with population growth. This reversal of signs may indicate that people undertake entrepreneurial activity in response to a lack of other economic opportunities. The establishment age and churning factor (young establishments) has a significant positive relationship with population growth. The positive coefficients on the establishment age and churning factor in the population growth and employment growth estimations reflect the findings of Schumpeter (1942) and Davis et al. (2008) that creative destruction, or churning, promotes the growth of strong new industries.

The business size/competitiveness (small business) factor is the most highly significant entrepreneurship variable. A larger presence of small businesses has a positive and significant association with the growth rates in population and per capita income and a negative and significant association with employment growth. These results support Shaffer's (2002) and

Steinle's (1992) findings that a larger number of small firms is associated with stronger economic growth. In the version of the model with the innovation factor, industrial specification has a negative and significant relationship to income growth. The relative industry wage has no significant associations with the outcome measures.

V. CONCLUSION

Variables reflecting regional competitiveness inputs (innovation inputs, knowledge workers, labor employability, and entrepreneurial environment) are shown to affect various outcome measures outcomes (growth rates of population, employment, and per capita income) differently. Coefficients on explanatory variables have different values and levels of significance in estimations of different competitiveness outcomes. For example, the innovation inputs factor has a negative association with population growth, a positive association with employment growth, and no statistically significant relationship with per capita income growth. The conclusions of this study agree with previous studies (e.g., Camagni, 2002; Kitson et al., 2004; and Malecki, 2004) that regional economic competitiveness is a complicated process. Furthermore, lagged outcome variables are highly significant, suggesting a strong hysteresis effect.

Limitations of this study include data unavailability and methodological issues. Venture capital, patent, and cost of living data are excluded from the study due to measurement error and correlation with other factors despite being identified as unique variables in the factor analysis.[15] Similarly, business ownership data is unavailable for this study; however, the exclusion of a measure of establishment ownership is not believed to introduce omitted variable bias because ownership is measured to some degree by the entrepreneurial environment and business size/competitiveness factors. A more thorough accounting of industry size in each MSA would provide additional information on industrial structure because, for example, a region specialized in tourism will experience different growth patterns than a region specialized in high-tech enterprises.

Furthermore, the innovation inputs and knowledge workers factors from the factor analysis are correlated, producing unreliable results if the two factors are included in the same estimation (Greene, 2003; Intriligator, 1978). Population and employment, and thus the growth rates of these measures, are highly correlated. The error terms from the population and employment growth regressions are also correlated. However, the use of seemingly unrelated regression, did not appreciably improve the results.

Policy inputs are shown to have a different effect on different competitiveness outcomes (growth in population, employment, and income). This suggests that researchers and policymakers should clearly specify their measures of competitiveness and acknowledge potential conflicts between the measures (e.g., population growth and per capita income growth). Nevertheless, the general notion of “competitiveness” prevails in the literature. Future research might examine the balance of competitiveness outcomes in determining this overarching ideal.

Endnotes

1. The New Economy is generally accepted to be a knowledge-based economy, but researchers define the New Economy many ways (Atkinson and Court, 1998; Norton, 2000). It is often associated with computers and high-technology industries. However, traditional manufacturing establishments have adapted to the New Economy by using computer networks to manage supply, production, and distribution. The New Economy is believed to fuel unprecedented economic growth (Norton, 2000).

2. However, Atkinson (1990), Harvey (1989), and Scott and Lodge (1985) provide earlier references to competitiveness.

3. Wilmington, DE-MD, is actually a metropolitan division within the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD, MSA, and Wilmington is not included in this study. The Washington, DC MSA is excluded from this study because, as the nation's capitol, Washington is dominated by government activity. Washington's economy is fundamentally different from those of other Southern cities.

4. Enid, OK, was a metropolitan statistical area in 2000, but Enid became a micropolitan statistical area with the introduction of that designation in 2003. It is not a metropolitan statistical area in 2006 and is excluded from this study.

5. The percent of employment in computer, science, and engineering occupations and the percent of the population ages 25 and up with less than a high school diploma are each related strongly related to more than one element of the pyramid model. Intuitively, overlap exists between elements of regional economic competitiveness. Factor analysis indicates that these variables each load on two factors.

6. The selected factor structure is one of several possible structures. Other factors and other variables may be valid as predictors of competitiveness as well. In fact, patenting and venture capital data were initially included in the data set, but these variables were dropped due to measurement error (missing observations and MSA definitions that differ from the definitions of this study) and potential correlation with other variables despite high uniqueness scores. (The factor analysis did not group patents or venture capital with other variables.) After several factor analysis iterations, the six factors identified best meet the criteria of the statistical tests, the economic theory, and the structure of the data set.

7. The reader should note that the data for all variables in Table 3 are for the year 1990.

8. The standard deviations of the factors are as follows: innovation inputs, 0.9231; knowledge workers, 2.1433; labor force availability and quality, 1.0692; entrepreneurial environment, 1.5490; percent young establishments and churning, 0.9590; and small establishment competition, 0.9518.

9. Per capita income is not adjusted for cost of living in the reported estimations. The results of models that relied on adjusted per capita income are not reported due to measurement errors arising from non-reporting cities.

10. The Carruthers-Mulligan model specification is also estimated using three-stage least squares (3SLS) approach. In 3SLS, specification errors in one equation can bias all outcomes because the third stage enables correlation between the error terms. The results of the 2SLS of 3SLS simultaneous system estimations are compared (1) to ordinary least squares (OLS) regressions (both standard and White-adjusted) of the outcomes on the initial conditions and actual values of the simultaneous level outcomes and (2) to White-adjusted 2SLS estimations in which only 2000 base year outcomes are included on the right-hand side of the stage one estimation. The results of all five estimation methods are reasonably similar. The 2SLS estimations of the simultaneous system produce coefficients and standard errors that are consistent with the alternative specifications. The 3SLS estimations produce coefficients that are larger in absolute value and slightly smaller standard errors.

    An alternative specification suggested by Glaeser et al. (1995) is also estimated to determine the sensitivity of estimates to the model specification. Glaeser et al. treat the equations for changes in population, employment, and income as separate equations. Estimations relying on the Glaeser et al. separate equations specification produce similar results.

11. Similarly, Carruthers and Mulligan (2008) include human capital and quality of life measures in separate regressions due to correlation between these initial conditions.

12. The other variables in the regressions maintain their signs and similar magnitudes in regardless of whether the innovation or knowledge workers variable is included in the model. However, the innovation and knowledge workers variables are significant only if the other factor is dropped from the estimation. The condition number for the estimation including both the innovation and knowledge workers factors is 24.79; the condition number for the estimation in which knowledge workers are dropped is 6.46.

13. Regressions estimated using year 2000 values for both the base year outcomes and the initial policy and structure/legacy conditions provide similar results.

14. To simplify discussion of regression results, the term “variable” is used to refer both to the variable groupings identified through factor analysis and to variables excluded from factor groupings (e.g., the industrial specialization and traded wage variables and the lagged outcome measures).

15. Attempts were made to use data on patents (Harvard, 2008), venture capital (PricewaterhouseCoopers, 2008), and cost of living (American Chamber of Commerce Researchers Association, 1990, 2000, 2006). However, the measurement and correlation errors in the data led to unreliable results.

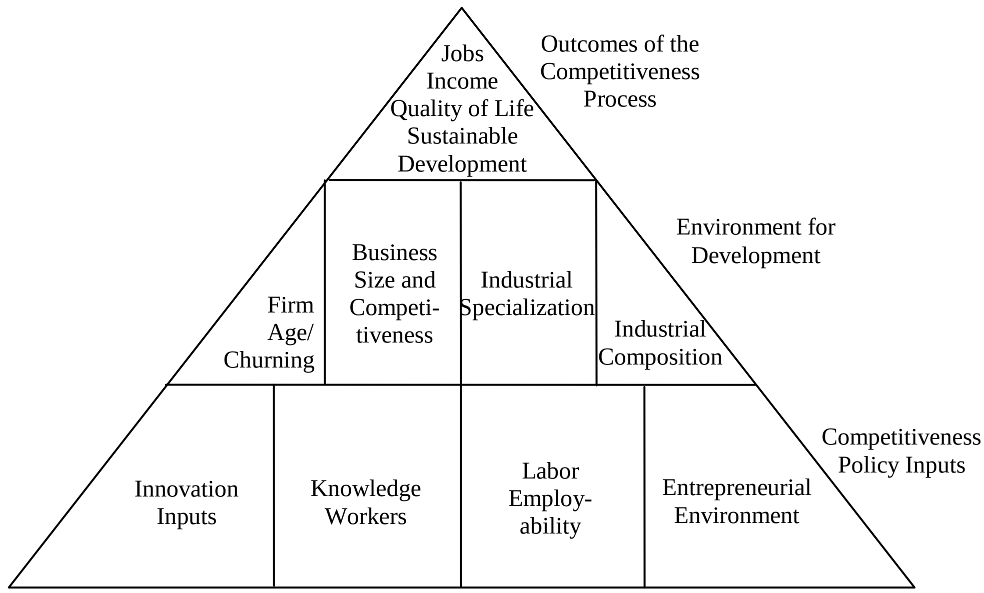

Figure 1. Regional Competitiveness Pyramid.

Table 1. Competitiveness Variables, Years, and Data Sources.

Element	Variable	Year	Data Source
Outcomes	Growth rate of population (and lagged population)	2006	US Census Bureau, 2007a, 2006 American Community Survey, Table B01003
		2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P1
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P001
	Growth rate of employment (and lagged employment)	2006	US Census Bureau, 2008a, County Business Patterns
		2000	US Census Bureau, 2008a, County Business Patterns
		1990	US Census Bureau, 2008a, County Business Patterns
	Growth rate of per capita income (and lagged per capita income)	2006	US Census Bureau, 2007a, 2006 American Community Survey, Table B19301
		2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P82
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P114A
Measures of the Competitiveness Policy Inputs:			
Innovation inputs	College and graduate school enrollment per 10,000 population	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P36
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P054
	Percent of population ages 25+ with an advanced degree	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P37
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P054
	Graduate students in science and engineering per 10,000 residents	2000	National Science Foundation, 2002b
		1994	National Science Foundation, 1996
	Science and engineering PhD's per 10,000 residents	2000	National Science Foundation, 2001
		1994	National Science Foundation, 1995
	Academic R&D spending per capita	2000	National Science Foundation, 2002a
		1990	National Science Foundation, 1999
	Percent of employment in computer, science, and engineering occupations	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P50
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P078
	Patents per 10,000 workers	2000	Harvard Business School, 2008
		1990	Harvard Business School, 2008
	Venture capital investment per capita, 2000-2006	2000	PricewaterhouseCoopers, 2008
		1990	PricewaterhouseCoopers, 2008

Continued.

Table 1. Competitiveness Variables, Years, and Data Sources, Continued.

Measures of the Competitiveness Policy Inputs, Continued:			
Element	Variable	Year	Data Source
Knowledge workers	Percent of employment in computer, science, and engineering occupations	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P50
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P078
	Percent of employment in management, business/operations, finance, computers, math, architecture, engineering, sciences, law, education, healthcare, arts, design, entertainment, media, and high-end sales occupations	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P50
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P078
	Percent of employment in professional, scientific, and technical services industries	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P49
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P077
	Percent of employment in manufacturing sectors	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P49
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P077
	Percent of population ages 25+ with a bachelor's degree	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P37
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P054
	Percent of population ages 25+ with less than high a school diploma	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P37
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P054
Labor employability	Percent of population ages 25+ with less than high a school diploma	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P37
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P054
	Percent of population of working age (25-64)	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P8
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P013
	Labor force participation rate	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P43
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P070
	Employment rate (employed/labor force)	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P43
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P070
	Percent of population who speak English well	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P19
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P028
	Out-of-poverty rate	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P87
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P117

Continued.

Table 1. Competitiveness Variables, Years, and Data Sources, Continued.

Measures of the Environment for Development:			
Element	Variable	Year	Data Source
Proprietorship	Number of proprietors per capita	2000	US BEA, 2008, Local Area Personal Income, Table CA030
		1990	US BEA, 2008, Local Area Personal Income, Table CA030
	Proprietors' income as a share of total earnings	2000	US BEA, 2008, Local Area Personal Income, Table CA05
		1990	US BEA, 2008, Local Area Personal Income, Table CA05
	Percent of population that is a racial minority	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P6
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P008
Establishment age and churning	Percent of establishments fewer than 5 years old	2000	US Census Bureau, 2008b, Special Tabulation
		1990	US Census Bureau, 2008b, Special Tabulation
	Business churning ([births + deaths]/initial establishments)	2000	US Census Bureau, 2001b, 2000-2001 Statistics of US Businesses
		1998	US Census Bureau, 1999, 1998-1999 Statistics of US Businesses
Business size and competitiveness	Establishments per employee	2000	US Census Bureau, 2008a, County Business Patterns
		1990	US Census Bureau, 2008a, County Business Patterns
	Percent of establishmets with fewer than 20 employees	2000	US Census Bureau, 2008a, County Business Patterns
		1990	US Census Bureau, 2008a, County Business Patterns
Industrial specialization	Employment specialization index	2000	US Census Bureau, 2002b, 2000 Decennial Census, Table P49
		1990	US Census Bureau, 1993, 1990 Decennial Census, Table P077
Industrial composition	Relative wage of occupations in traded industries	2000	Harvard Business School, 2008
		1990	Harvard Business School, 2008

Table 2. Descriptive Statistics.

Variable	Mean	Med.	Min.	Max.	S.D.
Growth rate of population, 2000-2006	0.0732	0.0667	-0.2846	0.5033	0.0803
Growth rate of employment, 2000-2006	0.0909	0.0764	-0.2277	0.7120	0.1020
Growth rate of per capita income, 2000-2006	0.1543	0.1537	-0.0185	0.3453	0.0536
Population, 2006	557,768.33	240,450.50	71,667	5,982,787	954,544.68
Employment, 2006	261,731.99	116,224.00	26,745	2,977,990	465,670.42
Per capita income, 2006	22,076.24	21,496.50	11,919	34,650	3,580.58
Population, 2000	507,829.85	227,569.00	49,832	5,161,544	845,857.62
Employment, 2000	233,344.03	101,289.00	18,815	2,550,873	400,279.30
Per capita income, 2000	18,892.78	18,403.73	9,899	31,195	2,921.95
Population, 1990	425,571.78	192,018.50	28,701	4,056,100	670,269.79
Employment, 1990	196,796.60	81,021.50	10,542	2,055,606	328,981.62
Per capita income, 1990	12,321.36	12,044.43	6,630.00	21,386.00	2,008.43
Graduate students in science and engineering per 10,000 residents	19.06	4.76	0.00	322.39	44.99
Science and engineering PhD's per 10,000 residents	1.15	0.00	0.00	28.74	3.61
Academic R&D spending per capita	73.93	0.0000	0.0000	1,806.65	224.83
College and graduate school enrollment per 10,000 residents	719.69	630.51	288.89	2,707.92	392.86
Percent of population ages 25+ with an advanced degree	6.03%	5.52%	2.62%	16.19%	2.32%
Percent of employment in computer, science, and engineering occupations	4.64%	4.55%	2.77%	7.79%	0.87%
Patents per 10,000 workers	2.87	2.26	0.26	11.75	2.21
Venture capital investment per capita, 2000-2006	79.68	0.0000	0.0000	1,875.82	236.31
Percent of employment in management, business/ operations, finance, computers, math, architecture, engineering, sciences, law, education, healthcare, arts, design, entertainment, media, and high-end sales occupations	37.93%	37.88%	27.05%	49.55%	4.24%
Percent of employment in professional, scientific, and technical services industries	4.06%	4.03%	2.39%	5.90%	0.68%
Percent of population ages 25+ with a bachelor's degree	11.22%	10.67%	5.99%	20.72%	3.04%
Percent of population ages 25+ with less than high a diploma	28.76%	27.96%	16.23%	53.39%	6.31%
Percent of population of working age (25-64)	50.12%	50.16%	41.15%	55.49%	2.67%
Labor force participation rate	48.80%	49.17%	36.36%	61.46%	4.23%
Employment rate (employed/labor force)	93.72%	93.84%	85.69%	96.77%	1.77%
Percent of population who speak English well	98.47%	99.40%	77.56%	99.82%	3.30%
Out-of-poverty rate	83.95%	84.76%	58.12%	92.45%	5.50%
Number of proprietors per capita	0.0729	0.0694	0.0223	0.1767	0.0213
Proprietors' income as a share of total earnings	0.0867	0.0842	0.0303	0.2308	0.0291
Percent of population that is a racial minority	20.44%	20.66%	1.60%	45.72%	11.00%
Establishments per employee	0.0712	0.0693	0.0470	0.1052	0.0125
Percent of establishments with fewer than 20 employees	87.03%	86.92%	82.84%	91.79%	1.60%
Percent of employment fewer than 5 years old	44.18%	43.56%	33.82%	60.79%	4.68%
Business churning ([births + deaths]/initial establishments)	0.2226	0.2200	0.1550	0.3265	0.0278
Relative wage of occupations in traded industries	0.7387	0.7257	0.3808	1.2957	0.1402
Employment specialization index	0.2661	0.2514	0.0809	0.7295	0.0947

0.0619	0.0769	0.0774	0.0946	0.9329	0.0655	-0.2064
0.3083	0.0256	-0.3513	-0.1850	0.7072	0.0201	0.0343
0.1736	0.1823	0.2140	0.0306	0.8336	-0.0080	0.1334
0.3433	0.4986	0.1110	-0.1184	0.5841	0.1274	0.1491
0.2876	0.3303	-0.0713	0.1163	0.5361	0.1368	-0.319
0.1350	0.2365	-0.0437	0.1210	-0.5636	-0.6769	-0.1289
0.0860	0.2730	0.2529	0.1588	0.2076	0.7503	0.3797
0.1435	0.3164	-0.1723	-0.0177	0.2437	-0.7031	-0.0684
0.1302	-0.0587	0.2030	0.2215	0.0558	0.8770	0.062
0.0557	-0.0595	0.2115	0.0354	0.0139	0.8923	0.3137
0.1514	0.0619	-0.1278	-0.0792	0.0296	0.6561	0.6251
0.1231	0.0671	0.0809	0.0083	0.117	0.4765	0.7906
0.1111	0.0085	-0.0405	-0.0645	-0.0719	0.1255	0.9285
0.0987	0.0125	0.0215	-0.0084	-0.005	0.0514	0.9446
0.0546	-0.0254	0.0086	0.0022	-0.0189	0.0792	0.9685
0.0404	-0.0065	0.0042	0.0019	-0.0292	0.0768	0.9761
I Stru Inde	C E	and I	Proprietorship	En Labor	Work Kno	Innovation Inputs
7/8	6	5	4	3	2	1

Factor

7/8	6	5	4	3	2	1
0.6010	0.4224	0.0312	0.0984	0.2756	0.3603	0.0399
0.6069	-0.1504	0.2765	0.0257	0.0598	-0.4631	0.2744
0.2593	-0.8453	0.1141	0.1004	-0.0437	0.0293	-0.0164
0.1213	-0.8720	0.2527	0.0530	-0.1225	0.1031	-0.0601
0.2224	-0.2092	0.7837	-0.0339	0.0229	0.3349	-0.0289
0.1343	-0.1977	0.8438	-0.0099	0.1447	0.2711	0.0062
0.5166	0.2494	0.0278	-0.4832	-0.3034	0.3048	-0.0082
0.3380	-0.1399	-0.0290	0.7230	-0.2383	0.1382	-0.1348
0.3331	-0.034	-0.0183	0.7301	0.1896	0.2713	0.0271
Stru Inde	E	l and	Proprietorship	En Labor	Work Kno	Innovation inputs

Factor

	Knowledge W			Innovation Factor		
	ln(y	ln(e	ln(p	ln(y	ln(e	ln(p
	-0.2094	0.8171	--	-0.1820	0.8971	--
	(-2.27)	(11.71)		(-1.76)	(12.05)	
	--	--	-0.0140	--	--	-0.0325
			(-17.75)			(-18.38)
	0.2076	--	0.0175	0.1854	--	0.0354
	(2.23)		(17.33)	(1.76)		(18.17)
	--	-0.8241	--	--	-0.9057	--
		(-11.72)			(-12.10)	
	--	0.2755	-0.1499	--	0.2540	-0.1480
		(4.17)	(-3.50)		(3.65)	(-3.48)
	-0.1755	--	--	-0.1400	--	--
	(-3.02)			(-2.34)		
	--	--	--	0.0071	0.0112	-0.0080
				(1.49)	(2.15)	(-2.00)
	0.0100	-0.0051	-0.0016	--	--	--
	(4.32)	(-1.01)	(-0.80)			
	0.0155	-0.0004	-0.0010	0.0158	0.0000	-0.0025
	(2.55)	(-0.82)	(-0.20)	(2.40)	(0.07)	(-0.45)
	-0.0055	0.0125	-0.0085	-0.0026	0.0148	-0.0092
	(-1.05)	(3.87)	(-4.02)	(-0.77)	(4.44)	(-4.37)
	-0.0050	0.0155	0.0242	0.0019	0.0075	0.0225
	(-0.55)	(1.68)	(5.07)	(0.32)	(0.92)	(4.81)
	0.0254	-0.0289	0.0204	0.0328	-0.0329	0.0195
	(3.87)	(-3.85)	(4.36)	(4.95)	(-4.55)	(4.27)
	-0.0026	0.0005	-0.0006	-0.0101	-0.0005	0.0017
	(-0.62)	(0.11)	(-0.18)	(-2.58)	(-0.07)	(0.35)
	-0.0055	0.0059	-0.0054	0.0026	0.0047	-0.0036
	(-0.70)	(1.05)	(-1.40)	(0.51)	(0.85)	(-1.55)
	2.0545	-3.5589	1.9954	1.0766	-3.0174	2.0045
	(3.45)	(-3.07)	(4.36)	(2.70)	(-4.65)	(4.70)
2	0.3147	0.7046	0.8255	0.2587	0.7635	0.8540

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