THE EFFECTS OF RURALITY AND INDUSTRIAL SPECIALIZATION ON INCOME GROWTH: U.S. COUNTIES 2000 TO 2003*

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Abstract

This paper— part of a comprehensive project on industry clusters and rural competitiveness— explores the role of industrial specialization and rurality on economic performance for counties in the continental United States. Regression models are estimated that evaluate the impact of industry cluster-specific employment shares on per capita income growth overall, as well as in a sequence of different contextual settings. Overall, the results suggest that economic disparities across U.S. counties will diminish. The results also suggest that economic specialization "per se" is not a guarantee for economic growth. Instead, economic growth very much depends on the type of specialization and the contextual setting, with distinct differences between, for example, the metropolitan sphere, the rural sphere, and the rural-metro interface.

Key words: Economic Growth, Industry Clusters, Rural America
JEL codes: O18, O51, R11

* The paper is part of a comprehensive EDA-funded project on industry clusters and rural competitiveness (EDA Grant *11.312-EDA-7-15-2005*). The research reported in this paper utilizes the project's industry cluster definitions developed by Christine Nolan from the Purdue Center for Regional Development (PCRD). It also draws heavily on the extensive data base assembled by Carol O. Rogers and her staff at the Indiana Business Research Center (IBRC). I especially would like to thank Steven Poelhekke, Department of Economics, European University Institute, Italy, for his many valuable comments on an earlier version that I presented at the North American Meetings of RSAI in Toronto, Canada.

Introduction

A great deal of research in regional science focuses on industry clusters, addressing a variety of issues. These issues range from the proper delineation of industry clusters, to their role in regional development strategies, to applications for specific regions that wish to capitalize on their competitive advantages in certain industry specializations.

This paper—part of a comprehensive project on industry clusters and rural competitiveness—is geared towards understanding the linkages between industry clusters, rurality, and economic growth. Does specialization in a particular industry cluster, such as agribusiness, have an effect on economic growth? Is it a dampening or magnifying effect? Is the effect uniform across all regions, or does the effect differ between urban versus rural settings?

Understanding such differences is of pivotal importance as even small differences in growth rates may, if persistent over long periods of time, lead to ever-increasing inequalities across the country. For example, if growth rates in rural areas are consistently below their urban counterparts, one will see an increasing divide between rural and urban regions, with rural populations experiencing a lower standard of living than people in urban areas.

This paper explores the role of industrial specialization and rurality on economic performance for counties in the continental United States, using data for the time period from 2000 to 2004. Regression models are estimated that evaluate the impact of industry cluster-specific employment shares on per capita income growth overall, as well as in a sequence of different contextual settings that represent the metropolitan sphere, the rural sphere, as well as the rural-metro interface.

The paper is divided into four sections. Following the introduction, the second section provides the background on industry clusters and economic growth, the industry clusters considered in this study, and the crucial question of how to define rurality. The empirical analysis, including data, methods and results, is presented in the third section. The final section summarizes the results.

Background

Industry clusters and economic development

The concept of industry clusters has a long tradition that dates back to work by Walter Isard, Jean Paelinck, Leo Klaassen and others in the 1950s, 1960s and 1970s (see for example the review by Czamanski and Ablas 1979). This well-known concept of industry clusters experienced a strong "revival" in the 1990s when Porter's work (Porter 1990, 1997, 2003, 2004) contributed to it being pushed into the applied realm of planning strategies and policies (see for example Held 1996; Bergman and Feser 1997; Berman et al. 1997; Sweeney and Feser 1998; Cortwright and Dukehart 2002; Jockel and Richardsen 2002; Feser 2004; Cortwright 2006;). The revival of industry clusters was also fueled by the growing literature on agglomeration economies that has so prominently put regions into the center of discussion (Krugman 1991; Fujita et al. 1999, Saxenian 1996; Hewings et al. 1998; Rosenthal and Strange 2003; Cheshire and Malecki 2004).

In an idealized sense, industrial clusters consist of a number of firms that share two characteristics: they are located in close geographic proximity to each other (i.e., within a region) and they engage in a similar economic activity (e.g., electronics industry). These two commonalities set the stage for formal and informal inter-firm information exchanges and thus foster learning, innovation, and ultimately economic growth. "When members of a cluster are located in close proximity, they can capture synergies that increase productivity, innovative capacity and new business formation." (Porter 2001**,** p. xv).

The linkages between spatial proximity and innovation potential are important from a regional development perspective, since supportive policies and a nurturing business environment may further strengthen the innovative milieu and thus enhance regional advantages. It is thus not surprising that development strategies have adopted regional perspectives that focus on the spatial concentrations of industries connected by inter-industry linkages within the industry clusters.

Such a regional perspective is particularly needed in rural places that—in isolation—cannot compete against the ever growing urban agglomeration. Thus, rural places need to join forces across a wider area so as to survive. Compared to urban areas, rural areas tend to have lower per capita income, higher poverty rates, and lagging educational levels. The urgency to join forces at a regional level is further exacerbated as many places in rural America have been struggling for economic vitality for a long time, leading to persistent and often growing rural-urban disparities.

Defining industry clusters

Cortright (2006) correctly points out that the term "industry cluster" is not a precisely defined term, but that it should be understood as an umbrella concept. In this regard, there is actually little disagreement over its meaning and definition, namely that it is "a geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue, that share specialized infrastructure, labor markets and services, and that are faced with common opportunities and threats." (National Governors Association 2002). In fact, close geographic proximity to each other, engagement in similar or related economic activities are the key issues, setting the stage for formal and informal inter-firm information exchanges, learning, innovation, and ultimately economic growth. Knowledge spillovers are crucial in that they are a key driver of the spatial clustering and—at the same time—the mechanism that allows firms to benefit from the clustering. As Porter (2001, p. xv) points out, "[w]hen members of a cluster are located in close proximity, they can capture synergies that increase productivity, innovative capacity and new business formation" (p. xv).

In applied settings, however, the definition of industry clusters needs to go beyond the "umbrella concept" and a clear assignment of which industries belong to which cluster becomes a necessity. There are a number of very promising approaches to identifying clusters. For example, Porter (2004) distinguishes between 41 traded clusters. For the current study (which is part of a larger project including an in-depth analysis of industry clusters in a primarily rural region of southern Indiana), a set of cluster definitions was developed that could be usefully applied to analyzing the specific rural region in southern Indiana but could also be applied to the entire United States. In total, 17 clusters were defined of which four were selected to represent a county's industry mix and specialization: a business and financial services cluster, an information technology and telecommunications cluster, an agribusiness, food processing and technology cluster, and a manufacturing cluster.

The business and financial services cluster

The business and financial services cluster is an important cluster in terms of employment share, accounting for over 8.5 percent of total employment in 2004. The industries that make up this cluster include only the more advanced and specialized services; for example, NAICS 522110, -120 and -130 Commercial Banking, Savings Institutions and Credit Unions are excluded from this cluster. The vast majority of counties have a very low representation of this cluster. In fact, about 83 percent of all counties have a location quotient of less than 0.5; however, extreme specialization with very high location quotients is also rare. In total, the location quotient of the business and financial services cluster exceeds 1.2 in 99 counties.

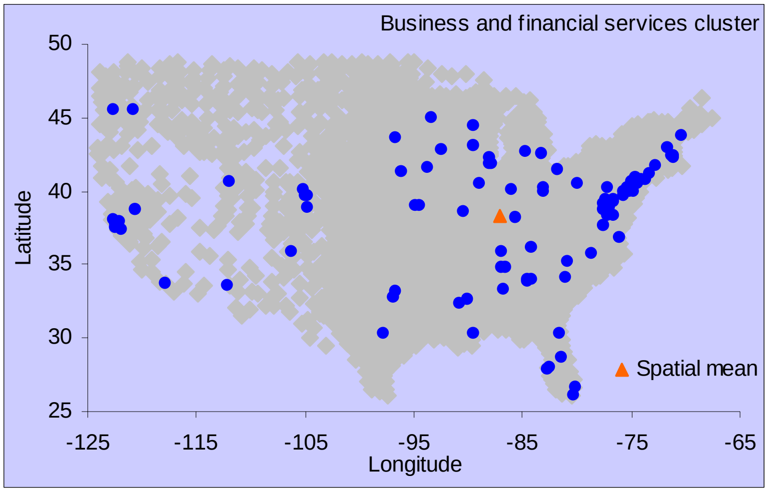

Figure 1. Counties specialized[1] in the business and financial services cluster, 2004

[1] A county i is considered to be specialized in an industry cluster j if the location quotient $LQ_{ij} > 1.2$, that is if the county's employment share in the industry cluster exceeds that of the nation by at least 20 percent. Note that the threshold of 1.2 is somewhat arbitrary. However, it is high enough to ensure that counties considered specialized have an employment share that is substantially higher than what could easily be a result of measurement error.

These counties are primarily concentrated along the East coasts, in the San Francisco area as well as in the metropolitan areas of the country's interior, such as in and around Chicago, Indianapolis, and Denver. Thus, the average location is barely representative of the primarily coastal concentration of the business and financial services cluster. In fact, on average, the counties specialized in the business and financial services cluster are almost 700 miles away from the spatial mean.

The information technology and telecommunications cluster

In 2004, 81 counties specialized in the information technology and telecommunications cluster. Many of those counties are part of metropolitan areas. In particular, the data indicate an elongated hotspot stretching along the east coast megalopolis from Boston to the District of Columbia, as well as strong concentrations in major metro areas of the west coast and several other parts of the nation. The average location for the counties specializing in the information technology and communication cluster is in the St. Louis, MO area. However, the dispersion around the average location is extremely high for the counties specializing in the information technology and communication cluster. On average, the specialized counties are more than 800 miles away from the average location.

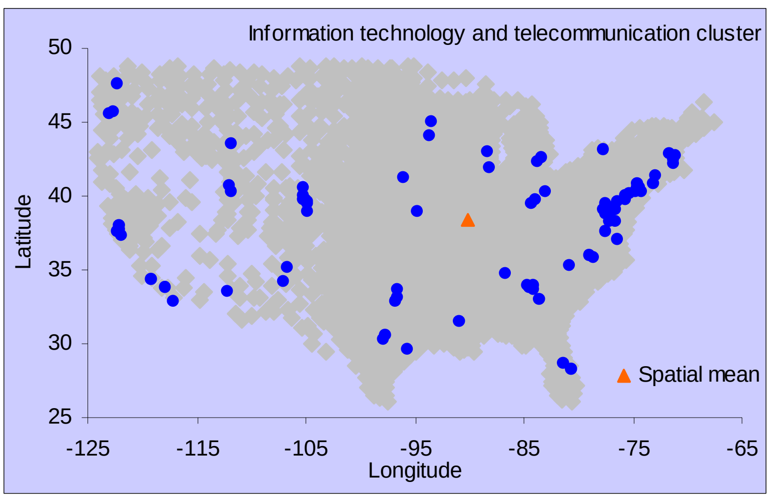

Figure 2. Counties specialized in the information technology and telecommunications cluster, 2004

The manufacturing cluster

With over 5 percent of total employment, the manufacturing cluster accounts for the third largest employment share in the U.S. economy. For 484 counties, the location quotients exceed 1.2, and those counties are heavily concentrated in the old *rustbelt* states.

Taking a closer look inside the manufacturing cluster reveals that different manufacturing subclusters have distinct spatial patterns.For example, the computer-and-electronic product-manufacturing industries have distinct concentrations on the West Coast, in Minnesota, and the Northeast.

In contrast, the locational pattern of the very traditional transportation equipment manufacturing industries form an axis of concentration from Michigan south to Indiana, Kentucky and Tennessee. Overall, however, most counties with a strong manufacturing specialization are located east of 100° western longitude with local concentrations primarily in the upper Midwest. The spatial mean is located about 170 miles south of Chicago with a standard distance of only 421 miles.

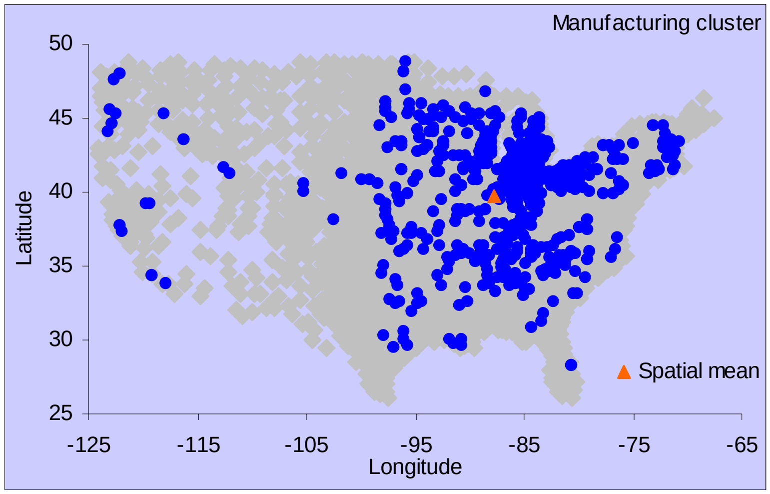

Figure 3. Counties specialized in the manufacturing cluster, 2004

The agribusiness, food processing and technology cluster

The locational pattern of the agribusiness cluster industries is quite distinct. About 53 percent of all counties have a very low representation of industries associated with the agribusiness, food processing and technology cluster (LQ<0.5), but about 29 percent of all U.S. counties have an above average concentration with a location quotient that exceeds 1.2.

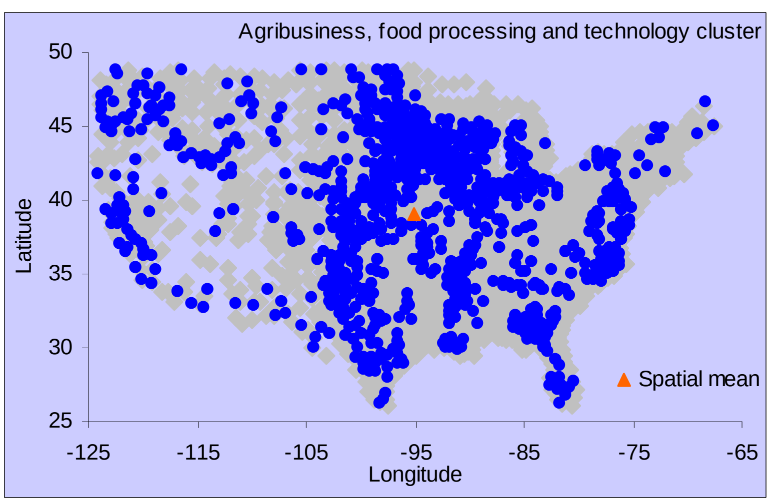

Figure 4. Counties specialized in the agribusiness, food processing and technology cluster, 2004

Strong spatial concentrations of the agribusiness, food processing and technology industry exist in a number of states, including the Corn Belt states and prairie states, Florida and California. Concentrations of agribusiness, food processing and technology industries are noticeably absent (or at least underrepresented) in several states, including West Virginia and some of the New England states. The spatial mean is located in northeastern Kansas, and is thus quite close to the vast majority of counties specialized in the agribusiness, food processing and technology cluster. On average, they are only 611 miles away from the spatial mean. However, that distance would most certainly be smaller if it were not for the agricultural concentrations along the West and East coasts.

Defining Rurality[2] and the Rural-Metropolitan Interface

Rurality is a vague concept. Being rural as opposed to urban, or the related notion of degree of rurality, is an attribute that people easily attach to a place based on their perceptions of its characteristics. These may include low population density, abundance of farmland, and remoteness from urban areas.

In contrast to the colloquial use of "rural" and "urban," researchers and policy makers require a precise definition. However, there is no consensus about how to define or measure the concept of rurality. Moreover, many existing measures are ill suited, if not flawed. As Isserman (2005) pointed out, rural research and rural policy are based on ill-defined distinctions between rural and urban. He criticized the common use of the metropolitan/non-metropolitan distinction (Office of Management and Budget 2000, 2003) as a proxy for, or even worse, as synonymous with, a rural-urban distinction.

A similar criticism applies to the rural-urban continuum code and the urban influence code defined by USDA's Economic Research Service (ERS). Although their names and numeric coding suggest a "continuous" and monotonic increase of rurality with increasing numbers on the coding scales, this perception is illusory as the codes obscure the distinction between metro and non-metro counties. As a result, many counties with low population size and low density are allocated to the same category as highly urban counties such as Cook County, Illinois, or Marion County, Indiana, home to Chicago and Indianapolis, respectively.

To remedy these shortcomings, Isserman (2005) suggested a rural-urban density typology that is independent of OMB's metropolitan/non-metropolitan differentiation. It utilizes thresholds for three variables—population density, the percentage of the population living in urban areas as delineated by the U.S. Census Bureau, and the population size of the largest urban area—to define 1,790 rural and 171 urban counties. The remaining counties not meeting the threshold criteria are subsequently labeled "mixed rural" (1,022 counties)

[2] Parts of this section are based on a more extensive discussion in Waldorf, B. 2006. A Continuous Multi-dimensional Measure of Rurality: Moving Beyond Threshold Measures. Paper selected for the Annual Meetings of the Association of Agricultural Economics, Long Beach, CA, July 2006. http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=21522&ftype=.pdf

or “mixed urban” (158 counties) and this distinction is made solely based on a population density threshold.

Although Isserman’s typology avoids using the misleading metro/non-metro classification, it does fall into the so-called “threshold trap.” That is, it utilizes thresholds to define a finite number of rurality categories. Not only are thresholds arbitrary, but they also create artificial similarities and dissimilarities. That is, by imposing artificial boundaries between the categories, similar counties may be classified as different, whereas counties that are very dissimilar may be grouped together in the same category.

As a result of the shortcomings of Isserman’s methods, this project used a recently introduced, continuous, multidimensional measure of rurality (Waldorf 2006, 2007), the Index of Relative Rurality (IRR). The IRR does not answer the question ‘Is a county rural or urban?’ but instead addresses the question ‘What is a county’s degree of rurality?’ It improves our understanding of rurality, is independent of OMB’s metropolitan/non-metropolitan distinction and does not fall into the threshold trap. Its ability to offer a more sensitive perspective on the intricate relationships between rurality, industrial clusters, and economic performance was important for this project.

The IRR is based on four dimensions of rurality: population, population density, extent of urban (built-up) area, and remoteness. These dimensions are unquestioned in terms of their contribution to rurality and are incorporated implicitly in many existing rurality definitions. The index is scaled from 0 to 1, with zero representing the most urban place and one representing the most rural county.

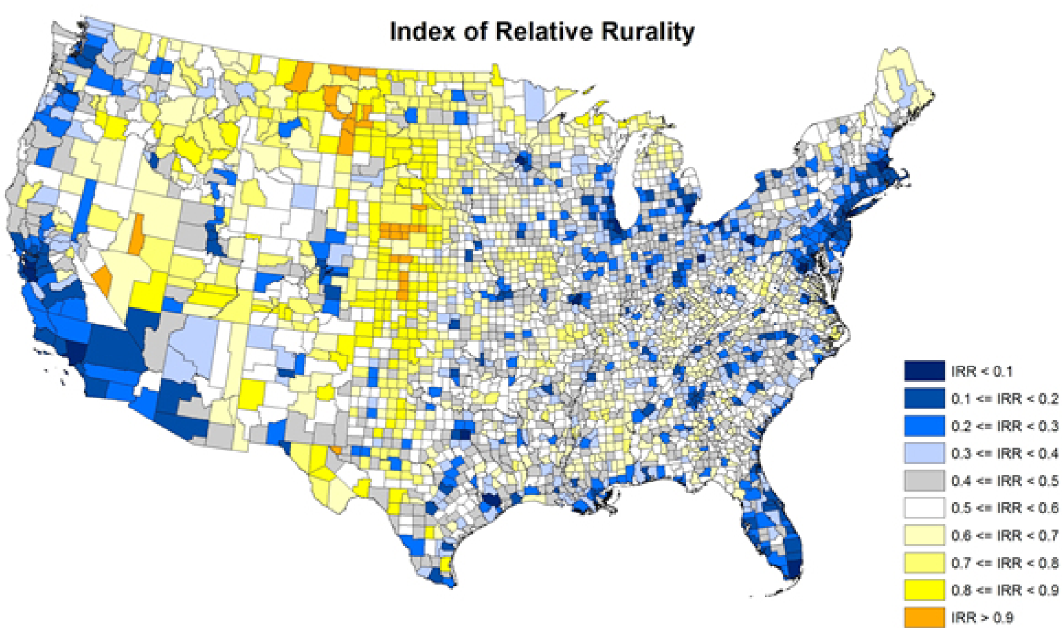

Figure 5. Index of relative rurality, U.S. counties 2000
Source: Indraneel Kumar, PCRD

Figure 5 shows the variations in the index across counties in the continental United States in 2000. The lowest rurality scores (i.e., highly urban areas) are recorded for counties along the coasts as well as for the urban centers along the Great Lakes. Counties east of the Mississippi have low to medium levels of rurality; the most rural county east of the Mississippi is Keweenaw, MI, with an IRR value of 0.895. Moving west from the Midwest to the Great Plains coincides with a distinct increase in rurality. In fact, extreme rurality (IRR>0.8) is widely prevalent in many counties of the Great Plains and the Mountain States.

The rural-metropolitan interface, i.e., rural counties located at the metropolitan fringe, is of particular importance. The concept of a rural-metropolitan interface is rooted in the idea that rurality plays out differently for counties within the influence of a metropolitan area versus places that are far away from a metropolitan area. The most obvious reason for this difference is accessibility to the amenities of a metro area such as airports, shopping and cultural opportunities. Metropolitan areas also offer agglomeration economies from which nearby places may benefit.

Table 1. Definitions of the Rural-metropolitan Interface Levels

Level	Definition	Location Relative to Metro Area	Degree of Rurality
	Metropolitan Sphere		
A	Metropolitan central counties with a population of at least 500,000.	Within	Low
B	Metropolitan central counties with a population of less than 500,000.	Within	Low
C	Outlying metropolitan counties with IRR< 0.4	Within	Low
	Rural-Metropolitan Interface		
D	Outlying metropolitan counties with IRR >= 0.4	Within	High
E	Non-metropolitan counties adjacent to a metropolitan area and IRR< 0.4	Adjacent	Low
F	Non-metropolitan counties adjacent to a metropolitan area and IRR >= 0.4	Adjacent	High
	Rural Sphere		
G	Non-metropolitan counties not adjacent to a metropolitan area	Remote	High

To define the rural-metropolitan interface adequately, I combined the index of relative rurality with the urban influence code as defined by USDA's Economic Research Service. This yields seven levels that are jointly defined by rurality and metropolitan access.

- Levels *A* and *B* refer to highly urban metropolitan core counties. They differ by population size (above versus below 500,000).

- Levels *C* and *D* are outlying metropolitan counties. They differ by degree of rurality (IRR above versus below 0.4).
- Levels *E* and *F* are non-metropolitan counties adjacent to a metropolitan area. They, too, differ by the degree of rurality (above versus below 0.4).
- Finally, level *G* includes non-metropolitan counties that are not adjacent to a metropolitan area.

It is in levels *D*, *E*, and *F* where the metropolitan sphere meets the rural sphere. These three levels will be referred to as the rural-metropolitan interface. Table 1 provides the definitions of the rural-metropolitan interface levels.

Figure 6 shows the spatial distribution of the seven rural-metropolitan levels. Three features are most notable: first, there is an abundance of metropolitan counties along the coasts and the Great Lakes; second, the counties of the rural-metropolitan interface (levels *D*, *E*, and *F*) form rings around the highly urban core of the metropolitan areas; and third, in the western part of the United States, the rural-metropolitan interface consists primarily of level *F* counties. These are counties that are rural in character and adjacent to metropolitan core counties. A reason for the absence of level *D* and level *E* counties is undoubtedly the large size of counties that are often big enough to encompass a good deal of the urban sprawl.

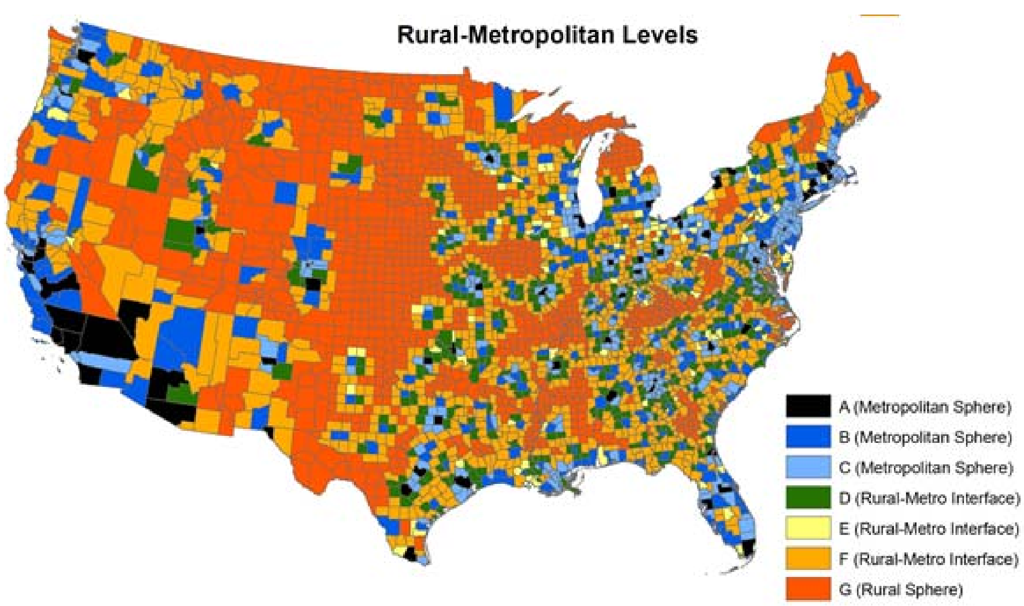

Figure 6: Rural-metropolitan levels, U.S. counties 2000
Source: Indraneel Kumar, PCRD

Table 2 shows the relationship between each of the seven levels defined above, the index of relative rurality, and the distance to the closest metropolitan core. On average, both the rurality (IRR) and the distance to the metropolitan center increase as one proceeds from level A to level G. Only the 400 counties of level *D* deviate from this trend and deserve particular attention. Level D counties are part of metropolitan areas but are rural in character. In fact, they are typically more rural than the 108 counties of level *E* that are adjacent but not within a metro area. Level D counties are also the counties with the fastest population growth, amounting to 17.9 percent between 1990 and 2000 compared to only 13.13 percent for the entire population in the 3,108 counties of the continental United States. As a result, they slightly increased their share of the total population. In contrast, counties outside metropolitan areas (levels *E* , *F*, and *G*) had a below-average population growth and thus a dwindling population *share* during the 1990s.

Table 2. Selected Characteristics of Rural-Metropolitan Levels

Rural-Metropolitan Level	Number of Counties	Share of Total Population		Population Growth: 1990-2000 [%]	Index of Relative Rurality		Distance to Metropolitan Center [km]	
		1990	2000		Average	Std. Dev.	Average	Std. Dev.
				Metropolitan Sphere				
A	64	29.80	29.57	12.3	0.112	0.040	0.0	0.0
B	294	19.42	19.30	12.4	0.253	0.066	0.0	0.0
C	327	28.78	29.62	16.5	0.263	0.089	39.3	14.5
				Rural-Metropolitan Interface				
D	400	4.08	4.25	17.9	0.527	0.078	48.0	17.8
E	108	2.63	2.55	9.6	0.360	0.037	47.7	14.5
F	947	9.05	8.86	10.8	0.543	0.092	65.6	25.2
				Rural Sphere				
G	968	6.25	5.86	6.1	0.632	0.138	133.3	58.3

Empirical Analysis

Model Specification and Data

The models of economic growth across U.S. counties are specified as "convergence-style models" (Barro and Sala-i-Martin 1992, Chatterji and Dewhurst 1996). Thus, the dependent variable, *y*, is the logarithm of economic growth, and the logarithm of economic condition in the base year, *x*, is the exogenous variable:

$$\ln y = \alpha + \beta \ln x + \varepsilon$$

There will be economic convergence across U.S. counties if $\beta < 0$, i.e., if counties with poor economic conditions in the base year grow faster than those with good economic conditions in the base year. This basic model is further refined by allowing economic growth to be influenced by an extended set of exogenous variables, including industry-cluster-specific employment shares and rurality. In addition, we also included human capital as an important covariate that can serve as a proxy for innovation potential.

The empirical models are based on 3,054 counties in the continental United States. Table 3 provides the source and summary statistics for the variables entering the empirical analysis. Most importantly, economic growth is operationalized by the ratio of per capita income in 2003 over per capita income in 2000.[3] The set of exogenous variables includes per capita income in the baseline year 2000. The per capita income data are taken from the Bureau of Economic Analysis (BEA).

Table 3. Summary Statistics for Variables in the Models

	Minimum	Maximum	Average	Standard Deviation
Dependent Variable				
Ratio per capita income 2000 over per capita income 2003	0.84	1.95	1.09	0.07
Exogenous Variables				
Per capita income in 2000	7459	85829	23051	5820
Index of Relative Rurality	0.00	1.00	0.50	0.18
Employment share in:				
Business & Financial Services	0.00	0.25	0.03	0.03
Information Tech & Telecom	0.00	0.26	0.01	0.02
Agribusiness, Food Processing & Techn	0.00	0.44	0.03	0.05
Manufacturing Supercluster	0.00	0.61	0.03	0.05
% adults with Bachelor's Degree	0.00	40.28	10.91	4.89
% adults without High School Degree	3.06	65.45	22.66	8.72

The model refinements extend the set of exogenous variables. In particular, they will include the index of relative rurality as presented in section 2.3. Equally important, they control for industry mix. Industry mix is measured by employment shares in the four industry clusters presented in section 2.2: the business and financial services cluster, the information technology and telecommunications cluster, the agribusiness, food processing and technology cluster, and the manufacturing cluster.

Two main reasons guided the selection of industry clusters for the estimated regressions models. First, the industry clusters selected here make up a good deal of total employment. For example, on average, the manufacturing cluster accounts for 3 percent of county employment, but can be as high as 61 percent. Employment shares in the information technology and telecommunications cluster are the smallest among the four industry clusters. Yet, even here there are some counties where the cluster accounts for over 20 percent of employment. Second, the four selected industry clusters represent urban-oriented clusters (business and financial services, and information technology and telecommunications), a group of clusters co-locating with manufacturing, such as advanced materials, and the group of less-urban oriented industry clusters dominated by the agribusiness, food processing and technology cluster.

Finally, the extended models also include two variables that capture variations in human capital. They are the extremes of the educational attainment scale, that is, the percent of the adult population (age 25 and older) that holds at least a bachelor's degree and the

[3] Note, in this version there is no adjustment for variations in cost-of-living.

percent of the adult population without a high school degree.[4] Note that the amount of variation in educational attainment levels is substantial. For example, the percentage of adults without a high school degree varies from only 3 percent to 65 percent. In general, the more highly educated populations are found in the more urban counties.[5]

Empirical results

The estimation results are summarized in Table 4. The unconditional growth model (Model 1) suggests overall convergence of per capita income across the U.S. counties, at a convergence rate of about 3.6 percent per year. That is, counties that have a low per capita income grow at a faster rate than counties that have a high per capita income. In the end, if these trends continue, per capita income differences across U.S. counties will disappear. Adding information on counties' rurality (Model 2) does not change this conclusion.

Table 4. Estimates for Models of Per Capita Income Growth, U.S. Counties 2000-2003

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	b	t	b	t	b	t	b	t
Intercept	1.106	24.443	1.092	20.689	1.0746	17.892	1.5890	22.035
Per Capita Income	-0.102	-22.667	-0.101	-18.767	-0.1000	-17.553	-0.1542	-21.943
Index of Relative Rurality			0.0013	0.504	-0.0048	-1.379	-0.0072	-2.024
Employment Share in:								
Bus. & Financial Services.					0.0027	1.570	-0.0003	-0.192
Info Tech &Telecom					-0.0003	-0.526	-0.0013	-2.117
Agribusiness, Food Proc. & Tech					0.0030	3.838	0.0031	3.971
Manufacturing Supercluster					-0.0060	-7.128	-0.0041	-4.839
% adults with Bachelor's Degree							0.0029	8.498
% adults without HS Degree							-0.0007	-3.859
df	3052		3051		3047		3045	
Adj. R^2	0.144		0.144		0.161		0.203	
λ	3.598		3.543		3.512		5.582	

[4] We experimented with alternative measures of educational attainment levels, such as the percentage of the adult population with at least a master's degree, and the percentage of the population with at least some college education. However, these modification in the operationalization of the human capital variable did not affect the results.

[5] The correlation coefficient between the index of relative rurality and the % of adults with at least a bachelor's degree is -0.381.

In Model 3, industry mix is added as a possible source for variations in growth rates. The estimation results suggest that employment shares in the two urban industry clusters—business and financial services and information technology and communication—do not influence the growth rate. However, high employment shares in the agribusiness, food processing and technology cluster significantly increase the per capita growth rate, while high employment shares in the manufacturing cluster significantly decrease the growth rate.

Model 4 conditions growth rates also on information about human capital. The results indicate that human capital is a primary factor influencing income growth. Other things equal, a county with a high percentage of adults with at least a bachelor's degree will have a higher growth rate than a county with a low percentage of college graduates. The opposite holds true for the percentage of adults not having completed high school. Note that, once human capital is taken into account, the degree of rurality also plays a role: the higher the degree of rurality, the lower the growth of per capita income.

Model 4 accounts for 20 percent of the variance in per capita income growth in U.S. counties. The unexplained variation may be due to the fact that the impact of the exogenous variable on economic growth plays out differently in different contextual settings. To account for these possible nuances, Model 4 is re-estimated for each of the seven rural-metropolitan levels. The results are shown in Tables 5, 6, and 7.

Table 5. Estimates for Models of Per Capita Income Growth, Layers of the Metropolitan Sphere 2000-03

	Metropolitan Sphere					
	Level A		**Level B**		**Level C**	
	b	t	b	t	b	t
Intercept	0.8674	2.0167	1.2594	6.6174	1.4058	7.144
Per Capita Income	-0.0818	-2.0860	-0.1173	-6.5037	-0.1253	-6.572
Index of Relative Rurality	-0.0037	-0.3402	-0.0121	-1.0096	-0.0233	-2.852
Employment Share in:						
Bus. & Financial Services.	0.0457	2.3468	0.0071	0.9736	0.0295	4.344
Info Tech &Telecom	-0.0505	-3.9302	0.0006	0.1849	-0.0056	-1.772
Agribusiness, Food Proc. & Tech	-0.0057	-0.6696	-0.0007	-0.3367	-0.0048	-1.599
Manufacturing Supercluster	-0.0049	-0.5993	-0.0092	-3.8959	-0.0056	-2.023
% adults with Bachelor's Degree	-0.0009	-0.4960	-0.0003	-0.3252	-0.0028	-3.073
% adults without High School Degree	-0.0016	-1.4106	-0.0007	-1.3818	-0.0015	-2.338
df	54		278		295	
Adj. R^2	0.416		0.209		0.330	
λ	2,844		4.159		4.462	

Table 6. Estimates for Models of Per Capita Income Growth, Layers of the Rural-Metropolitan Interface 2000-2003

	Rural-Metropolitan Interface					
	Level D		**Level E**		**Level F**	
	b	**t**	**b**	**t**	**b**	**t**
Intercept	1.2269	6.111	0.7807	2.677	1.3265	8.732
Per Capita Income	-0.1240	-6.363	-0.0702	-2.410	-0.1333	-9.150
Index of Relative Rurality	-0.0362	-1.837	-0.0413	-0.627	-0.0007	-0.058
Employment Share in:						
Bus. & Financial Services.	-0.0043	-1.141	0.0108	1.132	-0.0012	-0.407
Info Tech &Telecom	0.0001	0.112	0.0050	1.289	-0.0020	-2.094
Agribusiness, Food Proc. & Tech	0.0022	1.211	0.0029	0.858	0.0032	2.577
Manufacturing Supercluster	-0.0021	-1.081	-0.0053	-1.607	0.0007	0.485
% adults with Bachelor's Degree	0.0027	2.699	-0.0001	-0.091	0.0060	8.368
% adults without High School Degree	0.0006	1.363	0.0008	1.130	0.0009	3.169
df	386		90		931	
Adj. R^2	0.153		0.175		0.163	
λ	4.413		2.426		4.768	

The estimation results suggest that, at each rural-metropolitan level, economic convergence persists. That is, counties with low per capita income experience significantly higher growth than counties with a high per capita income. However, the speed of convergence —as indicated by λ—differs across the seven levels. It is fastest within the rural sphere (level G), followed by the most rural counties of the rural-metropolitan interface (level F). The estimated convergence speed is slowest among non-metropolitan counties that are neighboring a metro area, i.e., for level-E counties.

The estimation results also show that the explanatory variables operate differently at each rural-metropolitan level. How rural a county is influences income growth in two of the seven levels. Among level-C counties, that is, counties with suburban character located within a metropolitan area, increased degrees of rurality are associated with lower growth rates of per capita income. In contrast, among level-G counties, that is, within the large group of counties within the rural sphere, increased rurality has an advantageous effect on the per capita income growth rate.

Table 7. Estimates for Models of Per Capita Income Growth, Rural Sphere 2000-2003

	Rural Sphere	
	Level G	
	b	**t**
Intercept	1.8275	13.326
Per Capita Income	-0.1700	-12.947
Index of Relative Rurality	0.0508	3.519
Employment Share in:		
Bus. & Financial Services.	0.0006	0.176
Info Tech &Telecom	0.0019	1.471
Agribusiness, Food Proc. & Tech	0.0038	2.515
Manufacturing Supercluster	-0.0048	-2.477
% adults with Bachelor's Degree	0.0025	3.665
% adults without High School Degree	-0.0013	-3.911
df	957	
Adj. R^2	0.202	
λ	6.211	

Context dependency is also discernible in the effects of industry specialization on income growth. For level-A and level-C counties of the metropolitan sphere, increasing the employment share of the business and financial services cluster has a positive impact on income growth. In contrast, in the counties of the rural-metropolitan interface and the counties of the rural sphere, employment shares in business and financial services do not have an impact on per capita income growth.

The opposite is true for the (co-locating) information technology and communication cluster. Employment shares of the co-locating information technology and telecommunication cluster have an adversarial impact on per capita income growth in level A and level-C counties in the metropolitan sphere, and on level-F counties of the rural-metropolitan interface. In all other spheres, employment shares of the co-locating information technology and telecommunication cluster have —by and large— no effect on income growth.

Employment shares in the agribusiness, food processing and technology cluster are only influential for the most rural counties (levels F and G) where high shares positively influence income growth. Manufacturing employment shares negatively influence per capita income growth, but the effect is only significant for level-B and level-C counties in the metropolitan sphere, and level-G counties in the rural sphere.

The effects of the human capital variables on income growth are puzzling. For rural counties—whether within (level D), adjacent to (level F), or remotely located (level G) from a metropolitan area—the percentage of college graduates has a strong and positive effect on income growth. Surprisingly, however, it has no effect or even a negative effect in counties with low degrees of rurality. The percentage of poorly educated residents (no high school degree) has the expected negative effect on per capita income growth among level-C and level-G counties. Somewhat counterintuitive, however, the percentage of adults without a high school degree positively influences per capita income growth in rural counties neighboring metropolitan areas (level-F counties).

Summary and Conclusions

A focus on industrial clusters increasingly dominates the discussion on regional development and economic specialization (Porter 1990, 2001, 2003; Sweeney and Feser 1998; Feser 2004, Cortright 2006). Not surprisingly, today's regional development strategies are often geared towards capitalizing on the competitive advantages of their strongest industry clusters. However, the question remains whether specialization in particular industry clusters truly propels economic growth. Does it matter whether specialization is, for example, in manufacturing or agriculture or information technology? Do certain specializations have more beneficial effects in some contextual settings than in others?

To address these questions, this study estimates economic growth in a series of convergence-style models that control for rurality, industry mix, and human capital. The results suggest that the future growth trajectory of U.S. counties will be marked by declining disparities. In general, lagging counties will grow at a faster rate than counties already enjoying a higher economic standard.

In general, industry specialization matters for growth. Whether the effect is positive or negative depends on the industrial sector and the context. That is, the impact of industry mix, rurality, and human capital on income growth differs across the rural-metropolitan landscape. Within the rural sphere, counties with the most extreme rurality tend to grow slower, and so do counties specializing in manufacturing. It is important to note that economic growth in rural counties is positively influenced by human capital. Within the metropolitan sphere, industry mix has an important impact on growth rates, with specialization in business and financial services and financial services increasing growth rates, and specialization in information technology and communication decreasing growth rates. At the rural-metropolitan interface—defined as the rural counties of metropolitan areas and the non-metropolitan counties adjacent to metropolitan areas—neither the industry mix nor the degree of rurality play a pivotal role for economic growth. However, just as in the rural sphere, economic growth in the rural counties of the rural-metropolitan interface is heavily influenced by human capital, reinforcing once again the need for rural counties to invest in the education of its population.

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